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2022-12-14 JCC Buckley SFB_RTA Drawings, Civil_CAD (zip file)

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SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 35

SPECIAL INSPECTIONS

11/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 DEFINITIONS
 - 1.3.1 Continuous Special Inspections
 - 1.3.2 Perform
 - 1.3.3 Observe
 - 1.3.4 Special Inspector (SI)
 - 1.3.5 Associate Special Inspector (ASI)
 - 1.3.6 Third Party
 - 1.3.7 Contracting Officer
 - 1.3.8 Contractor's Quality Control (QC) Manager
 - 1.3.9 Structural Engineer of Record (SER)
 - 1.3.10 Statement of Special Inspections (SSI)
 - 1.3.11 Schedule of Special Inspections (SSI)
 - 1.3.12 Definable Feature of Work (DFOW)
- 1.4 SUBMITTALS
- 1.5 SPECIAL INSPECTOR QUALIFICATIONS
 - 1.5.1 Steel Construction and High Strength Bolting
 - 1.5.1.1 Special Inspector
 - 1.5.1.2 Associate Special Inspector
 - 1.5.2 Welding Structural Steel
 - 1.5.2.1 Special Inspector
 - 1.5.2.2 Associate Special Inspector
 - 1.5.3 Nondestructive Testing of Welds
 - 1.5.3.1 Special Inspector
 - 1.5.3.2 Associate Special Inspector
 - 1.5.4 Cold Formed Steel Framing
 - 1.5.4.1 Special Inspector
 - 1.5.4.2 Associate Special Inspector
 - 1.5.5 Concrete Construction
 - 1.5.5.1 Special Inspector
 - 1.5.5.2 Associate Special Inspector
 - 1.5.6 Masonry Construction
 - 1.5.6.1 Special Inspector
 - 1.5.6.2 Associate Special Inspector
 - 1.5.7 Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements
 - 1.5.7.1 Special Inspector
 - 1.5.7.2 Associate Special Inspector
 - 1.5.8 Deep Foundations
 - 1.5.8.1 Special Inspector
 - 1.5.8.2 Associate Special Inspector
 - 1.5.9 Sprayed Fire Resistant Material
 - 1.5.9.1 Special Inspector

- 1.5.9.2 Associate Special Inspector
- 1.5.10 Mastic and Intumescent Fire Resistant Coatings
 - 1.5.10.1 Special Inspector
 - 1.5.10.2 Associate Special Inspector
- 1.5.11 Fire-Resistant Penetrations and Joints
 - 1.5.11.1 Special Inspector
 - 1.5.11.2 Associate Special Inspector
- 1.5.12 Smoke Control
 - 1.5.12.1 Special Inspector
 - 1.5.12.2 Associate Special Inspector

PART 2 PRODUCTS

2.1 FABRICATOR SPECIAL INSPECTIONS

PART 3 EXECUTION

3.1 RESPONSIBILITIES

- 3.1.1 Quality Control Manager
 - 3.1.2 Special Inspectors
- 3.2 DEFECTIVE WORK

-- End of Section Table of Contents --

SECTION 01 45 35

SPECIAL INSPECTIONS

11/20

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)

ICC IBC

(2021) International Building Code

1.2 GENERAL REQUIREMENTS

Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the Prime Contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

1.3 DEFINITIONS

1.3.1 Continuous Special Inspections

Continuous Special Inspections is the constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.

1.3.2 Perform

Perform these Special Inspections tasks for each welded joint or member.

1.3.3 Observe

Observe these Special Inspections items on a periodic daily basis. Operations need not be delayed pending these inspections.

1.3.4 Special Inspector (SI)

A qualified person retained by the Contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.

1.3.5 Associate Special Inspector (ASI)

A qualified person who assists the SI in performing Special Inspections

but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.

1.3.6 Third Party

A Special inspector must not be an employee of the Contractor or of any Sub-Contractor performing the work to be inspected.

1.3.7 Contracting Officer

The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

1.3.8 Contractor's Quality Control (QC) Manager

An individual retained by the Prime Contractor and qualified in accordance with the Section 01 45 00.00 10 QUALITY CONTROL having the overall responsibility for the Contractor's QC organization.

1.3.9 Structural Engineer of Record (SER)

A registered design professional employed by the Government responsible for the overall design and review of submittal documents prepared by others. The SER is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in the state in which the design professional works. The SER is also referred to as the Engineer of Record (EOR) in design code documents.

1.3.10 Statement of Special Inspections (SSI)

A document developed by the SER identifying the material, systems, components and work required to have Special Inspections. This statement is included at the end of this specification.

1.3.11 Schedule of Special Inspections (SSI)

A schedule which lists each of the required Special Inspections, the extent to which each Special Inspection is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. This schedule is included at the end of this specification.

1.3.12 Definable Feature of Work (DFOW)

An inspection group that is separate and distinct from other inspection groups, having inspection requirements or inspectors that are unique.

1.4 SUBMITTALS

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

SD-06 Test Reports

Special Inspections Daily Reports

Special Inspections Biweekly Reports

SD-07 Certificates

AISC Certified Steel Fabricator

Certificate of Compliance

Special Inspector Qualifications; G

SD-11 Closeout Submittals

Interim Report of Special Inspections for Each DFOG; G

Comprehensive Final Report of Special Inspections; G

1.5 SPECIAL INSPECTOR QUALIFICATIONS

Submit qualifications for each special inspector.

1.5.1 Steel Construction and High Strength Bolting

1.5.1.1 Special Inspector

- a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
- b. Registered Professional Engineer with three years of related experience

1.5.1.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.2 Welding Structural Steel

1.5.2.1 Special Inspector

- a. ICC Structural Welding Special Inspector certificate with one year of related experience, or
- b. AWS Certified Welding Inspector

1.5.2.2 Associate Special Inspector

AWS Certified Associate Welding Inspector

1.5.3 Nondestructive Testing of Welds

1.5.3.1 Special Inspector

NDT Level III Certificate

1.5.3.2 Associate Special Inspector

NDT Level II Certificate plus one year of related experience

1.5.4 Cold Formed Steel Framing

1.5.4.1 Special Inspector

- a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
- b. ICC Commercial Building Inspector with one year of experience, or
- c. ICC Residential Building Inspector with one year of experience, or
- d. Registered Professional Engineer with three years related experience

1.5.4.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.5 Concrete Construction

1.5.5.1 Special Inspector

- a. ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or
- b. ACI Concrete Construction Special Inspector, or
- c. Registered Professional Engineer with three years of related experience

1.5.5.2 Associate Special Inspector

- a. ACI Concrete Construction Special Inspector in Training, or
- b. Engineer-In-Training with one year of related experience

1.5.6 Masonry Construction

1.5.6.1 Special Inspector

- a. ICC Structural Masonry Special Inspector Certificate with one year of related experience, or
- b. Registered Professional Engineer with three years of related experience

1.5.6.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.7 Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements

1.5.7.1 Special Inspector

- a. ICC Soils Special Inspector Certificate with one year of related experience, or
- b. NICET Soils Technician Level II Certificate in Construction Material Testing, or
- c. Geologist-In-Training with three years of related experience, or

- d. Registered Professional Engineer with three years of related experience

1.5.7.2 Associate Special Inspector

- a. NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or
- b. Engineer-In-Training with one year of related experience

1.5.8 Deep Foundations

1.5.8.1 Special Inspector

- a. NICET Soils Technician Level II Certificate in Construction Material Testing, or
- b. Geologist-In-Training with three years of related experience, or
- c. Registered Professional Engineer with three years of related experience

1.5.8.2 Associate Special Inspector

- a. NICET Soils Technician Level I Certificate in Construction Material Testing with one year of related experience, or
- b. NICET Geotechnical Engineering Technician Level I Construction or Generalist Certificate with one year of related experience, or
- c. Engineer-In-Training with one year of related experience

1.5.9 Sprayed Fire Resistant Material

1.5.9.1 Special Inspector

- a. ICC Spray-applied Fireproofing Special Inspector Certificate, or
- b. ICC Fire Inspector I Certificate with one year of related experience, or
- c. Registered Professional Engineer or Architect with related experience

1.5.9.2 Associate Special Inspector

Engineer-In-Training with one year of related experience

1.5.10 Mastic and Intumescent Fire Resistant Coatings

1.5.10.1 Special Inspector

- a. ICC Spray-applied Fireproofing Special Inspector Certificate, or
- b. ICC Fire Inspector I Certificate with one year of related experience, or
- c. Registered Professional Engineer or Architect with related experience

1.5.10.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

[*Am-4] [**Am-4] 1.5.11 Fire-Resistant Penetrations and Joints

1.5.11.1 Special Inspector

- a. Passed the UL Firestop Exam with one year of related experience, or
- b. Passed the FM Firestop Exam with one year of related experience, or
- c. Registered Professional Engineer with related experience

1.5.11.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.12 Smoke Control

1.5.12.1 Special Inspector

- a. AABC Technician Certification with one year of related experience, or
- b. Registered Professional Engineer with related experience

1.5.12.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

PART 2 PRODUCTS

2.1 FABRICATOR SPECIAL INSPECTIONS

Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the following certificationS to the Contracting Officer for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

AISC Certified Steel Fabricator.

At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special Inspections, stating that the materials supplied and work performed by the fabricator are in accordance with the construction documents.

PART 3 EXECUTION

3.1 RESPONSIBILITIES

3.1.1 Quality Control Manager

- a. Supervise all Special Inspectors required by the Contract Documents and the IBC.

- b. Verify the qualifications of all of the Special Inspectors.
- c. Verify the qualifications of fabricators.
- d. Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the SER.
- e. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report.

3.1.2 Special Inspectors

- a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections.
- b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.
- c. Submit a copy of the daily reports to the QC Manager.
- d. Report discrepancies that are observed during Special Inspections to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.
- e. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:
 - (1) A brief summary of the work performed during the reporting time frame.
 - (2) Changes and discrepancies with the drawings, specifications that were observed during the reporting period.
 - (3) Discrepancies which were resolved or corrected.
 - (4) A list of nonconforming items requiring resolution.
 - (5) All applicable test result including nondestructive testing reports.
- f. At the completion of each DFOW requiring Special Inspections, submit an interim report of Special Inspections that documents the Special Inspections completed for that DFOW. Identify the inspector responsible for each item inspected and corrections of all discrepancies noted in the daily reports. The interim report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.
- g. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and indicate the certification of

the special inspector qualifying them to conduct the inspection.

3.2 DEFECTIVE WORK

Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Contracting Officer to accept such work.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 04 - MASONRY

SECTION 04 20 00

UNIT MASONRY

11/15, CHG 2: 05/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Shop Drawings
 - 1.3.2 Masonry Mock-Up Panels
 - 1.3.2.1 Mock-Up Panel Location
 - 1.3.2.2 Mock-Up Panel Configuration
 - 1.3.2.3 Mock-Up Panel Composition
 - 1.3.2.4 Mock-Up Panel Construction Method
 - 1.3.2.5 Mock-Up Panel Purpose
 - 1.3.3 Special Masonry Inspector Qualifications
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 Masonry Units
 - 1.4.2 Reinforcement, Anchors, and Ties
 - 1.4.3 Cementitious Materials, Sand and Aggregates
- 1.5 PROJECT/SITE CONDITIONS
 - 1.5.1 Hot Weather Procedures
 - 1.5.2 Cold Weather Procedures

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Design - Specified Compressive Strength of Masonry
 - 2.1.2 Performance - Verify Masonry Compressive Strength
- 2.2 MANUFACTURED UNITS
 - 2.2.1 General Requirements
 - 2.2.2 Concrete Units
 - 2.2.2.1 Aggregates
 - 2.2.2.2 Concrete Masonry Units (CMU)
 - 2.2.2.2.1 Cement
 - 2.2.2.2.2 Recycled Content
 - 2.2.2.2.3 Size
 - 2.2.2.2.4 Surfaces
 - 2.2.2.2.5 Weather Exposure
 - 2.2.2.2.6 Unit Types
 - 2.2.2.2.7 Jamb Units
 - 2.2.2.3 Architectural Units
 - 2.2.2.4 Patterned, Decorative Screen Units
 - 2.2.2.5 Fire-Rated Concrete Masonry Units
 - 2.2.3 Precast Concrete Units
 - 2.2.3.1 General
 - 2.2.3.2 Precast Concrete Lintels
- 2.3 EQUIPMENT
 - 2.3.1 Vibrators

- 2.3.2 Grout Pumps
- 2.4 MATERIALS
 - 2.4.1 Mortar Materials
 - 2.4.1.1 Cementitious Materials
 - 2.4.1.2 Hydrated Lime and Alternates
 - 2.4.1.3 Colored Mortar
 - 2.4.1.4 Admixtures for Masonry Mortar
 - 2.4.1.5 Aggregate and Water
 - 2.4.2 Grout and Ready-Mix Grout Materials
 - 2.4.2.1 Cementitious Materials for Grout
 - 2.4.2.2 Admixtures for Grout
 - 2.4.2.3 Aggregate and Water
- 2.5 MORTAR AND GROUT MIXES
 - 2.5.1 Mortar Mix
 - 2.5.2 Grout and Ready Mix Grout Mix
- 2.6 ACCESSORIES
 - 2.6.1 Grout Barriers
 - 2.6.2 Anchors, Ties, and Bar Positioners
 - 2.6.2.1 General
 - 2.6.2.2 Wire Mesh Anchors
 - 2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction
 - 2.6.2.4 Adjustable Anchors
 - 2.6.2.4.1 Anchorage to Structural Steel
 - 2.6.2.4.2 Anchorage of Veneer to Light Gauge Steel or Concrete Backing
 - 2.6.2.5 Veneer Anchor Screws
 - 2.6.2.6 Bar Positioners
 - 2.6.3 Joint Reinforcement
 - 2.6.4 Reinforcing Steel Bars
 - 2.6.5 Concrete Masonry Control Joint Keys
 - 2.6.6 Through Wall Flashing and Weeps
 - 2.6.6.1 General
 - 2.6.6.2 Stainless Steel Flashing
 - 2.6.6.3 Rubberized Flashing
 - 2.6.6.4 Weep Ventilators
 - 2.6.6.5 Single-Wythe Exterior Wall CMU Flashing System
 - 2.6.6.6 Metal Drip Edge
 - 2.6.7 RIGID BOARD-TYPE INSULATION

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
 - 3.2.1 Stains
 - 3.2.2 Loads
 - 3.2.3 Concrete Surfaces
 - 3.2.4 Shelf Angles
 - 3.2.5 Bracing
- 3.3 ERECTION
 - 3.3.1 General
 - 3.3.1.1 Jointing
 - 3.3.1.1.1 Tooled Joints
 - 3.3.1.1.2 Flush Joints
 - 3.3.1.1.3 Door and Window Frame Joints
 - 3.3.1.1.4 Joint Widths
 - 3.3.1.2 Cutting and Fitting
 - 3.3.1.3 Unfinished Work
 - 3.3.1.4 Control Joints
 - 3.3.1.5 Decorative Architectural Units

- 3.3.2 Anchored Veneer Construction
- 3.3.3 Reinforced, Single Wythe Concrete Masonry Units Walls
 - 3.3.3.1 Concrete Masonry Unit Placement
 - 3.3.3.2 Preparation for Reinforcement
- 3.3.4 ANCHORAGE
 - 3.3.4.1 Anchorage to Concrete
 - 3.3.4.2 Anchorage to Structural Steel
 - 3.3.4.3 Anchorage at Intersecting Walls
- 3.3.5 Lintels
 - 3.3.5.1 Masonry Lintels
 - 3.3.5.2 Precast Concrete and Steel Lintels
- 3.3.6 Sills and Copings
- 3.4 INSTALLATION
 - 3.4.1 Bar Reinforcement Installation
 - 3.4.1.1 Preparation
 - 3.4.1.2 Positioning Bars
 - 3.4.1.3 Splices of Bar Reinforcement
 - 3.4.2 Placing Grout
 - 3.4.2.1 General
 - 3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls
 - 3.4.2.3 Horizontal Grout Barriers
 - 3.4.2.4 Grout Holes and Cleanouts
 - 3.4.2.4.1 Grout Holes
 - 3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction
 - 3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction
 - 3.4.2.5 Grout Placement
 - 3.4.3 Joint Reinforcement Installation
 - 3.4.4 Bond Beams
 - 3.4.5 Flashing and Weeps
- 3.5 APPLICATION
 - 3.5.1 Insulation
 - 3.5.2 Interface with Other Products
 - 3.5.2.1 Built-In Items
 - 3.5.2.2 Door and Window Frame Joints
 - 3.5.2.3 Bearing Plates
 - 3.5.3 Tolerances
- 3.6 FIELD QUALITY CONTROL
 - 3.6.1 Tests
 - 3.6.1.1 Field Testing of Mortar
 - 3.6.1.2 Field Testing of Grout
 - 3.6.1.3 Prism Tests
 - 3.6.2 Special Inspection
- 3.7 POINTING AND CLEANING
 - 3.7.1 Dry-Brushing Concrete Masonry
- 3.8 CLOSE-OUT TAKE-BACK PROGRAM
- 3.9 PROTECTION

-- End of Section Table of Contents --

SECTION 04 20 00

UNIT MASONRY

11/15, CHG 2: 05/19

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

- ACI 216.1 (2014) Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
- ACI 318 (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
- ACI SP-66 (2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

- ASTM A153/A153M (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A167 (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM A185/A185M (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- ASTM A615/A615M (2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A641/A641M (2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
- ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- ASTM A951/A951M (2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement

ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1008/A1008M	(2020) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C90	(2016) Standard Specification for Loadbearing Concrete Masonry Units
ASTM C129	(2017) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2020) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C641	(2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C780	(2020) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C979/C979M	(2016) Standard Specification for Pigments for Integrally Colored Concrete
ASTM C1019	(2019) Standard Test Method for Sampling and Testing Grout
ASTM C1314	(2014) Standard Test Method for Compressive Strength of Masonry Prisms
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars
ASTM C1611/C1611M	(2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications

ASTM D2287

(2019) Nonrigid Vinyl Chloride Polymer and
Copolymer Molding and Extrusion Compounds

THE MASONRY SOCIETY (TMS)

TMS MSJC

(2016) Masonry Standard Joint Committee's
(MSJC) Book - Building Code Requirements
and Specification for Masonry Structures,
Containing TMS 402/ACI 530/ASCE 5, TMS
602/ACI 530.1/ASCE 6, and Companion
Commentaries

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Cut CMU Drawings; G

Reinforcement Detail Drawings; G

SD-03 Product Data

Concrete masonry units (cmu) face and sill units; G

Reinforcement, Anchors, and Ties; G

Hot Weather Procedures; G

Cold Weather Procedures; G

Cement; G

Cementitious Materials; G

Recycled Content for Steel Reinforcement; S

Recycled Content for Concrete Masonry Units; S

SD-04 Samples

Mock-Up Panel; G

Concrete Masonry Units (CMU); G

Admixtures for Masonry Mortar; G

SD-05 Design Data

Masonry Compressive Strength; G

Fire-Rated Concrete Masonry Units

Bracing Calculations; G

SD-06 Test Reports

Fire-Rated Concrete Masonry Units

Field Testing of Mortar

Field Testing of Grout

Prism Tests

SD-07 Certificates

Special Masonry Inspector Qualifications

Concrete Masonry Units (CMU)

Precast Concrete Units

Cementitious Materials

Admixtures for Masonry Mortar

Admixtures for Grout

Anchors, Ties, and Bar Positioners

Joint Reinforcement

Insulation

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar

Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

SD-11 Closeout Submittals

Recycled Content of Cement; S

1.3 QUALITY ASSURANCE

1.3.1 Shop Drawings

Submit drawings showing elevations of walls exposed to view and indicating the location of all CMU products.

1.3.2 Masonry Mock-Up Panels

1.3.2.1 Mock-Up Panel Location

After material samples are approved and prior to starting masonry work,

construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the Contracting Officer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

1.3.2.2 Mock-Up Panel Configuration

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. Provide a straight panel or a leg of an L-shaped panel of minimum size 8 feet long by 6 feet high.

1.3.2.3 Mock-Up Panel Composition

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. Include a a masonry bonded corner, a bond beam corner, and installation of electrical boxes and conduit. When the panel represents reinforced masonry, include a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

1.3.2.4 Mock-Up Panel Construction Method

Where anchored veneer walls or cavity walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Demonstrate provisions to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. When water-repellent is specified to be applied to the masonry, apply the approved product to the mock-up panel. Construct panels on a properly designed concrete foundation.

1.3.2.5 Mock-Up Panel Purpose

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved. Perform cleaning procedures on the mockup and obtain approval of the Contracting Officer prior to cleaning the building. After completion of the work, completely remove the mock-up panels, including all foundation concrete, from the construction site.

1.3.3 Special Masonry Inspector Qualifications

Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the masonry special inspector.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

- a. Pack glazed brick, glazed structural clay tile, and prefaced concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.
- b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F and the wind velocity is greater than 8 mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

1.5.2 Cold Weather Procedures

When ambient temperature is below 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly

completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, $f'm$, is as indicated on the design drawings.

2.1.2 Performance - Verify Masonry Compressive Strength

Verify specified compressive strength of masonry using the "Unit Strength Method" of TMS MSJC. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used. Submit test results.

2.2 MANUFACTURED UNITS

2.2.1 General Requirements

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

2.2.2 Concrete Units

2.2.2.1 Aggregates

Test lightweight aggregates, and blends of lightweight and heavier aggregates in proportions used in producing the units, for stain-producing iron compounds in accordance with ASTM C641, visual classification method. Do not incorporate aggregates for which the iron stain deposited on the filter paper exceeds the "light stain" classification.

2.2.2.2 Concrete Masonry Units (CMU)

2.2.2.2.1 Cement

Use only cement that has a low alkali content and is of one brand.

2.2.2.2.2 Recycled Content

Provide units with a minimum of 10 percent post-consumer recycled content, or a minimum of 40 percent pre-consumer recycled content, based on mass, cost, or volume. Submit product data for recycled content for concrete masonry units.

2.2.2.2.3 Size

Provide units with specified dimensions, as follows:

- a. Structural:
 - 1. 7 5/8" inches wide, 7 5/8" inches high, [*Am-4] 15 5/8" [**Am-4] inches long
- b. Face CMU:
 - 1. 3 5/8" inches wide, 3 5/8" inches high, 23 5/8" inches long
 - 2. 3 5/8" inches wide, 7 5/8" inches high, 23 5/8" inches long
 - 3. 3 5/8" inches wide, 11 5/8" inches high, 23 5/8" inches long
- c. Window Sills
 - 1. Manufacturer's standard sill as indicated.

2.2.2.2.4 Surfaces

Provide units with exposed surfaces that are smooth and of uniform texture, unless indicated otherwise on the drawings.

2.2.2.2.5 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather.

2.2.2.2.6 Unit Types

- a. Hollow Load-Bearing Units: ASTM C90, lightweight. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.
- b. Hollow Non-Load-Bearing Units: ASTM C129, lightweight. Load-bearing units may be provided in lieu of non-load-bearing units.
- c. Solid Load-Bearing Units: ASTM C90, lightweight or medium weight or normal weight units. Provide solid units as indicated.

2.2.2.2.7 Jamb Units

Provide jamb units 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.

Provide sash jamb units with a 3/4 by 3/4 inch groove near the center at end of each unit.

2.2.2.3 Architectural Units

Provide architectural units with patterned face shell: as indicated.

Provide units that are integrally colored with natural aggregates during manufacture, with color as indicated.

2.2.2.4 Patterned, Decorative Screen Units

Provide patterned, decorative screen units that conform to ASTM C90 . Provide units that have uniform through-the-wall pattern, color, and texture.

2.2.2.5 Fire-Rated Concrete Masonry Units

For indicated fire-rated construction, provide concrete masonry units of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated by linear interpolation based on the percent by dry-rodded volume of each aggregate used in manufacturing the units.

TABLE I FIRE-RATED CONCRETE MASONRY UNITS							
Aggregate Type	Minimum Equivalent Thickness for Fire-Resistance Rating, inch						
	1/2 hour	3/4 hour	1 hour	1-1/2 hour	2 hours	3 hours	4 hours
Calcareous or siliceous gravel (other than limestone)	2.0	2.4	2.8	3.6	4.2	5.3	6.2
Limestone, cinders, or air-cooled slag	1.9	2.3	2.7	3.4	4.0	5.0	5.9
Expanded clay, expanded shale, or expanded slate	1.8	2.2	2.6	3.3	3.6	4.4	5.1
Expanded slag or pumice	1.5	1.9	2.1	2.7	3.2	4.0	4.7

Determine equivalent thickness in accordance with ACI 216.1. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; include the thickness of plaster or brick or other material in the assembly in determining the equivalent thickness. Submit calculation results.

2.2.3 Precast Concrete Units

2.2.3.1 General

- a. Provide precast concrete copings that are factory-made units in a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, provide precast concrete with minimum 3000 psi compressive strength, conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and with reinforcement required for handling of the units. Maintain minimum clearance of 3/4 inch between reinforcement and faces of units.
- b. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, either damp-cure for 24 hours or steam-cure and then age under cover for 28 days or longer. In precast concrete members weighing over 80 pounds provide built-in loops of galvanized wire or other approved provisions for lifting and anchoring.
- c. Fabricate units with beds and joints at right angles to the face, with sharp true arises and with drip grooves on the underside where units

overhang walls. Form exposed-to-view surfaces free of surface voids, spalls, cracks, and chipped or broken edges and with uniform appearance and color. Unless otherwise specified, provide units with a smooth dense finish.

- d. Prior to installation, wet and inspect each unit for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.
- e. Submit specified factory certificates.
- f. Provide architectural cast stone masonry trim, copings, heads, and sills that are manufactured in a plant by a producer regularly engaged in producing cast stone. Provide cast stone units that comply with ASTM C1364. Submit test reports and three exemplars of the same cast stone product installed in similar projects in similar climatic conditions.

2.2.3.2 Precast Concrete Lintels

Provide precast concrete lintels, unless otherwise shown, of a thickness equal to the wall and reinforced with minimum two No. 4 bars for the full length. Provide top and bottom bars for lintels over 36 inches in length. Provide at least 8 inches bearing at each end. Label the top of lintels and clearly mark each lintel to show location in the structure. Design reinforced lintels in conformance with ACI 318 for flexural and shear strength, using concrete with a minimum 28 day compressive strength of 3,000 psi. Limit lintel deflection due to dead plus live load to $L/600$ or 0.3 inches.

2.3 EQUIPMENT

2.3.1 Vibrators

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

2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

2.4 MATERIALS

2.4.1 Mortar Materials

2.4.1.1 Cementitious Materials

Provide cementitious materials that conform to those permitted by ASTM C270.

2.4.1.2 Hydrated Lime and Alternates

Provide lime that conforms to one of the materials permitted by ASTM C207 for use in combination with portland cement, hydraulic cement, and blended hydraulic cement. Do not use lime in combination with masonry cement or mortar cement.

2.4.1.3 Colored Mortar

Use mortar pigment that conforms to ASTM C979/C979M. Add pigment to mortar to produce a uniform color matching as indicated. Furnish pigments

in accurately pre-measured and packaged units that can be added to a measured amount of cementitious materials or supply pigments via preblended cementitious materials or dry mortar mix.

- a. In masonry cement or mortar cement, do not exceed 5 percent of cement weight for mineral oxide pigment; do not exceed 1 percent of cement weight for carbon black pigment.
- b. In cement-lime mortar mix, do not exceed 10 percent of cementitious materials' weight for mineral oxide pigment; do not exceed 2 percent of cementitious materials' weight for carbon black pigment.

2.4.1.4 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to ASTM C1384. Provide a water-repellent admixture, conforming to ASTM C1384 and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

2.4.1.5 Aggregate and Water

Provide aggregate (sand) and water that conform to materials permitted by ASTM C270.

2.4.2 Grout and Ready-Mix Grout Materials

2.4.2.1 Cementitious Materials for Grout

Provide cementitious materials that conform to those permitted by ASTM C476.

2.4.2.2 Admixtures for Grout

Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.

2.4.2.3 Aggregate and Water

Provide fine and coarse aggregates and water that conform to materials permitted by ASTM C476.

2.5 MORTAR AND GROUT MIXES

2.5.1 Mortar Mix

- a. Provide mortar Type S unless specified otherwise herein. Do not use masonry cement in the mortar. Do not use air-entrainment in the mortar.
- b. Use ASTM C270 Type S cement-lime mortar or mortar cement mortar for

seismic-force-resisting elements indicated.

- c. Provide Type S mortar for non-load-bearing, non-shear-wall interior masonry.
- d. For field-batched mortar, measure component materials by volume. Use measuring boxes for materials that do not come in packages, such as sand, for consistent batching. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar unless approved by the Contracting Officer. Maintain workability of mortar by remixing or retempering. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.
- e. For preblended mortar, follow manufacturer's mixing instructions.

2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to ASTM C476, fine. Use conventional grout with a slump between 8 and 11 inches. Use self-consolidating grout with slump flow of 24 to 30 inches and a visual stability index (VSI) not greater than 1. Provide minimum grout strength of 3,000 psi in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

2.6 ACCESSORIES

2.6.1 Grout Barriers

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

2.6.2 Anchors, Ties, and Bar Positioners

2.6.2.1 General

- a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 5/8 inch mortar cover from each face of masonry.
- b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.
- c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.
- d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with

ASTM A653/A653M, Coating Designation G60.

- e. Submit two anchors, ties and bar positioners of each type used, as samples.

2.6.2.2 Wire Mesh Anchors

Provide wire mesh anchors of 1/4 inch mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 12 inches, at intersections of interior non-bearing masonry walls.

2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction

Provide rectangular-shaped wall ties, fabricated of hot-dipped galvanized W1.7 diameter steel wire. Provide rectangular wall ties no less than 4 inches wide.

Provide adjustable type wall ties, if approved for use, that consist of two essentially U-shaped elements fabricated of minimum W2.8 diameter steel wire or pintle type ties that are inserted to eyes of horizontal joint reinforcement, hot-dip galvanized. Provide adjustable ties with double pintle legs and allows a maximum offset of 1-1/4 inch between each element of the tie and maximum distance between connecting parts no more than 1/16 inch. Form the pintle and eye elements shall be formed so that both can be in the same plane. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT.

2.6.2.4 Adjustable Anchors

2.6.2.4.1 Anchorage to Structural Steel

Provide hot-dip galvanized adjustable anchors for connecting masonry walls to the structural steel frame as detailed on the drawings. Provide zinc-rich paint for touching up paint after welding galvanized anchors to structural steel.

2.6.2.4.2 Anchorage of Veneer to Light Gauge Steel or Concrete Backing

Use one of the following types of adjustable anchors to connect veneer to light gauge steel or concrete backing:

- a. sheet metal at least 7/8 inch wide, 0.06 inch thick, and with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch or bent, notched or punched to provide equivalent performance;
- b. wire anchors of minimum size W1.7 with ends bent to form a minimum 2 inches extension and without drips;
- c. or wire pintle anchors used in conjunction with joint reinforcement.

Do not exceed 1/16 inch clearance between connecting parts of the tie. Assemble adjustable anchors to prevent disengagement. Provide pintle anchors with one or more pintle legs of wire size W2.8 and an offset not exceeding 1-1/4 inch.

2.6.2.5 Veneer Anchor Screws

Provide screws for attachment of veneer anchors to cold-formed steel

framing members of size as required by design to provide the needed pullout load capacity but not less than No. 12. Provide length of screws such that the screws penetrate the holding member by not less than 5/8 inch.

2.6.2.6 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized. Bar positioners must be suitable for intended use and be corrosion resistant steel. Bar positioners not fully contained within the wythe must be hot-dip galvanized.

2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9 gauge. Size joint reinforcement to provide a minimum of 5/8 inch cover from each face. Space crosswires not more than 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60. Provide minimum 45 percent post-consumer recycled content, or minimum 90 percent pre-consumer recycled content. Submit product data for recycled content for steel reinforcement.

2.6.5 Concrete Masonry Control Joint Keys

Provide control joint keys of a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

2.6.6 Through Wall Flashing and Weeps

2.6.6.1 General

Provide stainless steel sheet and except that the material shall be one which is not adversely affected by dampproofing material.

2.6.6.2 Stainless Steel Flashing

Provide stainless steel, ASTM A167, Type 304 or 316, 0.015 inch thick, No. 2D finish. Where indicated, provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions, where deformations consist of dimples, diagonal

corrugations, or a combination of dimples and transverse corrugations.

2.6.6.3 Rubberized Flashing

Provide self-adhesive rubberized asphalt sheet flashing consisting of 32-mil thick pliable and highly adhesive rubberized asphalt compound bonded completely and integrally to 8-mil thick, high density, cross-laminated polyethylene film to produce an overall thickness of 40 mils. Provide rubberized, asphalt-based mastic and surface conditioner that are each approved by flashing manufacturer for use with flashing material.

2.6.6.4 Weep Ventilators

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges to fit in a standard 3/8 inch wide mortar joint and with height equal to the nominal height of the unit.

2.6.6.5 Single-Wythe Exterior Wall CMU Flashing System

In single-wythe exterior CMU walls, provide a system of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. For exterior CMU walls, provide a flashing/weep system in open cores that do not receive grout. Cell flashing pans are to have integral weep spouts built into mortar bed joints that extend into the cell to prevent clogging with mortar.

2.6.6.6 Metal Drip Edge

Provide stainless steel drip edge, 15-mil thick, hemmed edges, with down-turned drip at the outside edge and upturned dam at the inside edge for use with membrane flashings.

2.6.7 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as specified in Section 07 21 13 BOARD AND BLOCK INSULATION.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

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

3.2.2 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.

3.2.3 Concrete Surfaces

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

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

3.3.1 General

- a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in the indicated bond pattern. Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus 1/2 inch. Adjust each unit to its final position while mortar is still soft and has plastic consistency.
- b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.
- c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Toothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of 610 mm 2 feet down on each side of the wall and hold securely in place.
- d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation

joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.

- e. In multi-wythe construction with collar joints no more than 3/4 inch wide, bring up the inner wythe not more than 16 inches ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces concave, using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint. No exterior joints are to be left un-tooled.

3.3.1.1.2 Flush Joints

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

3.3.1.1.3 Door and Window Frame Joints

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

3.3.1.1.4 Joint Widths

- a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit, within tolerances permitted by TMS MSJC.
- b. Provide 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.
- c. Provide 3/8 inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.
- d. Maintain mortar joint widths within tolerances permitted by TMS MSJC

3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

- a. Carefully make openings in the masonry 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. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.
- b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

3.3.1.3 Unfinished Work

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

3.3.1.4 Control Joints

Provide control joints in concrete masonry as indicated. Construct by using open end stretcher units placed with the closed end at the joint in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating courses on each side of the joint. Interrupt the control joint key in courses containing continuous bond beam reinforcement. Do not interrupt the horizontal reinforcement and grout at the control joint.

Where mortar was placed in the joint, rake both faces of the control joints to a depth of 3/4 inch. Install backer rod and sealant on both faces in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.1.5 Decorative Architectural Units

Place decorative masonry units with the patterned face shell properly aligned in the completed wall.

3.3.2 Anchored Veneer Construction

- a. Construct exterior masonry wythes to the thickness indicated on the drawings. Provide a minimum 2 inch air space behind the masonry veneer. Provide means to ensure that the cavity space and flashings are kept clean of mortar droppings and other loose debris. Maintain chases and raked-out joints free from mortar and debris.
- b. Place masonry in running bond pattern.

- c. For veneer over stud framing, do not install veneer until the exterior sheathing, moisture barrier, veneer anchors and flashing have been installed on the backing. Take extreme care to avoid damage to the moisture barrier and flashing during construction of the masonry veneer. Repair or replace portions of the moisture barrier and flashing that are damaged prior to completion of the veneer. Provide a continuous cavity as indicated.
- d. For veneer with a masonry backup wythe, lay up both the inner and the outer wythes together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, install through-wall flashings with the exterior wythe, securing the top edge of the flashing with a termination bar and sealant, or protect flashings that are installed with the interior wythe from damage until they are fully enclosed in the wall.
- e. Provide anchors (ties) to connect the veneer to its backing in sufficient quantity to comply with the following requirements: maximum wall area per anchor {tie} of 2.67 ft², and maximum vertical spacing of 24 inches, and maximum horizontal spacing of 32 inches. Provide additional anchors around openings larger than 16 inch in either direction. Space anchors around perimeter of opening at a maximum of 24 inches on center. Place anchors within 12 inches of openings. Anchors with drips are not permitted.
- f. With solid units, embed anchors in mortar joint and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar cover to the outside face.
- g. With hollow units, embed anchors in mortar or grout and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar or grout cover to outside face.

3.3.3 Reinforced, Single Wythe Concrete Masonry Units Walls

3.3.3.1 Concrete Masonry Unit Placement

- a. Fully bed units used to form piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout in mortar under both face shells and webs. Provide mortar beds under both face shells for other units. Mortar head joints for a distance in from the face of the unit not less than the thickness of the face shell.
- b. Solidly grout foundation walls below grade.
- c. Stiffen double walls 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 each wall within the double wall. Adequately reinforce walls and partitions for support of wall-hung plumbing fixtures when chair carriers are not specified.
- d. Submit drawings showing elevations of walls exposed to view and indicating the location of all cut CMU products.

3.3.3.2 Preparation for Reinforcement

Lay units in such a manner as to preserve the unobstructed vertical

continuity of cores to be grouted. Remove mortar protrusions extending 1/2 inch or more into cells before placing grout. Position reinforcing bars accurately as indicated before placing grout. Where vertical reinforcement occurs, fill cores solid with grout in accordance with paragraph PLACING GROUT in this Section.

3.3.4 ANCHORAGE

3.3.4.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 24 inches on center horizontally.

3.3.4.2 Anchorage to Structural Steel

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

3.3.4.3 Anchorage at Intersecting Walls

Provide wire mesh anchors at maximum 16 inches spacing at intersections of interior non-bearing masonry walls.

Anchor structural masonry walls with bond beams and horizontal joint reinforcement as indicated, overlapping masonry units, and strap anchors of minimum size 1/4 inch x 1-1/2 inch x 28 inches including 2 inch) 90 degree bends at each end to form U or Z shape at maximum spacing 48 inches, grouted into the wall, unless the drawings indicate a movement joint at the intersection.

3.3.5 Lintels

3.3.5.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 5 bars in the bottom course unless otherwise indicated. Extend lintel reinforcement beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Support reinforcing bars in place prior to grouting and locate 1/2 inch above the bottom inside surface of the lintel unit.

3.3.5.2 Precast Concrete and Steel Lintels

Provide precast concrete and steel lintels as shown on the Drawings. Set lintels in a full bed of mortar with faces plumb and true. Provide steel and precast lintels with a minimum bearing length of 8 inches unless otherwise indicated. In partially grouted masonry, provide fully grouted units under the full lintel bearing length, unless otherwise indicated.

3.3.6 Sills and Copings

Set sills and copings in a full bed of mortar with faces plumb and true. Slope sills and copings to drain water. Mechanically anchor copings and sills longer than 4 feet as indicated.

3.4 INSTALLATION

3.4.1 Bar Reinforcement Installation

3.4.1.1 Preparation

Submit detail drawings showing bar splice locations. Identify bent bars on a bending diagram and reference and locate such bars on the drawings. Show wall dimensions, bar clearances, and wall openings. Utilize bending details that conform to the requirements of ACI SP-66. 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, resubmit the approved shop drawings with the additional openings shown along with the proposed changes. Clearly highlight location of these additional openings. Provide wall elevation drawings with minimum scale of 1/4 inch per foot. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, and other coatings that might destroy or reduce its bond prior to placing grout. Do not use bars with kinks or bends not shown on the approved shop drawings. Place reinforcement prior to grouting. Unless otherwise indicated, extend vertical wall reinforcement to within 2 inches of tops of walls.

3.4.1.2 Positioning Bars

- a. Accurately place vertical bars within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of 1/2 inch between the bars and masonry units for coarse grout and a minimum clearance of 1/4 inch between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 1 inch or one diameter of the reinforcement, whichever is greater. Vertical reinforcement 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 or by other means to prevent displacement beyond permitted tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.
- b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.
- c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.
- d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent when permitted by TMS MSJC.

3.4.1.3 Splices of Bar Reinforcement

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified

yield strength of the reinforcement.

3.4.2 Placing Grout

3.4.2.1 General

Fill cells containing reinforcing bars with grout. Solidly 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. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls

In multi-wythe composite walls, provide grout barriers in the collar joint not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.4.2.3 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.2.4 Grout Holes and Cleanouts

3.4.2.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of hollow unit masonry is indicated. Form such openings not less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units, provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet 4 inches. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped

for more than 4 hours. Provide cleanouts not less than 3 by 3 inch by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction

Provide cleanouts for construction of walls that incorporate a grout filled cavity between solid masonry wythes, provide cleanouts at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.5 Grout Placement

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

- a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.
- b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.
- c. If the masonry has cured at least 4 hours, grout slump is maintained between 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 10 to 11 inches, place conventional grout in lifts not exceeding 5 feet 4 inches.
- d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 12 inches in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not

permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.

- e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.
- f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.3 Joint Reinforcement Installation

Install joint reinforcement at 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 5/8 inch cover to either face of the unit.

3.4.4 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.4.5 Flashing and Weeps

- a. Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by turning the flashing 1/2 inch into the mortar bed joint of backup masonry lapping a minimum of 6 inches under the weather resistive barrier. Terminate the horizontal leg of the flashing by extending the sheet metal 1/2 inch beyond the outside face of masonry and turning downward with a hemmed drip. Provide sealant below the drip edge of through-wall flashing.
- b. Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of weep ventilators. Locate weeps not more than 24 inches on centers in mortar joints of the exterior wythe directly on the horizontal leg of through-wall flashing over foundations, bond beams, and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to 16 inches on center and approved by the Contracting Officer. Maintain weeps free of mortar

and other obstructions.

- c. Install single-wythe CMU flashing system in bed joints of CMU walls where CMU cells are open. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall on the exterior side. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.5 APPLICATION

3.5.1 Insulation

Insulate cavity walls (multi-wythe noncomposite masonry walls), where shown, by installing board-type insulation on the cavity side of the inner wythe. Apply board type insulation directly to the masonry or thru-wall flashing with adhesive. Neatly fit insulation between obstructions without impaling insulation on ties or anchors. Apply insulation in parallel courses with vertical joints breaking midway over the course below and in moderate contact with adjoining units without forcing. Cut to fit neatly against adjoining surfaces. Tape or seal the joints between the boards.

3.5.2 Interface with Other Products

3.5.2.1 Built-In Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

3.5.2.2 Door and Window Frame Joints

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of 3/8 inch.

3.5.2.3 Bearing Plates

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

3.5.3 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

3.6.1.1 Field Testing of Mortar

Perform mortar testing at the following frequency: prior to construction,

each of the first days of construction, and per 5,000 SF of wall area per week (whichever occurs first). For each required mortar test, provide a minimum of three mortar samples.

Prepare and test mortar samples for mortar aggregate ratio in accordance with ASTM C780 Appendix A4. Prepare and test mortar compressive strength specimens in accordance with ASTM C780 Appendix A6.

3.6.1.2 Field Testing of Grout

- a. Perform grout testing at the following frequency: each 30 cubic yards of grout or fraction thereof placed each day and when mix proportions are changed. For each required grout property to be evaluated, provide a minimum of three specimens.
- b. Sample and test conventional and self-consolidating grout for compressive strength and temperature in accordance with ASTM C1019.
- c. Evaluate slump in conventional grout in accordance with ASTM C1019.
- d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with ASTM C1611/C1611M.

3.6.1.3 Prism Tests

Perform at least one prism test sample for each 5,000 square feet of wall but not less than three such tests for any building. Evaluate three prisms in each test. Fabricate, store, handle, and test prisms in accordance with ASTM C1314.

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. If the compressive strength of any prism falls below the specified value by more than 500 psi, take steps 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, take three specimens for each prism test more than 500 psi below the specified value. Masonry in the area in question will be considered structurally adequate if the average compressive strength of three specimens is equal to or exceeds the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results will be permitted.

3.6.2 Special Inspection

Perform special inspections and testing in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

3.7 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff

bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.8 CLOSE-OUT TAKE-BACK PROGRAM

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. 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.

3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 2 feet down on each side of the wall and hold securely in place. Before starting or resuming work, clean top surface of masonry in place of loose mortar and foreign material.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 14 00.20

INTERIOR SIGNAGE

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 EXTRA MATERIALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Samples
 - 1.4.2 Detail Drawings
 - 1.4.3 Sign Fabricator
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 [Enter Appropriate Subpart Title Here]
- 2.2 SYSTEM REQUIREMENTS
 - 2.2.1 Features
 - 2.2.2 Graphics and Typography
 - 2.2.3 Colors and Finishes
 - 2.2.4 ADA Compliance
 - 2.2.5 Materials and Construction
 - 2.2.6 Basic System Description
 - 2.2.7 Graphics / Typography
- 2.3 ROOM IDENTIFICATION SIGN
 - 2.3.1 Sign Faces
 - 2.3.2 Frame Sizes
 - 2.3.3 Room Identification Tactile Letters
- 2.4 EXIT DOOR TACTILE SIGN
- 2.5 BUILDING DIRECTORIES
 - 2.5.1 Doors
 - 2.5.1.1 Door Glazing
 - 2.5.1.2 Door Construction
 - 2.5.1.3 Door Locks
 - 2.5.2 Fabrication
 - 2.5.3 Non-Illuminated Unit
 - 2.5.3.1 Construction
 - 2.5.3.2 Message Strips
- 2.6 PRESSURE SENSITIVE LETTERS
 - 2.6.1 Fabrication
 - 2.6.2 Size
- 2.7 MATERIALS
 - 2.7.1 Aluminum Alloy Products
 - 2.7.2 Organic Coating
 - 2.7.3 Plastic Laminate Sheet
 - 2.7.4 Fabrication and Manufacture
 - 2.7.4.1 Factory Workmanship

- 2.7.4.2 Dissimilar Materials
- 2.7.5 Typeface
- 2.8 GRAPHICS
 - 2.8.1 Subsurface Copy
 - 2.8.2 First Surface Copy Direct Print (Non-Tactile)
 - 2.8.3 Photopolymer
- 2.9 COLOR, FINISH, AND CONTRAST

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Anchorage
 - 3.1.2 Protection and Cleaning

-- End of Section Table of Contents --

SECTION 10 14 00.20

INTERIOR SIGNAGE

08/20

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA PK-1 (2015) Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings & Ingot

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604 (2017a) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM B209 (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B221 (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM C1048 (2018) Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1 (2009) Accessible and Usable Buildings and Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2021) Life Safety Code

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

36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and
Facilities; Architectural Barriers Act
(ABA) Accessibility Guidelines

1.2 SUBMITTALS

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

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Room Identification Sign with Patient Information; G

Exit Door Tactile Sign; G

Building Directories; G

SD-04 Samples

Interior Signage; G

Software; G

Room Identification Sign with Patient Information; G

Exit Door Tactile Sign; G

Building Directories; G

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G

Protection and Cleaning; G

1.3 EXTRA MATERIALS

Provide one copy of the software for user produced signs and inserts after project completion and equipment necessary for removal of signage parts

and pieces.

1.4 QUALITY ASSURANCE

1.4.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: all sign types included in project. Approved samples may be installed in the work, provided each sample is identified and location recorded.

- a. Sign Type ST - Stair Sign.
- b. Sign Type WR - Women Restroom sign.
- c. Sign Type US-1_- User Space sign.
- d. Sign Type CR - Conference Room sign.
- e. Sign Type RB - Restroom Blade sign.
- f. Sign Type IDS - Interior Directional sign.
- g. Sign Type STX - Stair Exterior Sign.

1.4.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.

1.4.3 Sign Fabricator

Sign Fabricator to follow room number strategies created by designer. The room numbering system to be reviewed and approved by the Contracting Officer and command end users during the shop drawing phase, and prior to fabrication.

1.5 DELIVERY, STORAGE, AND HANDLING

Package materials to prevent damage and deterioration during shipment, handling, storage and installation. Deliver products to the jobsite in manufacturer's original packaging and store in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective interior signage materials and workmanship for a period of 2 years from date of final acceptance of the work.

PART 2 PRODUCTS

[*Am-4] [*Am-3] 2.1 NOT USED [**Am-3] [**Am-4]

2.2 SYSTEM REQUIREMENTS

Modular sign and display system shall feature solutions for all required

sign types, including but not limited to wall mounted personnel signs, work station personnel signs, primary room identification, directories, directionals, overhead signs, projection wall signs, free standing signs, restroom signs, regulatory and information signs, stair signs and changeable slide conference room signs. All signs within the system must feature the same family of components and/or convey a uniform look throughout.

2.2.1 Features

- a. Sign Frames: Sign frame assemblies shall be comprised of aluminum extrusions with a core material rigid enough to support the sign's display/insert material.
- b. Sign Depth: No wall mounted signs, excluding any decorative backers, should feature a depth greater than 5/8". Wall mounted signs 17"w or less shall feature a maximum depth of 7/16".
- c. Updatability: Signs must allow for easy updating of message inserts for all sign types and must offer an option of front-loading/re-loading of insert panels.
- d. Tamper Resistance: System must offer an option for a concealed locking method to increase level of tamper resistance.
- e. Mounting: Signs must be able to accommodate installation via fully concealed mechanical fasteners.

2.2.2 Graphics and Typography

As selected from manufacturer's standards.

2.2.3 Colors and Finishes

Match existing MPO standard. Reference sign drawings.

2.2.4 ADA Compliance

Sign system shall comply with all applicable provisions of the 2010 Standards for Accessible Design (the updated ADA Accessibility Guidelines, ADAAG), effective in March 2011. This includes requirements regarding which sign types require Braille/tactile features, character heights, raised character spacing, raised character stroke width, color contrast and installation locations / mounting heights within the facility.

2.2.5 Materials and Construction

- a. Sign assemblies shall be comprised of an extruded aluminum frame and an inner core rigid enough to properly support the display/insert material. Overall depth of all frames 17"w or less shall not exceed 7/16". Frames must allow for front loading/re-loading of insert panels and must offer an option for a concealed locking method to increase tamper resistance.
- b. Aluminum frame extrusions shall be extruded in the USA.
- c. ADA-compliant components shall be [*Am-4] [*Am-3] DP-Tactile [**Am-3] [**Am-4] process direct-print, UV-cured, 1/32" thick tactile characters and fully domed Braille printed on an acrylic or aluminum

plaque.

- d. Graphic Inserts/Panels are as per sign drawings and should be easily updatable without the need to replace the entire sign assembly.
- e. Fasteners: Signs shall be able to accommodate fully concealed mechanical fasteners.

2.2.6 Basic System Description

[*Am-3]Basic System Description: Low profile aluminum FullView sign frames with a wide range of graphics inserts and displays. Larger directional and directory signs are of [*Am-4]the Accord15 modular system, aesthetically compatible with FullView. Reference drawings for colors, finishes, type styles and other details. Reference sign schedule for exact messages.

a. FullView Assembly Type

- 1. E-Series (FVE) with Flex-In / Flex-Out, 1/16" thick acrylic inserts.

b. Edge Profile Shape

- 1. Square
- 2. Contour

c. Frame Finish

- 1. Natural Satin Anodized
- 2. Painted Finish
 - a) Manufacturer's Color Standard:
 - Similar to APCO A88 Blue
 - Similar to APCO A69 Red
 - Similar to APCO A72 Bone White [**Am-3][**Am-4]

- c. Core Sign Types: Reference sign type drawings for colors, finishes, sizes and details. Reference signage schedule for graphics/copy specifications

- 1. Sign Type ST - Stair ID Sign .
- 2. Sign Type AR - Area of Refuge ID Sign.
- 3. Sign Type PD Elevator Lobby sign.
- 4. Sign Type WR - Women Restroom ID sign.
- 5. Sign Type MR - Men Restroom ID sign.
- 6. Sign Type RR - Single User Restroom ID sign.
- 7. Sign Type US-1_ - User Space Room ID.
- 8. Sign Type US-2_ - Secondary User Space Room ID Sign.
- 9. Sign Type RB - Restroom Blade ID Sign.
- 10. Sign Type NM - Mothers Room ID sign.
- 11. Sign Type CR - Conference Room ID sign.
- 12. Sign Type FB - Fire Extinguisher ID Blade Sign.
- 13. Sign Type IDS - Interior Directional sign.
- 14. Sign Type SR - Support Room ID sign.
- 15. Sign Type EX - Tactile Exit sign.
- 16. Sign Type DR - Directory sign.
- 17. Sign Type SRX - Support Room Exterior sign.
- 18. Sign Type STX - Stair Exterior sign.

2.2.7 Graphics / Typography

- a. Type Sizes: Selected from manufacturer's standard sizes indicated in SCHEDULE for particular units; meet ADA requirements for letter proportions and sizes.
- b. Typography: Reference signage schedule and individual signtype drawings for details. Font(s) selected from manufacturer's standards unless otherwise specified. All text and graphics shall be a true representation of the typeface(s) and/or graphics specified. Letter spacing and interline spacing shall be set by the manufacturer.
 - 1. Helvetica Neue 65 Medium
- c. Type: Uppercase.
- d. Type: Indicated in [*Am-4]signage drawings.
- e. Surface Copy Direct Print: Match existing MPO standard direct-print colors and indicated in the signage drawings; color contrast background colors in accord with ADA requirements.
- f. Copy/Message List: Indicated in signage drawings.
- g. Reference signage drawings[**Am-4] for details.
- h. All text and graphics shall be a true representation of typeface(s) and/or graphics specified.

2.3 ROOM IDENTIFICATION SIGN

2.3.1 Sign Faces

Provide sign faces of clear acrylic or PETG plastic with 0.125 inch thickness minimum, with dimensions of sign face being as indicated. Sign faces can be direct printed and contain two window openings for acrylic inserts; include a space for ADA compliant room tactile and Braille. Sign faces may also have approved printed logos for brand recognition.

2.3.2 Frame Sizes

- a. Frame Sizes Selected from Manufacturer's Standards.
- b. Insert/Display Components to Include:
 - 1. 1/8" Thick Non-Glare Acrylic Lens with Subsurface ADO ([*Am-4] [*Am-3] [**Am-3] [**Am-4] Digital Output) or Laser-Printed Insert.
 - 2. 1/8" Thick Painted Acrylic Plaque with Direct-Print Graphics
 - 3. 1/8" Thick Acrylic with UV-Cured, Direct-Print Raised Characters & Braille.
 - 4. 1/16" Thick Acrylic ADA Bottom Plaque with UV-Cured, Direct-Print Raised Characters & Braille, with Aluminum Divider
 - 5. 1/8" Thick Acrylic ADA Bottom Plaque with UV-Cured, Direct-Print Raised Characters & Braille, without Aluminum Divider.

6. 1 1/8" h Aluminum Slider Band.

c. Mounting/Installation Types to Include

1. Surface Wall Mount

a) Concealed Mechanical Fasteners (MF)

2. Projection Wall Mount with Aluminum Bracket.

2.3.3 Room Identification Tactile Letters

Provide ADA compliant material per 36 CFR 1191 which is raised 1/32 inch from the first surface, has a minimum 5/8 inch in height and is an ADA acceptable font. The color of the tactile letters is required to contrast with the sign face color per ADA standards. The ADA required Braille has a minimum durometer reading of 90.

2.4 EXIT DOOR TACTILE SIGN

Provide tactile sign with the message EXIT at each exit door that requires an exit sign to conform with NFPA 101. Sign tactile message is to comply with ICC/ANSI A117.1.

2.5 BUILDING DIRECTORIES

Provide building directories as lobby directories or floor directories, with a changeable directory. Provide dimensions, details, and materials of sign and message content as indicated on the drawings.

2.5.1 Doors

2.5.1.1 Door Glazing

Provide door glazing with 1/4 inch thick polished clear glass, fully tempered in accordance with ASTM C1048 and ANSI Z97.1.

2.5.1.2 Door Construction

Provide extruded aluminum door frame of same finish as surrounding frame; mitered corners, and assembled with concealed fasteners. Provide continuous concealed hinges in finish to match frames and trim. Set glazing in frame with clear silicone adhesive.

2.5.1.3 Door Locks

Provide manufacturer's standard door locks; keyed alike. Provide two sets of keys.

2.5.2 Fabrication

Provide extruded aluminum frames and trim with welded corners and mitered to a hairline fit, with no exposed fasteners.

2.5.3 Non-Illuminated Unit

Directory consists of a non-illuminated unit with changeable aluminum insert slots that accept a user-printed cardstock insert. Design of unit as indicated on the drawings.

2.5.3.1 Construction

The directory is 2 3/4 inches deep frame constructed of aluminum with black anodized finish . Unit is surface mounted. Unit has a 3 inch header size and lettering as shown. Unit has a 1 15/32 inch face door frame with concealed hinges and locking system or other secure method. Door frame matches directory material and finish.

2.5.3.2 Message Strips

Message strips are sized in accordance with manufacturer's standard. Provide letters and numbers in accordance with the drawings.

2.6 PRESSURE SENSITIVE LETTERS

2.6.1 Fabrication

Ensure that vinyl letter edges and corners of finished letterforms and graphics are true and clean. Do not use letterforms and graphics with rounded positive or negative corners, nicked, cut, or ragged edges.

2.6.2 Size

Letter size: as indicated.

2.7 MATERIALS

2.7.1 Aluminum Alloy Products

Aluminum extrusions are at least 1/8 inch thick, and aluminum plate or sheet are at least 0.0508 inch thick. Extrusions conform to ASTM B221; plate and sheet conforms to ASTM B209. Where anodic coatings are specified, alloy conforms to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes are as shown. Welding for aluminum products conforms to AWS D1.2/D1.2M.

2.7.2 Organic Coating

Organic coating conforms to AAMA 2604, with total dry film thickness not less than 1.2 mils.

2.7.3 Plastic Laminate Sheet

ANSI/NEMA LD 3, general purpose HGS grade, 0.048 inch nominal thickness.

2.7.4 Fabrication and Manufacture

2.7.4.1 Factory Workmanship

Holes for bolts and screws are drilled or punched. Drilling and punching produces clean, true lines and surfaces. Exposed surfaces of work have a smooth finish; exposed riveting is flush. Conceal fastenings where practicable.

2.7.4.2 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces prevent galvanic or corrosive action.

2.7.5 Typeface

Helvetica Neue 65 Medium.

2.8 GRAPHICS

Provide signage graphics for modular signs to the following:

2.8.1 Subsurface Copy

Copy is transferred to the back face of clear acrylic sheeting forming the panel face to produce precisely formed opaque image. This method bonds all sign elements (color, graphics, lettering, Braille and substrate) into a single unit.

2.8.2 First Surface Copy Direct Print (Non-Tactile)

Message may be applied to panel using a direct print process. Original art is defined as artwork that is a first generation reproduction of the specified art. Provide clean edges and corners.

2.8.3 Photopolymer

Integral graphics and Braille achieved by photomechanical stratification processes. Provide photopolymer used for ADA compliant graphics of the type that has a minimum durometer reading of 90. Tactile graphics are raised 1/32 inch from the first surface of plaque by photomechanical stratification process.

2.9 COLOR, FINISH, AND CONTRAST

Provide color as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers. Finish of eggshell, matte, or other non-glare finish for all signs as required in handicapped-accessible buildings.

PART 3 EXECUTION

3.1 INSTALLATION

Install signs plumb and true and in accordance with approved manufacturer's instructions at locations shown on the signage plans. Submit operating instructions outlining the step-by-step procedures required for system operation. The instructions include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Provide each set permanently bound with a hard cover. The following identification must be inscribed on the covers: "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Submit in accordance with Section 01 78 23 OPERATING AND MAINTENANCE DATA. Mounting height and mounting location complies with 36 CFR 1191. Install required blocking. Do not install signs on doors or other surfaces until finishes on such surfaces have been installed. Signs installed on glass surfaces are installed with matching blank back-up plates in accordance with manufacturer's instructions.

Do not install items that show visual evidence of biological growth.

3.1.1 Anchorage

Provide anchorage in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown includes slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Provide exposed anchor and fastener materials compatible with metal to which applied with matching color and finish.

- a. Signs mounted to painted gypsum board surfaces must be removable for painting maintenance.
- b. Mount signs to lay-in ceiling grids with clip connections to ceiling tees.
- c. Install signs mounted on metal surfaces with magnetic tape.
- d. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.
- e. Install signs to workstation panels with panel clips.

3.1.2 Protection and Cleaning

Protect the work against damage during construction. Adjust hardware and electrical equipment for proper operation. Clean glass, frames, and other sign surfaces at completion of signage installation in accordance with the manufacturer's written instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 22 39

FOLDING PANEL PARTITIONS

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certification
 - 1.3.1.1 Indoor Air Quality for Finish Covering
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Coordination Drawings
 - 1.4.2 Installer Qualifications
 - 1.4.3 Manufacturer's Qualifications
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY
 - 1.6.1 Warranty Periods

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Manual Operation
 - 2.1.2 Performance Requirements
 - 2.1.2.1 Laboratory Acoustical Requirements
- 2.2 MATERIALS
- 2.3 FOLDING PANEL PARTITIONS
 - 2.3.1 Panels
 - 2.3.2 Partition System
 - 2.3.3 Track
 - 2.3.4 Suspension System
- 2.4 ACCESSORIES
 - 2.4.1 Pass Doors
 - 2.4.1.1 Pass Door Hardware
 - 2.4.2 Metal Soffit
 - 2.4.3 Markerboards
- 2.5 SEALS AND SWEEPSTRIPS
- 2.6 COLOR
 - 2.6.1 Sample Size

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Preparation Work
 - 3.1.2 Adjustment
- 3.2 FIELD TESTS
 - 3.2.1 Operational Test
 - 3.2.2 Visual Test
 - 3.2.3 Acoustical Test
 - 3.2.3.1 Partition Testing

3.3 CLEANING

-- End of Section Table of Contents --

SECTION 10 22 39

FOLDING PANEL PARTITIONS

08/20

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 A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D751	(2006; R 2011) Coated Fabrics
ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E336	(2020) Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
ASTM E413	(2016) Classification for Rating Sound Insulation
ASTM E557	(2012; R 2020) Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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CHEMICAL FABRICS AND FILM ASSOCIATION (CFFA)

CFFA-W-101-D	(2002) Quality Standard for Vinyl Coated Fabric Wallcovering
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 286 (2019) Standard Methods of Fire Tests for
Evaluating Contribution of Wall and
Ceiling Interior Finish to Room Fire Growth

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Coordination Drawings; G
Layouts; G

Installation Drawings; G

SD-03 Product Data

Folding Panel Partitions; G

Recycled Content for Steel Components; S

Recycled Content for Aluminum Components; S

SD-04 Samples

Partition System Samples; G

SD-06 Test Reports

Acoustical Test Reports; G

Field Sound Test Reports

SD-07 Certificates

Indoor Air Quality for Finish Covering; S

Installer Qualifications

Manufacturer's Qualifications

SD-08 Manufacturer's Instructions

Installation Instructions

SD-10 Operation and Maintenance Data

Folding Panel Partitions, Data Package 1 and 2; G

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certification

1.3.1.1 Indoor Air Quality for Finish Covering

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 QUALITY ASSURANCE

1.4.1 Coordination Drawings

Provide reflected ceiling plans, applicable details and other drawings as required to suit conditions, drawn to scale, for the following coordinated items, using input from adjacent materials/systems installers, field measurements and verification of conditions:

- a. Partition track, track supports and seismic bracing, switches, turning space, and storage layout.
- b. Suspended ceiling system components and structural members used for attachment.
- c. Items penetrating finished ceiling in vicinity of folding panel partition location.
- d. Accessories located within the folding panel partitions.

1.4.2 Installer Qualifications

Installer must have a minimum of 5 years of documented successful experience in the installation of folding panel partitions. When required by manufacturer, folding panel partitions must be installed by an authorized dealer with a certified crew.

1.4.3 Manufacturer's Qualifications

Manufacturer must have a minimum of 10 years of documented successful experience in designing and manufacturing folding panel partitions conforming to the requirements specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the jobsite in the manufacturer's original, unopened, and undamaged packages with labels legible and intact. Provide labels to indicate the manufacturer, brand name, size, finish, and placement

location. Store partitions and accessories in unopened packages in a manner to prevent damage. Handle partition materials in accordance with manufacturer's instructions. Protect materials from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for specified warranty periods from date of final acceptance of the work as follows:

1.6.1 Warranty Periods

- a. Structural: 5 years
- b. Plastic and Wood Materials: 2
- c. Fabric Materials: 2 years

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide manual operation, acoustical folding panel partitions, factory finished, supported from overhead track without floor gliders, as shown on the drawings including all hardware, seals, track and rollers as needed to close the specified opening.

Submit detail coordination drawings and installation drawings of each folding panel partition indicated. Include elevations, dimensions, clearances, details of construction and anchorage, and details of joints and connections.

Submit manufacturers' descriptive product data for each type of folding panel partition indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of folding panel partition in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Manual Operation

Manual operation must be a force no greater than 20 lbf to start movement at the rate of 3.33 ft/s (200 ft/min). Use a removable handle to extend and retract the bottom operable seals; vertical movement of seals must be 2 inches. Provide closure to the lead wall with the use of a flexible bulb; accomplish final closing by means of a lever exerting pressure against the wall.

2.1.2 Performance Requirements

2.1.2.1 Laboratory Acoustical Requirements

Provide partitions tested in accordance with ASTM E90, by a laboratory accredited by the U.S. Bureau of Standards, that have attained a sound transmission class (STC) of not less than [*Am-4] 56 [**Am-4] in a fully extended position, with a Noise Reduction Coefficient (NRC) of 0.25-0.30 for napped, tufted or looped fabric. Provide documentation that the partition tested is the same construction, materials, and model number as

the partition to be provided and be fully operable. Test specimen is not less than 126 square feet in area, (14 feet by 9 feet). Provide a minimum panel weight of 5.5 per square foot for STC up to 40, 7.5 psf for STC up to 45, 8.5 per square foot for STC up to 50, and 10.0 per square foot for STC up to 53. Design panel thickness (3 inch nominal) and composition to provide the required STC rating in accordance with ASTM E90 and ASTM E413. Submit acoustical test reports in accordance with ASTM E90, ASTM C423 and ASTM E413.

2.2 MATERIALS

Provide heavy-duty type hardware standard with the manufacturer. Provide pulls and latches for all partitions. Provide partitions with privacy latches. Provide manufacturer's standard finish hardware. Provide horizontal and vertical trim painted off white with matching rubber.

2.3 FOLDING PANEL PARTITIONS

Provide folding panel partitions using top hung ball bearing carriers which support modular panels.

- a. Provide partitions made up of a series of rigid panels, each panel being a one-piece assembly. Unless otherwise specified, use the least number of panels. The mechanical seal of the panel must actuate with a single operating action.
- b. Provide single (omni directional) type panels as indicated.

2.3.1 Panels

Provide panels of steel skin fiberboard laminated to appropriate structural acoustical backing, mounted in full perimeter protective frame. Steel for the panel frames must be manufacturer's standard. Frame must enclose and protect all edges of the surface material. Provide panels as indicated, except for end closure panels, and full height to track. Panels must lock in place to form a stable, rigid partition; low profile hinges may not project more than 1/4 inch maximum from panel edge. Panel surfacing must wrap around the vertical panel edges without vertical trim.

Provide steel components that contain a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for steel components.

Provide aluminum components that contain a minimum of 30 percent recycled content. Provide data identifying percentage of recycled content for aluminum components.

2.3.2 Partition System

Provide finish covering material minimum width and type as indicated on drawings, in accordance with CFFA-W-101-D, and conforming to ASTM D751 and NFPA 286. Provide acrylic backed fabric of 100 percent polyester. Provide non-allergenic stain and mildew resistant fabric that does not rot or support growth of bacteria. Provide finish covering that meets emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification of indoor air quality for finish covering.

2.3.3 Track

Provide recess enamel finish steel track as shown. Provide steel that conforms to ASTM A653/A653M. Provide track that is the manufacturer's standard product designed for the weight of the finished partition, including door. Provide track sections in the maximum lengths practicable, and not less than 6 feet long except for narrow doors and at ends of runs where short length and "drop-out service" sections of track are required. Provide suitable joint devices such as interlocking keys at each joint to provide permanent alignment of track.

2.3.4 Suspension System

Provide a suspension system consisting of steel track connected to the structural support by threaded rods, and trolleys designed to support the weight of the partition. Provide steel track of 7 gauge minimum, phosphate treated or painted. Provide center hung panel with 1 trolley with four ball bearing nylon or steel tired wheels per panel.

2.4 ACCESSORIES

2.4.1 Pass Doors

Provide ADA/ABA compliant pass door of the same materials, construction, acoustical qualities, finish and thickness as the basic panels. Pass door panel legs require bottom thresholds. Provide pass door leaf with perimeter trim to protect face finish and to provide visual identification as required by International Building Code. Pass door leaf incorporates a self-adjusting retractable bottom seal providing sound control when door is closed. Hinges finished to match other exposed hardware.

2.4.1.1 Pass Door Hardware

- a. Mechanically operated floor seal on panels containing pass doors.
- b. Concealed door closer.
- c. Latchset: Passage set.
- d. Exit Sign: Passive screen printed. .

2.4.2 Metal Soffit

Provide soffit when steel. Provide metal soffit of adequate thickness to protect the ceiling from damage by door operation and with the door manufacturer's standard neutral-color applied finish. Provide soffit on aluminum track that is an integral part of the track.

2.4.3 Markerboards

Provide markerboards with steel frame with writing surface of cast acrylic plastic with color fused to surface. Markerboard must be flush. Color: white.

2.5 SEALS AND SWEEPSTRIPS

Provide perimeter seals or sound insulation, of manufacturer's standard product, to achieve the sound transmission class specified and to pass the visual field test specified, without crack or craze when subjected to

severe usage. Provide mechanical bottom seal that can be raised or lowered for positive control. Provide manufacturer's vertical seals between panels to ensure acoustical rating. Bottom seals consist of a vinyl sweep mechanical seal which expands in place, or provide panels which can be lowered by a removable operating device. Provide vertical seal between panels which is anodized, architectural grade, aluminum extrusion with vinyl sound seal. Sweep strips must be vinyl or other material that will not crack or craze with severe usage. Provide sweep strip STC to the specified rating.

2.6 COLOR

Provide partition system samples in sizes indicated below and colors as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

2.6.1 Sample Size

- a. Textile Facing Material: Full width by not less than 36 inches long.
- b. Panel Facing Material: Manufacturer's standard size, not less than 6 inches square.
- c. Panel Edge and Chair Rail Materials: Manufacturer's standard size, not less than 6 inches long.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth. Install in accordance with the approved installation drawings and the manufacturer's written installation instructions.

3.1.1 Preparation Work

Verify dimensions and condition of openings scheduled to receive folding panel partitions. Install partitions in accordance with the approved partition layouts, manufacturer's directions, and ASTM E557. Provide structural support for the track support elements as indicated.

3.1.2 Adjustment

Adjust manually operated partitions to open and close from any position with a maximum horizontal force as specified in paragraph MANUAL OPERATION applied to pendant pull, box or handle.

3.2 FIELD TESTS

3.2.1 Operational Test

In the presence of the Contracting Officer, operate partition at least three times to demonstrate that partition is capable of being moved from the stored position to the fully extended position smoothly and quietly and without overloading the drive components. Activate the emergency release mechanism and demonstrate proper operation of the partition in the manual mode and activate mechanical seals top and bottom. Adjust partitions which do not operate properly and retest.

3.2.2 Visual Test

Conduct visual field tests for light leakage with all room lights turned on in the space on one side of the partition. Darken space on the other side of the partition. Light leakage from the lighted space to the darkened space is not acceptable. If light leakage does occur, adjust the partition to correct the problem and retest.

3.2.3 Acoustical Test

3.2.3.1 [*Am-4] Partition Testing

Provide partition testing by an independent certified acoustical consultant in accordance with ASTM E336, and achieve a Noise Isolation Class (NIC) of 45[**Am-4] plus or minus two. Adjust and/or modify partitions which do not comply, and retest. Submit field sound test reports.

3.3 CLEANING

Clean any soiled parts of the partition in accordance with manufacturer's written instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 26 00

WALL AND DOOR PROTECTION

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality
 - 1.3.1.1 Wall Covering and Panels
 - 1.3.1.2 Adhesives and Sealants
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 WARRANTY

PART 2 PRODUCTS

- 2.1 STANDARD PRODUCTS
 - 2.1.1 Resilient Material
 - 2.1.1.1 Minimum Impact Resistance
 - 2.1.1.2 Fire Resistance Rating
 - 2.1.1.3 Integral Color
 - 2.1.1.4 Chemical and Stain Resistance
 - 2.1.1.5 Fungal and Bacterial Resistance
- 2.2 CORNER GUARDS
 - 2.2.1 Resilient Corner Guards
- 2.3 FINISH
 - 2.3.1 Resilient Material Finish
- 2.4 ADHESIVES
- 2.5 COLOR

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Corner Guards and Wall Guards

-- End of Section Table of Contents --

SECTION 10 26 00

WALL AND DOOR PROTECTION

08/20

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 B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D543	(2020) Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F476	(2014) Standard Test Methods for Security of Swinging Door Assemblies
ASTM G21	(2015; R 2021; E 2021) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
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GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage
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SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1545	(2005; R 2014) Instrumental Color
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Difference Measurement for Exterior
Finishes, Textiles and Colored Trim

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168

(2017) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818

(2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Corner Guards; G

SD-03 Product Data

Corner Guards; G

Recycled content for aluminum component of corner guards; S

SD-04 Samples

Corner Guards; G

SD-06 Test Reports

Fire Resistance Rating

SD-07 Certificates

Indoor air quality for adhesives and sealants; S

SD-10 Operation and Maintenance Data

Corner Guards, Data Package 1; G

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality

1.3.1.1 Wall Covering and Panels

Provide sheet and high impact resistant resilient materials certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this section. Provide current product certification

documentation from certification body.

1.3.1.2 Adhesives and Sealants

Provide adhesives and sealants certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesives and sealants.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Keep materials dry, protected from weather and damage, and stored under cover. Store materials at approximately 70 degrees F for at least 48 hours prior to installation.

1.5 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a 1 year period from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

To the maximum extent possible, provide wall and door protection items that are standard products of a single manufacturer and furnished as detailed. Drawings show general configuration of products required.

Submit detailed shop drawings of each wall and door protection item indicated. Include elevations, dimensions, clearances, details of construction and anchorage, and details of joints and connections.

Submit manufacturers' descriptive product data for each wall and door protection item indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each wall and door protection item indicated in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Resilient Material

Provide resilient material consisting of high impact resistant extruded PVC free acrylic vinyl conforming to the following:

2.1.1.1 Minimum Impact Resistance

Minimum impact resistance must be 49.62 ft-lbs/sq. inch when tested in accordance with ASTM F476.

2.1.1.2 Fire Resistance Rating

Provide the following surface burning characteristics when tested and labeled in accordance with ASTM E84 by a qualified testing agency: maximum flame spread of 25 and a smoke developed rating of 450 or less.

Provide material rated as self extinguishing when tested in accordance with ASTM D635. Provide resilient material used for protection on fire rated doors and frames listed by the qualified testing agency performing the tests. Provide resilient material installed on fire rated wood/steel door and frame assemblies tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly are not acceptable.

2.1.1.3 Integral Color

Provide colored components having integral color and matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.1.1.4 Chemical and Stain Resistance

Provide materials resistant to chemicals and stains reagents in accordance with ASTM D543.

2.1.1.5 Fungal and Bacterial Resistance

Provide materials resistant to fungi and bacteria in accordance with ASTM G21, as applicable.

2.2 CORNER GUARDS

2.2.1 Resilient Corner Guards

Provide surface mounted corner guards, radius formed to profile shown. [*Am-4] Corner guard height must be as indicated on the drawings. [**Am-4] Furnish mounting hardware, cushions, and base plates. Provide assembly consisting of a snap-on corner guard formed from high impact resistant resilient material, mounted on a continuous aluminum retainer. Extruded aluminum retainer conforms to ASTM B221, alloy 6063, temper T5 or T6. Provide aluminum components that contain a minimum of 35 percent recycled content. Provide data identifying percentage of recycled content for aluminum component of corner guards. Flush mounted type guards act as a stop for adjacent wall finish material. Furnish factory fabricated end closure caps for top and bottom of surface mounted corner guards. Provide flush mounted corner guards installed in fire rated wall that maintain the rating of the wall. Manufacturer to provide insulating materials that are an integral part of the corner guard system. Provide exposed metal portions of fire rated assemblies with a paintable surface.

2.3 FINISH

Submit samples indicating color and texture of materials requiring color and finish.

2.3.1 Resilient Material Finish

Provide resilient material finish of embossed texture with colors in accordance with SAE J1545.

2.4 ADHESIVES

Provide adhesive for resilient material in accordance with manufacturers recommendations. Provide sealants and non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350

(limit requirements for either office or classroom spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification of indoor air quality for adhesives.

2.5 COLOR

Provide color as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Install items on surfaces that are clean, smooth, and free of obstructions.

3.1.1 Corner Guards and Wall Guards

- a. Mount guards as indicated and in accordance with manufacturer's written installation instructions.
- b. For wall guards, space brackets at no more than 3 feet on centers and anchor to the wall in accordance with the manufacturer's written installation instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 22 - PLUMBING

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

11/15, CHG 4: 05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
 - 1.2.1 Sustainable Design Submittals
- 1.3 STANDARD PRODUCTS
 - 1.3.1 Alternative Qualifications
 - 1.3.2 Service Support
 - 1.3.3 Manufacturer's Nameplate
 - 1.3.4 Modification of References
 - 1.3.4.1 Definitions
 - 1.3.4.2 Administrative Interpretations
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 PERFORMANCE REQUIREMENTS
 - 1.5.1 Welding
- 1.6 REGULATORY REQUIREMENTS
- 1.7 PROJECT/SITE CONDITIONS
- 1.8 INSTRUCTION TO GOVERNMENT PERSONNEL
- 1.9 ACCESSIBILITY OF EQUIPMENT
- 1.10 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Pipe Joint Materials
 - 2.1.2 Miscellaneous Materials
 - 2.1.3 Pipe Insulation Material
- 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS
- 2.3 VALVES
 - 2.3.1 Wall Faucets
 - 2.3.2 Wall Hydrants (Frostproof)
 - 2.3.3 Relief Valves
 - 2.3.4 Thermostatic Mixing Valves
- 2.4 FIXTURES
 - 2.4.1 Lavatories
 - 2.4.2 Automatic Controls
 - 2.4.3 Flush Valve Water Closets
 - 2.4.4 Flush Valve Urinals
 - 2.4.5 Wheelchair Flush Valve Type Urinals
 - 2.4.6 Wall Hung Lavatories
 - 2.4.7 Countertop Lavatories
 - 2.4.8 Break Room Sinks
 - 2.4.9 Wheelchair Drinking-Water Coolers
 - 2.4.10 Precast Terrazzo Mop Sinks
- 2.5 BACKFLOW PREVENTERS
- 2.6 DRAINS

- 2.6.1 Floor Drains
- 2.6.2 Floor Sinks
- 2.7 TRAPS
- 2.8 WATER HEATERS
 - 2.8.1 Automatic Electric Storage Type
 - 2.8.1.1 Electric Type
- 2.9 PUMPS
 - 2.9.1 Sump Pumps
 - 2.9.2 Circulating Pumps
- 2.10 DOMESTIC WATER SERVICE METER
- 2.11 ELECTRICAL WORK
- 2.12 MISCELLANEOUS PIPING ITEMS
 - 2.12.1 Escutcheon Plates
 - 2.12.2 Pipe Sleeves
 - 2.12.2.1 Sleeves in Masonry and Concrete
 - 2.12.2.2 Sleeves Not in Masonry and Concrete
 - 2.12.3 Pipe Hangers (Supports)
 - 2.12.4 Underground Pipe Hangers system
 - 2.12.4.1 Plumbing Pipe Support Below Structural Slabs
 - 2.12.5 Nameplates

PART 3 EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
 - 3.1.1 Water Pipe, Fittings, and Connections
 - 3.1.1.1 Utilities
 - 3.1.1.2 Cutting and Repairing
 - 3.1.1.3 Protection of Fixtures, Materials, and Equipment
 - 3.1.1.4 Mains, Branches, and Runouts
 - 3.1.1.5 Pipe Drains
 - 3.1.1.6 Expansion and Contraction of Piping
 - 3.1.1.7 Thrust Restraint
 - 3.1.1.8 Commercial-Type Water Hammer Arresters
 - 3.1.2 Joints
 - 3.1.2.1 Threaded
 - 3.1.2.2 Unions and Flanges
 - 3.1.2.3 Cast Iron Soil, Waste and Vent Pipe
 - 3.1.2.4 Copper Tube and Pipe
 - 3.1.2.5 Other Joint Methods
 - 3.1.3 Dissimilar Pipe Materials
 - 3.1.4 Corrosion Protection for Buried Pipe and Fittings
 - 3.1.5 Pipe Sleeves and Flashing
 - 3.1.5.1 Sleeve Requirements
 - 3.1.5.2 Flashing Requirements
 - 3.1.5.3 Waterproofing
 - 3.1.5.4 Optional Counterflashing
 - 3.1.5.5 Pipe Penetrations of Slab on Grade Floors
 - 3.1.5.6 Pipe Penetrations
 - 3.1.6 Fire Seal
 - 3.1.7 Supports
 - 3.1.7.1 General
 - 3.1.7.2 Pipe Supports and Structural Bracing Requirements
 - 3.1.7.3 Pipe Hangers, Inserts, and Supports
 - 3.1.7.4 Structural Attachments
 - 3.1.8 Welded Installation
 - 3.1.9 Pipe Cleanouts
 - 3.1.10 Water Meter
- 3.2 WATER HEATERS
 - 3.2.1 Relief Valves

- 3.2.2 Heat Traps
- 3.2.3 Connections to Water Heaters
- 3.2.4 Expansion Tank
- 3.3 FIXTURES AND FIXTURE TRIMMINGS
 - 3.3.1 Fixture Connections
 - 3.3.2 Flushometer Valves
 - 3.3.3 Height of Fixture Rims Above Floor
 - 3.3.4 Fixture Supports
 - 3.3.4.1 Support for Solid Masonry Construction
 - 3.3.4.2 Support for Concrete-Masonry Wall Construction
 - 3.3.4.3 Support for Steel Stud Frame Partitions
 - 3.3.4.4 Wall-Mounted Water Closet Gaskets
 - 3.3.5 Backflow Prevention Devices
 - 3.3.6 Access Panels
 - 3.3.7 Traps
- 3.4 VIBRATION-ABSORBING FEATURES
- 3.5 WATER METER REMOTE READOUT REGISTER
- 3.6 IDENTIFICATION SYSTEMS
 - 3.6.1 Identification Tags
 - 3.6.2 Pipe Color Code Marking
 - 3.6.3 Color Coding Scheme for Locating Hidden Utility Components
- 3.7 ESCUTCHEONS
- 3.8 PAINTING
 - 3.8.1 Painting of New Equipment
 - 3.8.1.1 Factory Painting Systems
- 3.9 TESTS, FLUSHING AND DISINFECTION
 - 3.9.1 Plumbing System
 - 3.9.1.1 Test of Backflow Prevention Assemblies
 - 3.9.2 Defective Work
 - 3.9.3 System Flushing
 - 3.9.3.1 During Flushing
 - 3.9.3.2 After Flushing
 - 3.9.4 Operational Test
 - 3.9.5 Disinfection
- 3.10 TESTING, ADJUSTIN AND BALANCING
- 3.11 POSTED INSTRUCTIONS
- 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT
 - 3.12.1 Storage Water Heaters
 - 3.12.1.1 Electric Storage Water Heater
- 3.13 TABLES

-- End of Section Table of Contents --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
11/15, CHG 4: 05/21

PART 1 GENERAL

1.1 REFERENCES

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

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010 (2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.3/CSA 4.3 (2019) Gas-Fired Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2 (2012; R 2017) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)

ASME A112.6.1M (1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.6.3 (2019) Standard for Floor and Trench Drains

ASME A112.19.2/CSA B45.1 (2018; ERTA 2018) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals

ASME A112.19.3/CSA B45.4 (2017; Errata 2017) Stainless Steel Plumbing Fixtures

ASME A112.19.5 (2017) Flush Valves and Spuds for Water Closets, Urinals, and Tanks

ASME A112.36.2M (1991; R 2017) Cleanouts

ASME B1.20.1 (2013; R 2018) Pipe Threads, General Purpose (Inch)

ASME B16.5 (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.12	(2019) Cast Iron Threaded Drainage Fittings
ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.29	(2017) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B31.1	(2020) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2017) BPVC Section IV-Rules for Construction of Heating Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2016) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1018	(2001; R 2021) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002)
ASSE 1019	(2011; R 2016) Performance Requirements

for Wall Hydrant with Backflow Protection
and Freeze Resistance

ASSE 1020 (2020) Performance Requirements for
Pressure Vacuum Breaker Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (2018) Hypochlorites

AWWA B301 (2018) Liquid Chlorine

AWWA C203 (2020) Coal-Tar Protective Coatings and
Linings for Steel Water Pipelines - Enamel
and Tape - Hot-Applied

AWWA C606 (2015) Grooved and Shouldered Joints

AWWA C651 (2014) Standard for Disinfecting Water
Mains

AWWA C652 (2019) Disinfection of Water-Storage
Facilities

AWWA C700 (2020) Cold-Water Meters - Displacement
Type, Metal Alloy Main Case

AWWA C701 (2019) Cold-Water Meters - Turbine Type
for Customer Service

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2019) Specification for Filler Metals for
Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME A17.1/CSA B44 (2021) Safety Code for Elevators and
Escalators

ASTM INTERNATIONAL (ASTM)

ASTM A74 (2021) Standard Specification for Cast
Iron Soil Pipe and Fittings

ASTM A105/A105M (2021) Standard Specification for Carbon
Steel Forgings for Piping Applications

ASTM A193/A193M (2020) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM A515/A515M (2017) Standard Specification for Pressure
Vessel Plates, Carbon Steel, for
Intermediate- and Higher-Temperature
Service

ASTM A516/A516M (2017) Standard Specification for Pressure

	Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A888	(2021) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B306	(2020) Standard Specification for Copper Drainage Tube (DWV)
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM C564	(2020a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns

ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
CAST IRON SOIL PIPE INSTITUTE (CISPI)	
CISPI 301	(2018) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2012) 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	(2016; 14/17) Copper Tube Handbook
INTERNATIONAL CODE COUNCIL (ICC)	
ICC A117.1 COMM	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities
ICC IPC	(2021) International Plumbing Code
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)	
MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends
MSS SP-110	(2010) Ball Valves Threaded,

Socket-Welding, Solder Joint, Grooved and
Flared Ends

NACE INTERNATIONAL (NACE)

NACE SP0169 (2013) Control of External Corrosion on
Underground or Submerged Metallic Piping
Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2020) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF/ANSI 61 (2020) Drinking Water System Components -
Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man (2016) Firestopping: Plastic Pipe in Fire
Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (2010) Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (2009) Hose Clamp Specifications

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star (1992; R 2006) Energy Star Energy
Efficiency Labeling System (FEMP)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SM 9223 (2004) Enzyme Substrate Coliform Test

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

40 CFR 141.80 National Primary Drinking Water

Regulations; Control of Lead and Copper;
General Requirements

UNDERWRITERS LABORATORIES (UL)

UL 174	(2004; Reprint Feb 2021) UL Standard for Safety Household Electric Storage Tank Water Heaters
UL 430	(2015; Reprint Feb 2018) UL Standard for Safety Waste Disposers

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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; G

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 must indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details must include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, must be drawn to scale.

SD-03 Product Data

Backflow Prevention Assemblies; G

Fixtures; S

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets; G

WaterSense Label for Flush Valve Water Closet; S

Flush Valve Urinals; G

WaterSense Label for Urinal; S

Wall Hung Lavatories; G

Countertop Lavatories; G

Breakroom Sinks; G

Wheelchair Drinking-Water Coolers; G

Energy Star Label for Wheelchair Electric Water Cooler; S

Water Heaters; G

Electric Storage Water Heater; S

Pumps; G

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; G

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System; G

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; G

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 must indicate the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation must 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 must have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor must provide written documentation of the tests performed and signed by the individual performing the tests. Prior to testing, submit to the Contracting Officer certification issued by the State or Local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory authority.

SD-07 Certificates

Materials and Equipment; G

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and

installation must conform to the code.

Bolts; G

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.2.1 Sustainable Design Submittals

Low-Emitting Materials - Interior adhesives and sealants applied on site:

- a. Meet the VOC emissions evaluation and meet the VOC content evaluation. The adhesives and sealants product category include all interior adhesives and sealants applied on site. Refer to 01 33 29 SUSTAINABILITY REPORTING and the LEED BDC Ref Guide v4.1 for full VOC content and emissions requirements.
- b. Provide LEED Submittal Cover Sheet in accordance with 01 33 29 SUSTAINABILITY REPORTING.
- c. Provide Environmental Product Declarations (EPD) for plumbing fixtures in accordance with 01 33 29 SUSTAINABILITY REPORTING.

1.3 STANDARD PRODUCTS

Specified materials and equipment must be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment must essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must 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 must 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 must 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 must 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, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions must be considered mandatory, the word "should" must be interpreted as "must." Reference to the "code official" must be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" must be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" must be interpreted to mean the "lessor." References to the "permit holder" must be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, must be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

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 must be notified 24 hours in advance of tests, and the tests must be performed at the work site if practicable. Welders or welding operators must apply their assigned symbols near each weld they make as a permanent record. Structural members must be welded in accordance with Section 05 12 00 STRUCTURAL STEEL.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work must be in accordance with

ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor must 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 must be thoroughly familiar with all parts of the installation and must be trained in operating theory as well as practical operation and maintenance work.

Instruction must 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 must 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.

1.10 WARRANTY

Provide equipment with manufacturer's standard 2 year parts and labor warranty.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services must be in accordance with TABLES I and II.

Pipe schedules must be selected based on service requirements. Pipe fittings must be compatible with the applicable pipe materials. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers must comply with PL 93-523 and NSF/ANSI 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9. Hubless cast-iron soil pipe must not be installed underground, under concrete floor slabs.

2.1.1 Pipe Joint Materials

Hubless cast-iron soil pipe must not be used underground. Solder containing lead must not be used with copper pipe. Cast iron soil pipe and fittings must be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials must conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Brazing Material: Brazing material must conform to AWS A5.8/A5.8M, BCuP-5.
- d. Brazing Flux: Flux must be in paste or liquid form appropriate for use with brazing material. Flux must be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- e. Solder Material: Solder metal must conform to ASTM B32.
- f. Solder Flux: Flux must be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- g. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- h. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns must be in accordance with ASME B16.5 class 150 and must have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material must conform to ASTM A105/A105M. Blind flange material must conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts must be high strength or intermediate strength with material conforming to ASTM A193/A193M.
- i. Copper tubing must conform to ASTM B88, Type K, L or M.

2.1.2 Miscellaneous Materials

Miscellaneous materials must conform to the following:

- a. Water Hammer Arrestor: PDI WH 201. Water hammer arrester must be piston type.
- b. Copper, Sheet and Strip for Building Construction: ASTM B370.
- c. Asphalt Roof Cement: ASTM D2822/D2822M.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.
- h. Hypochlorites: AWWA B300.

- i. Liquid Chlorine: AWWA B301.
- j. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- k. Thermometers: ASTM E1. Mercury must not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation must be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports must conform to MSS SP-58.

2.3 VALVES

Valves must be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller must be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger must have flanged iron bodies and bronze trim. Pressure ratings must 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 must conform to the following standards:

Description	Standard
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 Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4

Water Heater Drain Valves	ASME BPVC SEC IV, Part HLW-810: Requirements for Potable-Water Heaters Bottom Drain Valve
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

2.3.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer must be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle must be securely attached to stem.

2.3.2 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer must have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod must 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 must be provided. Valve rod and seat washer must be removable through the face of the hydrant. The hydrant must have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.3 Relief Valves

Water heaters and hot water storage tanks must have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve must 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 must have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves must be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh must have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh must have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve must be the size of the valve outlet.

2.3.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced must be line size and must be constructed with rough or finish bodies either with or without plating. Each valve must be 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 must be of an approved type. The body must be of heavy cast bronze, and interior parts must be brass, bronze,

corrosion-resisting steel or copper. The valve must be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves must maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 1.28 GPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped must be in accordance with ICC A117.1 COMM. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body must be provided. Porcelain enameled ware must 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 must 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, except grease interceptors, must be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts must be provided for supports, and polished chromium-plated pipe, valves, and fittings must be provided where exposed to view. Fixtures with the supply discharge below the rim must be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, pop-up stoppers of lavatory waste drains must be copper alloy with all visible surfaces chrome plated.

2.4.1 Lavatories

Vitreous china lavatories must be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate. Provide faucet with a maximum flow rate of 0.35 gpm at a flowing pressure of 60 psi. Water volume must be limited to 0.1 gal per metering cycle.

2.4.2 Automatic Controls

Flushing and faucet systems must consist of solenoid-activated valves with light beam sensors. Flush valve for water closet must include an override pushbutton. Flushing devices must be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.4.3 Flush Valve Water Closets

ASME A112.19.2/CSA B45.1, white vitreous china, siphon jet, elongated bowl, wall mounted, wall outlet. Top of toilet seat height above floor must be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide white solid plastic elongated open-front seat .

Water flushing volume of the water closet and flush valve combination must be 1.28 gallon per flush, and a MaP (Maximum Performance) minimum rating of 1,000.. Provide data identifying WaterSense label for flush valve water closet.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components must be chromium-plated or polished stainless steel. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve must not interfere with the hand rail in ADA stalls. Provide

hard-wired solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.4 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination must not exceed .125 gallon per flush. Provide data identifying WaterSense label for urinal. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components must be chromium-plated or polished stainless steel. Flush valves must be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Provide hard-wired solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.5 Wheelchair Flush Valve Type Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, blowout action, integral trap, elongated projecting bowl, 14 inches long from wall to front of flare, and ASME A112.19.5 trim. Provide large diaphragm (not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers), nonhold-open flush valve of chrome plated cast brass conforming to ASTM B584, including vacuum breaker and angle (control-stop) valve with back check. The water flushing volume of the flush valve and urinal combination must not exceed 0.125 gallon per flush. Provide data identifying WaterSense label for wheelchair flush valve urinal. Furnish urinal manufacturer's certification of conformance. Provide ASME A112.6.1M concealed chair carriers. Mount urinal with front rim a maximum of 17 inches above floor and flush valve handle a maximum of 44 inches above floor for use by handicapped on wheelchair. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the hard-wired solenoid.

2.4.6 Wall Hung Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the hard-wired solenoid.

2.4.7 Countertop Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, self-rimming, minimum dimensions of 19 inches wide by 17 inches front to rear, under counter mount, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide

aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Provide top mounted washerless centerset lavatory faucets. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the hard-wired solenoid.

2.4.8 Break Room Sinks

ASME A112.19.3/CSA B45.4, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 33 inches wide by 21 inches front to rear, single compartment, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 3.5 inch drain outlet. Provide aerator with faucet. Water flow rate must not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and stainless steel cup strainers. Provide separate 1.5 inch P-trap and drain piping to vertical vent piping from each compartment. Provide top mounted washerless sink faucets with hose spray. Provide UL 430 waste disposer in right compartment.

2.4.9 Wheelchair Drinking-Water Coolers

AHRI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor and bottle filler. Bubblers must also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. Provide electric water cooler that is Energy Star labeled. Provide data identifying Energy Star label for wheelchair electric water cooler.

2.4.10 Precast Terrazzo Mop Sinks

Terrazzo must be made of marble chips cast in white portland cement to produce 3000 psi minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers must meet the above requirements.

Backflow preventers with intermediate atmospheric vent must conform to ASSE 1012. Reduced pressure principle backflow preventers must conform to ASSE 1013. Hose connection vacuum breakers must conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers must conform to ASSE 1001.

Pressure vacuum breaker assembly must conform to ASSE 1020. Air gaps in plumbing systems must conform to ASME A112.1.2.

Reduced Pressure Zone Assemblies must be installed at each potential health hazard location to prevent backflow due to backsiphonage and/or backpressure. The assembly must consist of a pressure differential relief valve located in a zone between two positive seating check valves. Seats and seat discs must be replaceable in both check valves and the relief valve without the use of special tools. Service of all internal check valve components must be through top mounted access covers threaded to the main valve body. The check valve poppet assembly must be guided via the use of a corrosion resistant plastic guide. The check valve and relief valve seats must be push-in type. The relief valve cover must be secured with stainless steel bolts and must utilize a quarter-turn locking joint to capture the spring load of the relief valve. The relief valve must have an internal sensing line to sense the inlet water supply. All rubber elastomers must be of chloramine resistant material. The assembly must also include two resilient seated isolation valves, four top-mounted resilient seated test cocks and an air gap drain fitting.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains must consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains must be cast iron except where metallic waterproofing membrane is installed. Drains must be of double drainage pattern for embedding in the floor construction. The seepage pan must have weep holes or channels for drainage to the drainpipe. The strainer must be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane must be provided when required. Drains must be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains must conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer must meet ASSE 1018.

2.6.2 Floor Sinks

Floor sinks must be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink must have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size must be as indicated or of the same size as the connecting pipe.

2.7 TRAPS

Unless otherwise specified, traps must copper-alloy adjustable tube type with slip joint inlet and swivel. Traps must be without a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes must be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets must have rubber washer and copper alloy nuts for slip

joints above the discharge level. Swivel joints must be below the discharge level and must be of metal-to-metal or metal-to-plastic type as required for the application. Nuts must have flats for wrench grip. Outlets must have internal pipe thread, except that when required for the application, the outlets must have sockets for solder-joint connections. The depth of the water seal must be not less than 2 inches. The interior diameter must be not more than 1/8 inch over or under the nominal size, and interior surfaces must be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange must be provided for lavatories. The assembly must be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities must be as indicated. Each water heater must have replaceable anodes. Each primary water heater must have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater must have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems must be tied into building off-hour controls. The thermal efficiencies and standby heat losses must conform to TABLE III in PART 3 of this Section for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank must be installed on the cold water supply to each water heater. Expansion tanks must be specifically designed for use on potable water systems and must be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume must be as indicated. Provide water heater that is Energy Star eligible with Energy Star label. Provide data identifying Energy Star Label for Water Heater.

2.8.1 Automatic Electric Storage Type

Heaters must be complete with control system, temperature gauge, and pressure gauge, and must have ASME rated combination pressure and temperature relief valve.

2.8.1.1 Electric Type

Electric type water heaters must conform to UL 174 with dual heating elements. Each element must be 4.5 KW. The elements must be wired so that only one element can operate at a time.

2.9 PUMPS

2.9.1 Sump Pumps

Sump pump located in elevator pit must remove water in accordance with ASME A17.1/CSA B44 and provide pump shutdown in the event that oily water is detected. Pump and motor include an alarm that will be activated in the event of high water or high oil condition. The discharged line from the pump must be provided with a union or flange, a nonclog swing check valve in an accessible location above the sump pit.

2.9.2 Circulating Pumps

Domestic hot water circulating pumps must be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor must be supported by the piping on which it is installed. The shaft must be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor must be totally enclosed, fan-cooled and must have sufficient horsepower for the service required. Each pump motor must be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

Integral size motors must be premium efficiency type in accordance with NEMA MG 1. Pump motors smaller than 1 hp Fractional horsepower pump motors must have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards must shield exposed moving parts.

2.10 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller must be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger must be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, indicating as provided by the local utility. Meter must be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

Meters must be connected to the base wide energy and utility monitoring and control system (if this system exists) using the installation's advanced metering protocols.

Meter configuration and outputs must be coordinated with controls system outputs required and for base wide metering ARMS system requirements. Meter configuration and outputs must be coordinated for base wide cybersecurity requirements

AMRS compatible water metering solutions consist of a componential system to achieve the goal of delivering water consumption data into the AMRS. To accurately scale output pulses the contractor must obtain building water usage from base personnel, taking into account peak demand when sizing the components that are necessary as well as determining peak pulse rate as to not saturate the receiving device and risk losing captured pulse data. The various components that may be necessary include but are not limited to the following: Water Meter, Pulse Kit, High Speed Dividing Pulse Relay, Surge Suppression Device, Accumulator, and Electric Meter with digital input availability:

- a. Pulse kit must be able to produce a two-wire (Form A) pulse output via RS485.
- b. Water meter or attached pulse kit must include a visual register or dial.
- c. Pulse output must be delivered to a high speed dividing pulse relay that has the capability of producing a wetting voltage if necessary.
- d. High speed dividing pulse relay must provide isolated pulse outputs (Form A) that must be delivered to an AMRS compatible electric meter.
- e. Water meters that can communicate to AMRS via the Modbus/TCP

protocol may be acceptable if they can pass technical and cybersecurity evaluations directed by the AMRS PMO. At this time there are no tested or approved Modbus /TCP water meters.
f. All meter labels must be white on black phenolic.

The following list of meters were evaluated, meet the AMRS [*Am-4] requirements and are in use at Buckley SFB

- a. Schneider Electric PM5560
- b. Schneider Electric PM8000
- c. Schneider Electric ION 8650
- d. Siemens 9410
- e. Siemens 9810

[**Am-4]

The following device is compatible with the AMRS platform, is consistent with the need of the existing site conditions, and has been tested and passed cybersecurity requirements:

- a. Schneider Electric EGX150 Ethernet Gateway

2.11 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. 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 must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque must 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 must be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors must 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, must be provided. For packaged equipment, the manufacturer must provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.12 MISCELLANEOUS PIPING ITEMS

2.12.1 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.

2.12.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where supply drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.12.2.1 Sleeves in Masonry and Concrete

Provide steel 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.

2.12.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.12.3 Pipe Hangers (Supports)

Provide MSS SP-58 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.

2.12.4 Underground Pipe Hangers system

2.12.4.1 Plumbing Pipe Support Below Structural Slabs

a. All plumbing pipes must be supported by an approved suspension system.

b. System Structure:

1. Provides a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system must support the weight of suspended lateral pipes and typical backfill material throughout the construction process.
2. The system must be designed to temporarily position and suspend the lateral pipes at the specified height and slope until pipes are permanently anchored to the overhead structural slab by the securing hanger (clevis) system. The open, underground system will then remain independent from the securing hangers.
3. The open space of the system beneath the structural slab is designed to receive the infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will apply exclusively to the system and not the pipes. Therefore, the system must be designed to move separately and independently of the lateral pipes.

c. System Components:

1. The system must have waterproof components related to its intended performance.
2. The system must maintain its structural integrity in all humid environments.
3. The system must have industry-proven performance in inclement weather conditions.
4. The system must be able to perform when submerged in water.
5. All system components, excluding clevises, threaded rods, and nuts, must be furnished by the designed system manufacturer.
6. It is recommended that all independent components not included in the designed system should comply with the project specifications in order to get the intended results of the designed system.
7. Each vertical threaded rod must have a component secured toward the top end and be permanently affixed into the concrete slab in order to maintain the specified elevation.
8. System must be installed per the manufacturer's requirements and recommendations.
9. Acceptable Products: Proven systems that comply with these requirements.

[*Am-4]

10. Underground pipe Hanger and hardware should be of stainless steel material. [**Am-4]

2.12.5 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates must be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums must conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts must be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system must be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping must be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain must be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping must be connected to the exterior

service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes must be laid in separate trenches, except when otherwise shown. Exterior underground utilities must be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility must be marked with a stake or other acceptable means. Valves must 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 must be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system must 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, must 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 and flushing devices must be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work must be carefully laid out in advance, and unnecessary cutting of construction must be avoided. Damage to building, piping, wiring, or equipment as a result of cutting must be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings must be closed with caps or plugs during installation. Fixtures and equipment must be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment must be thoroughly cleaned, adjusted, and operated. Safety guards must be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping must be installed as indicated. Pipe must be accurately cut and worked into place without springing or forcing. Structural portions of the building must not be weakened. Aboveground piping must 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 must be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines must 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 must not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes must 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 must be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and

wide sweep bends are formed. The center-line radius of bends must 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 must consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps must be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance must be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser must have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers must be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers must be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length must be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility must be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility must 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 4 inches in diameter or larger must be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking must be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking must be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block must be poured against undisturbed earth. The side of the thrust block not subject to thrust must be poured against forms. The area of bearing will be as shown. Blocking must 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, must 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 must be provided on hot- and cold-water supplies and must be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, must be accessible by means of access doors or removable panels. Commercial-type water hammer arresters must conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings must 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 must be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints must have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads must be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or must have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Unions, flanges and mechanical couplings must not be concealed in walls, ceilings, or partitions. Unions must be used on pipe sizes 2-1/2 inches and smaller; flanges must be used on pipe sizes 3 inches 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 must be installed per the manufacturer's recommendations.

3.1.2.4 Copper Tube and Pipe

Soldered. Soldered joints must be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints must conform to ASME B31.5 and CDA A4015. Soldered joints must not be used in compressed air piping between the air compressor and the receiver.

3.1.2.5 Other Joint Methods

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe must be made with dielectric unions or flange waterways. Dielectric waterways must have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways must have metal connections on both ends suited to match connecting piping. Dielectric waterways must be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges must meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe must 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 must have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe must have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe must be in accordance with Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM. Coatings must be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe must be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings must be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape must conform to

AWWA C203 and must be applied with a 50 percent overlap. Primer utilized with tape type coating systems must be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves must be furnished and set in their proper and permanent location.

3.1.5.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

- a. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.
- b. 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 must 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 must 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 must cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly must be sized as recommended by the manufacturer to fit the pipe and sleeve involved.
- c. Sleeves must not be installed in structural members, except where indicated or approved. Rectangular and square openings must be as detailed. Each sleeve must extend through its respective floor, or roof, and must 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 must extend a minimum of 4 inches above the finished floor.
- d. Unless otherwise indicated, sleeves must be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors must 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.
- e. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, must be sealed as indicated with sealants conforming to ASTM C920 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve must not be sealed for interior walls which are not designated as fire rated.
- f. Sleeves through below-grade walls in contact with earth must be recessed 1/2 inch from wall surfaces on both sides. Annular space

between pipe and sleeve must 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 must be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls must conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof must be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing must be suitably formed, and the skirt or flange must extend not less than 8 inches from the pipe and must be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing must extend up the pipe a minimum of 10 inches. For cleanouts, the flashing must be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs must be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation must be sealed as indicated. Flashing for dry vents must be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield must be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane must be sleeved as described above. A waterproofing clamping flange must be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets must be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet must be perforated and turned down approximately 1-1/2 inches 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 must be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant must be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper must extend not less than 8 inches from the drainpipe and must 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 must be sealed with sealant and the flashing guard must be upturned approximately 1-1/2 inches 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 must 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 6 inches 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 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep must be formed around the pipe, fitting or drain. The groove must 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 must 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 must be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger must be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors must 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 must 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 must be used where each pipe crosses the base support member. Spacing of the base support members must not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods must not be formed or bent.

3.1.7.2 Pipe Supports and Structural Bracing Requirements

Piping and attached valves must be supported and braced to resist loads as specified in Section 23 05 48.19 BRACING FOR HVAC. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, must be provided. Material used for supports must be as specified in Section 05 12 00 STRUCTURAL STEEL.

3.1.7.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports must conform to MSS SP-58 except as modified herein.

- a. Types 5, 12, and 26 must not be used.
- b. Type 3 must not be used on insulated pipe.
- c. Type 18 inserts must 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 must be torqued per MSS SP-58 and must 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 must 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 must be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles must be welded to the pipe.
- h. Type 40 shields must:
 - (1) Be used on insulated pipe less than 4 inches.
 - (2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.
 - (3) Have a high density insert for all pipe sizes. High density inserts must have a density of 8 pcf or greater.
- i. Horizontal pipe supports must be spaced as specified in MSS SP-58 and a support must be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports must be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe must be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs must include allowances for expansion and contraction.
- j. Vertical pipe must be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers must include allowances for expansion and contraction.
- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides must be provided to allow longitudinal pipe movement. Slide materials must be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints must be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
 - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
 - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
 - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe must be the size of the outside diameter of the insulation. The insulation must 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 must include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe must be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

3.1.7.4 Structural Attachments

Plumbing equipment, piping and associated controls conduit must not be supported from overhead concrete filled metal decks or metal trays. Provide supports from structural framing to the greatest extent possible.

Concrete anchors and attachments included in this section are intended for utilization where attachment to structural framing is not possible. Provide scale layout and expected anchor sizing and carrying capacity calculations for wherever this occurs for approval.

Where necessary, attachment to building structure concrete and masonry must be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors must be applied with a safety factor not less than 5. Supports must not be attached to metal decking. Supports must 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 must be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments must be as indicated. Changes in direction of piping must 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 must 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 must conform to ASME B31.1. Weld defects must be removed and repairs made to the weld, or the weld joints must be entirely removed and rewelded. After filler metal has been removed from its original package, it must 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 must not be used.

3.1.9 Pipe Cleanouts

Pipe cleanouts must be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe must 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 must be caulked into the hub of the fitting and must be flush with the floor. Cleanouts in connection with other pipe, where indicated, must be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs. Plugs must be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug must be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is

provided under the floor. Cleanouts on pipe concealed in partitions must be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers must 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 must have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic must 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 must not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads must be cast iron.

3.1.10 Water Meter

Contractor must assume all existing equipment is working properly. If during the post award survey portion of the SOW an existing piece of equipment is found to be malfunctioning, then the contractor must bring it to the government's attention to determine how to proceed. An RFI must be submitted. This may require a contract change to delete this meter from the scope or to add a new meter.

All due diligence to survey the existing site conditions is the responsibility of the contractor.

New and relocated electric meters must be installed adjacent to the main distribution panel in a separate enclosure unless otherwise noted.

All new and relocated meter assemblies be located approximately 5 feet above the ground (4 feet minimum -- 6 feet maximum).

All new meter installations, including relocated existing meters, must include the installation of new properly sized split or solid core current transformers (CTs). Accurate sizing of new CTs is the responsibility of the contractor.

If CT installation method includes disturbing the bonds of existing cables or wiring within the gear, before and after IR scans must be performed before removing and after torquing the connections to ensure the integrity of the conductor bonds.

All new meter installations, including relocated existing meters, three phase voltage must be supplied from a breaker, disconnect or fused source which must be finger safe, labeled at the electrical meter and electrical panel.

All meter safety disconnect switches must be marked as follows "Meter Disconnect NOT Service Equipment" per the NEC. In addition, instructions to safely engage the safety disconnect switches and finger safe shorting blocks for CT conductors must be included inside each meter assembly.

Meter assemblies must be provided with finger safe voltage and current safety disconnect devices or equivalent so that the meter assembly can be worked on safely over the life of the meter installation and not require utility outages for servicing. Additionally, meters must have control power regardless of breaker position when installed in a split buss switchgear.

In the event communications equipment and/or a metering device has to be

located in an exterior location, the meter enclosure must be a lockable NEMA 4 enclosure. All new install interior meters are required to be enclosed in a lockable NEMA 3 enclosure unless otherwise noted.

All new meter installations, including relocated existing meters, must be connected via CAT6 cable from the meter, to a wall outlet in the mechanical room, to a patch panel in the communications room, and then to the Air Force switch in the communications room.

Cables labels must be permanent, wrap-around and self-laminating with text generated by a mechanical device. Labels must be applied at both ends of the cable, visible during normal maintenance of the infrastructure, resistant to environmental conditions (such as moisture, heat or ultraviolet light), and have a design life equal to or greater than that of the labeled component.

Preferred technical approach to network communication cabling in excess of 328 feet is: Fiber optic cable and fiber media converters with dedicated power outlets. Fiber media converter must be installed in the communications room within 6 feet of the network switch and within 6 feet of the electric meter enclosure.

All meter labels must be white on black phenolic.

All data cable test results (including fiber) must be completed only after the cable has been terminated in its permanent location, temporary cable test results will not be accepted.

Surge protection is required on all communication cabling extending from the exterior to the interior of a facility. This includes gas meter communication cables from the exterior to the interior of the building. Surge suppression devices must be installed w/in 3 feet of the building entrance inside the facility unless otherwise noted. Devices must be easily accessible and labeled to aide in location during future troubleshooting efforts. Surge protection devices must be Power over Ethernet (PoE) compatible and housed within an enclosure that allows space for a proper cable bend radius.

Meter assemblies and communication receptacles accessible to the public must be installed in a locked enclosure.

Electric meters with gas or water meters connected must have two internal registers configured - one for a raw pulse count and one for a weighted pulse count based on the scaling of the connected gas or water meter.

3.2 WATER HEATERS

3.2.1 Relief Valves

No valves must be installed between a relief valve and its water heater or storage tank. The P&T relief valve must be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve must be installed directly in a tapping in the tank or heater; otherwise, the P&T valve must be installed in the hot-water outlet piping. A vacuum relief valve must be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the water heater.

3.2.2 Heat Traps

Piping to and from each water heater and hot water storage tank must be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

3.2.3 Connections to Water Heaters

Connections of metallic pipe to water heaters must be made with dielectric unions or flanges.

3.2.4 Expansion Tank

A pre-charged expansion tank must be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor must adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings must 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 must be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool must be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment must be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons must be as specified. Drain lines and hot water lines of fixtures for handicapped personnel must be insulated and do not require polished chrome finish. Plumbing fixtures and accessories must 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 must be provided. Connections between earthenware fixtures and flanges on soil pipe must 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 must 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 must 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 must be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves must be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle must be installed on the wide side of the enclosure.

3.3.3 Height of Fixture Rims Above Floor

Lavatories must be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers must be installed with rim 42 inches above floor. Wall-hung service sinks must be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped must be in accordance with ICC A117.1 COMM.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, must be of the chair-carrier type. The carrier must provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability must be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, must be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.4.1 Support for Solid Masonry Construction

Chair carrier must be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate must be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier must be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate must be fastened to the concrete wall using through bolts and a back-up plate.

3.3.4.3 Support for Steel Stud Frame Partitions

Chair carrier must be used. The anchor feet and tubular uprights must be of the heavy duty design; and feet (bases) must be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, must be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.4.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets must be provided. The type of gasket furnished must be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

HVAC makeup water connections, Plumbing fixtures, equipment, and pipe connections must not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers must 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 must 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 must be located so that no part of the device will be

submerged. Backflow preventers must 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 must not be provided around backflow preventers. Access must be provided for maintenance and testing. Each device must be a standard commercial unit. Installers of backflow preventers must be licensed in backflow prevention and cross connection control.

3.3.6 Access Panels

Access panels must be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels must be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels must be as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

3.3.7 Traps

Each trap must be placed as near the fixture as possible, and no fixture must be double-trapped. Traps installed on cast-iron soil pipe must be cast iron. Traps installed on steel pipe or copper tubing must be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste must be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment and pumps, must be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation must include an adequate number of standard isolation units. Each unit must consist of machine and floor or foundation fastening, together with intermediate isolation material, and must be a standard product with printed load rating. Piping connected to mechanical equipment must be provided with flexible connectors.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register must be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number must be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags must be 1-3/8 inch minimum diameter, and marking must be stamped or engraved. Indentations must be black, for reading clarity. Tags must be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme must be provided in buildings having suspended grid ceilings. The color coding scheme must 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 must include valves, dampers, switches, linkages and thermostats. The color coding scheme must consist of a color code board and colored metal disks. Each colored metal disk must be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners must be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners must be manually removable without tools and must not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks must follow completion of the finished surface on which the disks are to be fastened. The color code board must have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board must be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols must be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board must be mounted and located in the mechanical or equipment room. The color code system must be per facility standards.

3.7 ESCUTCHEONS

Escutcheons must 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 must be fastened securely to pipe or pipe covering and must be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons must be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 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.

3.8.1 Painting of New Equipment

New equipment painting must be factory applied or shop applied, and must be as specified herein, and provided under each individual section.

3.8.1.1 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 must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If

manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system must be designed for the temperature service.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests must be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test must 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 and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test must include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly must be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges must be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges must be tested annually for accuracy in accordance with the requirements of 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), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Prior to testing, a copy of the current test gauge calibration must be provided to the Contracting Officer. Report form for each assembly must 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 must be repaired and retested.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material must be replaced or repaired as necessary and inspection and tests must be repeated. Repairs to piping must be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system must be flushed with hot potable water. Sufficient water must be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer must specify the number of fixtures to be operated during flushing. Contractor must 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 must be responsible for any flood damage resulting from flushing of the system. Flushing must 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/ANSI 61, Section 9, must be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.9.3.2 After Flushing

System must be drained at low points. Strainer screens must be removed, cleaned, and replaced. After flushing and cleaning, systems must 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 must be repaired by the Contractor. When the system flushing is complete, the hot-water system must be adjusted for uniform circulation. Flushing devices and automatic control systems must be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels must not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building must be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor must subject the plumbing system to operating tests to

demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests must cover a period of not less than 8 hours for each system and must 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. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.9.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system must be disinfected. Before introducing disinfecting chlorination material, entire system must be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure must be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material must be hypochlorites or liquid chlorine. The chlorinating material must be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet must be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks must then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet must be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer. Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with EPA SM 9223 . The testing method used must be EPA approved for drinking water systems and must comply with applicable local and state requirements.

Disinfection must be repeated until bacterial 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.

3.10 TESTING, ADJUSTIN AND BALANCING

The requirements for testing, adjusting, and balancing (TAB) are specified in 23 05 93TESTING, ADJUSTING, AND BALANCING FOR HVAC. Begin TAB only when the water supply and distribution, including controls, has been completed, with the exception of operational tests and disinfection." TAB must include domestic hot water circulating system along with DHWS.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, must 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 must be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions must be posted before acceptance testing of the systems.

3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 70 degrees F delta T.

SL = Standby loss is maximum (Btu/h) based on a 70 degrees F temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.12.1 Storage Water Heaters

3.12.1.1 Electric Storage Water Heater

- a. Storage capacity of 60 gallons must have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.
- b. Storage capacity of 60 gallons or more must have a minimum energy factor (EF) of 0.91 or higher per FEMP requirements.

3.13 TABLES

TABLE I						
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings must be marked with the CISPI trademark.	X	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings must be marked with the CISPI trademark.		X	X	X	X
3	Cast iron drainage fittings, threaded, ASME B16.12	X		X	X	
4	Copper drainage tube, (DWV), ASTM B306	X*	X	X*	X	X
5	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X
6	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X

TABLE I						
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
SERVICE: A - Underground Building Soil, Waste and Storm Drain B - Aboveground Soil, Waste, Drain In Buildings C - Underground Vent D - Aboveground Vent E - Condensate Drain Aboveground * - Hard Temper						

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
1	Seamless copper pipe, ASTM B42	X	X		X
2	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**	X**	X***
3	Cast bronze threaded fittings, ASME B16.15 for use with Item 1	X	X		X
4	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Item 1	X	X	X	X
5	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 2	X	X	X	X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C - Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints				

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
A. STORAGE WATER HEATERS				
Elect.	60 max.		10 CFR 430	EF = 0.93
Elect.	60 min.		10 CFR 430	EF = 0.91
Elect.	20 min.	12 kW max.	10 CFR 430	EF = 0.93-0.00132V minimum
Elect.	20 min.	12 kW max.	ANSI Z21.10.3/CSS (Addenda B)	SL = $20+35x(V^{1/2})$ maximum
TERMS: EF = Energy factor, minimum overall efficiency. ET = Minimum thermal efficiency with 70 degrees F delta T. SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements. V = Rated storage volume in gallons Q = Nameplate input rate in Btu/h				

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 11 20

FACILITY GAS PIPING

05/20

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 SYSTEM DESCRIPTION
 - 1.3.1 Gas Facility System and Equipment Operation
 - 1.3.2 Gas Facility System Maintenance
 - 1.3.3 Gas Facility Equipment Maintenance
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Welding Qualifications
 - 1.5.2 Jointing Thermoplastic Piping
 - 1.5.3 Shop Drawings
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Plastic Pipe

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
- 2.2 GAS PIPING SYSTEM AND FITTINGS
 - 2.2.1 Steel Pipe, Joints, and Fittings
 - 2.2.2 Steel Tubing, Joints and Fittings
 - 2.2.3 Thermoplastic Pipe, Tubing, Joints, and Fittings
 - 2.2.4 Corrugated Stainless Steel Tubing, Fittings and Accessories
 - 2.2.4.1 Tubing
 - 2.2.4.2 Mechanical Fittings
 - 2.2.4.3 Striker Plates
 - 2.2.4.4 Manifolds
 - 2.2.5 Sealants for Steel Pipe Threaded Joints
 - 2.2.6 Warning and Identification
 - 2.2.7 Flange Gaskets
 - 2.2.8 Pipe Threads
 - 2.2.9 Escutcheons
 - 2.2.10 Gas Transition Fittings
 - 2.2.11 Insulating Pipe Joints
 - 2.2.11.1 Insulating Joint Material
 - 2.2.11.2 Threaded Pipe Joints
 - 2.2.11.3 Flanged Pipe Joints
 - 2.2.12 Flexible Connectors
- 2.3 VALVES
 - 2.3.1 Valves 2 Inches and Smaller
 - 2.3.2 Valves 2-1/2 Inches and Larger
- 2.4 RISERS
- 2.5 PIPE HANGERS AND SUPPORTS
- 2.6 LINE AND APPLIANCE REGULATORS AND SHUTOFF VALVES
- 2.7 NATURAL GAS SERVICE

- 2.7.1 Service Regulators
- 2.7.2 Gas Meter
 - 2.7.2.1 Utility Monitoring and Control System (UMCS) / Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces
 - 2.7.2.2 Measurement Configuration
- 2.8 AUTOMATIC GAS SHUT-OFF
- 2.9 BOLTING (BOLTS AND NUTS)
- 2.10 GASKETS
- 2.11 IDENTIFICATION FOR ABOVEGROUND PIPING

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 EXCAVATION AND BACKFILLING
- 3.3 GAS PIPING SYSTEM
 - 3.3.1 Protection and Cleaning of Materials and Components
 - 3.3.2 Workmanship and Defects
- 3.4 PROTECTIVE COVERING
 - 3.4.1 Underground Metallic Pipe
 - 3.4.2 Aboveground Metallic Piping Systems
 - 3.4.2.1 Ferrous Surfaces
 - 3.4.2.2 Nonferrous Surfaces
- 3.5 INSTALLATION
 - 3.5.1 Metallic Piping Installation
 - 3.5.2 Metallic Tubing Installation
 - 3.5.3 Thermoplastic Piping, Tubing, and Fittings
 - 3.5.4 Connections Between Metallic and Plastic Piping
 - 3.5.5 Piping and Tubing Buried Under Buildings
 - 3.5.6 Concealed Piping in Buildings
 - 3.5.6.1 Piping and Tubing in Partitions
 - 3.5.6.2 Piping in Floors
 - 3.5.7 Aboveground Piping
 - 3.5.8 Final Gas Connections
 - 3.5.9 Meter Installation
- 3.6 PIPE JOINTS
 - 3.6.1 Threaded Metallic Joints
 - 3.6.2 Welded Metallic Joints
 - 3.6.3 Thermoplastic Joints
 - 3.6.3.1 Thermoplastic
 - 3.6.3.2 PE Fusion Welding Inspection
 - 3.6.4 Flared Metallic Tubing Joints
- 3.7 PIPE SLEEVES
- 3.8 PIPES PENETRATING WATERPROOFING MEMBRANES
- 3.9 FIRE SEAL
- 3.10 ESCUTCHEONS
- 3.11 SPECIAL REQUIREMENTS
- 3.12 BUILDING STRUCTURE
- 3.13 PIPING SYSTEM SUPPORTS
- 3.14 ELECTRICAL BONDING AND GROUNDING
- 3.15 SHUTOFF VALVE
- 3.16 LINE AND APPLIANCE PRESSURE REGULATORS
- 3.17 GAS SERVICE INSTALLATION
 - 3.17.1 Service Line
 - 3.17.2 Service Regulator
 - 3.17.3 Gas Meter
- 3.18 TESTING
 - 3.18.1 Pressure Tests
 - 3.18.2 Test With Gas
 - 3.18.3 Purging

3.18.4 Labor, Materials and Equipment
3.19 PIPE COLOR CODE MARKING

-- End of Section Table of Contents --

SECTION 23 11 20

FACILITY GAS PIPING
05/20

PART 1 GENERAL

1.1 SUMMARY

This specification section applies to gas piping installed within buildings incidental underground piping under building, above ground steel piping and corrugated stainless steel tubing (CSST) both outside (up to 5 feet beyond exterior walls) and within buildings in compliance with NFPA 54 /AGA Z223.1, "National Fuel Gas Code" , "Fuel Gas Piping".

Refer to Section 33 51 15, NATURAL-GAS DISTRIBUTION PIPELINES for natural gas piping requirements outside of the building.

1.2 REFERENCES

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

AMERICAN GAS ASSOCIATION (AGA)

AGA ANSI B109.1	(2000) Diaphragm Type Gas Displacement Meters (Under 500 cubic ft./hour Capacity)
AGA ANSI B109.2	(2000) Diaphragm Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over)
AGA ANSI B109.4	(2016) Self-Operated Diaphragm-Type Natural Gas Service Regulators for Nominal Pipe Size 1¼ inches (32 mm) and Smaller with Outlet Pressures of 2 psig (13.8 kPa) and Less
AGA XR0603	(2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service
AGA Z223.1	(2012) National Fuel Gas Code

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.15/CSA 9.1	(2009; Addenda A 2012, Addenda B 2013; R 2019) Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves
ANSI Z21.18/CSA 6.3	(2007; R 2017) Gas Appliance Pressure Regulators
ANSI Z21.21/CSA 6.5	(2019) Automatic Valves for Gas Appliances

ANSI Z21.24/CSA 6.10	(2015; R 2020) Connectors for Gas Appliances
ANSI Z21.41/CSA 6.9	(2014; R 2019) Quick-Disconnect Devices for Use with Gas Fuel Appliances
ANSI Z21.69/CSA 6.16	(2015; R 2020) Connectors for Movable Gas Appliances
ANSI Z21.78/CSA 6.20	(2010; R 2020) Standard Specification for Combination Gas Controls for Gas Appliances
ANSI Z21.80/CSA 6.22	(2019) Line Pressure Regulators
ANSI Z21.93/CSA 6.30	(2017) Excess Flow Valves for Natural Gas and Propane Gas with Pressures up to 5 psig

AMERICAN PETROLEUM INSTITUTE (API)

API 570	(2016; Addendum 1 2017; Addendum 2 2018; ERTA 1 2018) Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems
API RP 2009	(2002; R 2007; 7th Ed) Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants
API Spec 5CT	(2018) Casing and Tubing
API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves
API Std 598	(2009) Valve Inspecting and Testing
API Std 607	(2016) Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2020) Scheme for the Identification of Piping Systems
ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.33	(2012; R 2017) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psi, (Sizes NPS 1/2 - NPS 2)
ASME B18.2.1	(2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(2022) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B31.8	(2018; Supplement 2018) Gas Transmission and Distribution Piping Systems
ASME B31.9	(2020) Building Services Piping
ASME B36.10M	(2015; Errata 2016) Welded and Seamless Wrought Steel Pipe
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.9	(2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASTM INTERNATIONAL (ASTM)

ASTM 01.01	(2019) Steel - Piping, Tubing, Fittings
ASTM A105/A105M	(2021) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A181/A181M	(2014; R 2020) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2022) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel

Nuts for Bolts for High-Pressure or
High-Temperature Service, or Both

ASTM A513/A513M (2020a) Standard Specification for
Electric-Resistance-Welded Carbon and
Alloy Steel Mechanical Tubing

ASTM D2513 (2018a) Standard Specification for
Polyethylene (PE) Gas Pressure Pipe,
Tubing, and Fittings

ASTM F2015 (2000; R 2013) Standard Specification for
Lap Joint Flange Pipe End Applications

CSA GROUP (CSA)

ANSI LC 1/CSA 6.26 (2019) Fuel Gas Piping Systems Using
Corrugated Stainless Steel Tubing (CSST)

CGA 3.16-M88 (2015) Lever Operated Non-Lubricated Gas
Shut-Off Valves

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25 (2018) Standard Marking System for Valves,
Fittings, Flanges and Unions

MSS SP-58 (2018) Pipe Hangers and Supports -
Materials, Design and Manufacture,
Selection, Application, and Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2021) National Fuel Gas Code

NFPA 58 (2020; TIA 20-1; TIA 20-2; TIA 20-3)
Liquefied Petroleum Gas Code

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (2014; Rev C) Color Code for Pipelines and
for Compressed Gas Cylinders

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

49 CFR 192 Transportation of Natural and Other Gas by
Pipeline: Minimum Federal Safety Standards

UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE (2012) Flammable and Combustible Liquids
and Gases Equipment Directory

1.3 SYSTEM DESCRIPTION

The gas piping system includes natural gas and piping and appurtenances from point of connection with supply system, as indicated, to gas operated equipment within the facility. Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages.

1.3.1 Gas Facility System and Equipment Operation

Include shop drawings showing piping layout, locations of system valves, gas line markers; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system drawings); isolation procedures including valve operation to shutdown or isolate each section of the system (index valves to the system maps and provide separate procedures for normal operation and emergency shutdown if required to be different). Submit Data package No. 4.

1.3.2 Gas Facility System Maintenance

Include maintenance procedures and frequency for system and equipment; identification of pipe materials and manufacturer by locations, pipe repair procedures, and jointing procedures at transitions to other piping material or material from a different manufacturer. Submit Data Package No.4.

1.3.3 Gas Facility Equipment Maintenance

Include identification of valves, shut-offs, disconnects, and other equipment by materials, manufacturer, vendor identification and location; maintenance procedures and recommended tool kits for valves and equipment; recommended repair methods (i.e., field repair, factory repair, or replacement) for each valve and piece of equipment; and preventive maintenance procedures, possible failure modes and troubleshooting guide. Submit Data Package No. 3.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval for information only. When used, a code following the "G" classification 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

Gas Piping System; G

SD-03 Product Data

Pipe and Fittings; G

Gas Equipment Connectors; G

Gas Piping System; G

Pipe Coating Materials; G

Pressure Regulators; G

Risers; G

Transition Fittings; G

Valves; G

Warning and Identification Tape; G

SD-06 Test Reports

Testing; G

Pressure Tests; G

Test with Gas; G

SD-07 Certificates

Welders Procedures and Qualifications; G

Assigned Number, Letter, or Symbol; G

SD-08 Manufacturer's Instructions

PE Pipe and Fittings; G

Pipe Coating Materials; G

SD-10 Operation and Maintenance Data

Gas Facility System and Equipment Operation; G

Gas Facility System Maintenance; G

Gas Facility Equipment Maintenance; G

1.5 QUALITY ASSURANCE

Submit manufacturer's descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings in accordance with MSS SP-25.

1.5.1 Welding Qualifications

- a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9. Notify the Contracting Officer at least 24 hours in advance of tests, and perform at the work site if practicable.
- b. Submit a certified copy of welders procedures and qualifications metal and PE in conformance with ASME B31.9 for each welder and welding

operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the Contracting Officer. Weld all structural members in accordance with Section 05 12 00 STRUCTURAL STEEL, and in conformance with AWS A5.8/A5.8M, and AWS WHB-2.9.

1.5.2 Jointing Thermoplastic Piping

Perform all jointing of piping using qualified joiners and qualified procedures in accordance with AGA XR0603. Furnish the Contracting Officer with a copy of qualified procedures and list of and identification symbols of qualified joiners. Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart, including all PE pipe and fittings.

1.5.3 Shop Drawings

Submit drawings for complete Gas Piping System, within 30 days of contract award, showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of gas equipment connectors and supports.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Plastic Pipe

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe and fittings ends during transportation or storage to minimize dirt and moisture entry. Do not subject piping to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos are not allowed. Submit catalog data and installation instructions for pipe, valves, all related system components, pipe coating materials and application procedures. Conform to NFPA 54 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

2.2 GAS PIPING SYSTEM AND FITTINGS

2.2.1 Steel Pipe, Joints, and Fittings

Provide steel pipe conforming to ASME B36.10M; and malleable-iron threaded fittings conforming to ASME B16.1 and ASME B16.3. Provide steel pipe flanges and flanged fittings, including bolts, nuts, and bolt pattern in accordance with ASME B16.5 and ASTM A105/A105M. Provide wrought steel butt welding fittings conforming to ASME B16.9. Provide socket welding and threaded forged steel fittings conforming to ASME B16.11 and ASTM A181/A181M, Class 60.

2.2.2 Steel Tubing, Joints and Fittings

Provide steel tubing conforming to ASTM 01.01, and ASTM A513/A513M, with tubing joints made up with gas tubing fittings recommended by the tubing manufacturer.

2.2.3 Thermoplastic Pipe, Tubing, Joints, and Fittings

Provide polyethylene yellow thermoplastic pipe, tubing, casing and joints and fittings conforming to ASTM D2513 and API Spec 5CT.

2.2.4 Corrugated Stainless Steel Tubing, Fittings and Accessories

Provide corrugated stainless steel tubing conforming to ANSI LC 1/CSA 6.26 (austenitic stainless steel of series 300) with tubing joints made with special mechanical fittings as supplied by the tubing manufacturer.

2.2.4.1 Tubing

Austenitic stainless alloy of series 300 with polyethylene jacket/coating in accordance with ANSI LC 1/CSA 6.26 for sizes 3/8-inch through 2-inch

2.2.4.2 Mechanical Fittings

Copper alloy with one end matched to the corrugated tubing and one end with NPT threads in accordance with ASME B1.20.1

2.2.4.3 Striker Plates

Hardened steel designed to protect tubing from mechanical damage in accordance with ANSI LC 1/CSA 6.26

2.2.4.4 Manifolds

Malleable iron, steel or copper alloy with threaded connections/ports in accordance with ASME B1.20.1

2.2.5 Sealants for Steel Pipe Threaded Joints

Provide joint sealing compound as listed in UL FLAMMABLE & COMBUSTIBLE, Class 20 or less. For taping, use tetrafluoroethylene tape conforming to UL FLAMMABLE & COMBUSTIBLE.

2.2.6 Warning and Identification

Provide pipe flow markings, warning and identification tape, and metal tags as required.

2.2.7 Flange Gaskets

Provide gaskets of nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type, containing aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 600 degree F service, to be used for hydrocarbon service.

2.2.8 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

2.2.9 Escutcheons

Provide chromium-plated steel or chromium-plated brass escutcheons, either one piece or split pattern, held in place by internal spring tension or set screw.

2.2.10 Gas Transition Fittings

- a. Provide steel to plastic (PE) designed for steel-to-plastic with tapping tee or sleeve conforming to AGA XR0603 requirements for transitions fittings.. Coat or wrap exposed steel pipe with heavy plastic coating.
- b. Provide lever operated non-lubricated gas shut-off valves conforming to CGA 3.16-M88

2.2.11 Insulating Pipe Joints

2.2.11.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.11.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.11.3 Flanged Pipe Joints

Provide joints for flanged pipe consisting of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts. Provide lap joint flange pipe ends conforming to ASTM F2015.

2.2.12 Flexible Connectors

- a. Provide flexible connectors for connecting gas utilization equipment to building gas piping conforming to ANSI Z21.24/CSA 6.10 or ANSI Z21.41/CSA 6.9 for quick disconnect devices, and flexible connectors for movable food service equipment conforming to ANSI Z21.69/CSA 6.16. Provide combination gas controls for gas appliances conforming to ANSI Z21.78/CSA 6.20.
- b. Do not install the flexible connector through the appliance cabinet face. Provide rigid metallic pipe and fittings to extend the final connection beyond the cabinet, except when appliance is provided with an external connection point.

2.3 VALVES

Provide lockable shutoff or service isolation valves conforming to the following:

2.3.1 Valves 2 Inches and Smaller

Provide valves 2 inches and smaller conforming to ASME B16.33 of materials and manufacture compatible with system materials used.

2.3.2 Valves 2-1/2 Inches and Larger

Provide valves 2-1/2 inches and larger of carbon steel conforming to API Spec 6D, Class 150.

2.4 RISERS

Provide manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on or bracket or wall-mounted riser supports .

2.5 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58.

2.6 LINE AND APPLIANCE REGULATORS AND SHUTOFF VALVES

Provide regulators conforming to ANSI Z21.18/CSA 6.3 for appliances ANSI Z21.78/CSA 6.20 for combination gas controls for gas appliances , and ANSI Z21.80/CSA 6.22 for line pressure regulators. Provide shutoff valves conforming to ANSI Z21.15/CSA 9.1 for manually controlled gas shutoff valves and ANSI Z21.21/CSA 6.5 for automatic shutoff valves for gas appliances.

2.7 NATURAL GAS SERVICE

2.7.1 Service Regulators

- a. Provide ferrous bodied pressure regulators for individual service lines, capable of reducing distribution line pressure to pressures required for users. Provide service regulators conforming to AGA ANSI B109.4 CGA-6.18-M95 with full capacity internal relief and overpressure shutoff. Set pressure relief at a lower pressure than would cause unsafe operation of any connected user.
- b. Adjust regulators for liquified petroleum gas to 2.5 to 3 kPa 10 to 12 inches of water column, with pressure relief set at 4 kPa 16 inches of water column.
- c. Provide regulator(s) having a single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas flow rate at the regulator inlet pressure. Provide regulator valve vent of resilient materials designed to withstand flow conditions when pressed against the valve port, capable of regulating downstream pressure within limits of accuracy and limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Provide a self-contained service regulator, and pipe not exceeding exceed 2 inch size.

2.7.2 Gas Meter

AGA ANSI B109.1AGA ANSI B109.2 pedestal mounted, diaphragm style, enamel-coated steel case. Provided with a strainer immediately upstream. Provide diaphragm-type meter conforming to AGA ANSI B109.1 for required flow rates less than 500 cfh, or AGA ANSI B109.2, for flow rates 500 cfh and above as required by local gas utility supplier. Provide combined

odometer-type register totalizer index, UV-resistant index cover, water escape hole in housing, and means for sealing against tampering. Provide temperature-compensated type meters sized for the required volumetric flow rate and suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Provide meters with over-pressure protection as specified in 49 CFR 192 and ASME B31.8. Provide meters that are tamper-proof with frost protection and fungus protection. Provide meters with a pulse switch initiator capable of operating up to speeds of 500 maximum pulses per minute with no false pulses and requiring no field adjustments. Provide not less than one pulse per 100 cubic feet of gas. Minimum service life must be 30,000,000 cycles.

AMRS compatible gas metering solutions consist of a componential system to achieve the goal of delivering gas consumption data into the AMRS. To accurately scale output pulses the contractor must obtain building gas usage from base personnel, taking into account peak demand when sizing the components that are necessary as well as determining peak pulse rate as to not saturate the receiving device and risk losing captured pulse data. The various components that may be necessary include but are not limited to the following: Gas Meter, Pulse Kit, High Speed Dividing Pulse Relay, Surge Suppression Device, Accumulator and Electric Meter with digital input availability:

- a. Pulse kit must be able to produce a two-wire (Form A) pulse output via RS485.
- b. Gas meter or attached pulse kit must include a visual register or dial.
- c. Pulse output must be delivered to a high speed dividing pulse relay that has the capability of producing a wetting voltage if necessary.
- d. High speed dividing pulse relay must provide isolated pulse outputs (Form A) that must be delivered to an AMRS compatible electric meter.
- e. Gas meters that can communicate to AMRS via the Modbus/TCP protocol may be acceptable if they can pass technical and cybersecurity evaluations directed by the AMRS PMO. At this time there are no tested or approved Modbus /TCP gas meters.
- f. All meter labels must be white on black phenolic.

The following list of meters were evaluated, meet the AMRS [*Am-4] requirements and are in use at Buckley SFB:

- a. Schneider Electric PM5560
- b. Schneider Electric PM8000
- c. Schneider Electric ION 8650
- d. Siemens 9410
- e. Siemens 9810

[**Am-4]

The following device is compatible with the AMRS platform, is consistent with the need of the existing site conditions, and has been tested and passed cybersecurity requirements:

- a. Schneider Electric EGX150 Ethernet Gateway

2.7.2.1 Utility Monitoring and Control System (UMCS) / Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces

Provide gas meters capable of interfacing the output signal, equivalent to volumetric flow rate, with the existing UMCS / EMCS for data gathering in units of cubic meters cubic feet. Provide meters that do not require

power to function and deliver data. Output signal must be either a voltage or amperage signal that can be converted to volumetric flow by using an appropriate scaling factor. Meters installed must comply with Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM.

2.7.2.2 Measurement Configuration

For buildings that already have a gas meter with a pulse output, ensure that the pulse output is connected to a data gathering device (i.e. electric meter). For buildings where a natural gas meter already exists but does not have a pulse output, add a pulse kit to the existing meter and tie the output to a data gathering device. If the existing gas meter will not accept a pulse kit or if no meter exists a new natural gas meter must be installed, also requiring a pulse output to a data gathering device. Ensure the pulse frequency and electronic characteristics are compatible with the existing data gathering device, if any.

2.8 AUTOMATIC GAS SHUT-OFF

Provide low pressure automatic gas shutoff or excess flow valve (EFV) downstream of the point of delivery after the meter/regulator conforming to ANSI Z21.93/CSA 6.30 and UL listed or CSA listed or International Association of Plumbing and Mechanical Officials (IAPMO) listed. The EFV may be either a bypass (automatic reset) or a non-bypass type (manual reset). Provide low pressure automatic gas shutoff or excess flow valve (EFV) at each branch to an appliance.

2.9 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts must conform with ASME B18.2.1 and ASME B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs must extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts must have American Standard regular square or heavy hexagon heads; nuts must be American Standard heavy semifinished hexagonal.

2.10 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.11 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all

dimensions in the field, and advise the Contracting Officer of any discrepancy or areas of conflict before performing the work.

3.2 EXCAVATION AND BACKFILLING

Provide required excavation, backfilling, and compaction as specified in Section 31 00 00 EARTHWORK.

3.3 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery, defined as the outlet of the meter set assembly service regulator and shutoff valve, as specified under "Gas Service" within this specification, to the connections to each gas utilization device that is in compliance with NFPA 54.

3.3.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.

3.3.2 Workmanship and Defects

Piping, tubing and fittings must be clear and free of cutting burrs and defects in structure or threading and must be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

3.4 PROTECTIVE COVERING

3.4.1 Underground Metallic Pipe

Provide service entrance piping up to natural gas meter. Protect buried metallic piping and tubing from corrosion by either: (1) applying protective coatings as specified in Section 33 51 15 NATURAL-GAS / LIQUEFIED PETROLEUM GAS DISTRIBUTION PIPELINES; (2) encasement in a water tight plastic conduit; or (3) encasement in a protective system designed and listed by the manufacturer for this application. When dissimilar metals are joined underground, gastight insulating fittings must be used.

3.4.2 Aboveground Metallic Piping Systems

3.4.2.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed. Mechanically clean surfaces that contain loose rust, loose mill scale and other foreign substances by power wire brushing and prime with ferrous metal primer. Finish primed surfaces with two coats of exterior oil paint.

3.4.2.2 Nonferrous Surfaces

Except for aluminum alloy pipe, do not paint nonferrous surfaces. Paint surfaces of aluminum alloy pipe and fittings to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. Solvent-clean the surfaces and treat with vinyl type wash coat. Apply a first coat of aluminum paint and a second coat of alkyd gloss enamel or

silicone alkyd copolymer enamel.

3.5 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54NFPA 58 and AGA XR0603, and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cut thermoplastic and fiberglass pipe in accordance with AGA XR0603.

3.5.1 Metallic Piping Installation

Bury underground piping a minimum of 18 inches below grade. Make changes in direction of piping with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction is not permitted. Branch connection may be made with either tees or forged branch outlet fittings. Provide branch outlet fittings which are forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Do not use aluminum alloy pipe in exterior locations or underground.

3.5.2 Metallic Tubing Installation

Install metallic tubing using gas tubing fittings approved by the tubing manufacturer. CSST gas piping systems must be installed by contractors who have completed the manufacturer's training program as indicated on a certification card. Make branch connections with tees. Prepare all tubing ends with tools designed for that purpose. Do not use aluminum alloy tubing in exterior locations or underground. Maintain electrical continuity of gas piping system in accordance with NFPA 54 , paragraph entitled 'Electrical Bonding and Grounding'.

3.5.3 Thermoplastic Piping, Tubing, and Fittings

Installation of thermoplastic and fiberglass piping, tubing, and fittings is permitted only outside and underground. Bury piping a minimum of 18 inches below grade. Install the piping to avoid excessive stresses due to thermal contraction, and use only where indicated. Installations must be made using qualified procedures, by qualified installers, and in compliance with AGA XR0603 and NFPA 54 , and must be inspected by a qualified inspector.

3.5.4 Connections Between Metallic and Plastic Piping

Connections between metallic and plastic piping are only allowed outside, underground, and with approved transition fittings.

3.5.5 Piping and Tubing Buried Under Buildings

Run underground piping and tubing installed beneath buildings in a steel pipe casing protected from corrosion with protective coatings as specified in Section 33 51 15 NATURAL-GAS / LIQUEFIED PETROLEUM GAS DISTRIBUTION PIPELINES or installed within a water tight plastic conduit or as part of a listed encasement system. Extend casing or encasement system at least 4 inches outside the building, and provide the pipe with spacers and end bushings to seal at both ends to prevent the entrance of water and/or the escape of gas. Extend a vent line from the annular space above grade

outside to a point where gas will not be a hazard, and terminate in a rain/insect-resistant fitting.

3.5.6 Concealed Piping in Buildings

Do not use combinations of fittings (unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints) to conceal piping within buildings.

3.5.6.1 Piping and Tubing in Partitions

Locate concealed piping and tubing in hollow, rather than solid, partitions. Protect tubing passing through walls or partitions against physical damage both during and after construction, and provide appropriate safety markings and labels. Provide protection of concealed pipe and tubing in accordance with ANSI LC 1/CSA 6.26.

3.5.6.2 Piping in Floors

Natural gas piping must route into the building above grade and must not be located underneath building footprint slabs or floors.

3.5.7 Aboveground Piping

Run aboveground piping as straight as practicable along the alignment and elevation indicated, with a minimum of joints, and separately supported from other piping system and equipment. Install exposed horizontal piping no farther than 6 inches from nearest parallel wall and at an elevation which prevents standing, sitting, or placement of objects on the piping.

3.5.8 Final Gas Connections

Unless otherwise specified, make final connections with rigid metallic pipe and fittings. Make final connections to kitchen ranges using flexible connectors not less than 40 inch long, to afford access to coupling and to permit movement of equipment for cleaning. Flexible connectors may be used for final connections to gas utilization equipment. In addition to cautions listed in instructions required by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.5.9 Meter Installation

Contractor must assume all existing equipment is working properly. If during the post award survey portion of the SOW an existing piece of equipment is found to be malfunctioning, then the contractor must bring it to the government's attention to determine how to proceed. An RFI must be submitted. This may require a contract change to delete this meter from the scope or to add a new meter.

All due diligence to survey the existing site conditions is the responsibility of the contractor.

New and relocated electric meters must be installed adjacent to the main distribution panel in a separate enclosure unless otherwise noted.

All new and relocated meter assemblies be located approximately 5 feet above the ground (4 feet minimum -- 6 feet maximum).

All new meter installations, including relocated existing meters, must include the installation of new properly sized split or solid core current transformers (CTs). Accurate sizing of new CTs is the responsibility of the contractor.

If CT installation method includes disturbing the bonds of existing cables or wiring within the gear, before and after IR scans must be performed before removing and after torquing the connections to ensure the integrity of the conductor bonds.

All new meter installations, including relocated existing meters, three phase voltage must be supplied from a breaker, disconnect or fused source which must be finger safe, labeled at the electrical meter and electrical panel.

All meter safety disconnect switches must be marked as follows "Meter Disconnect NOT Service Equipment" per the NEC. In addition, instructions to safely engage the safety disconnect switches and finger safe shorting blocks for CT conductors must be included inside each meter assembly.

Meter assemblies must be provided with finger safe voltage and current safety disconnect devices or equivalent so that the meter assembly can be worked on safely over the life of the meter installation and not require utility outages for servicing. Additionally, meters must have control power regardless of breaker position when installed in a split buss switchgear.

In the event communications equipment and/or a metering device has to be located in an exterior location, the meter enclosure must be a lockable NEMA 4 enclosure. All new install interior meters are required to be enclosed in a lockable NEMA 3 enclosure unless otherwise noted.

All new meter installations, including relocated existing meters, must be connected via CAT6 cable from the meter, to a wall outlet in the mechanical room, to a patch panel in the communications room, and then to the Air Force switch in the communications room.

Cables labels must be permanent, wrap-around and self-laminating with text generated by a mechanical device. Labels must be applied at both ends of the cable, visible during normal maintenance of the infrastructure, resistant to environmental conditions (such as moisture, heat or ultraviolet light), and have a design life equal to or greater than that of the labeled component.

Preferred technical approach to network communication cabling in excess of 328 feet is: Fiber optic cable and fiber media converters with dedicated power outlets. Fiber media converter must be installed in the communications room within 6 feet of the network switch and within 6 feet of the electric meter enclosure.

All meter labels must be white on black phenolic.

All data cable test results (including fiber) must be completed only after the cable has been terminated in its permanent location, temporary cable test results will not be accepted.

Surge protection is required on all communication cabling extending from the exterior to the interior of a facility. This includes gas meter

communication cables from the exterior to the interior of the building. Surge suppression devices must be installed w/in 3 feet of the building entrance inside the facility unless otherwise noted. Devices must be easily accessible and labeled to aide in location during future troubleshooting efforts. Surge protection devices must be Power over Ethernet (PoE) compatible and housed within an enclosure that allows space for a proper cable bend radius.

Meter assemblies and communication receptacles accessible to the public must be installed in a locked enclosure.

Electric meters with gas or water meters connected must have two internal registers configured - one for a raw pulse count and one for a weighted pulse count based on the scaling of the connected gas or water meter.

3.6 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.6.1 Threaded Metallic Joints

Provide threaded joints in metallic pipe with tapered threads evenly cut and made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 1-1/2 inches in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 2 inches in diameter may be made with approved joint sealing compound. After cutting and before threading, ream pipe and remove all burrs. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.6.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.6.3 Thermoplastic Joints

3.6.3.1 Thermoplastic

Conform jointing procedures to AGA XR0603. Do not make joints with solvent cement or heat of fusion between different kinds of plastics.

3.6.3.2 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect, in conformance with API 570, 100 percent of all joints and re-inspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Contracting Officer to make first time inspection.

3.6.4 Flared Metallic Tubing Joints

Make flared joints in metallic tubing with special tools recommended by the tubing manufacturer. Use flared joints only in systems constructed from nonferrous pipe and tubing, when experience or tests have demonstrated that the joint is suitable for the conditions, and when adequate provisions are made in the design to prevent separation of the joints. Do not use metallic ball sleeve compression-type tubing fittings for tubing joints.

3.7 PIPE SLEEVES

Provide pipes passing through concrete or masonry walls or concrete floors or roofs with pipe sleeves fitted into place at the time of construction. Do not install sleeves in structural members except where indicated or approved. Make all rectangular and square openings as detailed. Extend each sleeve through its respective wall, floor or roof, and cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Extend sleeves in mechanical room floors above grade at least 4 inches above finish floor. Unless otherwise indicated, use sleeves large enough to provide a minimum clearance of 1/4 inch all around the pipe. Provide steel pipe for sleeves in bearing walls, waterproofing membrane floors, and wet areas. Provide sleeves in nonbearing walls, floors, or ceilings of steel pipe, galvanized sheet metal with lock-type longitudinal seam. For penetrations of fire walls, fire partitions and floors which are not on grade, seal the annular space between the pipe and sleeve with fire-stopping material and sealant that meet the requirement of Section 07 84 00 FIRESTOPPING.

3.8 PIPES PENETRATING WATERPROOFING MEMBRANES

Install pipes penetrating waterproofing membranes as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.9 FIRE SEAL

Fire seal all penetrations of fire rated partitions, walls and floors in accordance with Section 07 84 00 FIRESTOPPING.

3.10 ESCUTCHEONS

Provide escutcheons for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.11 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54.

3.12 BUILDING STRUCTURE

Do not weaken any building structure by the installation of any gas piping. Do not cut or notch beams, joists or columns. Attach piping supports to metal decking. Do not attach supports to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

3.13 PIPING SYSTEM SUPPORTS

Support gas piping systems in buildings with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Do not support any gas piping system by other piping. Conform spacing of supports in gas piping and tubing installations to the requirements of NFPA 54. Conform the selection and application of supports in gas piping and tubing installations to the requirements of MSS SP-58. In the support of multiple pipe runs on a common base member, use a clip or clamp where each pipe crosses the base support member. Spacing of the base support members is not to exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. Rigidly connect the clips or clamps to the common base member. Provide a clearance of 1/8 inch between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.14 ELECTRICAL BONDING AND GROUNDING

Provide a gas piping system within the building that is electrically continuous and bonded to a grounding electrode as required by NFPA 54 and NFPA 70.

3.15 SHUTOFF VALVE

Install the main gas shutoff valve controlling the gas piping system to be easily accessible for operation, as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled. Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.16 LINE AND APPLIANCE PRESSURE REGULATORS

Install line pressure regulators and appliance regulators in accordance with the manufacturer's requirements and in accordance with NFPA 54. Install each regulator in an accessible location and install shutoff valves ahead of each line and appliance regulator to allow for maintenance. Where vent limiting devices are not included in the regulators, install a vent pipe to the exterior of the building. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.17 GAS SERVICE INSTALLATION

Gas service line, service regulator and gas company meter must be provided by natural gas utility company. Installations must be in accordance with 49 CFR 192 and ASME B31.8. Contractor must submit and use only tested and approved work procedures. Contractor must use only welders and jointers who have been recently qualified by training and test for joining and installing the gas pipe material used on this job. The finished product must be inspected by a person qualified to inspect joints made by the particular procedures used to make joints.

3.17.1 Service Line

Provide service line, branch connection to the main, and riser in accordance with 49 CFR 192 and ASME B31.8. Provide a minimum of 18 inches cover or encase the service line so that it is protected. Provide service line so that no undue stress is applied to the pipe, connection, or riser. Install approved riser and terminate with an approved isolation valve, EFV and automatic shutoff device. After laying of pipe and testing, backfill the trench.

Where steel pipe is used as service line, install corrosion prevention coating for the steel service line. Where connected to an existing cathodically protected steel pipe, ensure electrical continuity from the riser to the branch connection to the main. Install a dielectric fitting on the riser to prevent electrical continuity to the above ground piping.

Where plastic pipe is used as the service line, make joints in accordance with procedures qualified by test. Personnel joining plastic pipe must be qualified by making a satisfactory specimen joint that passes the required inspection and test listed in 49 CFR 192.285. Inspection must be made by inspectors qualified in evaluating joints made under the specific joining procedure, as required by 49 CFR 192.287.

3.17.2 Service Regulator

Provide service regulator in accordance with 49 CFR 192 and ASME B31.8 and this specification ensuring that the customer's piping is protected from over pressurization should the service regulator fail. A 3/8 inch tapped fitting equipped with a plug must be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. For inside installations, route the regulator vent pipe through the exterior wall to the atmosphere, and seal building penetrations for service line and vent. Terminate the regulator vent so that it is protected from precipitation and insect intrusion, so that it is not submerged during floods, and so that gas escaping will not create a hazard or enter the building through openings.

3.17.3 Gas Meter

Provide shutoff valve, meter set assembly, and service regulator on the service line outside the building, 18 inches above the ground on the riser. An insulating joint (dielectric connection) must be installed on the inlet side of the meter set assembly and service regulator and must be constructed to prevent flow of electrical current.

3.18 TESTING

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Test entire gas piping system to ensure that it is gastight prior to putting into service. Prior to testing, purge the system, clean, and clear all foreign material. Test each joint with an approved gas detector, soap and water, or an equivalent nonflammable solution. Inspect and test each valve in conformance with API Std 598 and API Std 607. Complete testing before any work is covered, enclosed, or concealed, and perform with due regard for the safety of employees and the public during the test. Install bulkheads, anchorage and bracing suitably designed to resist test

pressures if necessary, and as directed and or approved by the Contracting Officer. Do not use oxygen as a testing medium.

3.18.1 Pressure Tests

Submit test procedures and reports in booklet form tabulating test and measurements performed; dated after award of this contract, and stating the Contractor's name and address, the project name and location, and a list of the specific requirements which are being certified. Before appliances are connected, test by filling the piping systems with air or an inert gas to withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Do not use Oxygen for test. Measure pressure with a mercury manometer, slope gauge, or an equivalent device calibrated to be read in increments of not greater than 0.1 pound. Isolate the source of pressure before the pressure tests are made.

3.18.2 Test With Gas

Before turning on gas under pressure into any piping, close all openings from which gas can escape. Immediately after turning on the gas, check the piping system for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. Conform all testing to the requirements of NFPA 54. If leakage is recorded, shut off the gas supply, repair the leak, and repeat the tests until all leaks have been stopped.

3.18.3 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. Do not purge piping into the combustion chamber of an appliance. Do not purge the open end of piping systems into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.18.4 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

3.19 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS, conforming to ASME A13.1.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 25 - INTEGRATED AUTOMATION

SECTION 25 05 11.23

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND
CONTROL SYSTEM

05/21

PART 1 GENERAL

- 1.1 CONTROL SYSTEM APPLICABILITY
- 1.2 RELATED REQUIREMENTS
- 1.3 REFERENCES
- 1.4 DEFINITIONS
 - 1.4.1 Administrator Account
 - 1.4.2 Computer
 - 1.4.3 Controller
 - 1.4.4 Mission Space
 - 1.4.5 Network
 - 1.4.6 Network Connected
 - 1.4.6.1 Wireless Network Connected
 - 1.4.7 Network Media
 - 1.4.8 User Account Support Levels
 - 1.4.8.1 FULLY Supported
 - 1.4.8.2 MINIMALLY Supported
 - 1.4.8.3 NOT Supported
 - 1.4.9 Manual Local Input
 - 1.4.10 Card Reader
 - 1.4.11 User Interface
 - 1.4.11.1 Local User Interface
 - 1.4.11.2 Remote User Interface
 - 1.4.11.3 Types of User Interface (by capability)
 - 1.4.11.3.1 Read-Only User Interface
 - 1.4.11.3.2 Limited User Interface
 - 1.4.11.3.3 Full User Interface
 - 1.4.11.3.4 View-Only User Interface
 - 1.4.11.4 Other User Interface Terminology
 - 1.4.11.4.1 Writable User Interface
 - 1.4.11.4.2 Privileged User Interface
 - 1.4.12 Wireless Network
 - 1.4.13 Wired Broadcast Network
- 1.5 ADMINISTRATIVE REQUIREMENTS
 - 1.5.1 Points of Contact
 - 1.5.2 Coordination
- 1.6 SUBMITTALS
- 1.7 QUALITY CONTROL
 - 1.7.1 Qualifications
 - 1.7.2 Cybersecurity Subject Matter Expert Qualifications
- 1.8 CYBERSECURITY DOCUMENTATION
 - 1.8.1 Proposed STIG and SRG Applicability Report
 - 1.8.2 Cybersecurity Interconnection Schedule
 - 1.8.3 Network Communication Report
 - 1.8.4 Control System Inventory Report

- 1.8.5 Software and Configuration Backups
- 1.8.6 Cybersecurity Riser Diagram
- 1.8.7 STIG, SRG and Vendor Guide Compliance Result Report
- 1.8.8 Control System Cybersecurity Documentation
 - 1.8.8.1 Software Applications
 - 1.8.8.2 For HVAC Control System Devices
 - 1.8.8.2.1 HVAC Control System Devices FULLY Supporting User Accounts
 - 1.8.8.2.2 All Other HVAC Control System Devices
 - 1.8.8.3 Default Requirements for Control System Devices
- 1.9 SOFTWARE LICENSING
- 1.10 CYBERSECURITY DURING CONSTRUCTION
 - 1.10.1 Contractor Computer Equipment
 - 1.10.1.1 Operating System
 - 1.10.1.2 Anti-Malware Software
 - 1.10.1.3 Passwords and Passphrases
 - 1.10.1.4 User-Based Authentication
 - 1.10.1.5 Demonstration of Compliance
 - 1.10.1.6 Contractor Computer Cybersecurity Compliance Statements
 - 1.10.2 Temporary IP Networks
 - 1.10.2.1 Network Boundaries and Connections
 - 1.10.3 Government Access to Network
 - 1.10.4 Temporary Wireless IP Networks
 - 1.10.5 Passwords and Passphrases
 - 1.10.6 Contractor Temporary Network Cybersecurity Compliance Statements
- 1.11 CYBERSECURITY DURING WARRANTY PERIOD

PART 2 PRODUCTS

- 2.1 ETHERNET SWITCH
 - 2.1.1 Required Functionality
 - 2.1.2 Configuration Requirements
- 2.2 DAISY CHAIN IP CONTROLLERS

PART 3 EXECUTION

- 3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES
- 3.2 NETWORK REQUIREMENTS
 - 3.2.1 Wireless and Wired Broadcast Communication
 - 3.2.2 Non-IP Control Networks
 - 3.2.3 IP Control Networks
 - 3.2.3.1 IP Network Routers
 - 3.2.3.2 IP Devices With Multiple Ethernet Connection
 - 3.2.4 Cryptographic Protection
 - 3.2.5 Device Identification and Authentication
 - 3.2.5.1 For HVAC Control System Devices
 - 3.2.5.2 Default Requirements for Control System Devices
 - 3.2.6 Cryptographic Module Authentication
- 3.3 ACCESS CONTROL REQUIREMENTS
 - 3.3.1 User Accounts
 - 3.3.1.1 Computers
 - 3.3.1.2 Controllers
 - 3.3.1.2.1 HVAC Control Systems
 - 3.3.2 Unsuccessful Logon Attempts
 - 3.3.2.1 Devices MINIMALLY Supporting Accounts
 - 3.3.2.2 Devices FULLY Supporting Accounts
 - 3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

- 3.3.3 System Use Notification
 - 3.3.3.1 System Use Notification for Remote User Interfaces
 - 3.3.3.2 System Use Notification for Local User Interfaces
- 3.3.4 Permitted Actions Without Identification or Authentication
- 3.3.5 Enclosures
- 3.4 USER IDENTIFICATION AND AUTHENTICATION
 - 3.4.1 User Identification and Authentication for All System Types
 - 3.4.2 User Identification and Authentication for Specific System Types
 - 3.4.2.1 HVAC Control Systems Devices
 - 3.4.3 User Identification and Authentication for Specific Devices
 - 3.4.4 Implementation of Identification and Authorization Requirements
 - 3.4.5 Password-Based Authentication Requirements
 - 3.4.5.1 Passwords for Software and Applications Running on Computers
 - 3.4.5.2 Passwords for Controllers FULLY Supporting Accounts
 - 3.4.5.3 Passwords for Remote Interfaces
 - 3.4.5.4 Passwords for Devices Minimally Supporting Accounts
 - 3.4.5.5 Password Configuration and Reporting
 - 3.4.6 Authenticator Feedback
- 3.5 CYBERSECURITY AUDITING
 - 3.5.1 Audit Events, Content of Audit Records, and Audit Generation
 - 3.5.1.1 Computers
 - 3.5.1.1.1 Audited Events
 - 3.5.1.1.2 Audit Event Information To Record
 - 3.5.1.2 For HVAC Control System Controllers
 - 3.5.1.2.1 HVAC Control System Controllers FULLY Supporting User Accounts
 - 3.5.1.2.1.1 Audited Events
 - 3.5.1.2.1.2 Audit Event Information To Record
 - 3.5.1.2.2 Other HVAC Control System Controllers
 - 3.5.1.3 Default Requirements for Control System Controllers
 - 3.5.1.3.1 Controllers Which FULLY Support Accounts
 - 3.5.1.3.1.1 Audited Events
 - 3.5.1.3.1.2 Audit Event Information To Record
 - 3.5.1.3.2 Controllers Which Do Not FULLY Support Accounts
 - 3.5.2 Audit Time Stamps
 - 3.5.3 Auditing Front End Software
 - 3.5.3.1 Import and Upload Requirements
 - 3.5.3.2 Export Requirements
 - 3.5.4 Audit Storage Capacity and Audit Upload
 - 3.5.4.1 Device Audit Record Upload Software
 - 3.5.5 Response to Audit Processing Failures
- 3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY
 - 3.6.1 Device Capabilities
 - 3.6.2 Software
- 3.7 SYSTEM AND COMMUNICATION PROTECTION
 - 3.7.1 Collaborative Computing
 - 3.7.2 Denial of Service Protection
- 3.8 SAFE MODE AND FAIL SAFE OPERATION
- 3.9 SYSTEM MAINTENANCE TOOL SOFTWARE
- 3.10 DEVICE POWER
- 3.11 VULNERABILITY SCANNING
 - 3.11.1 Computers and Software Running on Computers
 - 3.11.2 Controllers
- 3.12 FIPS 201-2 REQUIREMENT
- 3.13 SYSTEM AND INTEGRATION INTEGRITY
 - 3.13.1 Malicious Code Protection
- 3.14 CONTROL SYSTEM CYBERSECURITY TESTING

- 3.14.1 Control System Cybersecurity Testing Procedures
- 3.14.2 Control System Cybersecurity Testing Execution
- 3.14.3 Control System Cybersecurity Testing Report
- 3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT
- 3.16 CYBERSECURITY TRAINING

-- End of Section Table of Contents --

SECTION 25 05 11.23

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS
ENERGY MANAGEMENT AND CONTROL SYSTEM

05/21

PART 1 GENERAL

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). [*Am-3] STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at <https://public.cyber.mil/stigs/downloads/> and an SRG/STIG Applicability Guide and Collection Tool is available at <https://public.cyber.mil/stigs/SCAP/>. [**Am-3] The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

1.1 CONTROL SYSTEM APPLICABILITY

There are multiple versions of this Section associated with this project. Different versions have requirements applicable to different control systems. This specific Section applies only to the following control systems: Energy Management And Control System, including HVAC and Advanced Metering.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, to include without constraint Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS and Section 26 27 13.10 30 ELECTRIC METERS, and as these requirements are conditioned on the control system being provided, there may be requirements in this Section that will not apply to this project. All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer Representative to determine which requirement applies to the project.

Note that the facility HVAC control system must connect to and integrate with existing Delta Control systems EMCS front end. In addition, utility metering for the facility is subject to existing AMRS requirements. Metering specifications must be assessed to ensure compatibility with existing AMRS platform. Coordination with the Government is required for any additional configurations regarding connection to site-specific network infrastructure.

1.3 REFERENCES

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

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

ASHRAE 135 (2020; Errata 2021) BACnet—A Data
Communication Protocol for Building
Automation and Control Networks

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.1x (2010) Local and Metropolitan Area
Networks - Port Based Network Access
Control

INTERNET ENGINEERING TASK FORCE (IETF)

IETF RFC 2819 (2000) Remote Network Monitoring (RMON)
Management Information Base (MIB)

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-2 (2001) Security Requirements for
Cryptographic Modules

NIST FIPS 201-2 (2013) Personal Identity Verification
(PIV) of Federal Employees and Contractors

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8551.01 (2014) Ports, Protocols, and Services
Management (PPSM)

DTM 08-060 (2008) Policy on Use of Department of
Defense (DoD) Information Systems -
Standard Consent Banner and User Agreement

1.4 DEFINITIONS

1.4.1 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system.

Also, most controllers will not have any support for accounts and will therefore not have an 'Administrator Account'.

1.4.2 Computer

A computer is one of the following:

- a. a device running a non-embedded desktop or server version of Microsoft Windows
- b. a device running a non-embedded version of MacOS
- c. a device running a non-embedded version of Linux
- d. a device running a version or derivative of the Android Operating System, where Android is considered separate from Linux
- e. a device running a version of Apple iOS

Unless otherwise indicated or clear from context use of the word "device" in this Section includes computers.

1.4.3 Controller

A device other than a computer or Ethernet switch.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a VAV box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an AHU in a mechanical room or on a rooftop may still be considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network.

1.4.6 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that (unlike many IT definitions of "Network Connected") a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats, and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter data, which is the "privilege" of the user interface (where effective privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as

they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

- a. Read-Only User Interfaces are not privileged user interfaces.
- b. Full User Interfaces are privileged user interfaces.
- c. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.
- d. User interfaces that allow for reprogramming a network connected device is a privileged user interface.
- e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, 900 MHz radio, 2.4 GHz, free space optical, point-to-point laser, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with The Contracting Office Representative (COR).

- a. Government Computer Access Point of Contact: The Contracting Office Representative (COR)
- b. HTTPS Certificate Point of Contact: The Contracting Office Representative (COR)
- c. Email Address Point of Contact: The Contracting Office Representative

(COR)

- d. Password Point of Contact: The Contracting Office Representative (COR)
- e. Mobile Code Point of Contact: The Contracting Office Representative (COR)
- f. PKI Infrastructure Point of Contact: The Contracting Office Representative (COR)

1.5.2 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

- a. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and installation.
- b. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and installation.
- c. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.
- d. The Cybersecurity Interconnection Schedule must be coordinated with other work that will be interconnected to, and interconnections must be approved by the Government before relying on them for system functionality.
- e. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.
- f. Passwords must be coordinated with the indicated contact for the project site.
- g. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.
- h. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.
- i. Installation of metering instrumentation must meet cybersecurity requirements in accordance with the Air Force Meter Data Management Plan (MDMP) and AMRS Meter Specification.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Device Account Lock Exception Request; G
Multiple Ethernet Connection Device Request; G
Contractor Computer Cybersecurity Compliance Statements; G
Contractor Temporary Network Cybersecurity Compliance Statements; G
Cybersecurity Interconnection Schedule; G
Cybersecurity Subject Matter Expert Qualifications
Proposed STIG and SRG Applicability Report; G

SD-02 Shop Drawings

Network Communication Report; G
Cybersecurity Riser Diagram; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-06 Test Reports

Control System Cybersecurity Testing Procedures; G
Control System Cybersecurity Testing Report; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Password Change Summary Report; G
Enclosure Keys; G
Software and Configuration Backups; G
Auditing Front End Software; G
Device Audit Record Upload Software; G
System Maintenance Tool Software; G
Control System Scanning Tools; G
STIG, SRG and Vendor Guide Compliance Result Report; G
Control System Inventory Report; G

1.7 QUALITY CONTROL

1.7.1 Qualifications

For the positions listed below resumes should be submitted to the Government within 14 days after notice to proceed. All certifications must be in effect prior to being hired. These positions may serve across the contract.

1.7.2 Cybersecurity Subject Matter Expert Qualifications

[*Am-4] The individual selected will oversee all work within this specification. This position requires that the individual currently possess professional qualifications consistent with Information Assurance Manager Level II and Information Assurance Technical Level II per DoD 8570.01-M, Information Workforce Improvement Program, and DoD 8140.01, Cyberspace Workforce Management. The individual will function in a system administrator role as required in support of cybersecurity activities outlined in this Section. [**Am-4]

1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

1.8.1 Proposed STIG and SRG Applicability Report

For each model of network connected or network infrastructure device, use the DISA SRG/STIG Applicability Guide and Collection Tool (available at <https://public.cyber.mil/stigs/SCAP/>) to identify applicable STIGs or SRGs and provide a report indicating applicable STIGs and SRGs for each model.

1.8.2 Cybersecurity Interconnection Schedule

{For Government Reference Only: This subpart relates to CA-3(b), PL-8, SC-7(9), SC-7(11); CCI-000258, CCI-003072, CCI-003073, CCI-003075, CCI-002398, CCI-002399, CCI-002401, CCI-002402, CCI-002403.}

Provide a completed Cybersecurity Interconnection Schedule documenting network connections between the installed system and other systems. Provide the following information for each device directly communicating between systems: Device Identifier, Device Description, Transport layer Protocol, Network Address, Port (if applicable), MAC (Layer 2) address (if applicable), Media, Application Protocol, Service (if applicable), Descriptive Purpose of communication. For communication with other authorized systems also provide the Foreign Destination and POC for Destination. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Cybersecurity Interconnection Schedule as an editable Microsoft Excel file (a template Cybersecurity Interconnection Schedule in Excel format is available at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>

1.8.3 Network Communication Report

{For Government Reference Only: This subpart (and its subparts) relates

to CA-9, PL-8; CCI-003075; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072, CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, SC-8 and SC-41 including CM-7(3), CCI-000388.}

Provide a network communication report. For each networked device, document the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP, document all TCP and UDP ports used. For non-IP communications, document communication protocol and media used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication Report as an editable Microsoft Excel file.

1.8.4 Control System Inventory Report

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Control System Inventory report using the Inventory Spreadsheet listed under this Section at

<https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>

documenting all devices, including networked devices, network infrastructure devices, non-networked devices, input devices (e.g. sensors) and output devices (e.g. actuators). For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Report as an editable Microsoft Excel file.

1.8.5 Software and Configuration Backups

{For Government Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each computer and control system device on which software is installed or a configuration file is modified under this project, provide a recovery image of the final as-built computer and device. This image must allow for bare-metal restore such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software. If additional user permissions are required to meet this requirement, coordinate the creation of the image with the identified Government Computer Access Point of Contact.

For all ethernet switches provide a backup of the switch configuration. For all controllers, provide a backup of the controller configuration and the source code for all loaded application programs (all software that is not common to every controller of the same manufacturer and model).

If any or all of these are provided under another Section, provide documentation indicating this and referencing those submittals.

1.8.6 Cybersecurity Riser Diagram

{For Government Reference Only: This subpart (and its subparts) relates to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073, CCI-003075}

Provide a cybersecurity riser diagram of the complete control system including all network and device hardware. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.8.7 STIG, SRG and Vendor Guide Compliance Result Report

For every component (device or software) with an applicable STIG or SRG in the Proposed STIG and SRG Applicability Report, provide a result report documenting compliance with the STIG or SRG requirements. For components which are scannable by the SCAP (security content automation protocol) tool (available online at <https://public.cyber.mil/stigs/scap>), provide the SCAP report and raw scan results.

For every component (device or software) with manufacturer provided cybersecurity documentation, procedure, or method for secure configuration or installation, provide a report documenting how the component was configured and any deviation from the manufacturer instructions.

1.8.8 Control System Cybersecurity Documentation

{For Government Reference Only: This subpart (and its subparts) relates to SA-5 (a), (b), (c); CCIs: CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129, CCI-003130, CCI-003131}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.8.8.1 Software Applications

For all software applications running on computers provide:

- a. administrator documentation that describes secure configuration of the software {For Government Reference Only: relates to CCI-003124}
- b. administrator documentation that describes secure installation of the software {For Government Reference Only: relates to CCI-003125}
- c. administrator documentation that describes secure operation of the software {For Government Reference Only: relates to CCI-003124}
- d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {For Government Reference Only: relates to CCI-003127}
- e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {For Government Reference Only: relates to CCI-003128}
- f. user documentation that describes user-accessible security functions

or mechanisms in the software and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}

- g. user documentation that describes methods for user interaction which enables individuals to use the software in a more secure manner {For Government Reference Only: relates to CCI-003130}
- h. user documentation that describes user responsibilities in maintaining the security of the software {For Government Reference Only: relates to CCI-003131}

1.8.8.2 For HVAC Control System Devices

1.8.8.2.1 HVAC Control System Devices FULLY Supporting User Accounts

For all HVAC Control System Devices which FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}
- b. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}
- c. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}
- d. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}
- e. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms; or a specific indication that there are no user-accessible security functions or mechanisms in the device {For Government Reference Only: relates to CCI-003129}
- f. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

1.8.8.2.2 All Other HVAC Control System Devices

For all HVAC Control System Devices which do not FULLY support user accounts, provide:

- a. Documentation that describes secure configuration of the device; or a specific indication that there are no secure configuration steps that apply {For Government Reference Only: relates to CCI-003124}
- b. Documentation that describes effective use and maintenance of security functions or mechanisms for the device; or a specific indication that there are no security functions or mechanisms in the device {For Government Reference Only: relates to CCI-003127}
- c. For devices which include a user interface, documentation that describes methods for user interaction which enables individuals to

use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

1.8.8.3 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

- a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}
- b. Documentation that describes secure installation of the device {For Government Reference Only: relates to CCI-003125}
- c. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}
- d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}
- e. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}
- f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}
- g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}
- h. Documentation that describes user responsibilities in maintaining the security of the device {For Government Reference Only: relates to CCI-003131}

1.9 SOFTWARE LICENSING

{For Government Reference Only: This subpart (and its subparts) relates to SI-2(a), SI-2(c), SI-7(14); CCI-001227, CCI-002605, CCI-002737}

For all software provided that has not already been licensed to the government or project site, provide a license to the Government for a period of no less than 5 years, and the license must also include the following software updates:

- a. Security and bug-fix patches issued by the software manufacturer.
- b. Security patches to address any vulnerability identified in the National Vulnerability Database at <http://nvd.nist.gov> with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

Provide a single Software Licenses submittal with documentation of the software licenses for all software provided

1.10 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, SA-3; CCI-000258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.10.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.10.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. Computers used on this project must be scanned using the installed software at least once per day.

1.10.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.10.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.10.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.10.1.6 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> Each Statement must be signed by a cybersecurity representative for the relevant company.

1.10.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited.

1.10.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.10.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

1.10.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.10.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1>. Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

1.11 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

All products used on this project must meet the indicated requirements, but not all products specified here will be required by every project.

2.1 ETHERNET SWITCH

Provide Open Systems Interconnection (OSI) Layer 2 Ethernet switches with the following capabilities, and with an interface to support switch configuration for these capabilities:

2.1.1 Required Functionality

Switches must:

- a. Copper Ethernet ports must auto negotiate for 10, 100 and 1000 megabits-per-second links.
- b. Be capable of implementing port level access control by MAC address and limit the number of MAC addresses to one MAC address per port.
- c. For LOW Impact Systems, be capable of implementing per-port access control lists (ACLs) where the list can be filtered by source and destination IP addresses, and by source and destination UDP or TCP ports.
- d. Support Remote Network Monitoring (RMON) Port Analysis in accordance with IETF RFC 2819
- e. Configure target port and analysis port such that switch clones all target port traffic to analysis port.
- f. Support authentication via RADIUS server (for management and 802.1x)
- g. Support IEEE 802.1x network login.

2.1.2 Configuration Requirements

Switches must:

- a. Support configuration save and restore.
- b. Support both manual IP address assignment and acquisition of a dynamic IP address via Dynamic Host Configuration Protocol (DHCP).
- c. Be capable of limiting access for configuration to one or more of: a web interface using HTTPS, a command line interface using SSH, or an SNMP connection using SNMP version 3 or later.
- d. Support the ability to lock configuration capability to a dedicated management port.

2.2 DAISY CHAIN IP CONTROLLERS

Controllers used as Daisy Chain IP Controllers must be IP controllers with exactly two Ethernet network connections and basic built-in switch capabilities to allow implementation of an Ethernet network in a daisy chain architecture. Switches incorporated by Daisy Chain IP Controllers are not required to meet the requirements for Ethernet Switches as defined in this Section.

PART 3 EXECUTION

3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with required functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Wireless and Wired Broadcast Communication

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, AC-18(3); CCI-001438, CCI-001439, CCI-002323, CCI-001441, CCI-002252}

Unless explicitly authorized by the Government, do not use any wireless or wired broadcast communication. If requesting authorization for wireless or wired broadcast communication, wired broadcast media such as powerline carrier is preferred to wireless.

3.2.2 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.2.3 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380, CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

IP Networks must be Ethernet networks and must use switches which are Ethernet Switches or Daisy Chain IP Controllers as defined in this Section. Do not use nonsecure functions, ports, protocols and services as defined in DODI 8551.01 unless those ports, protocols and services are specifically required by the control system specifications or otherwise specifically authorized by the Government. Do not use ports, protocols and services that are not specified in the control system specifications or required for operation of the control system.

3.2.3.1 IP Network Routers

Do not install any device that performs IP routing.

3.2.3.2 IP Devices With Multiple Ethernet Connection

Except for Ethernet Switches and Daisy Chain IP Controllers, devices must not have more than one Ethernet connection to IP networks unless doing so is required by the project specifications and the specific application is

approved. If a device with Multiple Ethernet Connections to IP networks is required, provide a Multiple Ethernet Connection Device Request using the Multiple Ethernet Connection Device Request Template at <https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1> to request approval for each device. If a device with Multiple Ethernet Connections to IP networks is not required, instead provide a document stating that no approval is being requested.

3.2.4 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

All remote user interfaces must use HTTPS for all traffic between the user interface client and user interface server.

For devices that have STIG/SRGs related to cryptographic protection (CCI-002450), comply with the requirements of those STIG/SRGs. Ensure that all IP network traffic is encrypted using NSA-approved cryptography; provision of digital signatures and hashing, and FIPS-validated cryptography.

3.2.5 Device Identification and Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-3; CCI-000777, CCI-000778, CCI-001958.}

All computers must support IEEE 802.1x for device authentication to the network.

3.2.5.1 For HVAC Control System Devices

Devices using HTTP as a control protocol must use HTTPS instead. Devices using Ethernet must support IEEE 802.1x. Devices using Fox Protocol must support IEEE 802.1x. Devices using BACnet must support network security as specified for BACnet Secure Connect in ASHRAE 135.

3.2.5.2 Default Requirements for Control System Devices

For control system devices where Device Identification and Authentication requirements are not otherwise indicated in this Section: Devices using HTTP as a control protocol must use HTTPS instead.

3.2.6 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.3 ACCESS CONTROL REQUIREMENTS

3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2;

CCI-002110, CCI-000213, CCI-002235, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification.

3.3.1.1 Computers

All computer operating systems must FULLY support user accounts and implement accounts for access. Each control system software application not supporting accounts and running on a computer must be installed such that use of the software is restricted by the computer operating system to specific users.

Applications running on computers shall not require the user be logged in to a computer operating system administrator account for normal operation. It is permissible to require the computer operating system administrator account for initial application installation and configuration.

3.3.1.2 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

- a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.
- b. For table entries of "None Required": The user interface is not required to support user accounts.
- c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.
- d. For table entries of "FULLY": The user interface must at FULLY support user accounts.
- e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a locked enclosure. Where this is required for a read only interface, this lock must prevent viewing of data on the interface; for other interfaces, this lock must prevent using the interface to alter data.
- f. For table entries of "Physical Security": For Local FULL interfaces, the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located

within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.

- g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.
- h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.2.1 HVAC Control Systems

User Interface Requirements for LOW Impact HVAC Control Systems	
<u>User Interface Type</u>	<u>Access Control Requirement</u>
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	None Required
Local Limited, Privileged	Physical Security
Local Full	MINIMALLY
Remote Read Only	None Required
Remote Limited, Non-Privileged	MINIMALLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged	

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237, CCI-002238}

Except for high availability user interfaces indicated as exempt, devices must meet the indicated requirements for handling unsuccessful logon attempts. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock

Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For LOW Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account after five consecutive failed login attempts and must unlock the user account after 15 minutes have elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

- a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.
- b. Once an account is locked, the account must stay locked until unlocked by an administrator. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.
- c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

There are no high availability interfaces which are exempt from unsuccessful logon attempts requirements.

3.3.3 System Use Notification

{For Government Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.3.4 Permitted Actions Without Identification or Authentication

{For Government Reference Only: This subpart (and its subparts) relates to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.3.5 Enclosures

Prior to final acceptance of the system, lock all lockable enclosures. Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1), IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954, CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003. }

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

For LOW Impact Systems: User interfaces provided by computer operating systems must implement multifactor authentication via PIV.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.2.1 HVAC Control Systems Devices

No additional system specific requirements apply.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements.

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

- a. Direct implementation in the user interface.
- b. For user interfaces on a computer: inheriting the Identification and Authorization from the computer operating system, either by the operating system limiting access to specific applications by user, or by the application itself having permissions based on the user logged into the computer.
- c. For remote interfaces: an implementation shared between the remote user interface server and the remote user interface client. For example, a requirement for PIV authentication may be met on a remote user interface by a PIV reader on a web browser client which sends the authentication information via HTTPS to the remote server.

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Software and Applications Running on Computers

All software and applications running on computers supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of 12 characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a minimum lifetime of 24 hours.
- g. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- h. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).
- i. Passwords must be cryptographically protected during storage and transmission.

3.4.5.2 Passwords for Controllers FULLY Supporting Accounts

All controllers FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of twelve (12) characters

- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five (5) passwords, where differ is defined as changing at least fifty percent of the characters.
- h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.3 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface supporting password-based authentication must enforce the following requirements:

- a. Minimum password length of twelve (12) characters
- b. Password must contain at least one uppercase character.
- c. Password must contain at least one lowercase character.
- d. Password must contain at least one numeric character.
- e. Password must contain at least one special character. The list of supported special characters must include at least 4 separate characters.
- f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
- g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).
- h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.4 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four characters.

3.4.5.5 Password Configuration and Reporting

For all devices with a password, coordinate the changing of passwords with the project site following testing of the system but prior to turnover to the Government. Coordinate with Password Point of Contact to determine

appropriate project site personnel to complete password changes. Accompany identified personnel to each device with a password and instruct personnel on the process of changing password. Record the time, date and personnel present when each device's password is changed and submit a Password Change Summary Report documenting this information.

Provide the Password Summary Report electronically in both PDF and Microsoft Excel.

3.4.6 Authenticator Feedback

{For Government Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGS/SRGs.

3.5 CYBERSECURITY AUDITING

Where an auditing requirement exists for email notification, notify via email the application administrator and Information System Security Officer (ISSO) of the event. Coordinate with the Email Address Point of Contact for email addresses. If outgoing email is not available to the system, configure the system for these notifications for future support of outgoing email.

3.5.1 Audit Events, Content of Audit Records, and Audit Generation

{For Government Reference Only: This subpart (and its subparts) relates to AU-2(a), AU-2(c), AU-2(d), AU-3, AU-10, AU-12, AU-13(3), AU-14(b), AU-14(1), AU-14(2), AU-14(3), CM-5(1), SC-7 (9); CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-00133, CCI-000134, CCI-001487, CCI-000166, CCI-001899, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910, CCI-001914, CCI-001919, CCI-001464, CCI-001462, CCI-001920, CCI-001814, CCI-002400. }

For devices that have STIG/SRGs related to audit events, content of audit records or audit generation, comply with the requirements of those STIG/SRGs.

If auditing requirements can be met using existing control system alarm or event capabilities, those existing capabilities may be used to meet these requirements.

3.5.1.1 Computers

For each computer, provide the capability to select audited events and the content of audit logs. Configure computers to audit the indicated events, and to record the indicated information for each auditable event

3.5.1.1.1 Audited Events

Configure each computer to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)

- b. Successful and unsuccessful logon attempts
- c. Successful logouts
- d. Privileged activities or other system level access
- e. Concurrent logons from different workstations
- f. Successful and unsuccessful accesses to objects
- g. All program initiations
- h. All direct access to the information system
- i. All account creations, modifications, disabling, and terminations.
- j. All kernel module load, unload, and restart

3.5.1.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

- a. What type of event occurred
- b. When the event occurred
- c. Where the event occurred
- d. The source of the event
- e. The outcome of the event
- f. The identity of any individuals or subjects associated with the event

3.5.1.2 For HVAC Control System Controllers

3.5.1.2.1 HVAC Control System Controllers FULLY Supporting User Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.2.1.1 Audited Events

Configure each controller to audit the following events:

- a. Successful and unsuccessful logon attempts to the controller
- b. Successful logouts
- c. All account creations, modifications, disabling, and terminations.
- d. All controller shutdown and startup

3.5.1.2.1.2 Audit Event Information To Record

Configure each controller to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. the identity of any individuals or subjects associated with the event

3.5.1.2.2 Other HVAC Control System Controllers

There are no requirements to perform auditing at HVAC field controllers that do not FULLY support accounts.

3.5.1.3 Default Requirements for Control System Controllers

For control system controllers where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.5.1.3.1 Controllers Which FULLY Support Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.3.1.1 Audited Events

Configure each controller to audit the following events:

- a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)
- b. Successful and unsuccessful logon attempts
- c. Successful logouts
- d. Concurrent logons from different workstations
- e. All account creations, modifications, disabling, and terminations.
- f. All kernel module load, unload, and restart

3.5.1.3.1.2 Audit Event Information To Record

Configure each controller to record, for each auditable event, the following information (where applicable to the event):

- a. what type of event occurred
- b. when the event occurred
- c. where the event occurred
- d. the source of the event

e. the outcome of the event

f. the identity of any individuals or subjects associated with the event

3.5.1.3.2 Controllers Which Do Not FULLY Support Accounts

For each controller which does not FULLY support accounts configure the controller to audit all controller shutdown and startup events and to record for each event the type of event and when the event occurred.

3.5.2 Audit Time Stamps

{For Government Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890.}

Any device (computer or controller) generating audit records must have an internal clock capable of providing time with a resolution of one second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device (computer or controller) generating audit records maintains accurate time to within 1 second. Note that if the control system specifications include requirement for clocks, the most stringent requirement applies.

3.5.3 Auditing Front End Software

The project site currently has the following software to support control system auditing: none. If there is no existing auditing front end software or the software is not compatible with the provided control systems, provide Auditing Front End Software with audit log import and upload, export, notification, and analysis functionality. The Auditing Front End Software may be provided as a component of the control system front end or as a separate software package, and a single package may serve multiple control systems provided under the same projects if they are sharing a cybersecurity authorization.

When the Auditing Front End Software is neither existing nor installed under the requirements of another Section, furnish the Auditing Front End Software media and license and install the software on the control system front end computer. Submit copies of Auditing Front End Software if this function is not part of the software provided with the control system to meet requirements of other Sections.

3.5.3.1 Import and Upload Requirements

Auditing Front End Software must be capable of importing audit logs from the Device Audit Record Upload Software and of uploading audit logs over the network from all control system devices supporting network upload of audit logs.

3.5.3.2 Export Requirements

Auditing Front End Software must be capable of exporting to a file format supported by Microsoft Excel.

3.5.4 Audit Storage Capacity and Audit Upload

{For Government Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

The creation of audit records must never interfere with normal device operation. Devices must cease collection of auditing information if required to maintain normal operation.

- a. For devices that have STIG/SRGs related to audit storage capacity (CCI-001848 or CCI-001849) comply with the requirements of those STIG/SRGs.
- b. For controllers capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.
- c. For computers, provide storage for at least 20 MB of audit records.

3.5.4.1 Device Audit Record Upload Software

For each device (computer or controller) required to audit events and for which audit logs cannot be uploaded over the network by the Auditing Front End Software, provide and license to the Government software implementing a secure mechanism of uploading audit records from the device and exporting them to the Auditing Front End Software. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

When Device Audit Record Upload Software is capable of uploading audit logs over the network, install Device Audit Record Upload Software on the same computer as the Auditing Front End Software. Submit copies of device audit record upload software if this function is not part of the software provided with the control system to meet requirements of other Sections. If there are no devices requiring this software, provide a document stating this in lieu of this submittal.

3.5.5 Response to Audit Processing Failures

{For Government Reference Only: This subpart (and its subparts) relates to AU-5; CCI-000139, CCI-000140, CCI-001490.}

In the case of a failure in the auditing system, computers associated with auditing must provide email notification. In case of an audit failure, if possible, continue to collect audit records by overwriting existing audit records.

3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(c), CM-7, CM-7(1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

3.6.1 Device Capabilities

For HVAC Control Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required. Do

not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

3.6.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

3.7 SYSTEM AND COMMUNICATION PROTECTION

3.7.1 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

3.7.2 Denial of Service Protection

{For Government Reference Only: This subpart relates to SC-5, SC-39, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. }

To the greatest extent practical, implement control logic without reliance on the network. Except when required to meet the requirements of the control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers.

3.8 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.9 SYSTEM MAINTENANCE TOOL SOFTWARE

{For Government Reference Only: This subpart (and its subparts) relates to MA-3; CCI-000865.}

Submit and license to the Government all software required to operate, maintain and modify the control system such the Government or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor, Vendor or Manufacturer. Submit hard copies of user manuals for each software with the software submittal.

For software provided and licensed to the Government under the requirements of another Section, submit a statement indicating the Section and Submittal under which the software was provided. For software provided to meet the requirements of this Section and not provided and licensed under another Section, submit software and software user manuals on DVD or CD as a Technical Data Package and submit two hard copies of the software user manual for each piece of software.

3.10 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. }

For LOW Impact Systems: Provide emergency power in accordance with the control system and equipment specification Sections.

3.11 VULNERABILITY SCANNING

{For Government Reference Only: This subpart (and its subparts) relates to RA-5 RA-5(a), RA-5(b), RA-5(c), RA-5(d); CCI-001054, CCI-001055, CCI-000156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059. }

All IP devices must be scannable, such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application, or functionality.

3.11.1 Computers and Software Running on Computers

Computers and applications running on computers must meet relevant vulnerability scanning STIGs/SRGs and respond to approved DoD vulnerability scanning tools.

3.11.2 Controllers

Controllers shall be scannable by standard control system discovery tools or control system browsers and return meaningful status information including the network inputs and outputs for the controller. This information shall contain sufficient detail to detect vulnerabilities or exploits of the controller.

Provide all software needed to scan the control system as the Control System Scanning Tools submittal. If the software required to scan the system is already installed at the project site or is provided under a separate section instead provide a statement indicating this.

3.12 FIPS 201-2 REQUIREMENT

{For Government Reference Only: This subpart (and its subparts) relates to SA-4 (10); CCI-003116}

Devices in the following systems which implement PIV must be on the NIST FIPS 201-2 approved product list (<https://www.idmanagement.gov/approved-products-list/>).

3.13 SYSTEM AND INTEGRATION INTEGRITY

3.13.1 Malicious Code Protection

{For Government Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers installed under this project, provide malware protection software media, provide licenses, and install and configure malware protection software as indicated. Coordinate with the Government Computer Access Point of Contact as required.

a. Provide malware protection software licenses.

- b. Provide malware protection software media.
- c. Install and configure malware protection software in accordance with the relevant STIGs.

3.14 CONTROL SYSTEM CYBERSECURITY TESTING

3.14.1 Control System Cybersecurity Testing Procedures

Prepare Control System Cybersecurity Testing Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system meets the requirements of this Section.

Submit 4 copies of the Control System Cybersecurity Testing Procedures. The Control System Cybersecurity Testing Procedures may be submitted as a Technical Data Package.

3.14.2 Control System Cybersecurity Testing Execution

Using the Control System Cybersecurity Testing Procedures verify that the control system meets the requirements of this Section. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. If testing reveals deficiencies in the system, correct the deficiency and retest until successful.

3.14.3 Control System Cybersecurity Testing Report

Prepare and submit a Control System Cybersecurity Testing Report documenting all tests performed and their results. Include all tests in the Control System Cybersecurity Testing Procedures and any additional tests performed during testing. Document test failures and repairs conducted with the test results.

Submit four copies of the Control System Cybersecurity Testing Report. The Control System Cybersecurity Testing Report may be submitted as a Technical Data Package.

3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of 40 hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity Testing specified in this section.

3.16 CYBERSECURITY TRAINING

Provide eight hours of classroom and hands-on training for six Government personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer

period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 27 13.10 30

ELECTRIC METERS

10/07, CHG 2: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Installation Drawings
 - 1.4.2 Standard Products
 - 1.4.3 Alternative Qualifications
 - 1.4.4 Material and Equipment Manufacturing Data
- 1.5 WARRANTY
- 1.6 SYSTEM DESCRIPTION
 - 1.6.1 System Requirements
 - 1.6.2 Selection Criteria

PART 2 PRODUCTS

- 2.1 POWER METERS
 - 2.1.1 Physical and Common Requirements
 - 2.1.2 Voltage Requirements
 - 2.1.3 Current Requirements
 - 2.1.4 Electrical Measurements
 - 2.1.5 Meter Accuracy
 - 2.1.6 An on the Meter Display, Output and Reading Capabilities
 - 2.1.7 Installation Methods
 - 2.1.8 Disconnecting Switches
 - 2.1.9 Meter Programming
 - 2.1.10 Meter Enclosure
- 2.2 COMMUNICATIONS
 - 2.2.1 Communications Methods
 - 2.2.1.1 Serial Port
 - 2.2.1.2 Ethernet
 - 2.2.2 Communications Protocols and Methods
 - 2.2.3 Communications Channels Surge Protection
- 2.3 METER DATA PROTOCOL
 - 2.3.1 Open Protocol
- 2.4 SPARE PARTS
 - 2.4.1 Parts List

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Communication Cable Installation
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Performance of Acceptance Checks and Tests
 - 3.2.1.1 Meter Assembly

- 3.2.1.2 Current Transformers
- 3.2.1.3 Potential Transformers
- 3.2.2 Follow-Up System Function Verification
- 3.2.3 Training

-- End of Section Table of Contents --

SECTION 26 27 13.10 30

ELECTRIC METERS

10/07, CHG 2: 08/18

PART 1 GENERAL

1.1 REFERENCES

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- | | |
|---------------|--|
| IEEE 100 | (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms |
| IEEE C2 | (2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code |
| IEEE C37.90.1 | (2013) Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus |
| IEEE C57.13 | (2016) Requirements for Instrument Transformers |

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

- | | |
|---------------|---|
| IEC 61000-4-5 | (2017) Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test |
| IEC 62053-22 | (2020) Electricity Metering Equipment (A.C.) - Particular Requirements - Part 22: Static Meters for Active Energy (Classes 0,2 S and 0,5 S) |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- | | |
|-------------|--|
| ANSI C12.20 | (2015; E 2018) Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes |
| ANSI C62.61 | (1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|---------|---|
| NFPA 70 | (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code |
|---------|---|

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification and on the drawings shall be as defined in IEEE 100.

1.3 SUBMITTALS

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

- a. Maintenance manual shall provide:
 1. Condensed description of how the equipment operates.
 2. Block diagram indicating major assemblies.
 3. Troubleshooting information
 4. Preventive maintenance.
 5. Spare parts information.
- b. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data."

SD-02 Shop Drawings

SD-03 Product Data

[*Am-3] Power Meters; G, AE

Current Transformers; G, AE

Potential Transformer; G, AE

Communications Module; G, AE

Protocol Modules; G, AE

Data Recorder; G, AE[**Am-3]

Submittals shall include manufacturer's information for each component, device, and accessory provided with the meter, protocol module or communications module.

SD-06 Test Reports

Acceptance Checks and Tests; G

SD-10 Operation and Maintenance Data

Power Meters; G

Communications Module; G

Protocol Modules; G

SD-11 Closeout Submittals

System Function Verification; G

1.4 QUALITY ASSURANCE

1.4.1 Installation Drawings

Drawings shall indicate but not be limited to the following:

a. Elementary diagrams and wiring diagrams with terminals identified of advanced meter, current transformers, potential transformers, protocol modules, communications modules, Ethernet connections, .

1.4.2 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 this section.

[*Am-3]Electric meters provided must be compliant with the Air Force Meter Data Management Plan 2020. [**Am-3]

1.4.3 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 Material and Equipment Manufacturing Data

Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 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 SYSTEM DESCRIPTION

1.6.1 System Requirements

The metering and reading system, consisting of commercial, off-the-shelf meters, protocol modules, communications modules, and communication channels, will be used to record the electricity consumption and other values as described in the sections that follow and as shown on the drawings.

1.6.2 Selection Criteria

Metering components are part of a system that includes the physical meter, data recorder function and communications method. Every building site identified shall include sufficient metering components to measure the electrical parameters identified and to store and communicate the values as required in the following sections. Contractor shall verify that the metering system installed on any building site is compatible with the facility-wide communication and meter-reading protocol system. Contractor must connect the metering system to the facility-wide energy and utility monitoring and control system.

PART 2 PRODUCTS

2.1 POWER METERS

2.1.1 Physical and Common Requirements

- a. Metering system components shall be installed according to the Metering System Schedule shown on the drawings.
- b. Power meter shall be panel-mounted design. Meters shall be semi-flush, back-connected, dustproof, draw-out switchboard type. Cases shall have window removable covers capable of being sealed against tampering. Meters shall be of a type that can be withdrawn through approved sliding contacts from fronts of panels or doors without opening current-transformer secondary circuits, disturbing external circuits, or requiring disconnection of any meter leads. Necessary test devices shall be incorporated within each meter and shall provide means for testing either from an external source of electric power or from associated instrument transformers or bus voltage.
- c. Meter shall be a Class 20, transformer rated design.
- d. Meter shall be rated for use at temperature from -40 degrees Centigrade to +70 degrees Centigrade.
- e. Meter shall have NEMA 3R enclosure for surface mounting.
- f. Surge withstand shall conform to IEEE C37.90.1.
- g. Meter shall have a standard 4-year warranty.
- h. Meter shall comply with IEC 62053-22 (Part 21: Static Meter for Active Energy, classes 0.2S and 0.5S), certified by a qualified third party test laboratory.

[*Am-4]

- i. The following list of meters were evaluated, meet the AMRS requirements and are in use at Buckley SFB:
 1. Schneider Electric PM5560
 2. Schneider Electric PM8000
 3. Schneider Electric ION 8650
 4. Siemens 9410
 5. Siemens 9810
- j. Meter shall have a minimum of two digital and one analog input(s) that shall count pulses from other devices. [**Am-4]

2.1.2 Voltage Requirements

- a. Meter shall be capable of connection to the service voltage phases and magnitude being monitored. If the meter is not rated for the service voltage, provide suitable potential transformers to send an acceptable voltage to the meter.
- b. Meter shall be capable of connection to the service voltage indicated in the Metering System Schedule:
- c. Meter shall accept independent voltage inputs from each phase. Meter shall be auto-ranging over the full range of input voltages.
- d. Voltage input shall be optically isolated to 2500 volts DC from signal and communications outputs. Components shall meet or exceed IEEE C37.90.1 (Surge Withstand Capability).
- e. The Contractor shall be responsible for determining the actual voltage ratio of each potential transformer. Transformer shall conform to IEEE C57.13 and the following requirements.
 1. Type: Dry type, of two-winding construction.
 2. Weather: Outdoor or Indoor rated for the application.
 3. Frequency: Nominal 60Hz, 50Hz for those bases that operate on 50Hz.
 4. Accuracy: Plus or minus 0.3% at 60Hz or 0.3% for those systems that operate at 50Hz.

2.1.3 Current Requirements

- a. Meter shall accept independent current inputs from each phase. Current transformer shall be installed with a full load rating as shown in the schedule.
- b. Single ratio current transformer shall have an Accuracy Class of 0.6 with a maximum error of +/- 0.6% at 5.0 amps.
- c. Current transformer shall have:
 1. Insulation Class: All 600 volt and below current transformers shall be rated 10 KV BIL. Current transformers for 2400 and 4160 volt service shall be rated 25 KV BIL.
 2. Frequency: Nominal 60Hz, 50Hz for bases that operate on 50Hz.
 3. Burden: Burden class shall be selected for the load.
 4. Phase Angle Range: 0 to 60 degrees.
- d. Meter shall accept current input from standard instrument transformers (5A secondary current transformers.)
- e. Current inputs shall have a continuous rating in accordance with IEEE C57.13.
- f. Multi-ratio current transformer where indicated shall have a top range equal to or greater than the actual load. The Contractor shall be

responsible for determining the actual ratio of each transformer.
Current transformer shall conform to IEEE C57.13.

2.1.4 Electrical Measurements

Power meter shall measure and report the following quantities:

- a. Kilowatt-hours ("kWh" in Metering Systems Schedule) of consumption. Cumulative.
- b. Kilowatts of demand ("kW" in Metering Systems Schedule). Peak average over a selectable demand interval between 5 and 60 minutes (typically 15 minutes).
- c. Reactive power ("kVAR" in Metering Systems Schedule). Measured over the same interval as the peak kW reading.
- d. Power factor ("PF" in Metering Systems Schedule). Measured over the same interval as the peak kW reading.

2.1.5 Meter Accuracy

Power meter shall provide the following accuracies. Accuracies shall be measured as percent of reading at standard meter test points.

- a. Power meter shall meet ANSI C12.20 for Class 0.2 and IEC 62053-22 accuracy requirements.

2.1.6 An on the Meter Display, Output and Reading Capabilities

Meter shall include the following output signals.

- a. The meter will have a face display plate and shall display every electrical parameter indicated to be recorded. Meters shall not be required to indicate interval data collected in a data logger with a communications output feature. Peak values, instantaneous and cumulative values shall be displayed.

2.1.7 Installation Methods

[*Am-4]Electric Meter shall be installed adjacent to the main distribution panel in a separate enclosure 5 feet above the ground. [**Am-4]

2.1.8 Disconnecting Switches

- a. Disconnecting wiring blocks shall be provided between the current transformer and the meter. A shorting mechanism shall be built into the wiring block to allow the current transformer wiring to be changed without removing power to the transformer. The wiring blocks shall be located where they are accessible without the necessity of disconnecting power to the transformer. For multi-ratio current transformers, provide a shorting block from each tap to the common lead. [*Am-4]Instructions explaining how to operate the CT shorting block must be visible inside each meter assembly. [**Am-4]
- b. Voltage-monitoring circuits shall be equipped with disconnect switches to isolate the meter base or socket from the voltage source.

2.1.9 Meter Programming

- a. Power meter shall be programmable by software supplied by the meter manufacturer.
- b. Software shall have a user-friendly, Windows-compatible interface.
- c. Software shall operate on Windows operating systems.
- d. Software shall allow the user to configure the meter, troubleshoot meter, query and display meter parameters and configuration data and stored values.
- e. Meter firmware shall be upgradeable through one of the communications ports without removing the unit from service.

[*Am-4] 2.1.10 Meter Enclosure

- a. Meter enclosures shall include finger safe voltage and current disconnects.
- b. Meter enclosure shall be fed by a load break 3-pole fusible disconnect switch that is external of the meter assembly. This safety disconnect switch shall be marked as follows: "METER DISCONNECT NOT SERVICE EQUIPMENT".

[**Am-4] 2.2 COMMUNICATIONS

2.2.1 Communications Methods

2.2.1.1 Serial Port

Provide serial port for connection to modem module where required in this specification.

- a. On-Board serial port types

- 1. RS232
- 2. RS485

2.2.1.2 Ethernet

For those meters using the Ethernet, logged information shall be sent using open standard Internet Protocols.

- a. On-board Ethernet port support

- 1. HTTP
- 2. SMTP
 - (a) Modbus

- b. Distribute stored data by

- 1. FTP

2.2.2 Communications Protocols and Methods

Communications protocols and methods shall be native to the meter. Provide communications module(s) as required to accomplish the following.

- a. Meter shall include an IR port ("IR" in Metering Systems Schedule) for communication to external devices such as handheld readers that support a minimum speed of 9600 baud.
- b. Meter shall include one RS-232 ("RS232" in Metering Systems Schedule) or one RS-485 digital communication port. Each port shall be user configurable with regard to speed, protocol, address, and other communications parameters. Ports shall support a minimum communication speed of 9600 baud for the RS232 port.
- c. Meter shall have a port that can be configured as a 10/100 Base-T Ethernet port ("BaseT" in Metering Systems Schedule)
 1. A communication module that converts serial RS232 or RS485 to Ethernet will be acceptable.

2.2.3 Communications Channels Surge Protection

Communications equipment shall be protected against surges induced on its communications channels. Communication interfaces to all field equipment shall be protected to meet the requirements of IEEE C37.90.1 or the requirements of IEC 61000-4-5, test level 4, while the equipment is operating. Fuses shall not be used for surge protection. Metallic cables and conductors which serve as communications channels between buildings shall have surge protection installed at equipment rated for the application installed at each end, within 3 feet of the building cable entrance. Surge protectors shall meet the requirements of the applicable extension of ANSI C62 (for example, ANSI C62.61).

2.3 METER DATA PROTOCOL

Power meters shall have communicating data protocols native or provided in supplemental modules to communicate with the communications methods that follow.

2.3.1 Open Protocol

Power meter shall support the following open protocols. Contractor shall verify that the meter native protocol is consistent with the facility data recording and communication and data storage system. Contractor shall provide additional converters and modules as required for a complete measurement, recording, communicating and data storage system.

- a. Meter must be compatible with the building automation system (BAS). The meter must be provided with BACnet communication protocol capabilities, to allow integration with the BAS. Coordinate communication requirement with the BAS supplier.

Systems capable of using more than one brand of commercially available meters are expected.

2.4 SPARE PARTS

2.4.1 Parts List

Provide spare parts as follows:

- a. Power meter - two for each type used.
- b. Current transformer - three for each type used.
- c. Potential transformer - three for each type used.
- d. Communications module - one for each type used.
- e. Protocol module - one for each type used.
- f. Other electronic and power components - one for each type used.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

[*Am-4] 3.1.1 Communication Cable Installation

- a. Meter shall be connected via CAT6 cable in conduit from the meter to a communication outlet near the meter. Communications outlet shall be routed to patch panel in the communications room. CAT6 cable shall not exceed 328 feet.
- b. Cables shall be labeled per I3A standards.
- c. Surge protection shall be provided on all cables extending to exterior of the building. Surge suppression devices shall be installed within 3 feet of entering the building. Devices shall be labeled and accessible.

[**Am-4] 3.2 FIELD QUALITY CONTROL

3.2.1 Performance of Acceptance Checks and Tests

3.2.1.1 Meter Assembly

- a. Visual and mechanical inspection
 - 1. Compare equipment nameplate data with specification and approved shop drawings.
 - 2. Inspect physical and mechanical condition.
 - 3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
 - 4. Verify grounding of metering enclosure.
 - 5. Verify the presence of surge arresters.

6. Verify that the CT ratio and the PT ratio are properly included in the meter multiplier or the programming of the meter.

b. Electrical tests

1. Verify that correct multiplier has been placed on face or meter where applicable.
2. Prior to system acceptance, the Contractor will demonstrate and confirm the meter is properly wired and is displaying correct and accurate electrical information.

3.2.1.2 Current Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specification and approved shop drawings.
2. Inspect physical and mechanical condition.
3. Verify correct connection.
4. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.
5. Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
2. Perform insulation-resistance test.
3. Perform a polarity test.
4. Perform a ratio-verification test.

3.2.1.3 Potential Transformers

a. Visual and mechanical inspection

1. PT's are rigidly mounted.
2. PT's are correct voltage.
3. Verify that adequate clearances exist between primary and secondary circuit.

b. Electrical tests

1. Perform a ratio-verification test.

3.2.2 Follow-Up System Function Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days' advance notice of the dates and times of checking and testing.

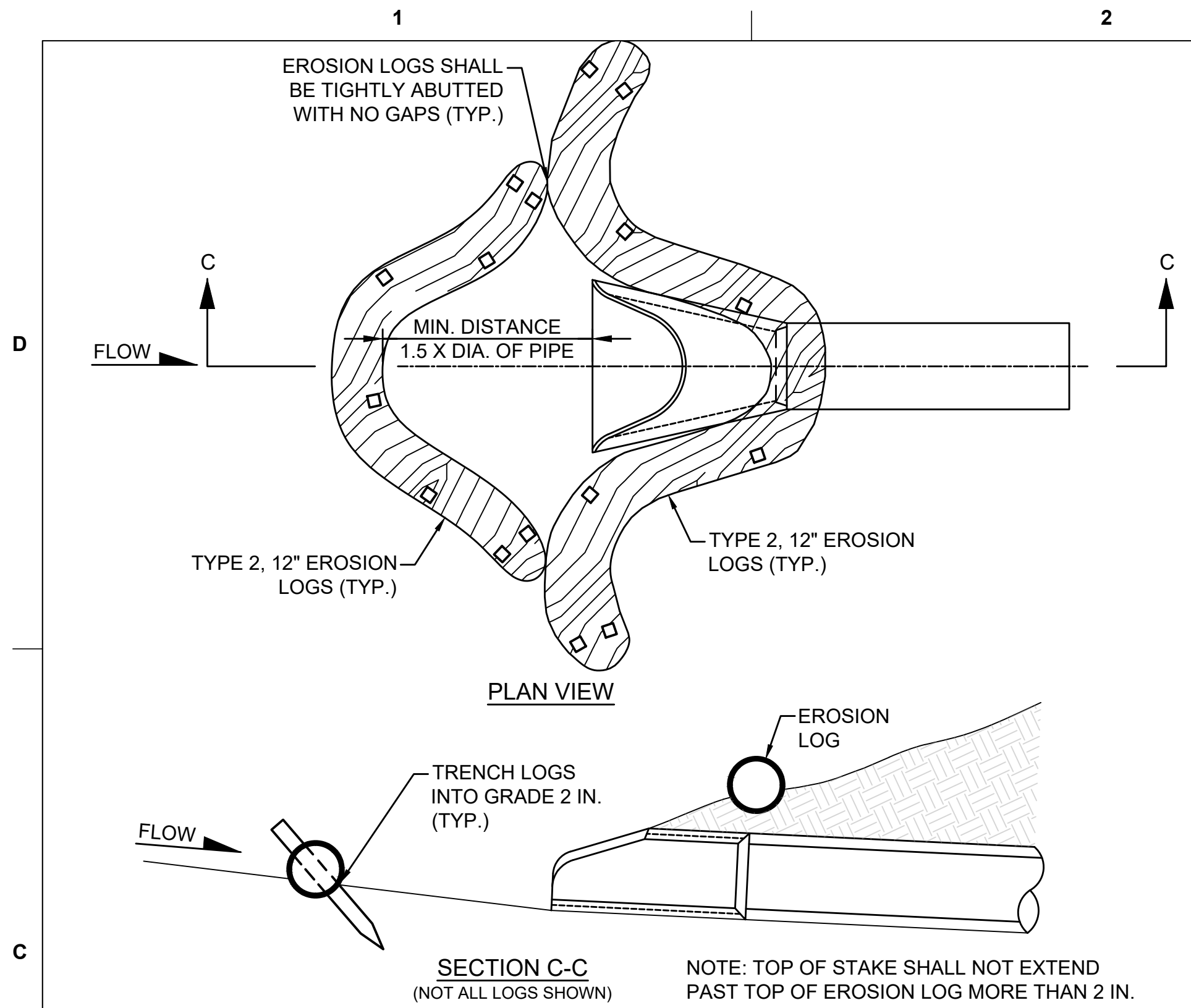
3.2.3 Training

The Contractor shall conduct a training course for meter configuration, operation, and maintenance of the system as specified. The training shall be oriented for all components and systems installed under this contract. Training manuals shall be delivered for 6 trainees with two additional copies delivered for archiving at the project site. The Contractor shall furnish all audiovisual equipment and all other training materials and supplies. A training day is defined as eight hours of classroom instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance in planning the required instruction, the Contractor shall assume that attendees have a high school education or equivalent, and are familiar with utility systems. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

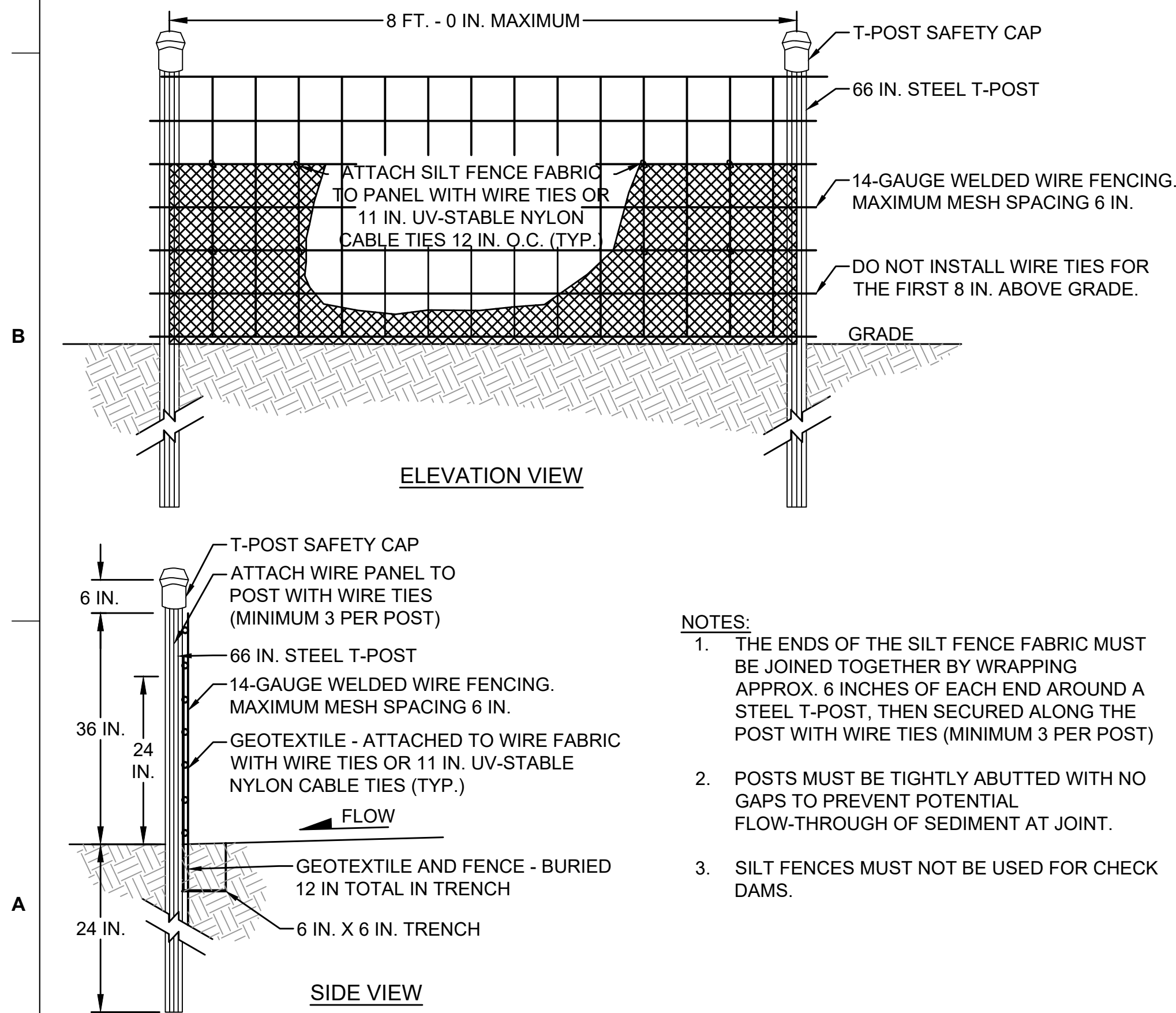
a. Training: The course shall be taught at the project site within thirty days after completion of the installation for a period of one day(s). A maximum of 6 personnel will attend the course. The training shall include:

1. Physical layout of each piece of hardware.
2. Meter configuration, troubleshooting and diagnostics procedures.
3. Repair instructions.
4. Preventive maintenance procedures and schedules.
5. Testing and calibration procedures.

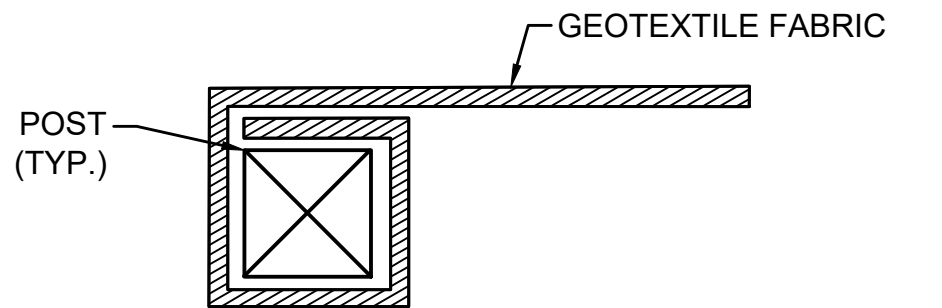
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C1 EROSION LOG CULVERT INLET PROTECTION
NTS
CE101
CE101A
CE102

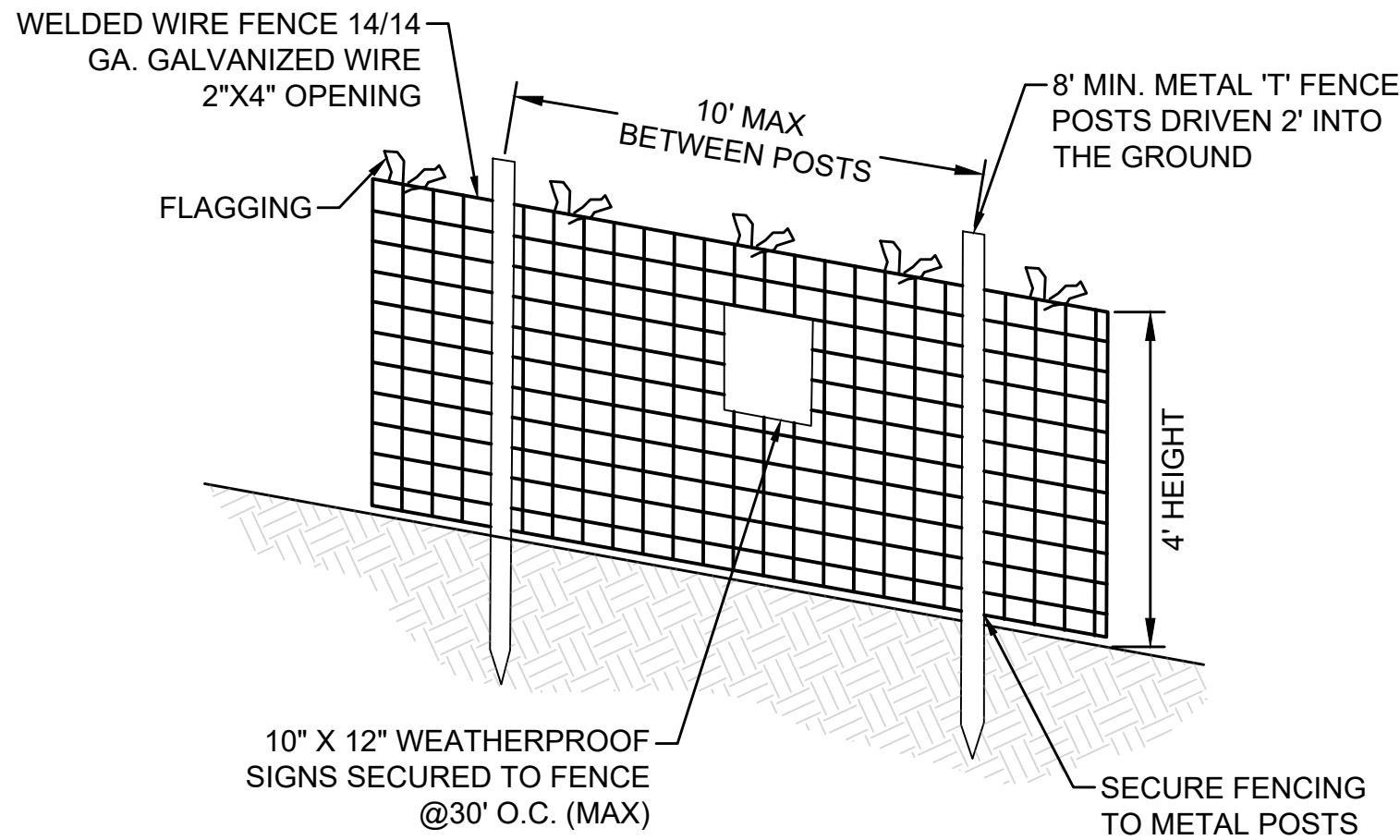


A1 SUPER SILT FENCE
NTS
CE101
CE101A
CE102

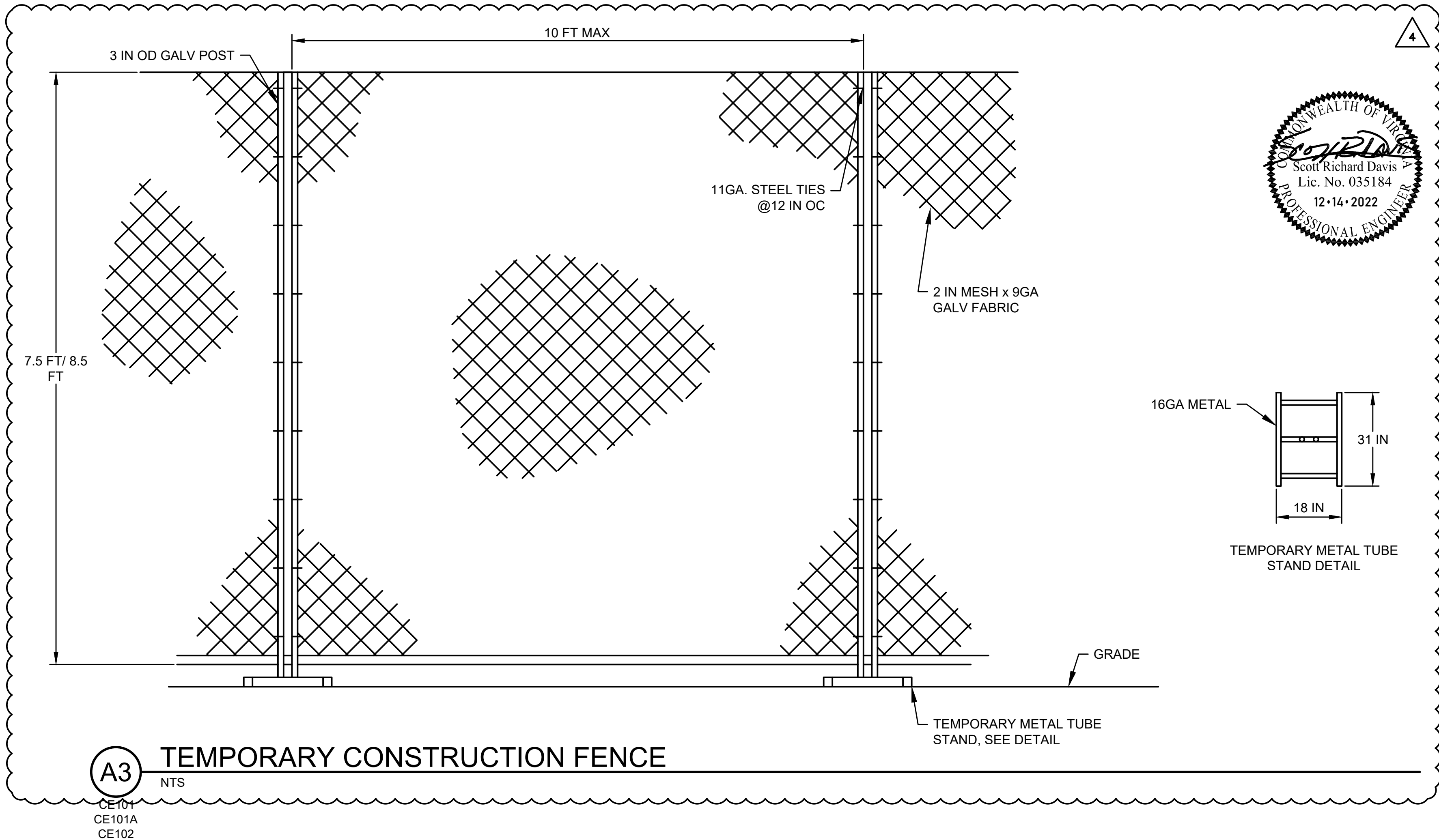


- NOTE:**
1. THE END OF THE SILT FENCE FABRIC MUST WRAPPED APPROX. 6 INCHES AROUND A WOODEN POST ONE FULL TURN, THEN SECURED ALONG THE POST WITH 6 HEAVY DUTY WIRE STAPLES AT LEAST 1 INCH LONG.
- NOTES:**
1. THE ENDS OF THE SILT FENCE FABRIC MUST BE JOINED TOGETHER BY WRAPPING APPROX. 6 INCHES OF EACH END AROUND A WOODEN POST ONE FULL TURN, THEN SECURED ALONG THE POST WITH 6 HEAVY DUTY WIRE STAPLES AT LEAST 1 INCH LONG.
 2. POSTS MUST BE TIGHTLY ABUTTED WITH NO GAPS TO PREVENT POTENTIAL FLOW-THROUGH OF SEDIMENT AT JOINT.

C3 SILT FENCE END/JOINING SECTION DETAILS
NTS
CE502



C4 TREE PROTECTION FENCE
NTS
CE101
CE101A
CE102



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DATE	FEB 2023
DESCRIPTION	
MARK	4

ISSUE DATE: 14 DECEMBER 2022	DESIGNED BY: S. DAVIS	FILE NUMBER: 12-14-2022
SOLICITATION NO.: W9128F23R006	DRAWN BY: J. CARDENAS	FILE NAME: ANSI 'D'
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US ARMY CORPS OF ENGINEERS
Omaha District
Omaha, NE

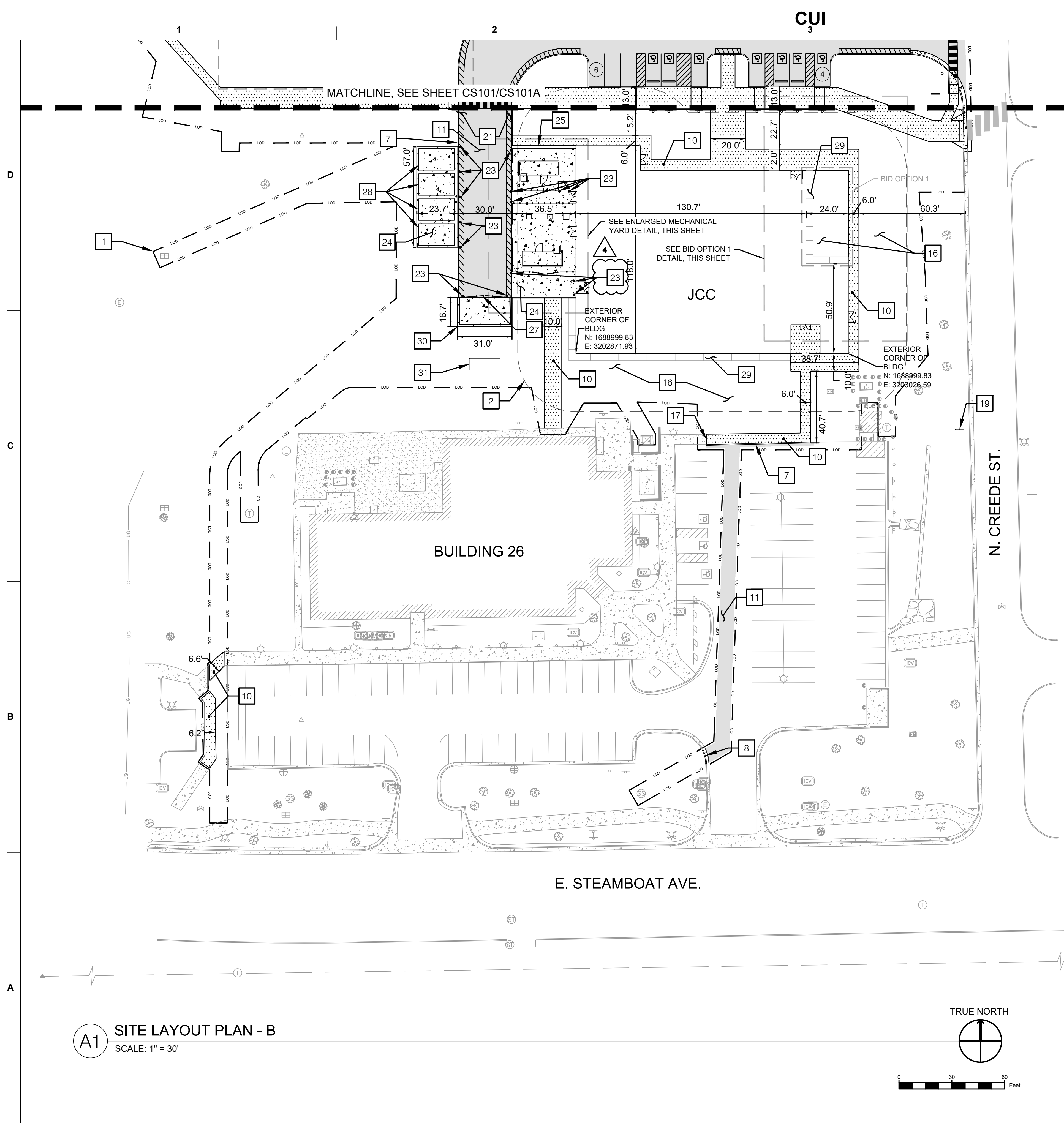
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1100 N. GLEBE ROAD, SUITE 500
ARLINGTON, VA 22201

DESIGN OF JOINT CRYPTOLOGIC CENTER (JCC) BUILDING
BUCKLEY SFB, CO

CIVIL - EROSION AND SEDIMENT
CONTROL DETAILS

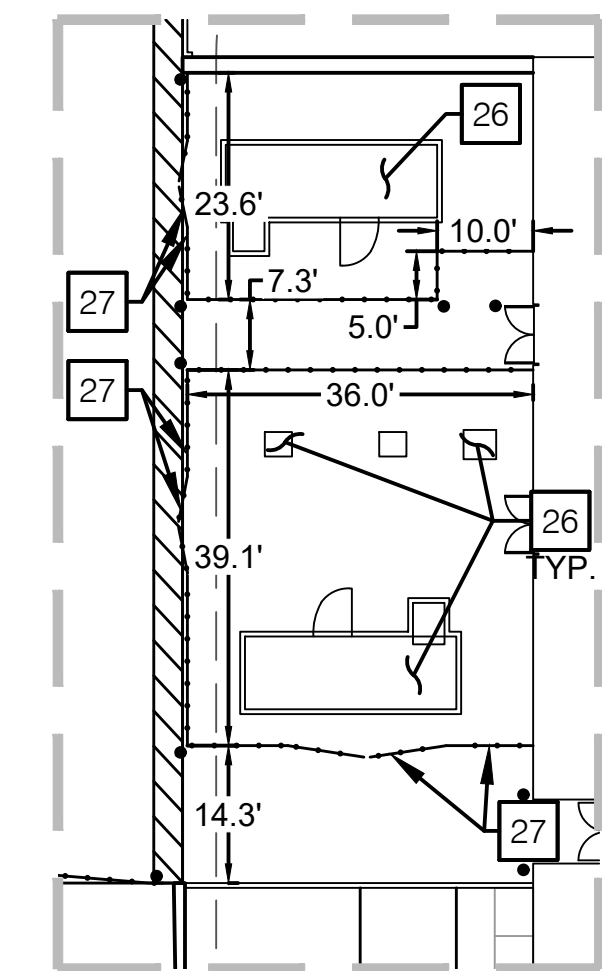
SHEET ID

CE502



A1 SITE LAYOUT PLAN - B
SCALE: 1" = 30'

C4 BID OPTION 1
SCALE: 1" = 30'



NOTE: COORDINATE LOCATION OF GATES WITH MECHANICAL EQUIPMENT MAINTENACNE ACCESS REQUIREMENTS.

B4 ENLARGED MECHANICAL YARD
SCALE: 1" = 20'

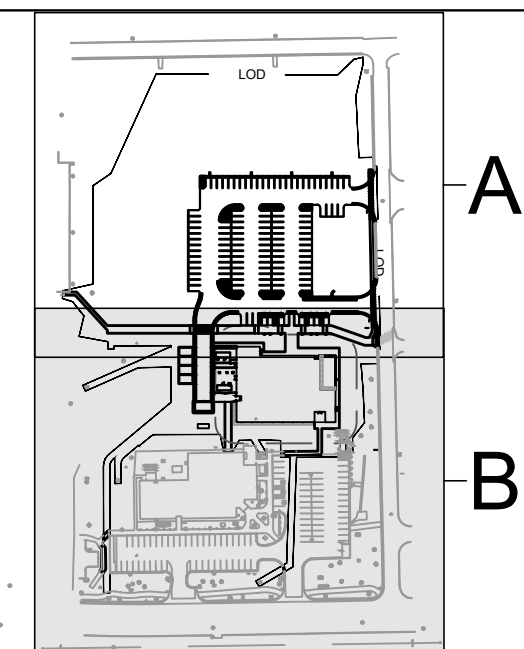
GENERAL SHEET NOTES

- A. AT/FP SETBACK IS 33 FEET FROM BUILDING FACE
- B. BUILDING DIMENSIONS SHOWN ARE APPROXIMATE. SEE ARCHITECTURAL SHEETS FOR ALL BUILDING DIMENSIONS.
- C. BID OPTION 1 INDICATED BY THE GREY DASHED LINE. SEE ARCHITECTURAL PLANS FOR DETAILS.
- D. COORDINATE WITH STRUCTURAL PLANS FOR ALL SIDEWALK AND PAVEMENT CONNECTIONS AT BUILDING ENTRANCES/SOOPS.

SHEET KEYED NOTES:

- 1. LIMITS OF DISTURBANCE
- 2. AT/FP UNOBSTRUCTED SPACE SETBACK (33 FT)
- 3. NOT USED
- 4. NOT USED
- 5. NOT USED
- 6. NOT USED
- 7. CONCRETE CURB, SEE B1/CS501
- 8. CONCRETE CURB AND GUTTER, SEE B2/CS501
- 9. NOT USED
- 10. CONCRETE SIDEWALK, SEE A1/CS501
- 11. ASPHALT PAVEMENT, SEE D1/CS501
- 12. NOT USED
- 13. NOT USED
- 14. NOT USED
- 15. NOT USED
- 16. LANDSCAPED AREA, SEE LANDSCAPE PLAN A1/LP102 FOR DETAILS
- 17. TIE INTO EXISTING CONCRETE SIDEWALK
- 18. NOT USED
- 19. FREESTANDING SIGN, SEE ARCHITECTURAL PLANS FOR DETAILS
- 20. NOT USED
- 21. FIRE LANE STRIPING WITH 12-INCH WHITE REFLECTIVE LETTERING STATING "NO PARKING FIRE LANE", SEE B2/CS505
- 22. NOT USED
- 23. CONCRETE FILLED STEEL BOLLARDS, SEE C4/CS502
- 24. CONCRETE PAVEMENT, SEE D2/CS501
- 25. SCREEN WALL, SEE STRUCTURAL PLANS FOR DETAILS
- 26. MECHANICAL EQUIPMENT, SEE MECHANICAL PLANS FOR DETAILS
- 27. CHAIN LINK FENCE WITH GATE, SEE C1/CS503, C1/CS504, AND C3/CS504
- 28. RELOCATED CONCRETE STORAGE CONTAINERS
- 29. 4 FOOT LANDSCAPE MOW STRIP, SEE A1/LP102
- 30. DUMPSTER ENCLOSURE, SEE STRUCTURAL PLANS FOR DETAILS
- 31. RELOCATED JUNGLE GYM

KEYPLAN:



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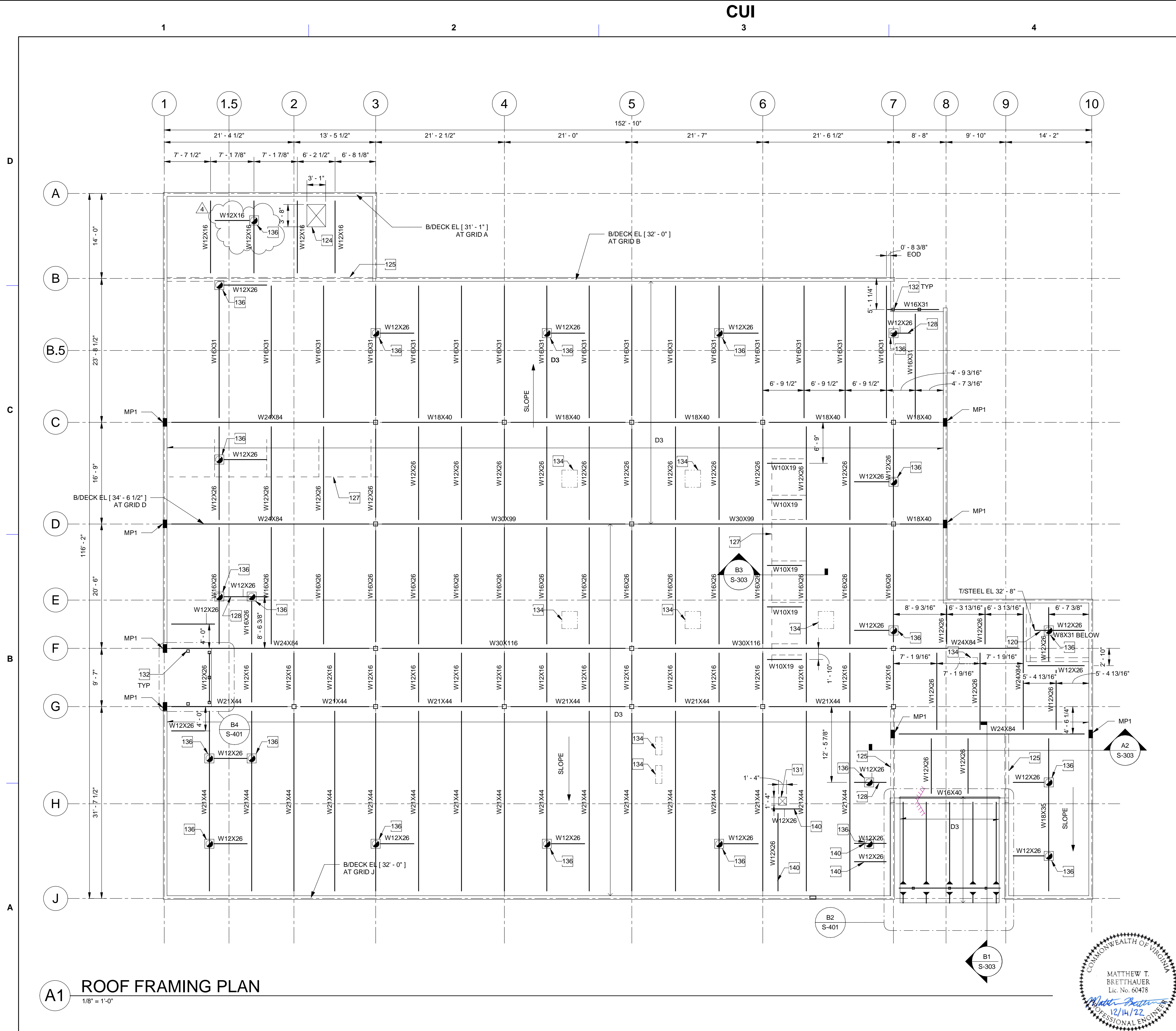
DATE	FEB 2023
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MARK	4

DESIGNED BY: S. DAVIS	ISSUE DATE: 14 DECEMBER 2022
DRAWN BY: J. CARDENAS	SOLICITATION NO.: W9128F23R0006
CHECKED BY: J. CARDENAS	CONTRACT NO.:
SUBMITTED BY: J. CARDENAS	FILE NUMBER:
SIZE: ANSI 'D'	FILE NAME:
US ARMY CORPS OF ENGINEERS Omaha District Omaha, NE	JACOBS 1100 N. GLEBE ROAD, SUITE 500 ARLINGTON, VA 22201

DESIGN OF JOINT CRYPTOLOGIC CENTER (JCC) BUILDING BUCKLEY SFB, CO	CIVIL - SITE LAYOUT PLAN - B
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SHEET ID

CS102



GENERAL SHEET NOTES

- ELEVATIONS SHOWN ARE BOTTOM OF DECK.
- BEAMS ARE EQUALLY SPACED BETWEEN GIRDERS AND GRIDS, UNLESS NOTED OTHERWISE.
- REFER TO ARCH AND PLUMB FOR ROOF DRAIN LOCATIONS AND ASSEMBLIES.

KEYNOTES

#	
120	ELEVATOR HOIST BEAM. COORDINATE LOCATION WITH ELEVATOR MANUFACTURER.
124	OPENING IN ROOF DECK FOR HATCH. COORDINATE SIZE AND LOCATION WITH ARCH. SEE DETAIL B3/S-506.
125	SEE DETAIL D1/S-505 FOR ROOF DECK ATTACHMENT.
127	OPERABLE PARTITION SUPPORT. SEE DETAIL D3/S-506.
128	ROOF FALL PROTECTION ANCHOR SUPPORT BEAM. COORDINATE LOCATION WITH ARCH.
131	OPENING IN ROOF DECK FOR MECH EQUIP. COORDINATE SIZE AND LOCATION WITH MECH. SEE DETAIL B3/S-506.
132	HSS5X5X5/16 PARAPET SUPPORT POST. COORDINATE HEIGHT WITH ARCH AND CFMS MANUFACTURER.
134	ROOFTOP CONDENSING UNIT. REFER TO DETAIL B3/S-506 FOR SUPPORT OF ROOFTOP CURB OR STANCHIONS. COORDINATE ANCHORAGE WITH EQUIPMENT MANUF.
136	ROOF FALL PROTECTION ANCHOR. COORDINATE LOCATION WITH ARCH.
140	FRAMING FOR TOILET PARTITION SUPPORT. COORDINATE LOCATION WITH ARCH AND EQUIPMENT MANUF. SEE DETAIL A4/S-506.

LEGEND


FOUNDATION WALL SCHEDULE.....	D1 / S-501
PIER CAP SCHEDULE.....	D3 / S-501
DRILLED PIER SCHEDULE.....	D4 / S-501
GRADE BEAM SCHEDULE.....	C1 / S-502
STEEL BASEPLATE SCHEDULE.....	A1 / S-506
STEEL DECKING SCHEDULE.....	A2 / S-510
ONE WAY SLAB SCHEDULE.....	C3 / S-503

GRAPHIC SCALE(S)

8 6 4 2 0 8 16

SCALE: 1/8" = 1'-0"

PLAN NORTH



US Army Corps of Engineers®

ISSUE DATE:	14 DECEMBER 2022
DESIGNED BY:	J. PAQUETTE
DRAWN BY:	D. PAQUETTE
CHECKED BY:	A. POZZOLO
SUBMITTED BY:	
FILE NAME:	
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SIZE	
MARK	4
REVISION	
DATE	FEB 2023

US ARMY CORPS OF ENGINEERS
Omaha District
Omaha, NE


JACOBS
1100 N. GLEBE ROAD, SUITE 500
ARLINGTON, VA 22201

DESIGN OF JOINT CRYPTOLOGIC CENTER (JCC) BUILDING
BUCKLEY SFB, CO

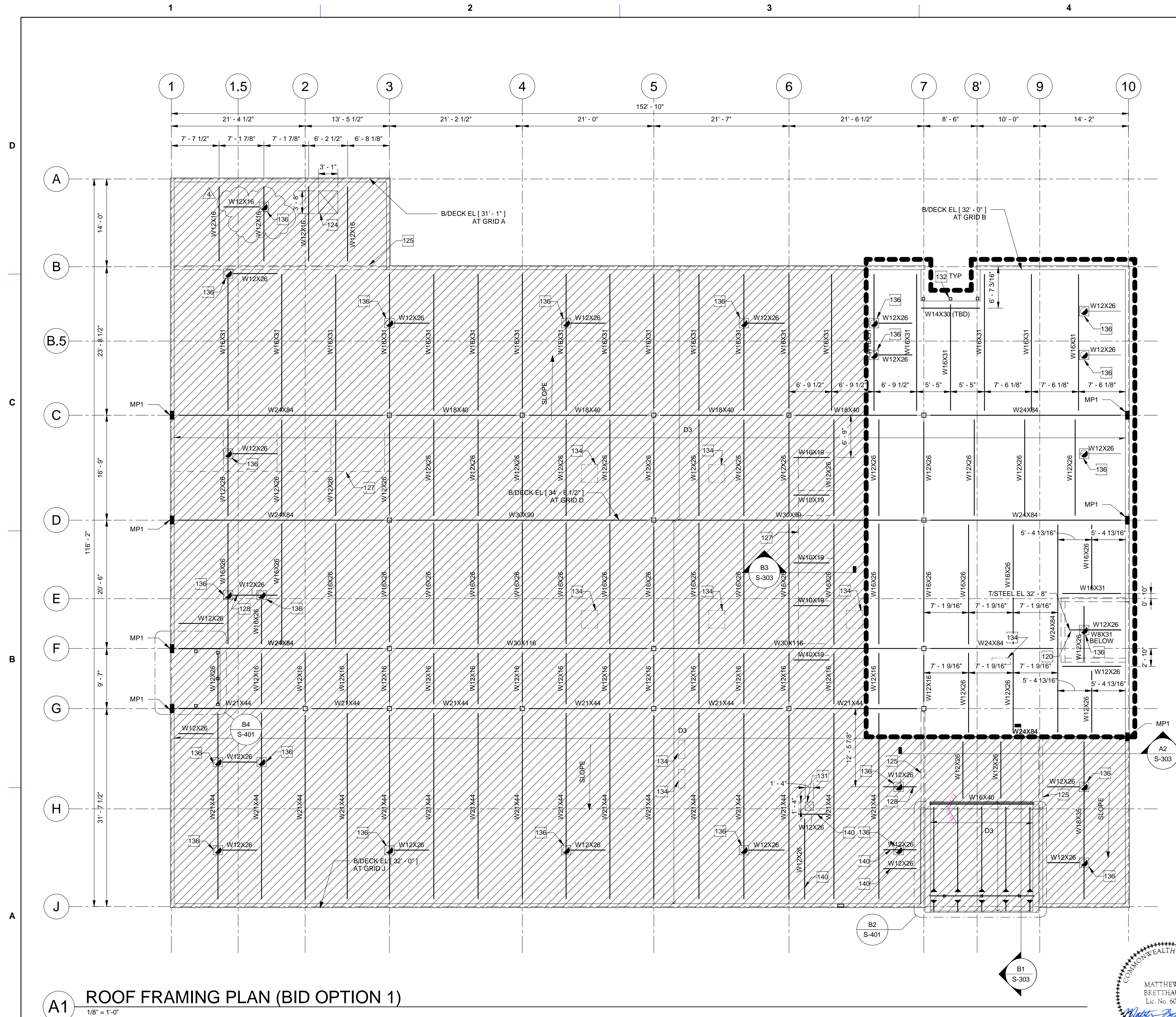
STRUCTURAL - ROOF FRAMING PLAN

SHEET ID

S-130



AMENDMENT 0004



GENERAL SHEET NOTES

1. ELEVATIONS SHOWN ARE BOTTOM OF STRUCTURAL SLAB/DECK.
2. BEAMS ARE EQUALLY SPACED BETWEEN GIRDERS AND GRIDS, UON.
3. REFER TO ARCH AND PLUMB FOR ROOF DRAIN LOCATIONS AND ASSEMBLIES.



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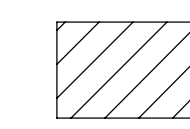
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KEYNOTES

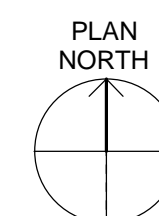
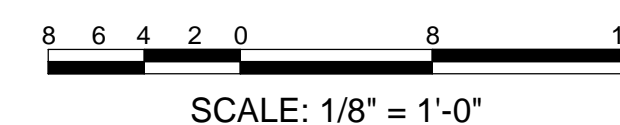
- 120 ELEVATOR HOIST BEAM. COORDINATE LOCATION WITH
ELEVATOR MANUFACTURER.
- 124 OPENING IN ROOF DECK FOR HATCH. COORDINATE SIZE AND
LOCATION WITH ARCH. SEE DETAIL B3/S-506.
- 125 SEE DETAIL D1/S-505 FOR ROOF DECK ATTACHMENT.
- 127 OPERABLE PARTITION SUPPORT. SEE DETAIL D3/S-506.
- 128 ROOF FALL PROTECTION ANCHOR SUPPORT BEAM.
COORDINATE LOCATION WITH ARCH.
- 131 OPENING IN ROOF DECK FOR MECH EQUIP. COORDINATE SIZE
AND LOCATION WITH MECH. SEE DETAIL B3/S-506.
- 132 HSS5X5X1/6 PARAPET SUPPORT POST. COORDINATE HEIGHT
WITH ARCH AND CFMS MANUFACTURER.
- 134 ROOFTOP CONDENSING UNIT. REFER TO DETAIL B3/S-506 FOR
SUPPORT OF FALL PROTECTION ANCHOR. COORDINATE
ANCHORAGE WITH EQUIPMENT MANUF.
- 135 ROOF FALL PROTECTION ANCHOR. COORDINATE LOCATION
WITH ARCH.
- 136 FRAMING FOR TOILET PARTITION SUPPORT. COORDINATE
LOCATION WITH ARCH AND EQUIPMENT MANUF. SEE DETAIL
A4/S-506.

LEGEND

FOUNDATION WALL SCHEDULE.....	D1 / S-501
PIER CAP SCHEDULE.....	D3 / S-501
DRILLED PIER SCHEDULE.....	D4 / S-501
GRADE BEAM SCHEDULE.....	C1 / S-502
STEEL BASEPLATE SCHEDULE.....	A1 / S-506
STEEL DECKING SCHEDULE.....	A2 / S-510
ONE WAY SLAB SCHEDULE.....	C3 / S-503



GRAPHIC SCALE(S)



SHEET ID

S-130A

AMENDMENT 0004

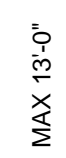


D1 — NTS



D3 — NTS

MARK	DEPTH (IN)	TOP REINF	BOT REINF	STIRRUPS	REMARKS
L1	24	--	(2) #5	#4 @ 16" OC	--
L2	48	--	(2) #6	#4 @ 16" OC	--
L3	16	--	(1) #5	--	--
L4	48	(2) #5	(2) #5	#4 @ 16" OC	--



(D4)

AT BEAM END		
BEAM SIZE	BEARING PLATE SIZE	HEADED STUD SPACING
W8 - W12	3/8 X 6" X 0'-10"	6 INCHES
W16 - W18	1/2 X 6" X 0'-10"	6 INCHES
W21 - W30	5/8 X 6" X 1'-0"	8 INCHES
AT CONTINUOUS BEAM		
BEAM SIZE	BEARING PLATE SIZE	HEADED STUD SPACING
W8 - W12	3/8 X 7" X 0'-10"	6 INCHES
W16 - W18	1/2 X 7" X 0'-10"	6 INCHES
W21 - W30	5/8 X 7" X 1'-0"	8 INCHES

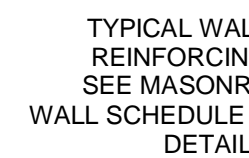
C1 — C_{NTS}



C2 — M
NTS



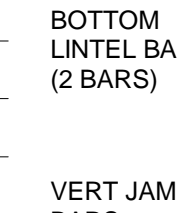
C4 — S
NTS



NOTES:

1. PROVIDE 135 DEGREE HOOK FOR BOND BEAM REINF AT ENDS OR CORNERS OF WALLS. HOOK HORIZ REINF AROUND VERT REINF.
2. PROVIDE CONTROL JOINT (CJ) SPACING AT NON-LOADBEARING CMU WALLS AT A DISTANCE EQUAL TO THE LESSER OF 25'-0" OR 1.5 TIMES THE WALL HEIGHT.
3. PROVIDE CONTROL JOINT SPACING AT LOAD-BEARING CMU WALLS AS INDICATED ON THE WALL ELEVATIONS, SEE S-200 SERIES DRAWINGS.
4. STOP HORIZ JOINT REINF ON EITHER SIDE OF CJ.
5. REINFORCE NON-LOAD BEARING CMU WALLS WITH #5@48" O.C.

(A1) $\frac{1}{1''} =$



NOTES:

1. TYPICAL WALL REINFORCING NOT SHOWN FOR CLARITY.
2. TYPICAL LINTEL/BOND BEAM BARS EQUAL 2-#5
3. VERTICAL JAMB REINF MUST MATCH TYP WALL REINF.
4. TYPICAL BOND BEAMS NOT SHOWN FOR CLARITY.
5. ONLY SOLID BOTTOM LINTEL BLOCK UNITS WILL BE ALLOWED OVER DOORS/WINDOWS.
6. OPENINGS WITH LESS THAN 24" BETWEEN THEM MUST BE CONSIDERED AS SINGLE OPENING WHEN SELECTING LINTEL SIZE.

MINIMUM REINFORCEMENT AROUND CMU OPENINGS

[illegible]

ISSUE DATE:	14 DECEMBER 2022
DESIGNED BY:	J. PAQUETTE
DRAWN BY:	J. PAQUETTE
CHECKED BY:	A. POZOLO
SUBMITTED BY:	
FILE NAME:	
SIZE:	
ANSI 'D'	
SOLICITATION NO.:	W9128F23R0006
CONTRACT NO.:	
FILE NUMBER:	

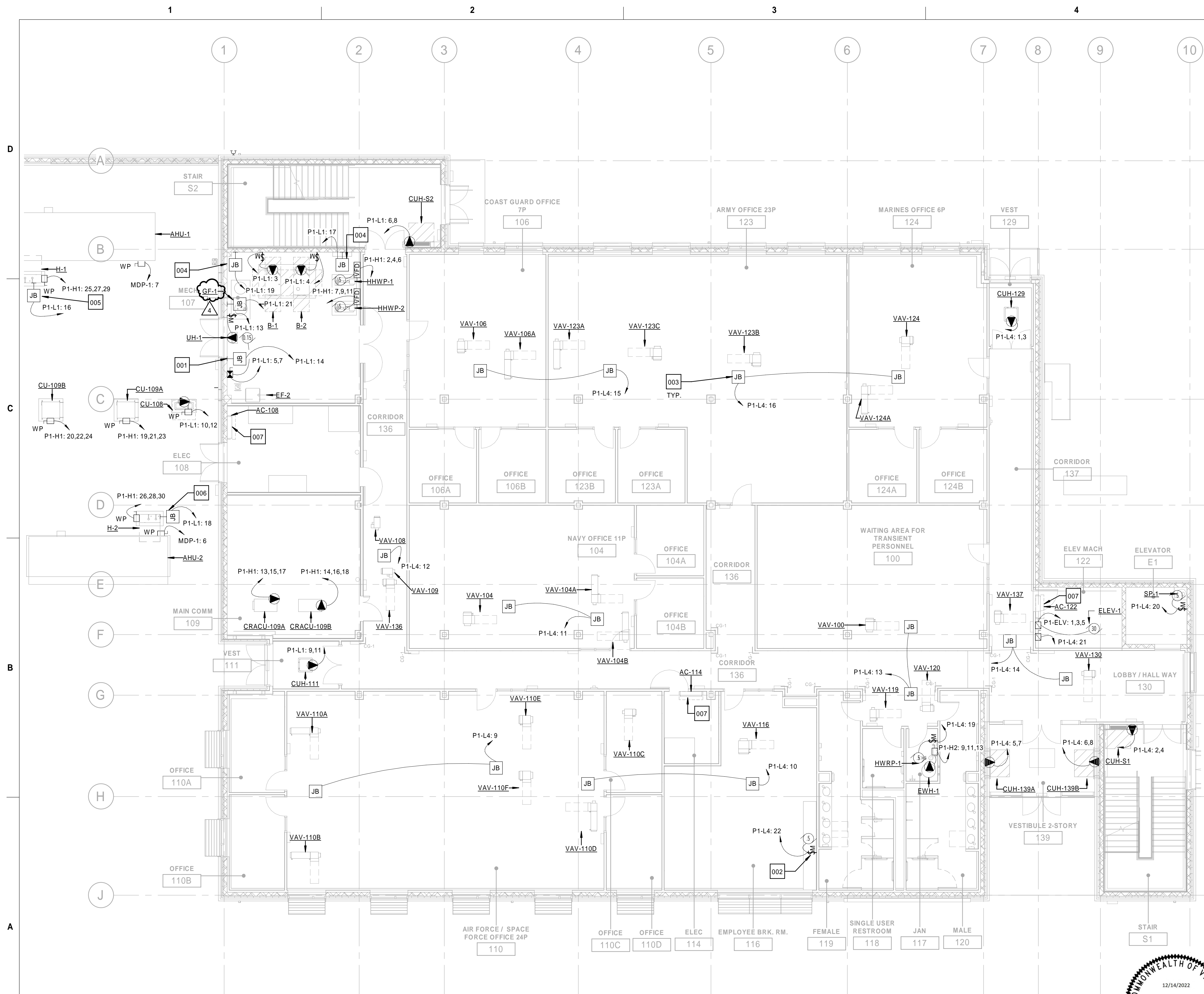
US ARMY CORPS OF ENGINEERS
Omaha District
Omaha, NE

JACOBS
1100 N. GLEBE ROAD, SUITE 500
ARLINGTON, VA 22201

STRUCTURAL - TYPICAL DETAILS - MASONRY

SHEET ID

S-505



A1 FIRST FLOOR - MECHANICAL EQUIPMENT - OVERALL

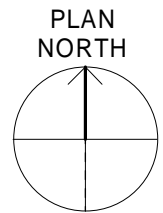
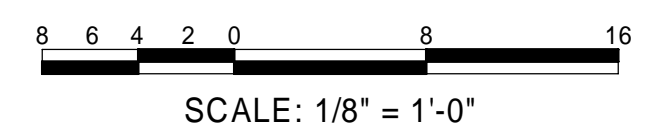
GENERAL SHEET NOTES

1. REFER TO EM701 FOR MECHANICAL CONNECTION SCHEDULE, FOR POWER REQUIRMENTS OF MECHANICAL EQUIPMENT.
2. REFER TO E-001 AND E-002 FOR GENERAL NOTES, ABBREVIATIONS, AND LEGENDS.
3. REFER TO E-700 SERIES DRAWINGS FOR PANEL SCHEDULES.

KEYNOTES

- | # | DESCRIPTION |
|------|--|
| 001. | JUNCTION BOX FOR TRAP PRIMER PANEL. |
| 002. | POWER CONNECTION FOR GARBAGE DISPOSAL. |
| 003. | POWER FOR VAV CONTROLLERS. MAXIMUM OF FOUR VAV BOXES TO BE FED FROM A SINGLE 120V CIRCUIT. |
| 004. | JUNCTION BOX FOR BAS CONTROL PANEL. |
| 005. | JUNCTION BOX FOR H-1 HEATER. |
| 006. | JUNCTION BOX FOR H-2 HEATER. |
| 007. | POWER TO INTERIOR AC UNIT ARE PROVIDED FROM CORRESPONDING EXTERIOR UNIT. |

GRAPHIC SCALE(S)



US Army Corps
of Engineers ®

DATE	DESCRIPTION	MARK
FEB 23	REVISED IAW AMENDMENT 0004	4

DESIGNED BY: Y. SOLOMON	ISSUE DATE: 14 DECEMBER 2022
DRAWN BY: Y. SOLOMON	SOLICITATION NO.: W912823R0006
CHECKED BY: Y. SOLOMON	CONTRACT NO.:
SUBMITTED BY: RK	FILE NUMBER:
SIZE: ANSI D	FILE NAME:

US ARMY CORPS OF ENGINEERS
Omaha District
Omaha, NE

DESIGN OF JOINT CRYPTOLOGIC CENTER (JCC) BUILDING
BUCKLEY SFB, CO

ELECTRICAL - FIRST FLOOR - MECH
EQUIPMENT

SHEET ID

EM110



NOT TO SCALE

12/14/2022

JOSEPH Z. SOLOMON

Lic. No. 0402047869

PROFESSIONAL ENGINEER

1. REFER TO E-001 AND E-002 FOR GENERAL NOTES, ABBREVIATIONS, AND LEGENDS.

[illegible]

US ARMY CORPS OF ENGINEERS 1100 N. GLEES ROAD, SUITE 500 ARLINGTON, VA 22201	DESIGNED BY: Y. SOLOMON	ISSUE DATE: 14 DECEMBER 2022
	DRAWN BY: M312B/2300068	SOLICITATION NO.: M312B/2300068
	CHECKED BY: Y. SOLOMON	CONTRACT NO.:
	SUBMITTED BY:	FILE NUMBER:
	RFE:	
	ANSI 'D'	FILE NAME:

DESIGN OF JOINT CRYPTOLOGIC CENTER (JCC) BUILDING BUCKLEY SFB, CO

SHEET ID

E-601

[illegible]

B

PANELBOARD: P1-L3					LOCATION: ELEC 114 SUPPLY FROM: P1-D1 MOUNTING: Surface ENCLOSURE: Type 1										VOLTAGE: 208/120V,3P,4W,60Hz BUS AMPS: 250 A MCB SIZE: 225 A														
NOTES	DESCRIPTIONS	TRIP AMPS	POLES	CKT NO.	A	B	C	A	B	C	CKT NO.	POLES	TRIP AMPS	DESCRIPTIONS	NOTES														
	EQN ARMY OFFICE 23P 123 FURNITURE SYSTEMS	20 A	2	1	0.875			0.525			2		20 A	EQN ARMY OFFICE 23P 123 FURNITURE SYSTEMS															
				3		0.875				0.525		4																	
	EQN ARMY OFFICE 23P 123 FURNITURE SYSTEMS	20 A	2	5			1.05			1.05	6		20 A	EQN ARMY OFFICE 23P 123 FURNITURE SYSTEMS															
				7	1.05						8																		
	REC MARINES OFFICE 11P 104	20 A	1	9		0.9				0.5	10	1	20 A	REC MARINES OFFICE 11P 104 COPIER															
	EQN NAVY OFFICE 6P 124	20 A	2	11			1.05			0.7	12		20 A	EQN COAST GUARD OFFICE 106 FURNITURE SYSTEMS															
				13	1.05				0.7		14																		
	REC OFFICE 106A	20 A	1	15		1.62			1.62		16	1	20 A	REC OFFICE 104B															
	REC ARMY OFFICE 23P 123	20 A	1	17			1.26			0.5	18	1	20 A	REC ARMY OFFICE 23P 123 COPIER															
	REC NAVY OFFICE 6P 124 COPIER	20 A	1	19	0.5			1.08			20	1	20 A	REC NAVY OFFICE 6P 124															
	REC OFFICE 124A	20 A	1	21		1.08			0.72		22	1	20 A	REC OFFICE 124A															
	REC WAITING AREA FOR TRANSIENT PERSONNE...	20 A	1	23			1.08			1.08	24	1	20 A	REC WAITING AREA FOR TRANSIENT PERSONNE...															
	EQN WAITING AREA FOR TRANSIENT PERSONNE...	20 A	1	25	1.08			1.08			26	1	20 A	REC WAITING AREA FOR TRANSIENT PERSONNE...															
	EQN WAITING AREA FOR TRANSIENT PERSONNE...	20 A	1	27		1.44			1.08		28	1	20 A	EQN WAITING AREA FOR TRANSIENT PERSONNE...															
	REC WAITING AREA FOR TRANSIENT PERSONNE...	20 A	1	29			0.36			0.9	30	1	20 A	REC WAITING AREA FOR TRANSIENT PERSONNE...															
	REC COVE 4P 126	20 A	1	31	1.08			1.44			32	1	20 A	REC COVE 4P 126															
	EQN CLASSROOM 125	20 A	1	33		1.08			1.08		34	1	20 A	EQN CLASSROOM 20P 125															
	EQN CLASSROOM 125	20 A	1	35			1.08			1.08	36	1	20 A	EQN CLASSROOM 20P 125															
	EQN ARMY OFFICE 23P 123 FURNITURE SYSTEMS	20 A	2	37	0.525			0.525			38		20 A	EQN COAST GUARD OFFICE 7P 106 FURNITURE SYSTEMS															
				39		0.525			0.525		40																		
	REC CLASSROOM 20P 125	20 A	1	41			1.62			0	42	1	20 A	SPARE															
	REC CLASSROOM 20P 125	20 A	1	43	0.36			0			44	1	20 A	SPARE															
	SPARE	20 A	1	45		0			0		46	1	20 A	SPARE															
	SPARE	20 A	1	47			0			0	48	1	20 A	SPARE															
	SPACE	--	1	49	--			--			50	1	--	SPACE															
	SPACE	--	1	51		--			--		52	1	--	SPACE															
	SPACE	--	1	53					--		54	1	--	SPACE															
TOTAL CONNECTED LOAD / PHASE:					12.92 kVA		13.57 kVA		12.81 kVA		TOTAL LOAD SUMMARY																		
										LOAD (kVA)					CURRENT (AMPS)														
										CONNECTED LOAD:					39,300 KVA					CONNECTED CURRENT:					109.1 A				
										ESTIMATED DEMAND LOAD:					35,090 KVA					ESTIMATED DEMAND CURRENT:					97.4 A				
										ESTIMATED DEMAND FACTOR:					89.29%														
										SPARE CAPACITY:					15%														
										ESTIMATED LOAD WITH SPARE:					40,354 kVA					ESTIMATED CURRENT WITH SPARE:					112 A				
PANELBOARD NOTES:																													

A

4

5

PANELBOARD: P1-L2

LOCATION: ELEC 114

SUPPLY FROM: P1-D1

MOUNTING: Surface

ENCLOSURE: Type 1

VOLTAGE: 208/120V,3P,4W,60Hz

BUS AMPS: 100 A

MCB SIZE: 100 A

NOTES	DESCRIPTIONS	TRIP AMPS	POLES	CKT NO.	A	B	C	A	B	C	CKT NO.	POLES	TRIP AMPS	DESCRIPTIONS	NOTES
	REC CORRIDOR 136	20 A	1	1	1.62			1.26			2	1	20 A	REC MECH 107	
	REC CORRIDOR 136	20 A	1	3		1.8			1.26		4	1	20 A	REC LOBBY / HALL WAY 130	
	REC FEMALE 119	20 A	1	5			1.44			1.44	6	1	20 A	REC EMPLOYEE BRK. RM. 116	
	REC AIR FORCE/SPACE FORCE OFFICE 110...	20 A	1	7	0.5			1.08			8	1	20 A	REC OFFICE 110A	
	REC OFFICE 110C	20 A	1	9		0.9			1.08		10	1	20 A	REC AIR FORCE / SPACE FORCE OFFICE 24P 110	
	REC EMPLOYEE BRK. RM. 116 REF.	20 A	1	11			0.725			1.44	12	1	20 A	REC OFFICE 110A	
	REC EMPLOYEE BRK. RM. 116 MICROWAVE	20 A	1	13	1.2			0.36			14	1	20 A	REC EMPLOYEE BRK. RM. 116	
	REC AIR FORCE/SPACE FORCE OFFICE 110...	20 A	1	15		0.5			1.2		16	1	20 A	REC EMPLOYEE BRK. RM. 116 MICROWAVE	
	REC OFFICE 104B	20 A	1	17			1.08			0.933	18				
	EQN AIR FORCE / SPACE FORCE OFFICE 24P 110 FURNITURE SYSTEMS	20 A	3	19	0.933			0.933			20	3	20 A	EQN AIR FORCE / SPACE FORCE OFFICE 24P 110 FURNITURE SYSTEMS	
21					0.933			0.933		22					
23						0.933			0.933		24				
	EQN MARINES OFFICE 104 FURNITURE SYSTEMS	20 A	2	25	1.05			0.933			26	3	20 A	EQN AIR FORCE / SPACE FORCE OFFICE 24P 110 FURNITURE SYSTEMS	
27					1.05			0.933		28					
	REC ELEV MACH 122	20 A	1	29			0.36			1.08	30	1	20 A	REC OFFICE 106A	
	REC COAST GUARD OFFICE 7P 106	20 A	1	31	0.72			0.18			32	1	20 A	REC ELEVATOR E1	
	SPARE	20 A	1	33		0			0.5		34	1	20 A	REC COAST GUARD OFFICE 7P 106 COPIER	
	SPARE	20 A	1	35			0			0	36	1	20 A	SPARE	
	EQN MARINES OFFICE 11P 104 FURNITURE SYSTEMS	20 A	2	37	0.35			0.525			38	2	20 A	EQN MARINES OFFICE 11P 104 FURNITURE SYSTEMS	
				39		0.35			0.525		40				
	REC EMPLOYEE BRK. RM. 116	20 A	1	41			0.725			0	42	1	20 A	SPARE	
	SPARE	20 A	1	43	0			0			44	1	20 A	SPARE	
	SPARE	20 A	1	45		0			0		46	1	20 A	SPARE	
	SPARE	20 A	1	47			0			0	48	1	20 A	SPARE	
	SPACE	--	1	49	--			0			50	1	20 A	SPARE	
	SPACE	--	1	51		--			0		52	1	20 A	SPARE	
	SPACE	--	1	53			--			0	54	1	20 A	SPARE	
TOTAL CONNECTED LOAD / PHASE:					11.645 kVA			11.965 kVA			11.09 kVA				

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

[illegible]

LUMINAIRE SCHEDULE

TAG	DESCRIPTION	BASIS OF DESIGN			LAMP TYPE	WATTS	LUMENS	LAMP COLOR TEMPERATURE	LUMINAIRE MOUNTING METHOD	NOTES
		MANUFACTURER	MODEL	ADDITIONAL APPROVED MANUFACTURERS						
A	RECESSED 2X4 FIXTURE WITH PREFRATED CENTER BACKET	FOCAL POINT	FLUL24	COLUMBIA LCAT	LED	61 W	5500 lm	3500 K	RECESSED	
B	RECESSED 1X1 FIXTURE WITH CENTER BASKET	FOCAL POINT	FEQ211	AXIS LIGHTING DIA	LED	21 W	1500 lm	3500 K	RECESSED	
C	6" DOWNLIGHT WITH TWO STAGE REFLECTOR SYSTEM	PORTFOLIO	LD6	GOTHAM EVO	LED	10 W	1000 lm	3500 K	RECESSED	
D	LINEAR RECESSED LED	LITE CONTROL	MOD6LRD	FOCAL POINT SEEM 6	LED	11 W	1100 lm	3500 K	RECESSED	
F	4' X 3" INDUSTRIAL PENDANT	METALUX	4SNLED	LITHONIA ZL1N	LED	25 W	3185 lm	3500 K	PENDANT 8'-0" AFF	
G	SURFACE MOUNTED 1'x4' EMERGENCY EGRESS FIXTURE	LITHONIA	FEML48	COLUMBIA LXEM	LED	22 W	3000 lm	3500 K	SURFACE 6'-0" AFF	
H	ORNAMENTAL PENDANT(3-14", 3-18", 4-24", 4-30" & 4-36" LENGTHS TOTAL 18)	OCL	GLOWSTICK CLUSTER GS1	GPI LIGHTING	LED	11 W	825 lm	3500 K	PENDANT	PENDANT LENGHTS:(3-14", 3-18", 4-24", 4-30" & 4-36")
K	4' X 6" LINEAR DIRECT / INDIRECT PENDANT	FOCAL POINT	FNRS	LITE CONTROL SAE101	LED	32 W	3500 lm	3500 K	PENDANT 8'-0" AFF	
L	WALL BRACKET & SURFACE MOUNTED VERTICAL OR HORIZONTAL LED	LITHONIA	WL4	COLUMBIA ESL	LED	39 W	4000 lm	3500 K	WALL 8'-0" AFF	INTEGRAL OCCUPANCY SENSOR
N	8" DIA. EXTERIOR WALL SCONCE UP AND DOWN	LUMINIS	SY802 L2L20R40BKT	COOPER LTG EONW2	LED	31 W	4315 lm	4000 K	WALL 10'-0" AFF	
P	EXTERIOR WALL PACK	STONCO	LYTEPRO LPW3250NWG34EBPUNVBK	HUBBELL RWL2	LED	45 W	5064 lm	4000 K	WALL 14'-0" AFF	
R	EXTERIOR PARKING LOT POLE LIGHT 1 HEAD	HUBBELL OUTDOOR	RAR1 80L403K75QWUNVASQBLT	AEL ATB MICRO	LED	37 W	4976 lm	3500 K	POLE	
X	EXIT LIGHT WITH DIE-CAST ALUMINUM HOUSING	LITHONIA	SIGNATURE LE	SURE LITE TPX	LED	2 W	270 lm	0 K	SURFACE	(NOTE 1) POLE 30'-ASQ-MAF-BLT SURFACE MOUNTED AT CEILING

NOTES

1. PARKING LOT LIGHT POLES MUST BE PROVIDED WITH CONCRETE FOUNDATIONS. REFER TO DETAIL A3 ON E-501.



**US Army Corps
of Engineers ®**

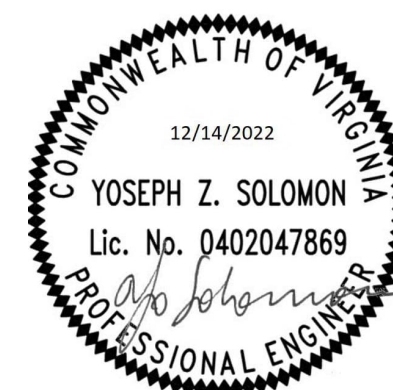
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3		REVISED I.A.W. AMENDMENT 0003		JAN 23	
2		REVISED I.A.W. AMENDMENT 0002		JAN 23	
MARK		DESCRIPTION		DATE	

US ARMY CORPS OF ENGINEERS	ISSUE DATE: 14 DECEMBER 2022
DESIGNED BY: Y. SOLOMON	SOLICITATION NO.: 15-00000000000000000000
CHECKED BY: D. PAXTON	CONTRACT NO.: W56H6-02-0-00000000000000000000
1100 N. CLEGG SUITE 500 ARLINGTON, VA 22201	FILE NUMBER: 15-00000000000000000000
	FILE NAME: ANSI 'D'

ELECTRICAL - LIGHTING FIXTURE SCHEDULE

SHEET ID

EL701



US Army Corps of Engineers®

DESIGNED BY:
R. FAUVELLE

DRAWN BY:
B. ARTERBURN

CHECKED BY:
H. FERRIS

SUBMITTED BY:
J. JACOBS

ISSUE DATE:
14 DECEMBER 2022

SOLICITATION NO.:
W9128F23R0006

CONTRACT NO.:

FILE NUMBER:
FILE NUMBER

DESIGN OF JOINT CRPTOLOGIC CENTER (JC3) BUILDING
BUCKET SITE, CO

SECURITY - SYMBOLS AND SCHEDULES

SHEET ID

TY001

SECURITY DEVICE SCHEDULE

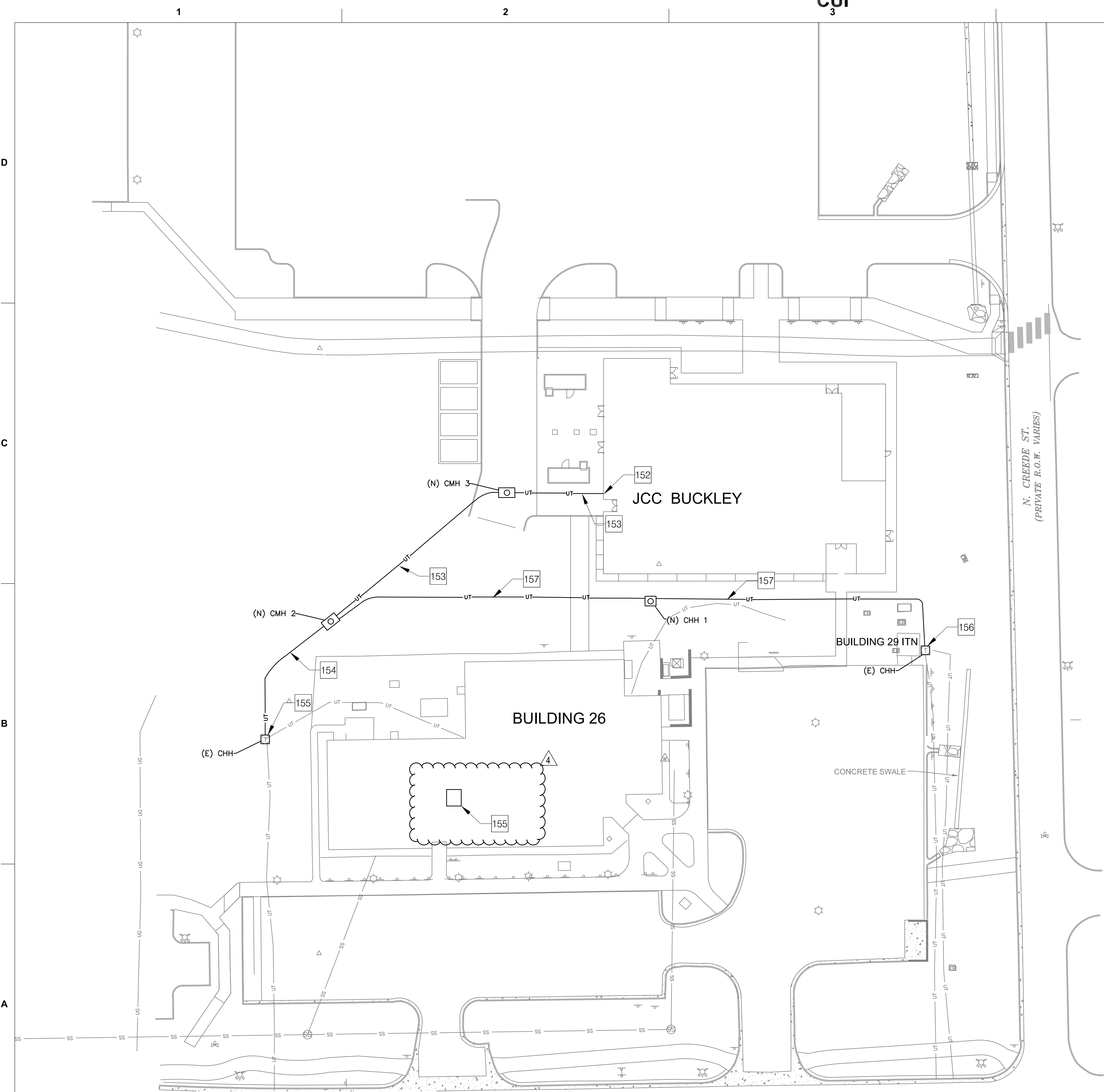
DEVICE NUMBER	DOOR NUMBER	DIB NUMBER	BID OPTION
CAM-1			
CAM-2			
CAM-3			
CAM-4			
CAM-5			
CAM-6			BID OPTION
CAM-7			BID OPTION
CAM-8			
CAM-9			
CAM-10			
R1	104	D11	
R2	106	D2	
R3	107	D3	
R4	108	D4	
R5	109	D14	
R6	110	D12	
R7	114	D10	
R8	123	D9	
R9	124	D6	
R10	129B	D5	
R11	138A	D15	BID OPTION
R12	139B	D8	
R13	203	D26	
R14	204	D25	
R15	211	D24	
R16	212	D21	
R17	216	D28	BID OPTION
R18	220	D20	
R19	225	D27	
R20	264A	D23	
R21	264B	D22	
R22	S2B	D1	
R23	252	D29	
S1	104	D11	
S2	106	D2	
S3	107	D3	
S4	107	D3	
S5	107A	D16	
S6	107A	D16	
S7	108	D4	
S8	108A	D17	
S9	108A	D17	
S10	109	D14	
S11	110	D12	
S12	111B	D18	
S13	111B	D18	
S14	114	D10	
S15	123	D9	
S16	124	D6	
S17	129B	D5	
S18	129B	D5	
S19	138A	D15	BID OPTION
S20	138B	D19	
S21	139B	D8	
S22	139B	D8	
S23	203	D26	
S24	204	D25	
S25	211	D24	
S26	212	D21	
S27	216	D28	BID OPTION
S28	220	D20	
S29	225	D27	
S30	264A	D23	
S31	264B	D22	
S32	S1B	D13	
S33	S1B	D13	
S34	S2B	D1	
S35	S2B	D1	
S36	109	D14	
S37	212	D21	
S38	211	D24	
S39	252	D29	

SECURITY PANEL SCHEDULE - ACS

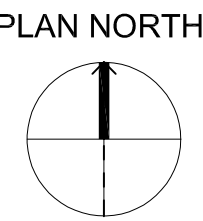
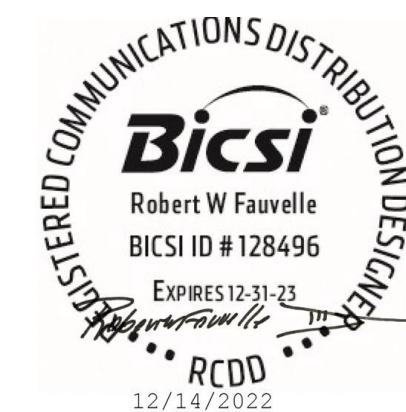
DIB NUMBER	DOOR NUMBER	PANEL	BID OPTION
D1	S2B	ACS-P1	
D2	106	ACS-P1	
D3	107	ACS-P1	
D4	108	ACS-P1	
D5	129B	ACS-P2	
D6	124	ACS-P2	
D8	139B	ACS-P2	
D9	123	ACS-P3	
D10	114	ACS-P3	
D11	104	ACS-P3	
D12	110	ACS-P3	
D14	109	ACS-P4	
D15	138A	ACS-P4	BID OPTION
D20	220	ACS-P5	
D21	212	ACS-P5	
D22	264B	ACS-P5	
D23	264A	ACS-P5	
D24	211	ACS-P7	
D25	204	ACS-P7	
D26	203	ACS-P7	
D27	225	ACS-P7	BID OPTION
D28	216	ACS-P6	BID OPTION
D29	252	ACS-P5	

SECURITY PANEL SCHEDULE - IDS

DIB NUMBER	DOOR NUMBER	PANEL	BID OPTION
D1	S2B	IDS-P1	
D2	106	IDS-P1	
D3	107	IDS-P1	
D4	108	IDS-P1	
D5	129B	IDS-P2	
D6	124	IDS-P2	
D8	139B	IDS-P2	
D9	123	IDS-P3	
D10	114	IDS-P3	
D11	104	IDS-P3	
D12	110	IDS-P3	
D13	S1B	IDS-P4	
D14	109	IDS-P4	
D15	138A	IDS-P4	BID OPTION
D16	107A	IDS-P5	
D17	108A	IDS-P5	
D18	111B	IDS-P5	
D19	138B	IDS-P5	BID OPTION
D20	220	IDS-P6	
D21	212	IDS-P6	
D22	264B	IDS-P6	
D23	264A	IDS-P6	
D24	211	IDS-P7	
D25	204	IDS-P7	
D26	203	IDS-P7	
D27	225	IDS-P7	BID OPTION
D28	216	IDS-P6	BID OPTION



A1 SITE COMMUNICATIONS PLAN
SCALE: 1" = 30'



GENERAL SHEET NOTES

- SEE SHEET T-001 FOR GENERAL NOTES, LEGEND, AND ABBREVIATIONS.
- FOR OSP (OUTSIDE PLANT) PROVIDE PATHWAYS AND CABLE TO INCLUDE COPPER, OPTICAL CABLE, SPLICE ENCLOSURES, HAND HOLES, MAINTENANCE HOLES, AND RACK HARDWARE. FOR ISP (INSIDE PLANT) PROVIDE PATHWAYS ONLY.

2

KEYNOTES

- 152 PROVIDE (6) 4-INCH ID CONDUITS AT THIS LOCATION. PROVIDE SWEEPING 90-DEGREE BEND OUTSIDE OF FOUNDATION FOOTING, AND PROVIDE TERMINATION WITH BUSHINGS 4-INCHES AFF. PROVIDE PULL STRINGS WITH FOOTAGE MARKS FOR ALL CONDUIT. CONDUIT WILL STUB UP IN THE MAIN COMMUNICATIONS ROOM 109.
- 153 PROVIDE (6) 4-INCH CONDUITS WITH 3-CELL FABRIC INNERDUCT AND PULL TAPE WITH FOOTAGE MARKS.
- 154 PROVIDE (4) 4-INCH CONDUITS WITH 3-CELL FABRIC INNERDUCT AND PULL TAPE WITH FOOTAGE MARKS.
- 155 PROVIDE CONTINUOUS RUN OF 144-STRAND OS2 SINGLEMODE OPTICAL CABLE FROM COMM ROOM 109 IN JCC BUCKLEY TO THE BUILDING 26 COMMUNICATIONS ROOM (LOCATION AS INDICATED). TERMINATE BOTH SIDES WITH DUPLEX LC.
- 4 156 PROVIDE CONTINUOUS RUN OF 100-PAIR PE89 COPPER CABLE FROM COMM ROOM 109 IN JCC BUCKLEY TO THE BUILDING 29 ITN. TERMINATE COPPER INSIDE BUILDING 29 ITN.
- 157 PROVIDE (2) 4-INCH ID CONDUITS WITH 3-CELL FABRIC INNERDUCT AND PULL TAPE WITH FOOTAGE MARKS.

GRAPHIC SCALE(S)



US Army Corps
of Engineers®

DATE	DESCRIPTION	MARK
FEB 2023	REVISED I.A.W. AMENDMENT 0004	4
JAN 2023	REVISED I.A.W. AMENDMENT 0002	2

ISSUE DATE: 14 DECEMBER 2022	DESIGNED BY: R. FAUVELLE	US ARMY CORPS OF ENGINEERS Omaha District Omaha, NE
SOLICITATION NO.: W9128F23R006	DRAWN BY: B. ARTERBURN	
CONTRACT NO.:	CHECKED BY: J. HIMES	
FILE NUMBER:	SUBMITTED BY:	
FILE NAME:	SIZE:	
ANSI D'		JACOBS 1100 N. GLEBE ROAD, SUITE 500 ARLINGTON, VA 22201

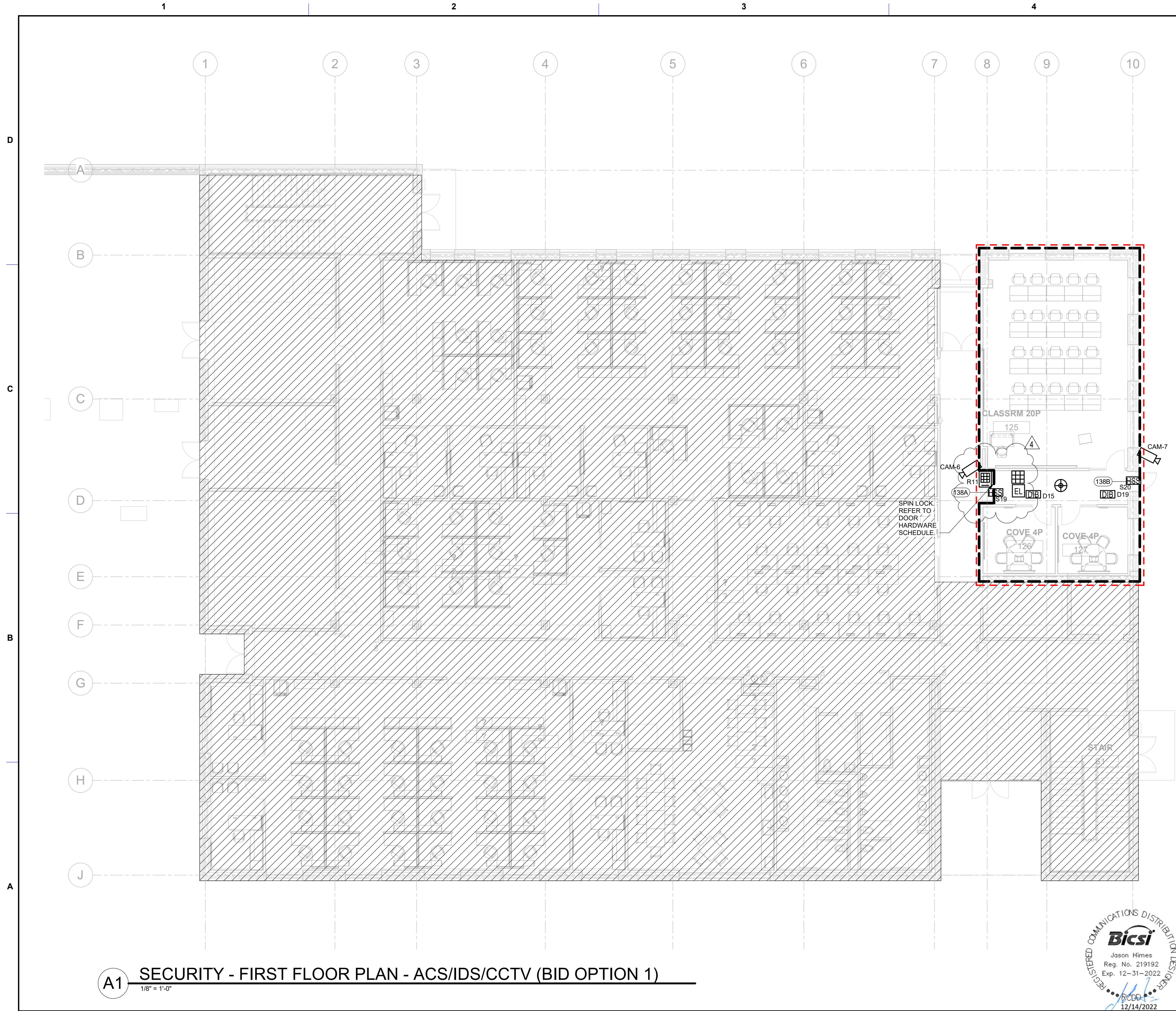
DESIGN OF JOINT CRYPTOLOGIC CENTER (JCC) BUILDING
BUCKLEY SHB, CO

TELECOM - SITE COMMUNICATIONS
PLAN

SHEET ID

TS010

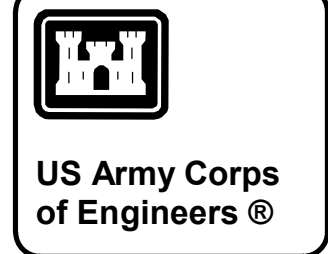
AMENDMENT 0004



A1 SECURITY - FIRST FLOOR PLAN - ACS/IDS/CCTV (BID OPTION 1)
1/8" = 1'-0"



GENERAL SHEET NOTES



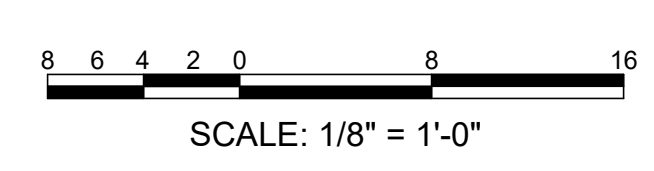
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4		REVISED I.A.W. AMENDMENT 0004	FEB 2023

KEYNOTES

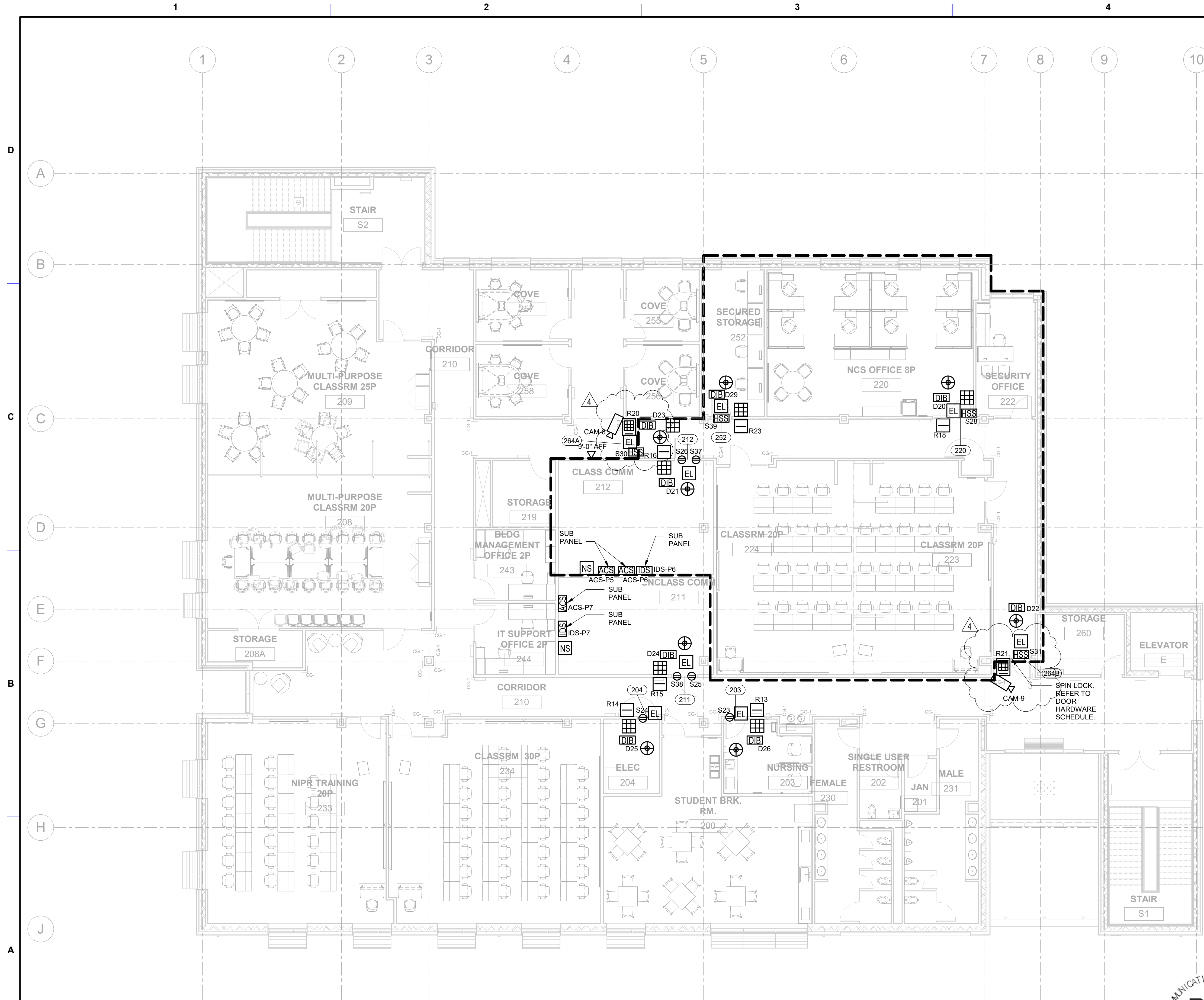
LEGEND

- AREA OF BID OPTION 1
- SECURE AREA
- AREA OF BASE BID

GRAPHIC SCALE(S)



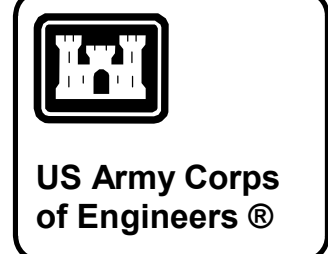
SHEET ID
TY140A



A1 SECURITY - SECOND FLOOR PLAN - ACS/IDS/CCTV
1/8" = 1'-0"



GENERAL SHEET NOTES



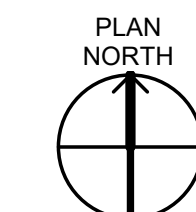
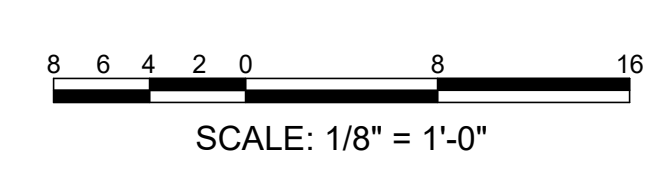
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3	REVISION 3
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98	REVISION 98
99	REVISION 99
100	REVISION 100

KEYNOTES

LEGEND

- AREA OF BID OPTION 1
- SECURE AREA
- AREA OF BASE BID

GRAPHIC SCALE(S)

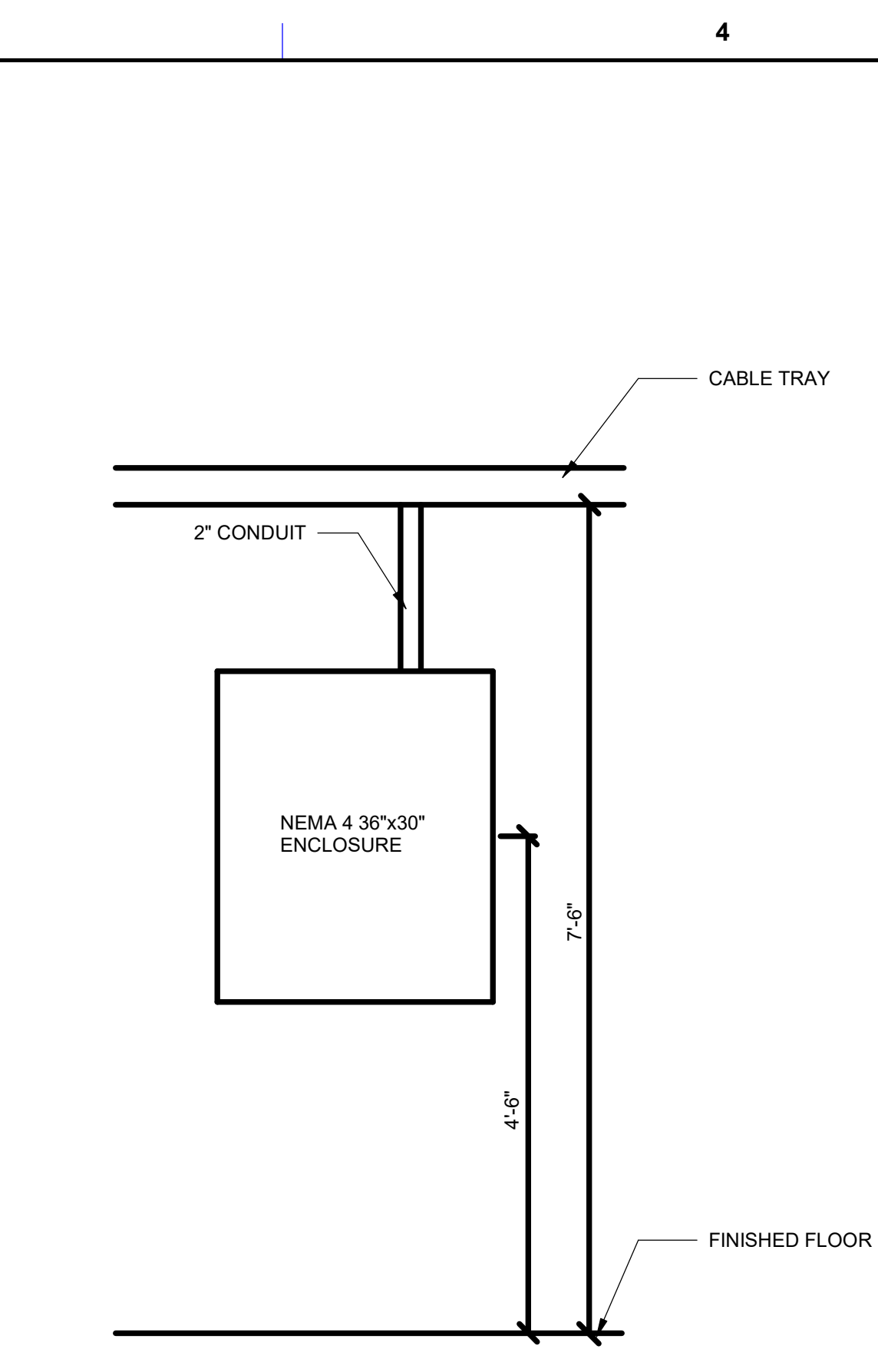


DESIGNED BY:	ISSUE DATE:
R. FAUVELLE	14 DECEMBER 2022
BY: J. FAUVELLE	SOLICITATION NO.:
CHECKED BY:	W9128Z30006
H. FERRIS	CONTRACT NO.:
SUBMITTED BY:	FILE NUMBER:
FILE NAME:	FILE NUMBER:
ANSI D	

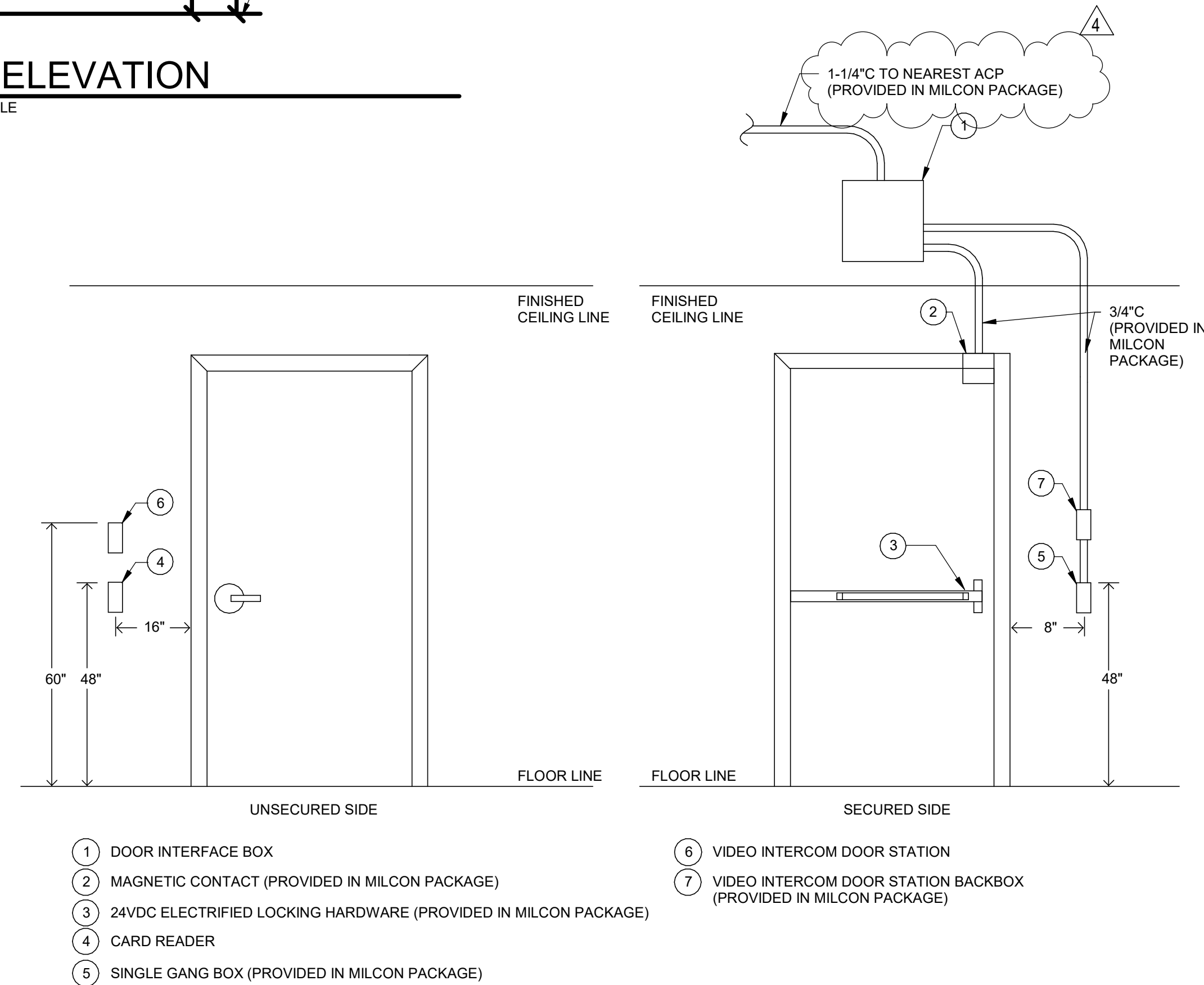
US ARMY CORPS OF ENGINEERS Omaha District Omaha, NE	JACOBS 1100 N. GLEBE ROAD, SUITE 500 ARLINGTON, VA 22201
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DESIGN OF JOINT CRYPTOLOGIC CENTER (JCC) BUILDING BUCKLEY SFB, CO	SECURITY - SECOND FLOOR PLAN - ACS/IDS/CCTV
--	--

SHEET ID
TY150



C3 **ACP ELEVATION**
NOT TO SCALE



A4 SINGLE DOOR WITH CARD READER
NOT TO SCALE

