

# CITY OF LINCOLN PARKS & REC HELEN BOOSALIS PARK INDOOR SHOOTING RANGE



## PROJECT MANUAL

ADA Project No. 12-121

April 26, 2013

OWNER:

City of Lincoln Parks & Rec  
440 S. 8th Street, Suite 200, Lincoln, NE 68516  
(402) 441-7410

Architectural Design Associates, P.C.  
7501 "O" Street, Suite 105  
Lincoln, NE 68510  
phone (402)486-3232  
fax (402)486-3380  
www.adalincn.com



PROJECT MANUAL

including specifications  
for the construction of

City of Lincoln

HELEN BOOSALIS PARK INDOOR SHOOTING COMPLEX

Superior Street and North 44<sup>th</sup> Street  
Lincoln, Nebraska

---

ARCHITECTS: Architectural Design Associates P.C.  
7501 "O" Street Suite 105  
Corporate Centre Office Park  
Lincoln, Nebraska 68510

Telephone: (402) 486-3232  
Fax: (402) 486-3380

OWNER: City of Lincoln Parks & Recreation  
440 South 8<sup>th</sup> Street  
Lincoln, NE 68516

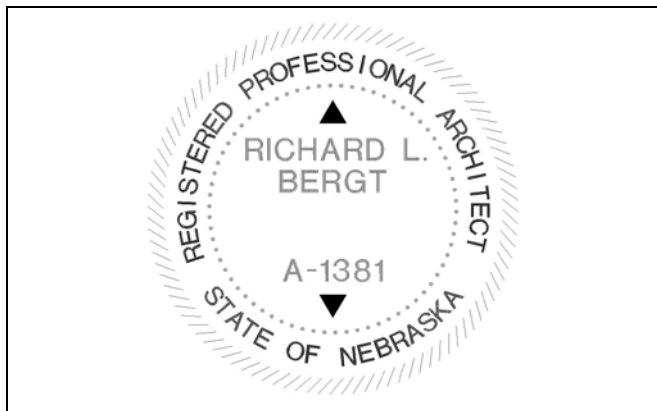
---

DATE: April 26, 2013

00 01 00 – PROJECT TITLE PAGE 1

SECTION 00 01 05

CERTIFICATIONS PAGE



I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly registered engineer under the laws of the State of Nebraska.

I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly registered engineer under the laws of the State of Nebraska.

Richard L. Bergt                                      A-1381  
 Name (Printed)                                      Registration Number

*Richard L. Bergt*  
 Signature

Vishal Khanna                                      E-6671  
 Name (Printed)                                      Registration Number

*Vishal Khanna*  
 Signature

Drawings covered by this Seal:  
A1.1 through A7.2

Drawings covered by this Seal:  
M1.1 through M3.2

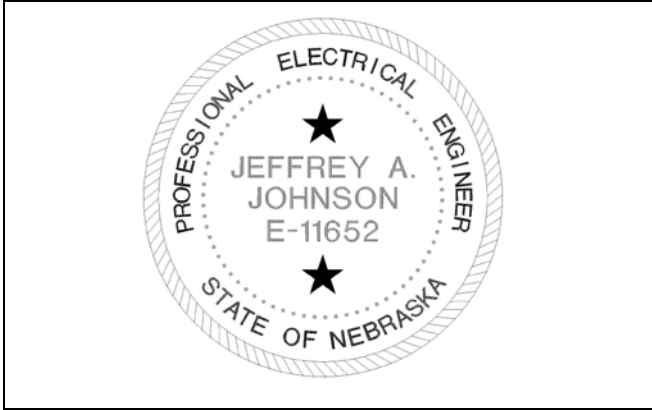
Sections covered by this Seal:  
Divisions 00 through 12  
Except Structural Divisions Listed Below.

Sections covered by this Seal:  
Divisions 21 through 23

Date Issued:  
April 26, 2013

Date Issued:  
April 26, 2013

**SECTION 00 01 05**  
**CERTIFICATIONS PAGE**



I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly registered engineer under the laws of the State of Nebraska.

I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly registered engineer under the laws of the State of Nebraska.

Jeffrey A. Johnson                      E-11652  
 \_\_\_\_\_  
 Name (Printed)                      Registration Number

Vance Behrens                              E-8733  
 \_\_\_\_\_  
 Name (Printed)                      Registration Number

\_\_\_\_\_  
 Signature

\_\_\_\_\_  
 Signature

Drawings covered by this Seal:  
 E0.1 through E4.1  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Drawings covered by this Seal:  
 S1.1 through S3.1  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Sections covered by this Seal:  
 Division 26  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

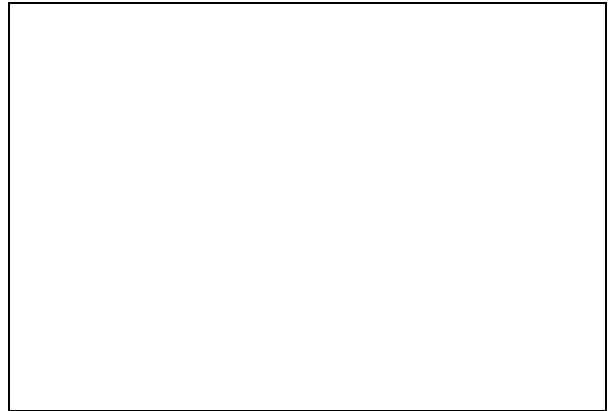
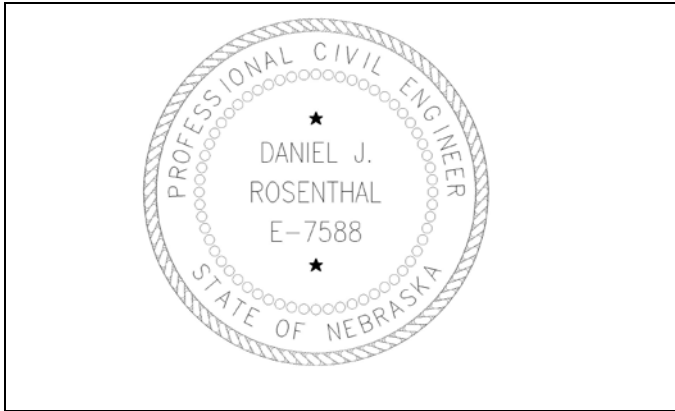
Sections covered by this Seal:  
 033000, 034100, 051200, 054000,  
 055000, 055013  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Date Issued:  
 April 26, 2013  
 \_\_\_\_\_

Date Issued:  
 April 26, 2013  
 \_\_\_\_\_


SECTION 00 01 05

CERTIFICATIONS PAGE



I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and responsible charge. I am a duly registered engineer under the laws of the State of Nebraska.

<u>Dan Rosenthal</u>	<u>E-7588</u>
Name (Printed)	Registration Number

<u></u>
Signature

Drawings covered by this Seal:  
T1.1, C1.1 through C1.7, C2.0 through C2.2  

---

---

---

Sections covered by this Seal:  
22 11 14, 31 20 00, 31 25 00, 32 13 13, 32 92 00,  
32 31 13, 31 10 00  

---

---

---

Date Issued:  
April 26, 2013  

---

Helen Boosalis Park Indoor Shooting Complex  
Superior Street and North 44th Street  
Lincoln, Nebraska

## TABLE OF CONTENTS

### DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

#### Introductory Information

00 01 00	Project Title Page
00 01 05	Certification Page
00 01 10	Table of Contents

#### Procurement Requirements

	Invitation to Bid - BY CITY PURCHASING DEPARTMENT
	Instructions to Bidders – BY CITY PURCHASING DEPARTMENT
	Bid Form - BY CITY PURCHASING DEPARTMENT
00 31 32	Geotechnical Data

#### Contracting Requirements

	General Conditions – BY CITY PURCHASING DEPARTMENT
--	--

### DIVISION 1 - GENERAL REQUIREMENTS

01 11 00	Summary of Work
01 21 00	Allowances
01 23 00	Alternates
01 25 00	Substitution Procedures
01 26 00	Contract Modification Procedures
01 29 76	Payment Procedures
01 31 00	Project Management and Coordination
01 32 00	Construction Progress Documentation
01 32 33	Photographic Documentation
01 33 00	Submittal Procedures
01 40 00	Quality Requirements
01 42 00	References
01 45 29	Testing Laboratory Services
01 50 00	Temporary Facilities and Controls
01 60 00	Product Requirements
01 73 00	Execution
01 73 29	Cutting and Patching
01 77 00	Closeout Procedures
01 78 23	Operation and Maintenance Data
01 78 39	Project Record Documents
01 79 00	Demonstration and Training

### DIVISION 2 – EXISTING CONDITONS

Not Used

### **DIVISION 3 - CONCRETE**

03 30 00 Cast-in-Place Concrete  
03 41 00 Precast Structural Concrete

### **DIVISION 4 - MASONRY**

Not Used

### **DIVISION 5 - METALS**

05 12 00 Structural Steel Framing  
05 40 00 Cold Formed Metal Framing  
05 50 00 Metal Fabrications  
05 50 13 Metal Embed Plates

### **DIVISION 6 – WOOD, PLASTICS AND COMPOSITES**

06 10 00 Rough Carpentry  
06 41 16 Plastic Laminate-Clad Architectural Cabinets

### **DIVISION 7 - THERMAL AND MOISTURE PROTECTION**

07 21 00 Thermal Insulation  
07 53 23 EPDM Roofing  
07 62 00 Sheet Metal Flashing, Trim, Gutters and Downspouts  
07 84 13 Penetration Firestopping  
07 92 00 Joint Sealants

### **DIVISION 8 - OPENINGS**

08 11 00 Metal Doors and Frames  
08 14 00 Flush Wood Doors  
08 33 13 Coiling Counter Doors  
03 33 23 Overhead Coiling Doors  
08 41 13 Aluminum-Framed Entrances and Windows  
08 71 00 Door Hardware  
08 81 00 Glass Glazing

### **DIVISION 9 - FINISHES**

09 29 00 Gypsum Board Assemblies  
09 51 13 Acoustical Panel Ceilings  
09 65 13 Resilient Base and Accessories  
09 68 13 Tile Carpeting  
09 77 33 FRP Sanitary Wall Panels  
09 91 00 Painting  
09 96 20 Epoxy Concrete Floor Paint

**DIVISION 10 - SPECIALTIES**

10 14 00	Signage
10 21 13.19	Plastic Toilet Compartments
10 22 26.33	Operable Partitions
10 28 00	Toilet Accessories
10 44 16	Fire Extinguishers

**DIVISIONS 11 – EQUIPMENT**

Not Used

**DIVISION 12 - FURNISHINGS**

12 32 16	Manufactured Plastic-Laminate-Clad Casework
12 36 23.13	Plastic-Laminate-Clad Countertops

**DIVISION 13 – SPECIAL CONSTRUCTION**

13 34 19	Metal Building Systems
13 70 00	Firing Range Scope of Work
13 70 50	Firing Range Equipment General
13 71 50	Shredded Rubber Bullet Trap Backstop
13 71 60	Modular Bullet Trap and Containment System (TCT II)
13 73 00	Ceiling Ballistic Protection System
13 73 10	Acoustical Wall Systems Shooting Range
13 80 00	Firing Range Ventilation General Requirements
13 81 00	Range Ductwork
13 82 00	Range Air Outlets and Inlets
13 88 00	Firing Range Air Balancing
13 94 00	Control Wiring
13 94 40	Firing Range Condition Lights

**DIVISION 14 - CONVEYING EQUIPMENT**

Not Used

**DIVISION 21 – FIRE SUPPRESSION**

Not Used

**DIVISION 22 – PLUMBING**

22 05 00	Common Work Results for Plumbing
22 05 29	Hangers and Supports for Plumbing Piping and Equipment
22 05 53	Identification for Plumbing Piping and Equipment
22 07 19	Plumbing Piping Insulation
22 11 13	Facility Water Distribution Piping
22 11 16	Domestic Water Piping
22 13 16	Sanitary Waste and Vent Piping



22 33 00 Electric, Domestic-Water Heaters

**DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING**

23 05 00 Common Work Results for HVAC  
23 05 53 Identification for HVAC Piping and Equipment  
23 05 93 Testing, Adjusting, and Balancing for HVAC  
23 07 13 Duct Insulation  
23 11 23 Facility Natural-Gas Piping  
23 31 13 Metal Ducts  
23 74 13 Packaged Outdoor Central-Station Air-Handling Units

**DIVISION 26 – ELECTRICAL**

26 05 00 Common Work Results for Electrical  
26 05 19 Low-Voltage Electrical Power Conductors and Cables  
26 05 26 Grounding and Bonding for Electrical Systems  
26 05 29 Hangers and Supports for Electrical Systems  
26 05 33 Raceways and Boxes for Electrical Systems  
26 05 53 Identification for Electrical Systems  
26 09 23 Lighting Control Devices  
26 24 16 Panelboards  
26 27 26 Wiring Devices  
26 28 16 Enclosed Switches and Circuit Breakers  
26 29 13 Enclosed Controllers  
26 43 13 Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits  
26 51 00 Interior Lighting  
26 56 00 Exterior Lighting

**DIVISION 31 – EARTHWORK**

31 10 00 Site Clearing  
31 20 00 Earth Moving  
31 25 00 Erosion Control

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 13 13 Concrete Paving  
32 31 13 Chain Link Fences & Gates  
32 92 00 Turf and Grasses

**DIVISION 33 – UTILITIES**

Not Used

END OF SECTION 00 01 10

**SECTION 00 31 32**  
**GEOTECHNICAL DATA**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
  - 1. Subsurface geotechnical exploration report.

1.03 DESCRIPTION

- A. General: A subsurface exploration report has been prepared for this site and follows this section.
- B. Use of Data: The report is available for the Contractor's information only, and is not a warranty of subsurface conditions or the continuity of such conditions between soil borings. The Contractor shall visit the site and acquaint himself fully with all existing conditions.

1.04 QUALITY ASSURANCE

- A. The General Contractor will be required to retain the services of a soils engineer to observe performance of work in connection with excavating, trenching, filling, backfilling, and grading, as specified in Division One Section, "Testing Laboratory Services."
- B. Adjustment of Work: Readjust all work performed that does not meet technical or design requirements, but make no deviations from the Contract Documents without specific approval from the Architect.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

END OF SECTION 00 31 32

# GEOTECHNICAL ENGINEERING REPORT

**Helen Boosalis Park Indoor Shooting Range**  
**NW of 44<sup>th</sup> and Superior Streets**  
**Lincoln, Nebraska**

PREPARED FOR

**Lincoln Parks and Recreation**  
c/o Architectural Design Associates P.C.  
7501 "O" Street  
Suite 105  
Lincoln, NE 68510

March 22, 2013



March 22, 2013

Lincoln Parks and Recreation  
c/o Mr. Dick Bergt  
Architectural Design Associates P.C.  
7501 "O" Street  
Suite 105  
Lincoln, NE 68510

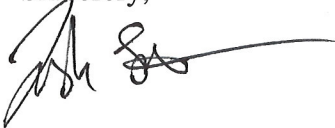
**REFERENCE:** Geotechnical Engineering Report  
Helen Boosalis Park Indoor Shooting Range  
NW of 44<sup>th</sup> and Superior Streets  
Lincoln, Nebraska

Dear Mr. Bergt:

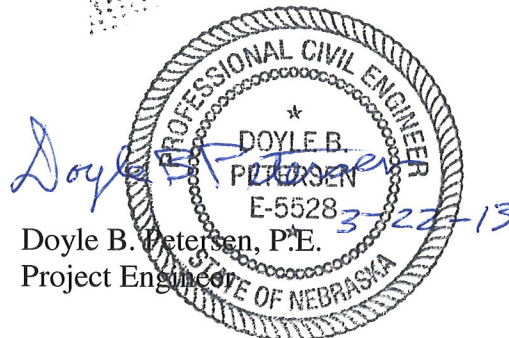
Alfred Benesch & Company (Benesch) is pleased to submit the enclosed report that summarizes the findings of a geotechnical engineering study and provides recommendations related to the design and construction of the foundation for the referenced project.

If any questions arise concerning this report or if additional information is needed about soil conditions at this site, please contact Benesch for assistance.

Sincerely,



Joshua M. Letts  
Engineering Geologist



Enclosures

Orig. & 2 pc.: Architectural Design Associates P.C.

# TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY .....	1
2.0	SUBSURFACE EXPLORATION .....	2
3.0	LABORATORY ANALYSES .....	3
4.0	GEOLOGY AND SITE CONDITIONS .....	4
5.0	DISCUSSION AND RECOMMENDATIONS .....	5
1.	Suitable Floor, Pavement and Foundation Subgrade Material .....	5
2.	Minimum Depth of Footings .....	6
3.	Allowable Bearing Pressure .....	6
4.	Settlement .....	6
5.	Vertical Modulus of Subgrade Reaction .....	7
6.	Preparation of the Building Area and Areas to be Paved .....	7
7.	OSHA Excavation Requirements .....	7
8.	Protective Slopes Around the Building .....	8
9.	Types of Soils to be Used as Fill and Backfill .....	8
10.	Placement of Fill and Backfill .....	8
11.	Pavement Thickness .....	9
12.	Grading Observation .....	10
14.	Subgrade Observation .....	10
15.	Applicability of Recommendations .....	10
6.0	CONCLUSIONS .....	11
	APPENDIX A. VICINITY MAP AND BORING LOCATION PLAN .....	
	APPENDIX B. DUTCH FRICTION-CONE PENETRATION DIAGRAMS .....	
	APPENDIX C. BORING LOGS .....	
	APPENDIX D. CRITERIA USED FOR SOIL CLASSIFICATION .....	

## 1.0 EXECUTIVE SUMMARY

### PROJECT OVERVIEW

Architectural Design Associates (ADA) has indicated that the proposed project will consist of the following:

<b>Structure Type:</b>	150-ft by 125-ft, single-story, slab-on-grade, metal building with an attached 90-ft by 30-ft, single story, slab-on-grade, masonry block building
<b>Type of Foundation(s) Being Considered:</b>	Shallow Footings and Grade Beams
<b>Estimated Maximum Column Load:</b>	24 kips (Dead Load) + 36 kips (Live Load)
<b>Estimated Maximum Wall Load:</b>	4 kips/ft (Dead Load) + 0.7 kips/ft (Live Load)
<b>Finished Floor Elevations:</b>	First Floor: To Be Determined
<b>Estimated Fill Height at Boring Locations:</b>	B-1 2.5 feet B-2 2.0 feet B-3 3.0 feet B-4 8.5 feet B-5 2.5 feet

1 kip = 1,000 lbf

### FACTORS AFFECTING SITE PREPARATION

- Unsuitable floor and pavement subgrade materials extend to depths of 0.5 to 1.2 feet.
- Low-moisture-content (moist) soils were encountered to depths of 4.1 to 6.5 feet. These soils could cause up to 0.6 inches of heave if they get wetter.
- Unsuitable fill materials were encountered to depths of 0.6 to 1.2 feet.
- Onsite soils are moist and will required wetting prior to use as fill.

### FACTORS AFFECTING FOUNDATION AND BUILDING DESIGN

- Natural foundation soils were encountered at elevations of 1149.5 to 1144.4 feet (0.7 to 2.5 feet below existing grade). These soils could be used to support the proposed building, however, portions of the soils are moist, and these moist soils could swell/heave if they get wetter.
- Previously removed structures are in the vicinity of the proposed building area. It is unknown whether all of the below grade remnants of these buildings were removed during demolition of the structures.

## 2.0 SUBSURFACE EXPLORATION

A program of Dutch friction-cone soundings, test borings and soil sampling was performed at the project site on March 15, 2013. Five (5) Dutch friction-cone soundings were made at the site. The results of the soundings were used to determine the depths for obtaining undisturbed soil samples from an exploratory boring made immediately adjacent to each sounding. Five (5) exploratory borings were taken to depths of 10 to 15 feet below the existing grade to establish the general subsurface conditions of the area under consideration.

The Dutch friction-cone soundings were performed with a mechanical penetrometer in accordance with ASTM D 3441, Standard Method for Deep, Quasi-Static, Cone, and Friction Cone Penetration Tests of Soil. The plot of the data from this test identifies the relative positions and thicknesses of hard and soft layers of soil.

The borings were made in accordance with ASTM D 1452, Standard Practice for Soil Investigation and Sampling by Auger Borings. A machine-driven, continuous-flight auger having a diameter of 6 inches used to advance the holes for and thin-walled tube sampling. The bore holes were stable and casing was not required.

Undisturbed soil samples were recovered for visual observation and laboratory testing in accordance with ASTM D 1587, Standard Method for Thin-Walled Tube Sampling of Soil, utilizing an open-tube sampler having an outside diameter of 3.0 inches.

The vicinity map and the boring location plan are presented in Appendix A. The penetration diagrams (see Appendix B) present the results of the Dutch friction-cone soundings. The boring logs (see Appendix C) present the data obtained in the subsurface exploration. The logs include the surface elevations, the approximate depths and elevations of major changes in the character of the subsurface materials, visual descriptions of the materials in accordance with the criteria presented in Appendix D, groundwater data, and the locations of undisturbed samples of soil.

The locations of the soundings and borings were determined by tape measurements from the center of the intersection of North 44<sup>th</sup> and Superior Streets. Elevations (approximate) at the sounding and boring locations were determined by survey with reference to a brass cap located in the intersection of North 44<sup>th</sup> and Superior Streets. ADA indicated that the elevation of this benchmark is 1143.95 feet (NAVD88). Water level readings were made in the auger borings at times and under conditions stated on the boring logs.

### 3.0 LABORATORY ANALYSES

The undisturbed soil samples obtained during the subsurface exploration were examined in the laboratory by a member of Benesch's professional engineering staff to supplement the field identification. Standard tests were performed on selected samples to determine the engineering properties of the foundation materials.

The moisture contents and dry unit weights of selected undisturbed soil samples were determined in the laboratory. These test results are presented in the boring logs opposite the respective sample locations. The moisture contents were determined in accordance with either ASTM D 4643, Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method, or ASTM D 2216, Standard Test Method for Determination of Water (Moisture) Content of Soil and Rock by Mass. The dry unit weights were determined in accordance with the Displacement Method of the Corps of Engineers, EM1110-2-1906, Appendix II, Unit Weights, Void Ratio, Porosity, and Degree of Saturation. These data correlate with the strength and compressibility of the soil. High moisture content and low density usually indicate low strength and high compressibility.

The unconfined compressive strengths of several undisturbed samples were estimated in the laboratory with a calibrated hand penetrometer. These strengths are presented on the boring logs and are estimates only. Actual values are generally lower than the estimated values indicated on the boring logs.



## 4.0 GEOLOGY AND SITE CONDITIONS

The city of Lincoln lies in the Dissected Till Plains section of Nebraska, a part of the Central Lowland province of the Interior Plains physiographic division<sup>1</sup>. The project site is located in northeast Lincoln on loess-mantled terraces. The terraces are located adjacent to alluvial bottomlands of Salt Creek, and generally consist of Peoria loess deposits atop alluvial silts and sands. The site has been previously graded as evidenced by the fill encountered at the boring locations.

HWS Consulting Group (now Benesch) published a “Desktop Geotechnical Report” for the project site in 2009, which noted that there were former buildings that were located in the approximate vicinity of the proposed building based on 1956 aerial photographs and a 1964 quadrangle map (see the boring location plan in Appendix A).

The subsurface materials encountered at the boring locations begin at the ground surface with either fill or topsoil, then extend down the soil development profile to subsoil, lower subsoil, and Peoria loess overlying cohesive and granular Peoria alluvium. Detailed descriptions are provided in the boring logs, which are presented in Appendix C.

Groundwater was not encountered to the depths of any of the borings. The water table could be expected to fluctuate several feet depending on surface drainage, rainfall, temperature, and other factors.

---

<sup>1</sup> Physiographic Provinces of North America, Map by A. K. Lobeck, 1948; The Geographical Press; Columbia University, New York

## 5.0 DISCUSSION AND RECOMMENDATIONS

Four basic requirements for a satisfactory foundation of a structure are as follows:

- A. The base of the foundation must be located below the depth to which the soil is subject to frost action and seasonal volume change caused by alternate wetting and drying.
- B. The foundation (including the earth beneath it) must be stable or safe from failure.
- C. The foundation must not settle or deflect enough to disfigure or damage the structure.
- D. The foundation structure must be properly located with respect to any future influence that could adversely affect its performance.

The following recommendations for design and construction of the foundation for the proposed shooting range building are based upon site conditions, the engineering properties of the subsurface materials, and the requirements of the proposed structure.

### 1. SUITABLE FLOOR, PAVEMENT AND FOUNDATION SUBGRADE MATERIAL

The building area will be filled approximately 2 to 8.5 feet above existing grade. The existing fill material and upper 0.5 feet of topsoil should not be used to support the footings, floor slab, pavement structure, or new fill. Any remaining soils may be left in the building area and areas to be paved if these soils are "wet" and prove stable under a loaded dump truck or similar piece of equipment. By Benesch's definition, a "wet" cohesive soil contains sufficient moisture to be rolled into a 1/8-inch-diameter thread without crumbling. A "moist" cohesive soil would crumble when being rolled to form a 1/8-inch-diameter thread. Footings could then be seated in either controlled earth fill, or natural soils at normal plan depths.

At the time of the exploration, portions of the topsoil, subsoil, lower subsoil, and Peoria were moist. Table 1 presents the locations of the moist soils at each boring location. These soils have moderate to high volume-change potential and will swell as their moisture contents increase. The estimated heave is 0.6 inches as these moist soils become wetter. The magnitude of potential heave is difficult to estimate and should only be used as a rough approximation. To eliminate the potential swell, all moist soils should be (a) removed and replaced with controlled earth fill, (b) reworked to conform to the moisture content and compaction recommendations presented in Table 2, or (c) "cured" to raise the moisture content of the soils. Controlled earth fill is defined as earth fill that is designed, compacted, and tested in accordance with generally accepted good practice and placed with observation by the Geotechnical Engineer. The potential swell might be reduced by using a chemical soil stabilizer like EcSS 3000<sup>TM</sup>. The design and injection of a soil stabilizer are highly specialized work requiring skilled personnel. Experts in this work should be contacted to determine if this is a feasible solution for this project site.

**TABLE 1  
LOCATION OF MOIST SOILS**

Boring No.	Top/Bottom Elevation, ft	Top/Bottom Depth Below Existing Grade, ft
1	Not Encountered	--
2	1149.0/1144.0	1.5/6.5
3	1146.7/1142.8	2.1/6.0
4	1143.4/1140.6	1.7/4.5
5	1148.0/1144.7	0.8/4.1

\*Depth of boring. Moist soils might extend below this depth

Curing of a soil that is low in moisture content consists of uniformly wetting the soil until the moisture content has increased to a level at least equal to its plastic limit (approximately 22%). The time required to uniformly cure the moist soil is dependent on several factors including the thickness of the dry materials, the variability of the subsurface material types, and weather conditions. The curing process could take from several days to two or more weeks to occur. Serious consideration should be given to starting the curing operations prior to beginning the subsequent construction activities. A moisture content at least equal to the plastic limit of the soil should be maintained until the footings, floor slab, and pavement structure are constructed. The Geotechnical Engineer should inspect areas that have been "cured" to verify that the moisture content of the subgrade soils has been increased to sufficient depth prior to the commencement of the construction activities.

**2. MINIMUM DEPTH OF FOOTINGS**

The bottoms of all exterior footings should be placed at a minimum depth of 40 inches below finished grade to provide reasonable protection against frost action and seasonal volume change.

**3. ALLOWABLE BEARING PRESSURE**

The allowable net bearing pressure on the natural materials located at or below the depths in Recommendation 1 or on controlled earth fill is 3,000 lbf/ft<sup>2</sup>. The net bearing pressure is the contact pressure at the base of the foundation in excess of the pressure at the same level due to the surrounding surcharge. The surcharge pressure is equal to the total weight of a column of soil that extends from the lowest immediately adjacent ground surface to the bottom of the foundation divided by the soil column's area.

**4. SETTLEMENT**

Settlement of the building is expected to be negligible (less than 1/4 inch), if the fill materials are properly placed (see Recommendation 10), and the recommendations in this report are carried out.

## 5. VERTICAL MODULUS OF SUBGRADE REACTION

The suggested value of the vertical modulus of subgrade reaction to be used in the design of footings and pavement structure is 75 and 100 lbf/in<sup>3</sup>, respectively.

## 6. PREPARATION OF THE BUILDING AREA AND AREAS TO BE PAVED

All vegetation, the existing fill materials, and the upper 0.5 foot of topsoil should be removed from the building area and areas to be paved. In addition, any existing footings, debris, rubble, etc. from the demolition of the former buildings should be removed. If the estimated heave presented in Recommendation 1 is considered excessive, all moist soils (see Table 1) should be (a) removed and replaced, (b) reworked, (c) cured or (d) possibly chemically stabilized. The removal, reworking, or curing of these materials should extend beyond the outside edges of the proposed footings a minimum horizontal distance of 3.0 feet or two-thirds the distance between the bottom-of-footing elevation and the surface of the suitable wet soils, whichever is greater. The sides of the excavation should be sloped to permit the controlled earth fill to be placed against the sides of the excavations to the recommended degree of compaction. Thereafter, the exposed ground located in areas that have been "cut" to the proposed subgrade elevations and areas to be filled should be proofrolled with a loaded dump truck or similar piece of equipment (in the presence of the Geotechnical Engineer) to locate unstable materials.

The Geotechnical Engineer should observe the building area and areas to be paved to verify conformance to the above recommendations. Upon approval of the site by the Geotechnical Engineer, any exposed ground surface that has not been previously reworked should be scarified to a minimum depth of 6 inches and reworked to conform to the moisture content and compaction recommendations presented in Table 2. Areas to be filled should then be raised to the desired elevation with controlled earth fill.

Immediately prior to placement of the pavement structure, the subgrade in cut and fill sections should be scarified to a minimum depth of 6 inches and reworked to a uniform condition conforming to the moisture content and compaction recommendations presented in Table 2.

The footing excavations should extend into either the controlled earth fill or suitable natural foundation materials located at normal plan depths. The Geotechnical Engineer should observe the foundation excavations to verify that the footings will be seated in suitable foundation material.

## 7. OSHA EXCAVATION REQUIREMENTS

Excavations that will be occupied by personnel should be made in accordance with the Occupational Safety and Health Administration (OSHA) Construction Standards-29 CFR Part 1926, Subpart P-Excavations as published in the Federal Register, Vol. 54, 209, Tuesday, October 31, 1989, Rules and Regulations. OSHA states that a soil should be reclassified if the properties, factors, or conditions affecting the soil's classification change in any way. Sheet piling and/or shoring will be necessary if the sides of the excavations cannot be sloped to meet OSHA regulations.

## 8. PROTECTIVE SLOPES AROUND THE BUILDING

The site should be graded in a manner that will divert water away from the building. The protective slopes around the building should meet the following requirements:

- A. Slope downward from the building to lower areas or drainage swales.
- B. Minimum horizontal length of 10 feet, minimum vertical fall of 6 inches (5 percent).
- C. Minimum gradient (beyond 10 feet from building):
  1. Impervious surface; 1/8 inch per foot (1 percent).
  2. Pervious surface; 1/4 inch per foot (2 percent).

## 9. TYPES OF SOILS TO BE USED AS FILL AND BACKFILL

Controlled earth fill placed within the building area and areas to be paved should be constructed of inorganic CL<sup>2</sup>, ML<sup>3</sup>, SM<sup>4</sup>, and/or SC<sup>5</sup> materials (all with a liquid limit less than 50 and a plasticity index less than 30). The lean clays encountered at the project site are considered suitable for use as fill within the building area and areas to be paved. It should be noted, however, that portions of these materials are low in moisture content and will require the addition of water to achieve a moisture content necessary for proper placement.

The materials used as fill and backfill outside the building area and areas to be paved may consist of CL, ML, SM, SC, and/or CH (fat clay, fat clay with sand, and/or sandy fat clay). Proposed fill and backfill materials should be subject to approval by the Geotechnical Engineer. Representative samples of the proposed fill and backfill materials should be submitted to the Geotechnical Engineer at least three days prior to placement so the necessary laboratory tests can be performed.

## 10. PLACEMENT OF FILL AND BACKFILL

The suggested basis for controlling the placement of fill and backfill on the site, excluding free-draining granular materials, are the "optimum moisture content" and "maximum dry density" as determined by ASTM D 698, Procedure A, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using **Standard Effort** (12,400 ft-lbf/ft<sup>3</sup>) (600 kN-m/m<sup>3</sup>). The recommended acceptable values of moisture content and degree of compaction are given in Table 2.

---

<sup>2</sup> Lean clay, lean clay with sand and sandy lean clay.

<sup>3</sup> Silt, silt with sand and sandy silt.

<sup>4</sup> Silty sand.

<sup>5</sup> Clayey sand.

**TABLE 2  
COMPACTION RECOMMENDATIONS FOR CONTROLLED EARTH FILL AND BACKFILL**

<b>Location</b>	<b>Soil Type</b>	<b>Minimum Moisture Content</b>	<b>Minimum Compaction*</b>
Below bottom-of-interior-footing elevation in the building area.	Glacial Till	Optimum	97%
	Silts and Lean Clays	2% Below Optimum	97%
	Silty and Clayey Sands	**	100%
From 0.0 to 1.0 foot below pavement subgrade elevation outside the building area.	Glacial Till	Optimum	100%
	Silts and Lean Clays	2% Below Optimum	100%
	Silty and Clayey Sands	**	100%
(a) Above bottom-of-interior-footing elevation in the building area and (b) greater than 1.0 foot below pavement subgrade elevation outside the building area.	Glacial Till	Optimum	95%
	Silts and Lean Clays	2% Below Optimum	95%
	Silty and Clayey Sands	**	95%
Backfill of footings and utility trenches outside the building area and outside of areas to be paved.	Silts and Clays	2% Below Optimum	92%

\*Percent of Maximum Dry Density (ASTM D 698, Procedure A)

\*\*Moisture as necessary to obtain density (near Optimum)

Clean free-draining sand used as backfill should be consolidated by means of a vibratory compactor to at least 55% "relative density", as determined in accordance with ASTM D 4253 (Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table) and D 4254 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density).

## 11. PAVEMENT THICKNESS

Assumptions used in the pavement thickness determinations included:

- Design life = 20 yrs.
- Annual "Traffic" Growth = 2%
- 28 day concrete compressive strength = 4000 lbf/in<sup>2</sup>
- Soil CBR = 5
- Soil resilient modulus = 7,500 lbf/in<sup>2</sup>
- Soil modulus of subgrade reaction = 100 lbf/in<sup>3</sup>

The recommended minimum pavement thicknesses are presented below.

- Light Duty Pavement (car and pickup traffic):
  - Asphalt = 6 inches
  - Concrete = 5 inches
- Medium Duty Pavement (buses and a garbage truck):
  - Asphalt = 7 inches
  - Concrete = 7 inches

## **12. GRADING OBSERVATION**

Observation and frequent testing by the Geotechnical Engineering Firm during compaction of fill and backfill are necessary to verify proper moisture content and degree of compaction. A professional opinion should be obtained from the Geotechnical Engineer that the site has been properly prepared, that all footings will be seated on suitable foundation materials, and that all fill, backfill, and subgrade materials conform to the moisture content and compaction recommendations presented above. If these testing and observation services are not performed, the allowable bearing pressure stated in Recommendation 3 might be invalid. As the Geotechnical Engineer for this project, Benesch has interpreted the results of the subsurface exploration and laboratory tests to arrive at the recommendations presented in this report. Consequently, Benesch is in the best position to relate actual observed conditions to those assumed for this report and to provide revised recommendations if differences are found during grading operations and construction of the foundation for the referenced project.

## **14. SUBGRADE OBSERVATION**

The floor subgrade, pavement subgrade and foundation materials should be observed by the Geotechnical Engineer immediately prior to placement of the concrete or paving components. Severe changes in the condition of these materials can occur after initial preparation as the result of rain, drying, freezing, and construction activities. Any subgrade or foundation material that becomes disturbed, desiccated, or does not conform to the moisture content and compaction recommendations previously presented should either be removed and replaced or reworked to meet these recommendations.

## **15. APPLICABILITY OF RECOMMENDATIONS**

The recommendations presented in this report are based in part upon Benesch's analyses of the data from the Dutch friction-cone soundings and soil borings. The penetration diagrams, boring logs, and related information depict subsurface conditions only at the specific sounding and boring locations and at the time of the subsurface exploration. Soil conditions might differ between the soundings and exploratory borings and might change with the passage of time. The nature and extent of any variations between the sounding and boring locations or of any changes in soil conditions (e.g., drying of soil) might not become evident until grading operations and construction of the foundation for the referenced project have begun. If variations and changes in the soil conditions then appear, it will be necessary to re-evaluate the recommendations stated in this report.

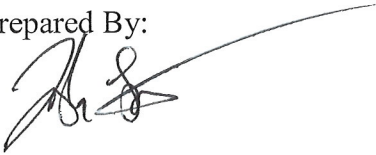
## 6.0 CONCLUSIONS

Benesch concludes, on the basis of the findings of the subsurface exploration at the project site and the evaluation of the engineering properties of samples of the foundation materials, that the proposed indoor shooting range can be supported by spread footings seated on either firm natural materials or controlled earth fill. The moist subsoil, lower subsoil, and Peoria have moderate to high volume-change potential and will swell as the moisture contents increase. Special attention should be paid to the recommendations provided above concerning the moist soils encountered on site.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices for exclusive use by the City of Lincoln, its designers, and contractors for specific application to the proposed Helen Boosalis Park indoor shooting range. The recommendations of this report are not valid for any other purpose.


Benesch should be contacted if any questions arise concerning this report or if changes in the nature, design or location of the structure are planned. If any such changes are made, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by Benesch and the conclusions of this report are modified or verified in writing. This report shall not be reproduced, except in full, without the written approval of Alfred Benesch & Company.

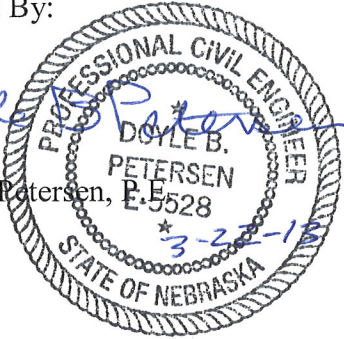
Prepared By:



Joshua M. Letts  
Engineering Geologist

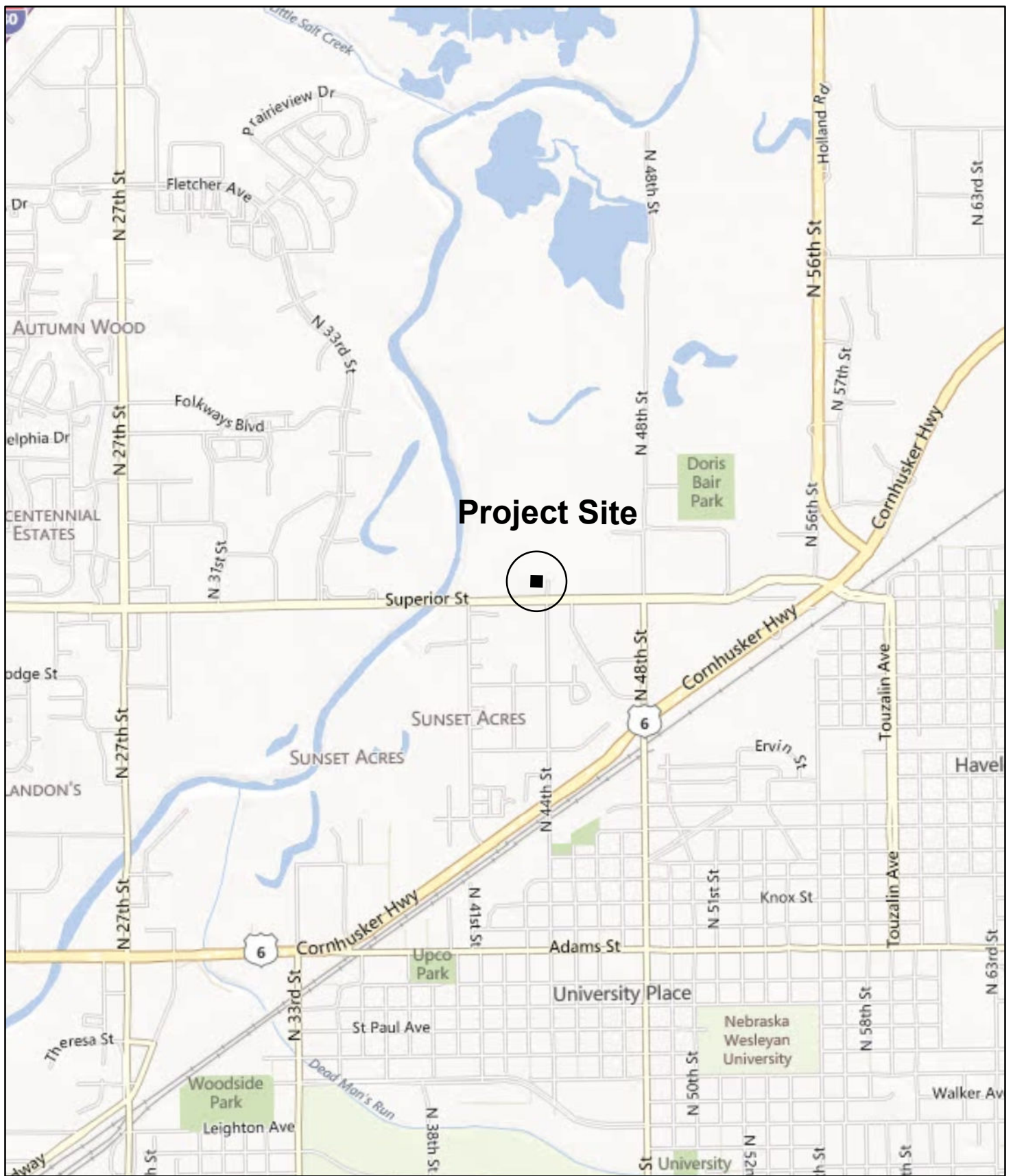
Reviewed By:

  
Doyle B. Petersen, P.E. 5528  
\*3-22-18





**APPENDIX A. VICINITY MAP AND BORING LOCATION PLAN**



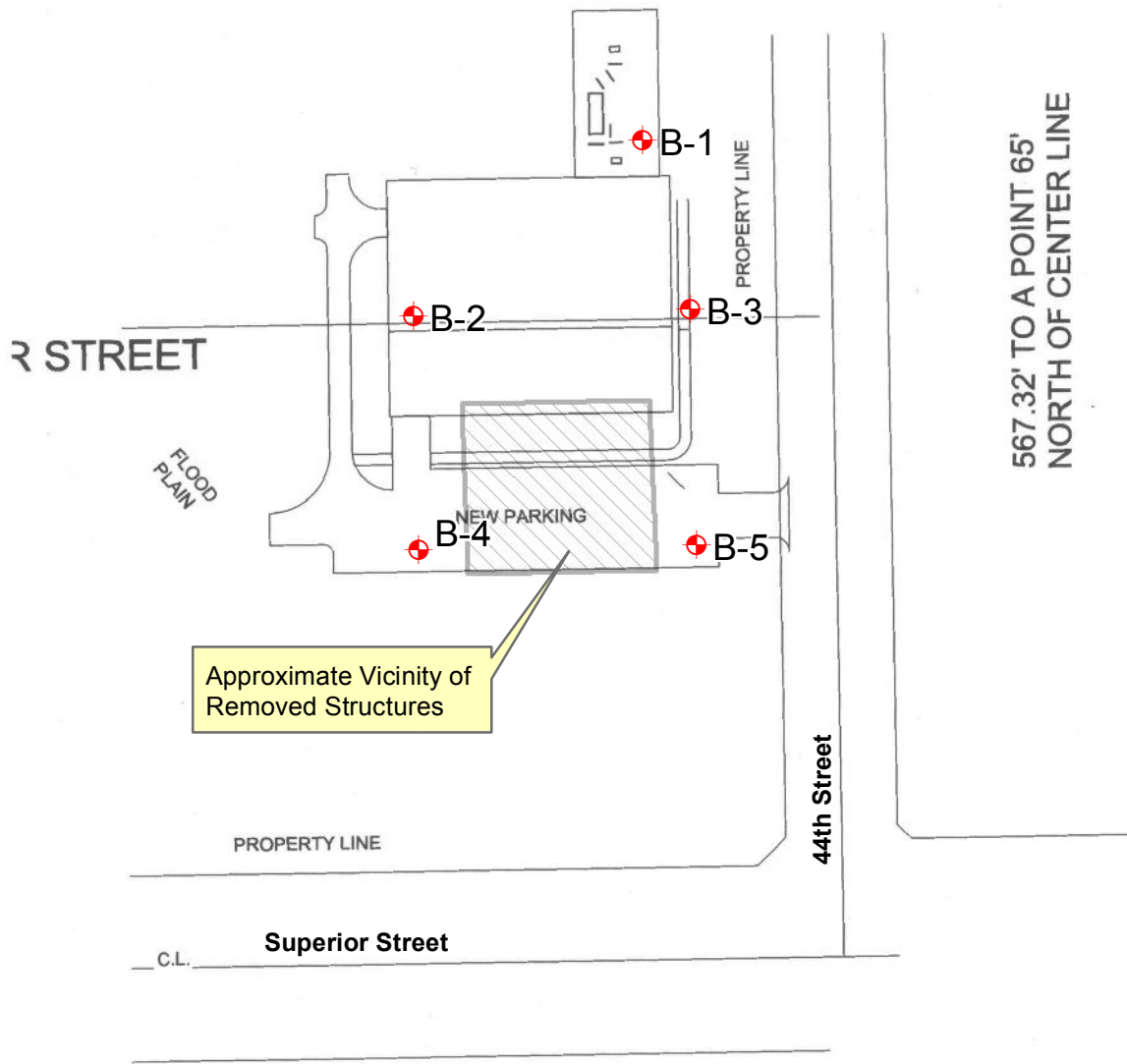
ADA Drawing



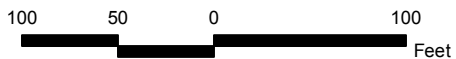
Helen Boosalis Park  
 Indoor Shooting Range  
 Lincoln, Nebraska



Vicinity Map  
 Figure A-1



ADA Drawing



Helen Boosalis Park  
Indoor Shooting Range  
Lincoln, Nebraska

**Boring Location  
Figure A-2**

**APPENDIX B. DUTCH FRICTION-CONE PENETRATION DIAGRAMS**



LINCOLN OFFICE  
825 "J" Street  
PO Box 80358  
Lincoln, NE 68508

**PENETRATION DIAGRAM OF  
DUTCH FRICTION-CONE PENETROMETER**

PROJECT: **Helen Boosalis Park Indoor Shooting Complex  
Lincoln, Nebraska**

SOUNDING NO.: **S-1**  
LOCATION: **B-1**  
SURFACE ELEVATION: **1149.1 feet**

DATE: **March 15, 2013**  
TESTED BY: **CL**  
RECORDED BY: **GW**

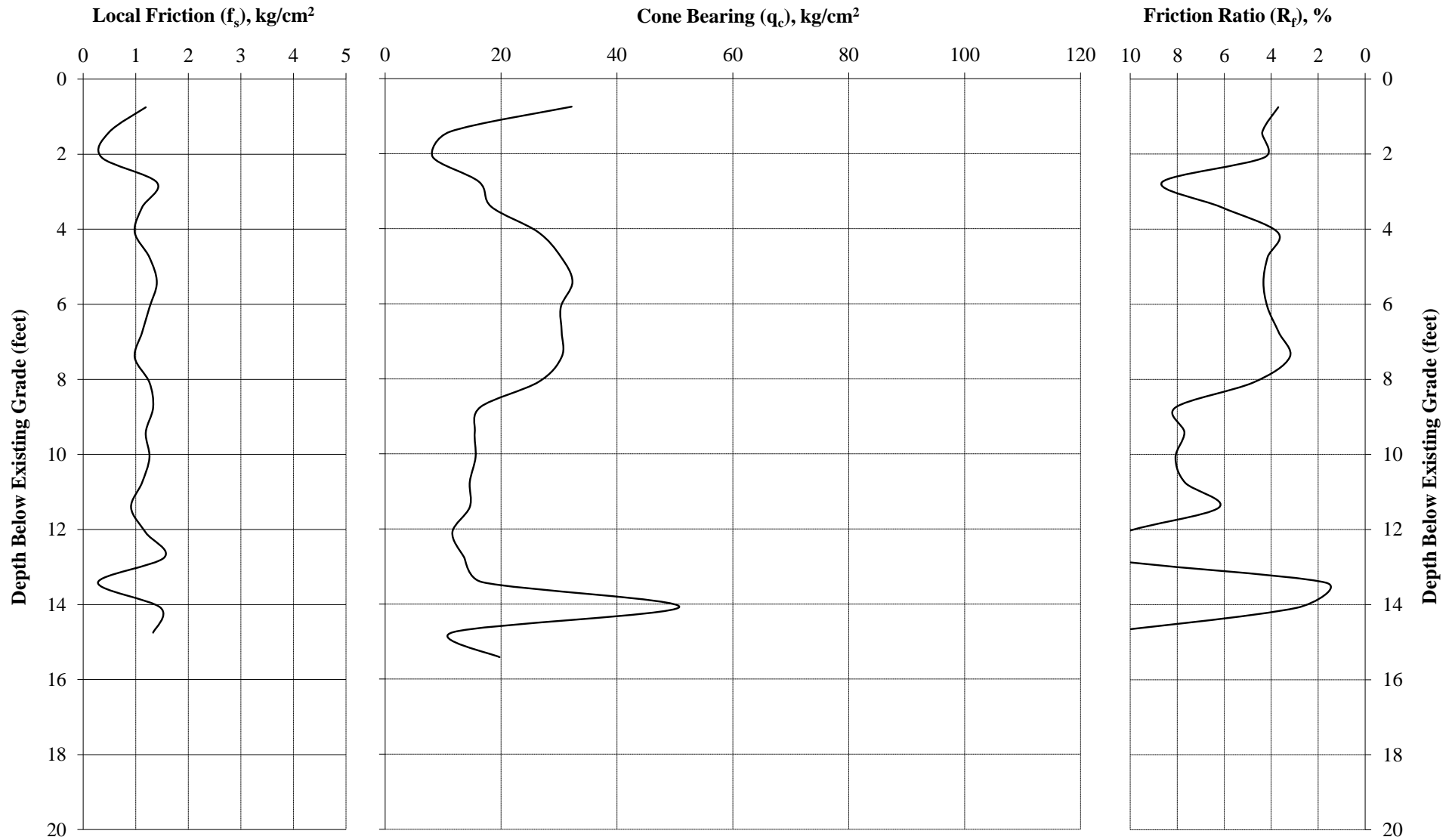


Figure C-1a



LINCOLN OFFICE  
825 "J" Street  
PO Box 80358  
Lincoln, NE 68508

# PENETRATION DIAGRAM OF DUTCH FRICTION-CONE PENETROMETER

PROJECT: **Helen Boosalis Park Indoor Shooting Complex**  
**Lincoln, Nebraska**

SOUNDING NO.: **S-2**  
LOCATION: **B-2**  
SURFACE ELEVATION: **1150.5 feet**

DATE: **March 15, 2013**  
TESTED BY: **CL**  
RECORDED BY: **GW**

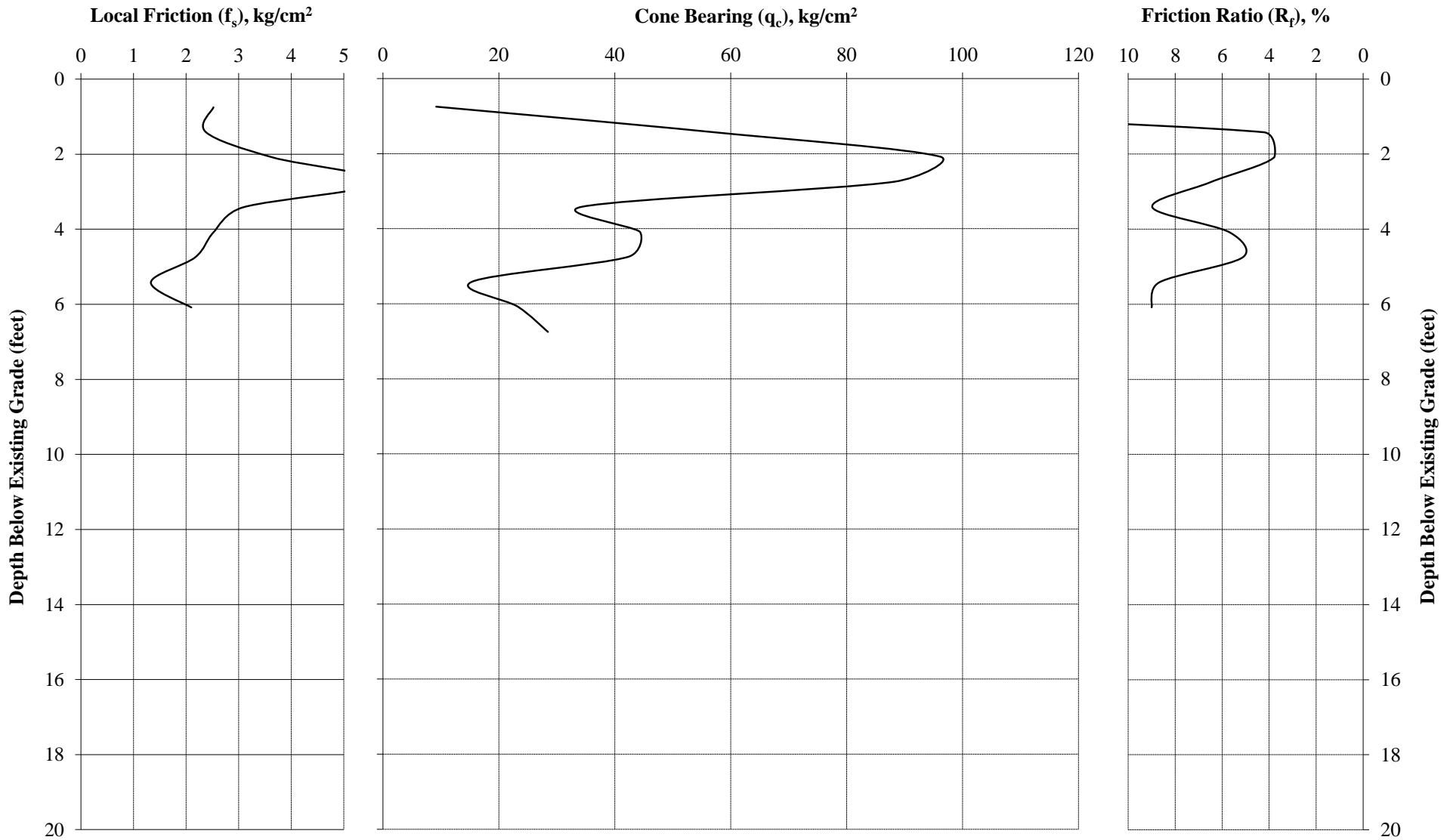


Figure C-2a



LINCOLN OFFICE  
825 "J" Street  
PO Box 80358  
Lincoln, NE 68508

# PENETRATION DIAGRAM OF DUTCH FRICTION-CONE PENETROMETER

PROJECT: **Helen Boosalis Park Indoor Shooting Complex  
Lincoln, Nebraska**

SOUNDING NO.: **S-3**  
LOCATION: **B-3**  
SURFACE ELEVATION: **0.0 feet**

DATE: **March 15, 2013**  
TESTED BY: **CL**  
RECORDED BY: **GW**

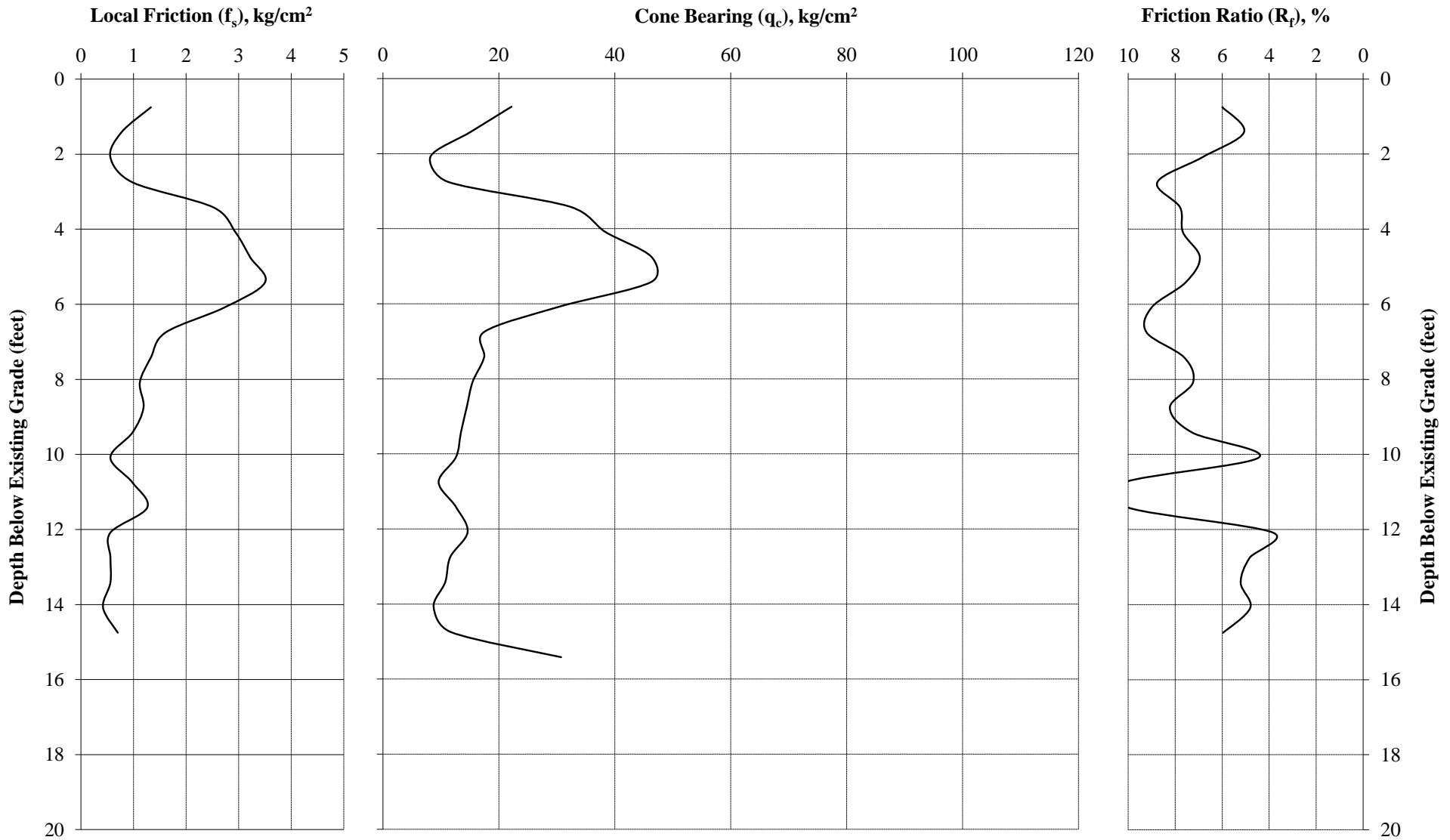


Figure C-3a



LINCOLN OFFICE  
825 "J" Street  
PO Box 80358  
Lincoln, NE 68508

**PENETRATION DIAGRAM OF  
DUTCH FRICTION-CONE PENETROMETER**

PROJECT: **Helen Boosalis Park Indoor Shooting Complex  
Lincoln, Nebraska**

SOUNDING NO.: **S-4**  
LOCATION: **B-4**  
SURFACE ELEVATION: **1145.1 feet**

DATE: **March 15, 2013**  
TESTED BY: **CL**  
RECORDED BY: **GW**

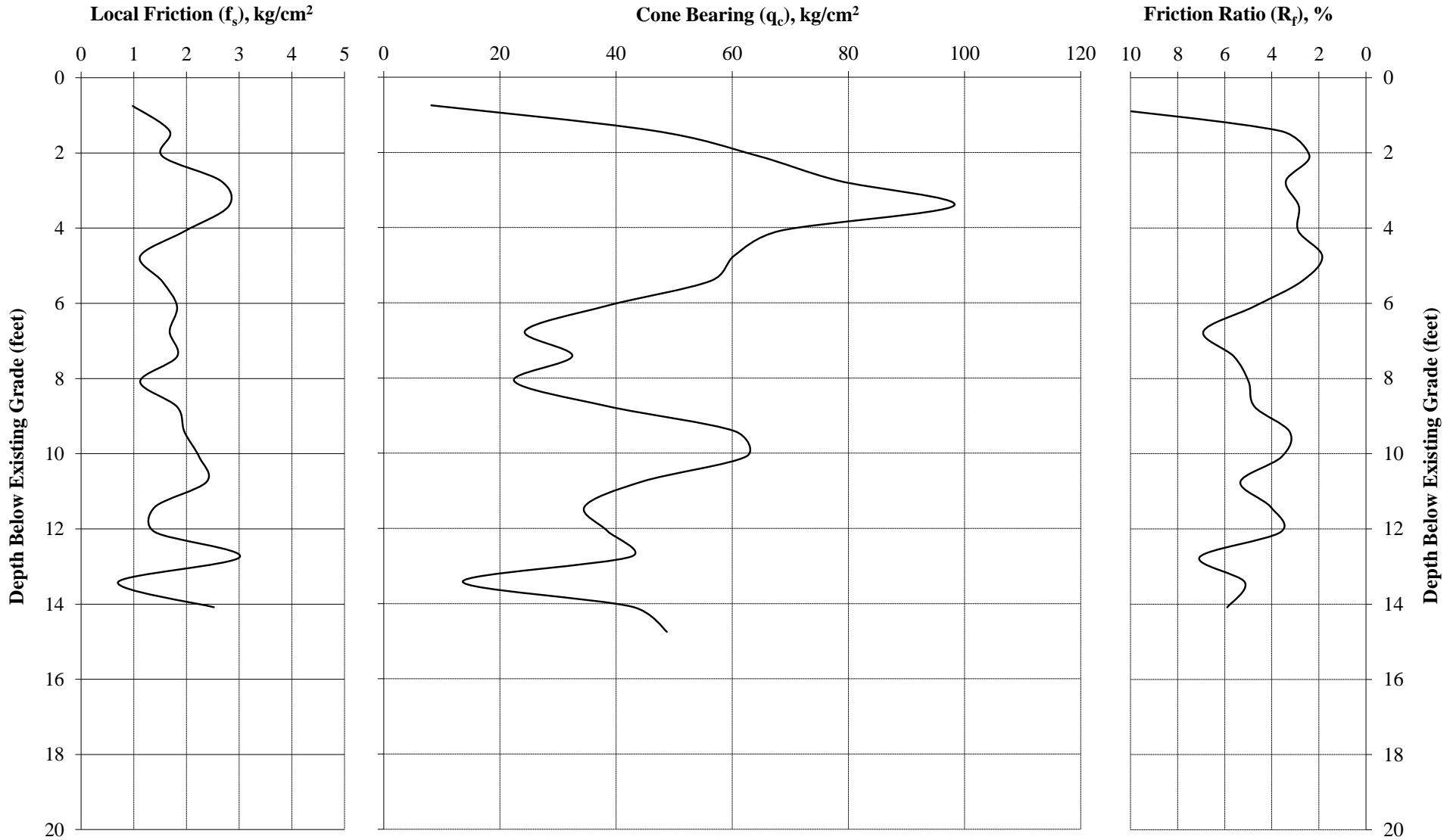


Figure C-4a





LINCOLN OFFICE  
825 "J" Street  
PO Box 80358  
Lincoln, NE 68508

# PENETRATION DIAGRAM OF DUTCH FRICTION-CONE PENETROMETER

PROJECT: **Helen Boosalis Park Indoor Shooting Complex**  
**Lincoln, Nebraska**

SOUNDING NO.: **S-5**  
LOCATION: **B-5**  
SURFACE ELEVATION: **1148.8 feet**

DATE: **March 15, 2013**  
TESTED BY: **CL**  
RECORDED BY: **GW**

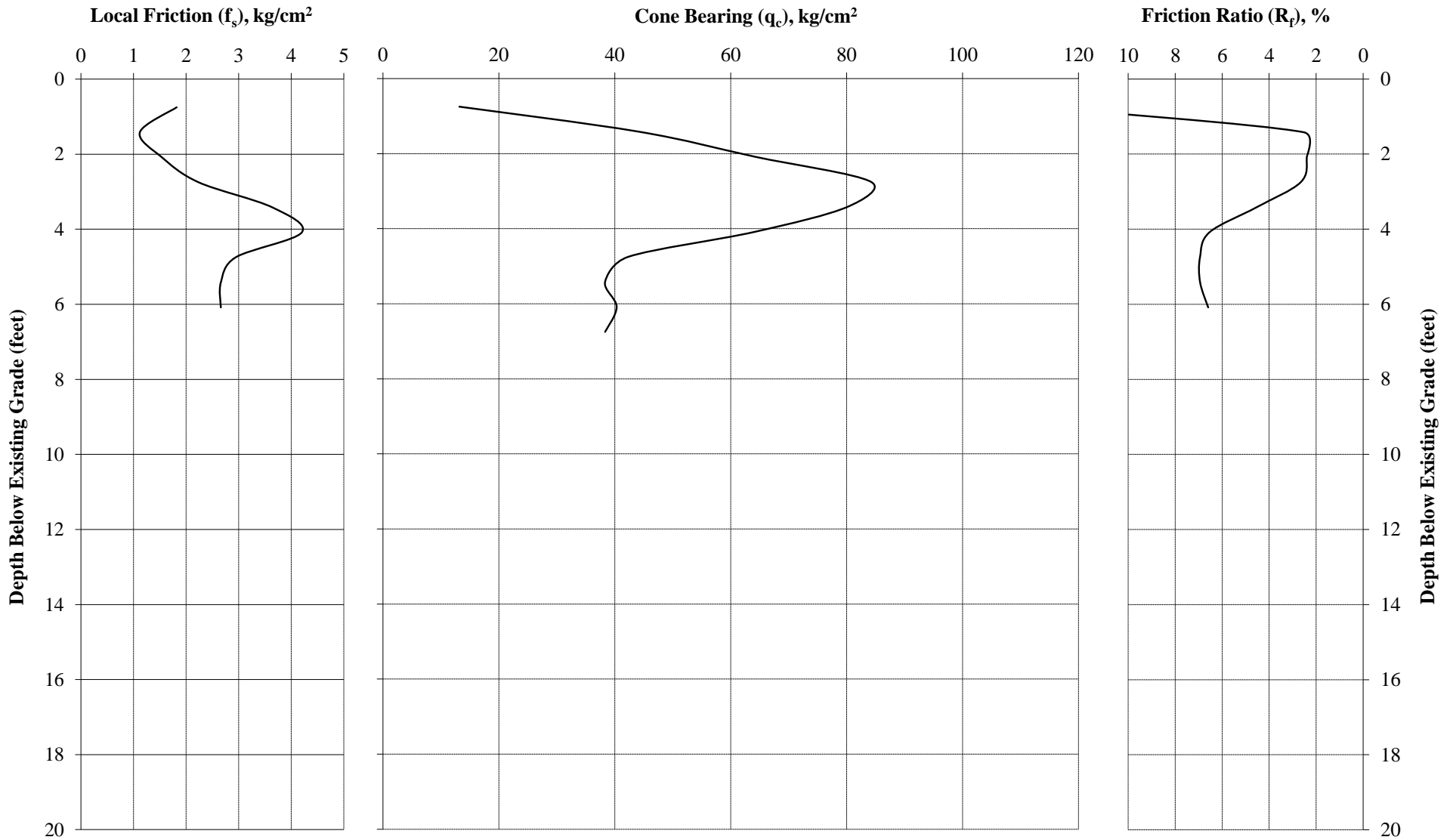


Figure C-5a

**APPENDIX C. BORING LOGS**



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

**BORING LOG**

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-1

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	qu (tsf)	DEPTH (feet)
1149.1	0.0		SM - SILTY SAND; 75-85% fine to coarse sand; nonplastic; black; moist; loose; with 40-50% of the sand made of cinders. (Fill)			0.0
1148.6	0.5		CL - LEAN CLAY; 5-15% fine to coarse sand; medium plasticity; very dark brown; wet; medium stiff. (Fill)			
1147.9	1.2		CL/CH - LEAN TO FAT CLAY; medium to high plasticity; black with very dark grayish brown and dark grayish brown; wet; very stiff. (Lower Subsoil)			
1147.1	2.0		CL - LEAN CLAY; medium plasticity; olive brown heavily mottled with dark grayish brown; wet; very stiff. (Lower Subsoil)			2.5
1146.1	3.0		CL - LEAN CLAY; medium plasticity; olive brown slightly mottled with white; wet; very stiff; with calcareous nodules. (Peoria)			
1143.5	5.6		CL - LEAN CLAY; medium plasticity; olive brown; wet; very stiff. (Peoria)	1	3.5*	5.0
1142.3	6.8		CL - LEAN CLAY; medium plasticity; light olive brown slightly mottled with white; wet; stiff; with trace of calcareous nodules. (Peoria)		3.75*	7.5
1141.1	8.0		CL - LEAN CLAY; medium plasticity; light olive brown; wet; stiff. (Peoria)			
1139.1	10.0		Boring Terminated at: 10.0ft			10.0
						12.5
						15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

\* Unconfined compressive strength was estimated using a calibrated hand penetrometer.

Figure C - 1



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

# BORING LOG

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-2

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1150.5	0.0		CL - LEAN CLAY; medium plasticity; black; wet; frozen. (Topsoil)				0.0
1150.0	0.5		CL - LEAN CLAY; medium plasticity; black; wet; soft to medium stiff. (Topsoil)				
1149.5	1.0		CH - FAT CLAY; high plasticity; brown; wet; very stiff. (Subsoil)				
1149.0	1.5		CH - FAT CLAY; high plasticity; olive brown with dark brown; moist; hard. (Subsoil)				
1148.0	2.5		CL - LEAN CLAY; medium plasticity; olive brown slightly mottled with brown; moist; hard. (Lower Subsoil)	2	89.8	15.3	2.5
1147.0	3.5		CL - LEAN CLAY; medium plasticity; light yellowish brown; moist; very stiff. (Peoria)				
1146.0	4.5		CL - LEAN CLAY; same as above except light olive brown. (Peoria)				5.0
1145.0	5.5		CL - LEAN CLAY; medium plasticity; light olive brown; moist to wet; very stiff. (Peoria)				
1144.0	6.5		CL - LEAN CLAY; medium plasticity; light olive brown; wet; very stiff. (Peoria)				7.5
1142.5	8.0		CL - LEAN CLAY; same as above except stiff to very stiff. (Peoria)				10.0
1140.0	10.5		CL - SANDY LEAN CLAY; 40-50% fine to medium sand; medium plasticity; olive brown; wet; very stiff. (Peoria Alluvium)				
1139.5	11.0		SP-SM - POORLY GRADED SAND with Silt; 85-95% fine to medium sand; nonplastic; light yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				
1139.0	11.5		SC - CLAYEY SAND; 55-65% fine sand; medium plasticity; olive brown; moist to wet; loose to medium dense. (Peoria Alluvium)				
1138.0	12.5		SM - SILTY SAND; 75-85% fine sand; low plasticity; light olive brown with olive brown; moist; loose to medium dense; with few thin clayey sand seams. (Peoria Alluvium)				12.5
1135.5	15.0		Boring Terminated at: 15.0ft				15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

Figure C - 2



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

**BORING LOG**

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-3

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	qu (tsf)	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1148.8	0.0		SC-SM - SILTY, CLAYEY SAND; 0-5% fine gravel; 75-85% fine to coarse sand; low to medium plasticity; black; moist to wet; loose to medium dense; with 20-30% cinders. (Fill)					0.0
1148.2	0.6		CL - LEAN CLAY; medium plasticity; very dark grayish brown; wet; medium stiff to stiff. (Topsoil)					
					1.75*			
1146.7	2.1		CL - LEAN CLAY; medium plasticity; dark brown; moist; hard. (Topsoil)					
1146.3	2.5		CL - LEAN CLAY; medium plasticity; dark brown with very dark brown; moist; hard. (Subsoil)	3	2.5*	102.7	13.4	2.5
1145.1	3.7		CL - LEAN CLAY; medium plasticity; light yellowish brown with dark grayish brown; moist; very stiff. (Lower Subsoil)					
1144.8	4.0		CL - LEAN CLAY; medium plasticity; light yellowish brown slightly mottled with dark grayish brown; moist to wet; very stiff. (Peoria)					
								5.0
1142.8	6.0		CL - LEAN CLAY; medium plasticity; light olive brown; wet; stiff. (Peoria)					
								7.5
1139.8	9.0		CL - LEAN CLAY; same as above except medium stiff to stiff. (Peoria)					
1138.8	10.0		Boring Terminated at: 10.0ft					10.0
								12.5
								15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

\* Unconfined compressive strength was estimated using a calibrated hand penetrometer.

Figure C - 3



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

# BORING LOG

BORING No.: B-4

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1145.1	0.0		CL - LEAN CLAY; medium plasticity; black; wet; medium stiff, friable. (Topsoil)				0.0
1144.4	0.7		CL/CH - LEAN TO FAT CLAY; medium to high plasticity; brown mottled with very dark grayish brown; wet; stiff. (Subsoil)				
1143.9	1.2		CL - LEAN CLAY; medium plasticity; olive brown slightly mottled with black; wet; stiff. (Peoria)				
1143.4	1.7		CL - LEAN CLAY; medium plasticity; yellowish brown slightly mottled with white; moist; hard. (Peoria)				
				4	88.4	12.2	2.5
1141.8	3.3		SM - SILTY SAND; 70-80% fine sand; low plasticity; yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				
1141.5	3.6		CL - SANDY LEAN CLAY; 35-45% fine to medium sand; medium plasticity; light yellowish brown; moist; very stiff. (Peoria Alluvium)				
1140.6	4.5		SM - SILTY SAND; 75-85% fine to medium sand; nonplastic; yellowish brown with olive brown; moist; loose to medium dense. (Peoria Alluvium)				5.0
1139.1	6.0		SC-SM - SILTY, CLAYEY SAND; 70-80% fine sand; low to medium plasticity; olive brown; moist; loose to medium dense. (Peoria Alluvium)				
1138.1	7.0		SC - CLAYEY SAND; 70-80% fine sand; medium plasticity; olive brown; wet; loose to medium dense. (Peoria Alluvium)				
1137.6	7.5		SM - SILTY SAND; 75-85% fine sand; low plasticity; light yellowish brown with light olive brown; moist; loose to medium dense. (Peoria Alluvium)				7.5
1135.6	9.5		SP - POORLY GRADED SAND; 95-100% fine sand; nonplastic; light yellowish brown; moist; medium dense. (Peoria Alluvium)				
1135.1	10.0		Boring Terminated at: 10.0ft				10.0
							12.5
							15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

Figure C - 4



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

**BORING LOG**

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-5

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1148.8	0.0		CL - LEAN CLAY; medium plasticity; very dark grayish brown; wet; medium stiff, friable. (Topsoil)				0.0
1148.0	0.8		CH - FAT CLAY; high plasticity; brown; moist; very stiff. (Subsoil)				
1147.3	1.5		CL - LEAN TO FAT CLAY; medium to high plasticity; light olive brown; moist; very stiff. (Lower Subsoil)				
1146.3	2.5		CL - LEAN CLAY; medium plasticity; brown slightly mottled with black; moist; hard. (Lower Subsoil)	5	98.1	15.7	2.5
1144.7	4.1		CL - LEAN CLAY; medium plasticity; yellowish brown mottled with yellowish red and black; wet; very stiff. (Peoria)				
1143.8	5.0		CL - LEAN CLAY; medium plasticity; light olive brown; wet; stiff to very stiff. (Peoria)				5.0
1141.3	7.5		CL - LEAN CLAY; same as above except stiff. (Peoria)				7.5
1137.3	11.5		CL - LEAN CLAY with Sand; 15-25% fine sand; medium plasticity; light olive brown; wet; stiff. (Peoria Alluvium)				10.0
1136.3	12.5		SM - SILTY SAND; 75-85% fine sand; low plasticity; light yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				12.5
1135.8	13.0		CL - SANDY LEAN CLAY; 30-40% fine sand; medium plasticity; light olive brown; moist; stiff. (Peoria Alluvium)				
1134.3	14.5		SM - SILTY SAND; 75-85% fine sand; nonplastic; light yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				
1133.8	15.0		Boring Terminated at: 15.0ft				15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

Figure C - 5

**APPENDIX D. CRITERIA USED FOR SOIL CLASSIFICATION**



## USCS SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LESS THAN 5% FINES)		GW	WELL-GRADED GRAVEL
				GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES (MORE THAN 12% FINES)		GM	SILTY GRAVEL (LOW PLASTIC FINES)
				GC	CLAYEY GRAVEL (MEDIUM TO HIGH PLASTIC FINES)
	SAND AND SANDY SOILS	CLEAN SANDS (LESS THAN 5% FINES)		SW	WELL-GRADED SAND
				SP	POORLY-GRADED SAND
SANDS WITH FINES (MORE THAN 12% FINES)	SANDS WITH FINES (MORE THAN 12% FINES)		SM	SILTY SAND (LOW PLASTIC FINES)	
			SC	CLAYEY SAND (MEDIUM TO HIGH PLASTIC FINES)	
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	SILT (0-15% SAND) SILT WITH SAND (15-30% SAND) SANDY SILT (30-50% SAND)
				CL	LEAN CLAY (0-15% SAND) LEAN CLAY WITH SAND (15-30% SAND) SANDY LEAN CLAY (30-50% SAND)
				OL	ORGANIC SILTS AND LEAN CLAYS
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	ELASTIC SILT (0-15% SAND) ELASTIC SILT WITH SAND (15-30% SAND) SANDY ELASTIC SILT (30-50% SAND)
				CH	FAT CLAY (0-15% SAND) FAT CLAY WITH SAND (15-30% SAND) SANDY FAT CLAY (30-50% SAND)
				OH	ORGANIC ELASTIC SILTS AND FAT CLAYS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

## GENERAL NOTES

### CRITERIA FOR DESCRIBING CLAY SOILS

MOISTURE CONDITION		CONSISTENCY	
Description	Criteria	Description	Penetration Resistance, $N_{60}$ (blows/ft) <sup>1</sup>
Dry	Absence of moisture, dusty, dry to touch.	Very Soft	Less than 3
Moist	Damp, slightly wet, moisture content below plastic limit.	Soft	3 to 4
Wet	Moisture content above the plastic limit.	Medium Stiff	5 to 8
Saturated	Very wet. Usually soil is below the water table.	Stiff	9 to 16
		Very Stiff	16 to 32
		Hard	Greater than 32

### CRITERIA FOR DESCRIBING GRANULAR SOILS

MOISTURE CONDITION		DENSITY	
Description	Criteria	Description	Penetration Resistance, $N_{60}$ (blows/ft) <sup>1</sup>
Dry	Absence of moisture, dry to the touch.	Very Loose	Less than 5
Moist	Damp but no visible free water.	Loose	5 to 10
Wet	Visible free water.	Medium Dense	11 to 30
Saturated	Usually soil is below water table.	Dense	31 to 50
		Very Dense	Greater than 50

### CRITERIA FOR DESCRIBING ROCK

#### STRENGTH/HARDNESS

Description	Criteria
Very Soft	Permits denting by moderate pressure of the fingers.
Soft	Resists denting by the fingers, but can be abraded and pierced to a shallow depth by a pencil point.
Moderately Soft	Resists a pencil point, but can be scratched and cut with a knife blade.
Moderately Hard	Resistant to abrasion or cutting by a knife blade, but can be easily dented or broken by light blows of a hammer.
Hard	Can be deformed or broken by repeated moderate hammer blows.
Very Hard	Can be broken only by heavy, and in some rocks, repeated hammer blows.

<sup>1</sup>Blow counts shown on the boring logs are those recorded directly in the field and have not been corrected for hammer efficiency. The boring log blow counts must be corrected to an equivalent hammer efficiency of 60% in order to use the criteria in this table.

## ROCK QUALITY DESIGNATION (RQD)

This is a general method by which the quality of the rock at a site is obtained based on the relative amount of fracturing and alteration.

The Rock Quality Designation (RQD) is based on a modified core recovery procedure that, in turn, is based indirectly on the number of fractures (except those due directly to drilling operations) and the amount of softening or alteration in the rock mass as observed in the rock cores from a drill hole. Instead of counting the fractures, an indirect measure is obtained by summing the total length of core recovered by counting only those pieces of hard and sound core which are 4 inches or greater in length. The ratio of this modified core recovery length to the total core run length is known as the RQD.

An example is given below from a core run of 60 inches. For this particular case, the total core recovery is 50 inches yielding a core recovery of 83 percent. On the modified basis, only 38 inches are counted the RQD is 63 percent.

---

<b>CORE RECOVERY, in</b>	<b>MODIFIED CORE RECOVERY, in</b>
10	10
2	-
2	-
3	-
4	4
5	5
3	-
4	4
6	6
4	4
2	-
5	5
-----	-----
50	38

$$\% \text{ Core Recovery} = 50/60 = 83\%; \text{ RQD} = 38/60 = 63\%$$

A general description of the rock quality can be made for the RQD value as follows:

<b><u>RQD</u></b>	<b><u>DESCRIPTION OF ROCK QUALITY</u></b>
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

---

**SECTION 01 11 00**  
**SUMMARY OF WORK**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes the following:
1. Work covered by the Contract Documents.
  2. Work phases.
  3. Work under other contracts.
  4. Use of premises.
  5. Specification formats and conventions.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Helen Boosalis Park Indoor Shooting Complex  
ADA Project # 12-121
1. Project Location: Superior Street and North 44<sup>th</sup> Street  
Lincoln, NE
- B. Owner: City of Lincoln, NE
1. Owner's Representative: J.J. Yost, City of Lincoln Parks & Recreation Department.
- C. Architect: Architectural Design Associates, P.C.
1. Project Manager/Principal-In-Charge: Dick Bergt
  2. Project Architect: John Hathaway
- D. The Work consists of the following:
1. Construction of an indoor shooting complex including a metal building designed for archery and a precast concrete building for a pistol range. The work generally includes site clearing; site grading and earthwork; site paving; site utilities; seeding of lawn areas; chain-link fencing and gates; cast-in-place concrete footings, foundations and slabs; some colored concrete floors; precast concrete walls and roof structure; a pre-engineered metal building system; EPDM roofing with roof insulation; sheet metal flashings, gutters and downspouts; aluminum entrances and windows; coiling counter doors and OH coiling door; wood doors; hollow metal doors and frames; gypsum board assemblies; acoustical ceiling systems; painting; tile carpeting; plastic laminate casework and counters; toilet partitions and accessories; folding panel partitions, mechanical and plumbing systems, and electrical systems.
- E. Project will be constructed under a single prime contract.

1.03 WORK PHASES

- A. The Work shall be conducted in a single phase.

#### 1.04 USE OF PREMISES

- A. General: Contractor shall have full use of the immediate premises for construction operations, as shown on the Drawings. No parking or material storage is allowed on public streets and adjacent private parking lots. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

#### 1.05 WORK RESTRICTIONS

- A. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor air intakes.

#### 1.06 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI/CSC's 2011 "MasterFormat" numbering system.

- 1. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

- 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

- a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

#### **PART 2 - PRODUCTS (Not Used)**

#### **PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 11 00

## SECTION 01 21 00

### ALLOWANCES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
  - 1. Certain materials and equipment are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
  - 1. Unit-cost allowances for material furnished.
  - 2. Each allowance is part of the contract amount and must be included in the base bid. Any allowance not used in the course of the project will be returned to the Owner through a credit change order ahead of the closeout of the project.
- C. Related Sections include the following:
  - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

##### 1.03 ALLOWANCES, GENERAL

- A. At Contract Closeout, the Contract Sum shall be adjusted by Change Order to recognize any cost change that is more or less than the allowances.

##### 1.04 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

##### 1.05 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

- C. Prior to Final Payment application, submit invoices for services performed or for materials delivered to the site for use in fulfillment of each allowance.

#### 1.06 UNUSED MATERIALS

- A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
- B. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### 3.01 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

#### 3.02 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

#### 3.03 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: CARPET TILE – Include a unit cost allowance of \$30.00 per square yard for the purchase and delivery of carpet tile material only, to be selected by the Architect and the Owner. Contractor shall be responsible for estimating the number of square yards of carpet tile required for the installation and shall include total number of estimated yards on the Bid Form. Cost of labor for installation of carpet tile and cost of carpet tile accessories shall be included in the Base Bid as specified in Division 9 Section "Tile Carpeting".

END OF SECTION 01 21 00

## SECTION 01 23 00

### ALTERNATES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for alternates.

##### 1.02 DEFINITIONS

- A. Alternate: An amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.
  - 1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the alternate into the Work. No other adjustments are made to the Contract Sum.

##### 1.03 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into the Project.
  - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to, or required for a complete installation whether or not indicated as part of the alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in the schedule contain requirements for materials necessary to achieve the work described under each alternate.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.01 SCHEDULE OF ALTERNATES

- A. ADD Alternate 1: On the Bid Form, state the cost to **ADD** all work associated with exterior concrete vehicular paving for the parking lot, trash dumpster pad, overhead door approaches, formed curbs and drives only, as indicated in the Drawings. Include in cost all site preparation for the paving. All sidewalks are included in the Base Bid. The purpose of this alternate is to determine the cost of this work which will be funded from a specific source.



- B. ADD Alternate 2: On the Bid Form, state the cost to **ADD** all work associated with providing and installing the three (3) folding panel partitions indicated for Classrooms 119, 121 and 122, as specified in Division 10 Section "Folding Panel Partitions". All bulkheads, steel beams and columns for the support of these partitions are included in the Base Bid.
- C. ADD Alternate 3: On the Bid Form, state the cost to **ADD** all work associated with the 10'-0" high chain link fence, hydraulic operated 16'-0" wide horizontal gate, a 4'-0" x 7'-0" personnel gate, and 4 concrete filled and painted pipe bollards, all as shown on the civil drawings and as specified in Division 32 Section "Chain Link Fences and Gates".
- D. ADD Alternate 4: On the Bid Form, state the cost to **ADD** all work associated with upgrading the 10m air gun range to a functioning 50 yard, .22cal pistol range, including: Remove temporary wall "L" and door 105B. Remove transfer air ductwork at this wall. Add air dams from 8'-0" above finished floor. Increase make-up-air unit MAU-1 to full fan speed. Add forced-air-unit FAU-1 with related ductwork and concrete curbs. Add specified rubber bullet trap with armored steel baffles. Add Troy Acoustics insulation to sidewalls and firing line side of the concrete Twin-Tee roof structure. Add 1/2" thick laminated glass at the range side of all HM framed windows. Add acoustical ceiling system above firing line. Refer to Drawings and Division 13 Specifications.
- E. ADD Alternate 5: On the Bid Form, state the additive cost to **ADD** all work associated with not installing the rubber bullet trap and baffles required in Alternate 4, and to add, in lieu thereof, a steel trap with redirective baffles, all as shown on the Drawings and specified in Division 13 Specifications.

END OF SECTION 01 23 00

## SECTION 01 25 00

### SUBSTITUTION PROCEDURES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for requests for substitutions by the Contractor that do not require modification of Contract Sum or Contract Time.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 1 Section "Contract Modification Procedures" for modifications requiring change of Contract Sum or Contract Time.

##### 1.03 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction proposed by the Contractor after award of the Contract and that do not require modification of Contract Sum or Contract Time are considered to be requests for substitutions.
- B. The following are not considered to be requests for substitutions:
  - 1. Substitutions requested during bidding, and accepted by Addendum prior to award of the Contract.
    - a. Substitutions requested during bidding period must be submitted no later than 5 working days prior to date of bid opening
  - 2. Specified choices of products and options included in the Contract Documents.

##### 1.04 SUBMITTALS

- A. Substitution Request Submittal: Submit the following:
  - 1. Submit 3 copies of each request for substitution for consideration.
  - 2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
  - 3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
    - a. Coordination information, including a list of changes or modifications needed to other parts of the Work that will be necessary to accommodate the proposed substitution.
    - b. A comparison of qualities of the proposed substitution with those of the Work specified.
    - c. Product Data, including Drawings and fabrication and installation procedures.
    - d. Samples, where applicable or requested.

4. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Architect will notify the Contractor of acceptance or rejection of the substitution within 2 weeks of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a letter from the Architect.

## **PART 2 - PRODUCTS**

### **2.01 SUBSTITUTIONS**

- A. The Architect will receive and consider the Contractor's request for substitution only when all of the following conditions are satisfied:
  1. Extensive revisions to the Contract Documents are not required.
  2. Proposed changes are in keeping with the general intent of the Contract Documents.
  3. The request is timely, fully documented, and properly submitted.
- B. Requests for substitutions must be based on at least one of the following conditions:
  1. The request is directly related to an "or-equal" clause in the Contract Documents.
  2. The specified product cannot be provided within the Contract Time.
  3. The specified product cannot receive necessary approval by a governing authority.
  4. The specified product cannot be provided in a manner that is compatible with other materials.
- C. The Architect's acceptance of Shop Drawings, Product Data, or Samples not complying with the Contract Documents does not constitute a valid request for substitution, nor do they constitute approval.

## **PART 3 - EXECUTION (Not Applicable)**

END OF SECTION 01 25 00

## SECTION 01 26 00

### CONTRACT MODIFICATION PROCEDURES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. If included, see Division 01 Section "Allowances" for procedural requirements for handling and processing allowances.
- C. If included, see Division 01 Section "Unit Prices" for administrative requirements for using unit prices.

##### 1.02 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on a form titled "Architect's Supplemental Instructions".

##### 1.03 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by the Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within five (5) days after receipt of the Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Architect.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  4. Include costs of labor and supervision directly attributable to the change.
  5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Architect will issue proposal requests on a form titled "Proposal Request".

#### 1.04 ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
1. Include installation costs in purchase amount only where indicated as part of the allowance.
  2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
  3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
  4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 21 days after such authorization.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
  2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

#### 1.05 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.06 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates the method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 26 00

## SECTION 01 29 00

### PAYMENT PROCEDURES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

##### 1.02 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with Continuation Sheets. Submittals Schedule and Contractor's Construction Schedule.
  - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the Schedule of Values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Submit draft of AIA Document G703 Continuation Sheets.
  - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
  - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  - 5. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

##### 1.03 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Progress payments shall be submitted to Architect as indicated in the Agreement between Owner and Contractor. The period covered by each Application for Payment is one month, ending on the last day of the month.
- D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets, as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
  - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit 4 signed and notarized original copies of each Application for Payment to Architect. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of Values.
  - 3. Contractor's Construction Schedule (preliminary if not final).
  - 4. Submittals Schedule (preliminary if not final).
  - 5. List of Contractor's staff assignments.
  - 6. List of Contractor's principal consultants.
  - 7. Copies of building permits.
  - 8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  - 9. Initial progress report.
  - 10. Report of preconstruction conference.
  - 11. Certificates of insurance and insurance policies.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
  - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  - 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
  - 1. Evidence of completion of Project closeout requirements.



2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 29 00

## SECTION 01 31 00

### PROJECT MANAGEMENT AND COORDINATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Project Meetings.
  - 3. Requests for Interpretation (RFI's).

##### 1.02 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

##### 1.03 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other Contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate Contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's Construction Schedule.
  - 2. Preparation of the Schedule of Values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.

6. Pre-installation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.
10. Sections.

#### 1.04 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
  
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
  1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for RFIs.
    - g. Procedures for testing and inspecting.
    - h. Procedures for processing Applications for Payment.
    - i. Distribution of the Contract Documents.
    - j. Submittal procedures.
    - k. Preparation of Record Documents.
    - l. Use of the premises and existing building.
    - m. Work restrictions.
    - n. Owner's occupancy requirements.
    - o. Responsibility for temporary facilities and controls.
    - p. Construction waste management and recycling.
    - q. Parking availability.
    - r. Office, work, and storage areas.
    - s. Equipment deliveries and priorities.
    - t. First aid.
    - u. Security.
    - v. Progress cleaning.
    - w. Working hours.
  3. Minutes: Record and distribute meeting minutes.

- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.
    - b. Options.
    - c. Related RFI's.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written recommendations.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at the earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at monthly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of the Owner and Architect, each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of the Project. Refer to "Monthly Coordination Meeting" Agenda following this section.

- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to the Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review the schedule for the next period.

- b. Review present and future needs of each entity present, including the following:

- 1) Interface requirements.
  - 2) Sequence of operations.
  - 3) Status of submittals.
  - 4) Deliveries.
  - 5) Off-site fabrication.
  - 6) Access.
  - 7) Site utilization.
  - 8) Temporary facilities and controls.
  - 9) Work hours.
  - 10) Hazards and risks.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of correction of deficient items.
  - 14) Field observations.
  - 15) RFIs.
  - 16) Status of proposal requests.
  - 17) Pending changes.
  - 18) Status of Change Orders.
  - 19) Pending claims and disputes.
  - 20) Documentation of information for payment requests.

- 3. Minutes: Record the meeting minutes.

- 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

- a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

#### 1.05 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at the Project meeting, prepare and submit an RFI in the form specified.

- 1. RFIs shall originate with the Contractor. RFIs submitted by entities other than the Contractor will be returned with no response.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in the Contractor's work or the work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of the item needing interpretation and the following:

- 1. Project name.
  - 2. Date.
  - 3. Name of Contractor.
  - 4. Name of Architect.

5. RFI number, numbered sequentially.
  6. Specification Section number and title and related paragraphs, as appropriate.
  7. Drawing number and detail references, as appropriate.
  8. Field dimensions and conditions, as appropriate.
  9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  10. Contractor's signature.
  11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Transmittal: Contractor's standard form. RFIs shall be submitted by e-mail in Adobe PDF format, or by facsimile (Fax).
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven (7) working days for the Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of the Architect's actions on submittals.
    - f. Incomplete RFIs or RFIs with numerous errors.
  2. The Architect's action may include a request for additional information, in which case the Architect's time for response will start again.
  3. The Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for the Contractor to submit a Change Proposal according to Division 01 Section "Contract Modification Procedures."
    - a. If the Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify the Architect in writing within ten (10) days of receipt of the RFI response.
- E. On receipt of the Architect's action, update the RFI log and immediately distribute the RFI response to the affected parties. Review response and notify the Architect within seven (7) days.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit the log at each Coordination Meeting. Include the following:
1. Project name.
  2. Name and address of the Contractor.
  3. Name and address of the Architect.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date the Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 31 00

## MONTHLY COORDINATION MEETING

**Project:**

**Date:**

1. Schedule - Status
2. Anticipated Delays
3. Questions with the contract documents.
4. Changes to the work.
5. Shop drawing-status, outstanding, or to be submitted.
6. Coordination of items provided by Owner.
7. Owner's comments.
8. Architect's comments.
9. Contractor's comments.
10. Subcontractor's comments.
11. Next meeting date and time.
12. Pay application review.



## SECTION 01 32 00

### CONSTRUCTION PROGRESS DOCUMENTATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's Construction Schedule.
  - 2. Submittals Schedule.
  - 3. Field Condition Reports.
- B. See Division 01 Section "Payment Procedures" for submitting the Schedule of Values.

##### 1.02 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either the Owner or the Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and the Contract completion date.
- E. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- F. Major Area: A story of construction, a separate building, or a similar significant construction element.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
  - 1. Scheduled date for first submittal.
  - 2. Specification Section number and title.
  - 3. Submittal category (action or informational).
  - 4. Name of subcontractor.
  - 5. Description of the Work covered.
  - 6. Scheduled date for the Architect's final release or approval.
- C. Contractor's Construction Schedule: Submit two opaque copies of the initial schedule, large enough to show the entire schedule for the entire construction period.
  - 1. Submit an electronic copy of the schedule, using the software indicated, on CD-R, and labeled to comply with the requirements for submittals. Include the type of schedule (Initial or Updated) and date on label.
- D. Field Condition Reports: Submit two (2) copies at the time of discovery of differing conditions.
- E. Transmit Contractor's Construction Schedule, Submittals Schedule and Field Condition Reports to Architect in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.

#### 1.04 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate Contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, List of Subcontracts, Submittals Schedule, Progress Reports, Payment Requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from parties involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## PART 2 - PRODUCTS

#### 2.01 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by the construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
  - 1. Coordinate Submittals Schedule with the list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
  - 2. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

#### 2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend the schedule from the date established for commencement of the Work to the date of Substantial and Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by a Change Order.
- B. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in the schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange the list of activities on the schedule by phase.
  2. Work Under More Than One Contract: Include a separate activity for each contract.
  3. Work by Owner: Include a separate activity for each portion of the Work performed by the Owner.
  4. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Substantial Completion.
    - e. Use of premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  5. Work Stages: Indicate important stages of construction for each major portion of the Work.
  6. Milestones: Include milestones indicated in the Contract Documents in the schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

## 2.03 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary Network Diagram: Submit diagram within fourteen (14) days of the date established for the commencement of the Work. Outline significant construction activities for the first sixty (60) days of construction. Include a skeleton diagram for the remainder of the Work and a cash requirement prediction based on the indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
1. Develop the network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than thirty (30) days after the date established for the commencement of the Work.
    - a. Failure to include any work item required for the performance of this Contract shall not excuse the Contractor from completing all work within the applicable completion dates, regardless of the Architect's approval of the schedule.
  2. Establish procedures for monitoring and updating the CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  3. Use "one workday" as the unit of time. Include a list of nonworking days and holidays incorporated into the schedule.

- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.
    - h. Work by the Owner that may affect or be affected by the Contractor's activities.
    - i. Testing and commissioning.
  2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
  3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
  4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Principal events of activity.
  4. Immediate preceding and succeeding activities.
  5. Early and late start dates.
  6. Early and late finish dates.
  7. Activity duration in workdays.
  8. Total float or slack time.
  9. Average size of workforce.
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
  2. Changes in early and late start dates.
  3. Changes in early and late finish dates.
  4. Changes in activity durations in workdays.
  5. Changes in the critical path.
  6. Changes in total float or slack time.
  7. Changes in the Contract Time.

## 2.04 REPORTS

- A. Field Condition Reports: Immediately on discovery of a difference between the field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## PART 3 - EXECUTION

### 3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update the schedule to reflect the actual construction progress and activities. Issue the schedule at each regularly scheduled progress meeting.
  - 1. Revise the schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with the updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of the approved schedule to the Architect, Owner, separate Contractors, testing and inspecting agencies, and other parties identified by the Contractor with a need-to-know schedule responsibility.
  - 1. Post copies in the Project meeting rooms and the temporary field offices.
  - 2. When revisions are made, distribute the updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in the performance of the construction activities.

END OF SECTION 01 32 00

## SECTION 01 32 33

### PHOTOGRAPHIC DOCUMENTATION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
- B. See Division 01 Section "Closeout Procedures" for submitting digital media as Project Record Documents at Project closeout.
- C. See Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of the Owner's personnel.

##### 1.02 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Construction Photographs: Submit digital photographs of each photographic view within seven (7) days of taking photographs.
  - 1. Format: Digital photos shall be submitted in either JPG image format or inserted into a Microsoft Word document or in an Adobe PDF document.
  - 2. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

#### PART 2 - PRODUCTS

##### 2.01 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 2.0 megapixels, and at an image resolution of not less than 1280 x 960 pixels.

#### PART 3 - EXECUTION

##### 3.01 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work.

- B. Film Images:
1. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so the stamp is integral to the photograph.
  2. Field Office Prints: Retain one set of prints of progress photographs in the field office at the Project site, available at all times for reference. Identify photographs the same as for those submitted to the Architect.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
1. Date and Time: Include the date and time in the filename for each image.
  2. Field Office Images: Maintain one set of images on CD-ROM in the field office at the Project site, available at all times for reference. Identify images the same as for those submitted to the Architect.
- D. Preconstruction Photographs: Before commencement of demolition, take digital photographs of the Project site and surrounding properties, including existing items to remain during construction, from different vantage points.
1. Flag construction limits before taking construction photographs.
  2. Take photographs to show existing conditions adjacent to the property before starting the Work.
  3. Take photographs of existing buildings on adjoining property to accurately record physical conditions at the start of construction.
  4. Take exterior and interior photographs of existing conditions of the property to accurately record physical conditions at the start of construction.
    - a. Show existing conditions including existing damage that might be misconstrued as damage caused by demolition or construction operations. Submit photos before Work begins.
- E. Periodic Construction Photographs: Take photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show the status of construction and progress since last photographs were taken.

END OF SECTION 01 32 33

## SECTION 01 33 00

### SUBMITTAL PROCEDURES

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, RFI's (Requests for Information) and other submittals.
- B. Transmit RFI's, Proposal Requests, Meeting notes, Test Reports, Shop Drawings, Product Data submittals and Close-out Submittals to Architect in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.
  - 1. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
  - 2. The electronic submittal process is not intended for the following:
    - a. Color samples, color charts, physical material samples.
    - b. Applications for Payment.
- C. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 1 Section "Closeout Procedures" for submitting warranties.
  - 2. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 3. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

##### 1.02 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

##### 1.03 SUBMITTAL PROCEDURES

- A. Submittal Exchange Website Service Fee: Include the cost of **\$2,895.00** for Submittal Exchange in the Base Bid, for the full contract administration services from Submittal Exchange. For questions, contact Submittal Exchange at 1-800-714-0024 or the Architect.
- B. Electronic Submittal Procedures:
  - 1. Submittal Preparation - Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via e-mail. Provide electronic (PDF) submittals to Contractor via the Submittal Exchange website.
  - 2. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
  - 3. Contractor shall transmit each submittal to Architect via e-mail. Submit electronic (PDF) submittals via the Submittal Exchange website, [www.submittalexchange.com](http://www.submittalexchange.com).



4. Architect / Engineer review comments will be forwarded by e-mail. Comments will be made available on the Submittal Exchange website for downloading, where Contractor will receive email notice of completed review.
  5. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
  6. Training: Training is available from Submittal Exchange regarding use of website and PDF submittals. Contact Submittal Exchange at 1-800-714-0024.
  7. Internet Service and Equipment Requirements:
    - a. Email address and Internet access at Contractor's main office.
    - b. Adobe Acrobat ([www.adobe.com](http://www.adobe.com)), Bluebeam PDF Revu ([www.bluebeam.com](http://www.bluebeam.com)), or other similar PDF review software for applying electronic stamps and comments.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow ten (10) business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow ten (10) business days for review of each resubmittal.
- F. Identification: The following is required on each submittal for identification:
1. Name of firm or entity that prepared each submittal.
  2. Include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name and address of Contractor.
    - e. Name and address of Subcontractor.
    - f. Name and address of Supplier.
    - g. Name of Manufacturer.
    - h. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 10 00.01).

- 2) Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06 10 00.01.A).
  - i. Number and title of appropriate Specification Section.
  - j. Drawing number and detail references, as appropriate.
  - k. Location(s) where product is to be installed, as appropriate.
  - l. Other necessary identification.
- G. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- H. Transmittal: Transmit Shop Drawings and Product Data to Architect in electronic (PDF) format using "Submittal Exchange", a website service designed for transmitting these submittals between construction team members. For Samples, package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, if received from sources other than Contractor.
  1. Transmittal Form: Use Contractor's standard form.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
- J. Distribution: Furnish PDF format copies and/or actual samples of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Use only final submittals with mark indicating "No Exceptions Taken" or "Make Corrections Noted" taken by Architect.

#### 1.04 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
  1. Architect makes no representations as to the accuracy or completeness of CAD drawings as they relate to the Contract Drawings. A waiver will be submitted for signature.
  2. CAD Software Program: The Contract Drawings are available in AutoCAD 2004.
  3. Payment of \$100.00 per request may be required by the Architect prior to the release of any Drawing in electronic format. Additionally, a signed copy of a "Digital Data Licensing Agreement", AIA Document C106 – 2007, will be required prior to the release of any Drawing in electronic format.

#### 1.05 SHOP DRAWINGS

- A. Submit newly prepared information drawn accurately to scale. Indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information. Standard information prepared without specific reference to the Project is not a Shop Drawing.
- B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings.

1. Do not use Shop Drawings without an appropriate final stamp indicating action taken.
2. Do not proceed with installation until a copy of Shop Drawings is in the Installer's possession.

#### 1.06 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Do not use Product Data without an appropriate final stamp indicating action taken.
2. Do not proceed with installation until a copy of Product Data is in the Installer's possession.

#### 1.07 SAMPLES

A. Submit full-size, fully fabricated Samples. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern. Mount or display Samples in the manner to facilitate review of qualities indicated.

B. Submittals: Submit 3 sets, unless otherwise required by the Architect. The Architect will retain two and return the other. Maintain sample, as returned, at the Project Site, for quality comparisons throughout the course of construction.

#### 1.08 QUALITY ASSURANCE SUBMITTALS

A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements. Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

#### 1.09 ARCHITECT'S ACTION

A. Except for submittals for the record or information, where action and return is required, the Architect will review each submittal, mark to indicate action taken, and return promptly.

B. Action Stamp: The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken.

C. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.

### **PART 2 - PRODUCTS (Not Applicable)**

### **PART 3 - EXECUTION (Not Applicable)**

END OF SECTION 01 33 00

## SECTION 01 40 00

### QUALITY REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 02 through 49 Sections for specific test and inspection requirements.

##### 1.02 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.
- D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

### 1.03 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.04 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- C. Reports: Prepare and submit certified written reports that include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and reinspecting.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.05 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.

2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

## 1.06 QUALITY CONTROL

- A. Contractor Responsibilities: Contractor will engage a qualified testing agency to perform these services.
1. Contractor will furnish Owner with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents shall be charged to Contractor as and additional expense, and the Contract Sum will not be adjusted by Change Order for these additional expenses.
- B. Tests and inspections not explicitly indicated or assigned are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
  2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Owner, Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Structural Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in electronic (PDF) format, directly to the Owner, Architect, Structural Engineer and Contractor, of each test, inspection, and similar quality-control service within 2 working days of attaining test results.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

## **PART 2 - PRODUCTS (Not Used)**

## **PART 3 - EXECUTION**

### **3.01 REPAIR AND PROTECTION**

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
  2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00



## SECTION 01 42 00

### REFERENCES

#### PART 1 - GENERAL

##### 1.01 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

##### 1.02 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

### 1.03 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. AA	Aluminum Association, Inc. (The)
2. AAADM	American Association of Automatic Door Manufacturers
3. AABC	Associated Air Balance Council
4. AAMA	American Architectural Manufacturers Association
5. AASHTO	American Association of State Highway and Transportation Officials
6. AATCC	American Association of Textile Chemists and Colorists (The)
7. ABAA	Air Barrier Association of America
8. ABMA	American Bearing Manufacturers Association
9. ACI	ACI International (American Concrete Institute)
10. ACPA	American Concrete Pipe Association
11. AEIC	Association of Edison Illuminating Companies, Inc. (The)
12. AF&PA	American Forest & Paper Association
13. AGA	American Gas Association
14. AGC	Associated General Contractors of America (The)
15. AHA	American Hardboard Association (Now part of CPA)
16. AHAM	Association of Home Appliance Manufacturers
17. AI	Asphalt Institute
18. AIA	American Institute of Architects (The)
19. AISC	American Institute of Steel Construction
20. AISI	American Iron and Steel Institute
21. AITC	American Institute of Timber Construction
22. ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
23. ALSC	American Lumber Standard Committee, Incorporated
24. AMCA	Air Movement and Control Association International, Inc.
25. ANSI	American National Standards Institute
26. AOSA	Association of Official Seed Analysts, Inc.
27. APA	Architectural Precast Association
28. APA	APA - The Engineered Wood Association
29. APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems
30. API	American Petroleum Institute
31. ARI	Air-Conditioning & Refrigeration Institute
32. ARMA	Asphalt Roofing Manufacturers Association
33. ASCE	American Society of Civil Engineers
34. ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
35. ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
36. ASME	ASME International (The American Society of Mechanical Engineers International)
37. ASSE	American Society of Sanitary Engineering
38. ASTM	ASTM International (American Society for Testing and Materials International)

- 39. AWCI AWCI International (Association of the Wall and Ceiling Industry International)
- 40. AWCMA American Window Covering Manufacturers Association (Now WCSC)
- 41. AWI Architectural Woodwork Institute
- 42. AWPA American Wood-Preservers' Association
- 43. AWS American Welding Society
- 44. AWWA American Water Works Association
- 45. BHMA Builders Hardware Manufacturers Association
- 46. BIA Brick Industry Association (The)
- 47. BICSI BICSI
- 48. BIFMA BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
- 49. BISSC Baking Industry Sanitation Standards Committee
- 50. CCC Carpet Cushion Council
- 51. CDA Copper Development Association
- 52. CEA Canadian Electricity Association
- 53. CFFA Chemical Fabrics & Film Association, Inc.
- 54. CGA Compressed Gas Association
- 55. CIMA Cellulose Insulation Manufacturers Association
- 56. CISCA Ceilings & Interior Systems Construction Association
- 57. CISPI Cast Iron Soil Pipe Institute
- 58. CLFMI Chain Link Fence Manufacturers Institute
- 59. CRRC Cool Roof Rating Council
- 60. CPA Composite Panel Association
- 61. CPPA Corrugated Polyethylene Pipe Association
- 62. CRI Carpet & Rug Institute (The)
- 63. CRSI Concrete Reinforcing Steel Institute
- 64. CSA Canadian Standards Association
- 65. CSA CSA International (Formerly: IAS - International Approval Services)
- 66. CSI Cast Stone Institute
- 67. CSI Construction Specifications Institute (The)
- 68. CSSB Cedar Shake & Shingle Bureau
- 69. CTI Cooling Technology Institute (Formerly: Cooling Tower Institute)
- 70. DHI Door and Hardware Institute
- 71. EIA Electronic Industries Alliance
- 72. EIMA EIFS Industry Members Association
- 73. EJCDC Engineers Joint Contract Documents Committee
- 74. EJMA Expansion Joint Manufacturers Association, Inc.
- 75. ESD ESD Association
- 76. FIBA Federation Internationale de Basketball (The International Basketball Federation)
- 77. FIVB Federation Internationale de Volleyball (The International Volleyball Federation)
- 78. FM Approvals FM Approvals
- 79. FM Global FM Global (Formerly: FMG - FM Global)
- 80. FMRC Factory Mutual Research (Now FM Global)
- 81. FRSA Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
- 82. FSA Fluid Sealing Association
- 83. FSC Forest Stewardship Council
- 84. GA Gypsum Association
- 85. GANA Glass Association of North America
- 86. GRI (Now GSI)
- 87. GS Green Seal
- 88. GSI Geosynthetic Institute
- 89. HI Hydraulic Institute

90. HI	Hydronics Institute
91. HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
92. HPVA	Hardwood Plywood & Veneer Association
93. HPW	H. P. White Laboratory, Inc.
94. IAS	International Approval Services (Now CSA International)
95. IBF	International Badminton Federation
96. ICEA	Insulated Cable Engineers Association, Inc.
97. ICRI	International Concrete Repair Institute, Inc.
98. IEC	International Electrotechnical Commission
99. IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
100. IESNA	Illuminating Engineering Society of North America
101. IEST	Institute of Environmental Sciences and Technology
102. IGCC	Insulating Glass Certification Council
103. IGMA	Insulating Glass Manufacturers Alliance
104. ILI	Indiana Limestone Institute of America, Inc.
105. ISO	International Organization for Standardization
106. ISSFA	International Solid Surface Fabricators Association
107. ITS	Intertek Testing Service NA
108. ITU	International Telecommunication Union
109. KCMA	Kitchen Cabinet Manufacturers Association
110. LMA	Laminating Materials Association (Now part of CPA)
111. LPI	Lightning Protection Institute
112. MBMA	Metal Building Manufacturers Association
113. MFMA	Maple Flooring Manufacturers Association, Inc.
114. MFMA	Metal Framing Manufacturers Association, Inc.
115. MH	Material Handling (Now MHIA)
116. MHIA	Material Handling Industry of America
117. MIA	Marble Institute of America
118. MPI	Master Painters Institute
119. MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
120. NAAMM	National Association of Architectural Metal Manufacturers
121. NACE	NACE International (National Association of Corrosion Engineers International)
122. NADCA	National Air Duct Cleaners Association
123. NAGWS	National Association for Girls and Women in Sport
124. NAIMA	North American Insulation Manufacturers Association
125. NBGQA	National Building Granite Quarries Association, Inc.
126. NCAA	National Collegiate Athletic Association (The)
127. NCMA	National Concrete Masonry Association
128. NCPI	National Clay Pipe Institute
129. NCTA	National Cable & Telecommunications Association
130. NEBB	National Environmental Balancing Bureau
131. NECA	National Electrical Contractors Association
132. NeLMA	Northeastern Lumber Manufacturers' Association
133. NEMA	National Electrical Manufacturers Association
134. NETA	InterNational Electrical Testing Association
135. NFHS	National Federation of State High School Associations
136. NFPA	NFPA (National Fire Protection Association)
137. NFRC	National Fenestration Rating Council
138. NGA	National Glass Association
139. NHLA	National Hardwood Lumber Association
140. NLGA	National Lumber Grades Authority

141.	NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
142.	NRCA	National Roofing Contractors Association
143.	NRMCA	National Ready Mixed Concrete Association
144.	NSF	NSF International (National Sanitation Foundation International)
145.	NSSGA	National Stone, Sand & Gravel Association
146.	NTMA	National Terrazzo & Mosaic Association, Inc. (The)
147.	NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
148.	NWWDA	National Wood Window and Door Association (Now WDMA)
149.	OPL	Omega Point Laboratories, Inc. (Now ITS)
150.	PCI	Precast/Prestressed Concrete Institute
151.	PDCA	Painting & Decorating Contractors of America
152.	PDI	Plumbing & Drainage Institute
153.	PGI	PVC Geomembrane Institute
154.	PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
155.	PTI	Post-Tensioning Institute
156.	RCSC	Research Council on Structural Connections
157.	RFCI	Resilient Floor Covering Institute
158.	RIS	Redwood Inspection Service
159.	SAE	SAE International
160.	SDI	Steel Deck Institute
161.	SDI	Steel Door Institute
162.	SEFA	Scientific Equipment and Furniture Association
163.	SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
164.	SGCC	Safety Glazing Certification Council
165.	SIA	Security Industry Association
166.	SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
167.	SJI	Steel Joist Institute
168.	SMA	Screen Manufacturers Association
169.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
170.	SMPTE	Society of Motion Picture and Television Engineers
171.	SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
172.	SPIB	Southern Pine Inspection Bureau (The)
173.	SPRI	Single Ply Roofing Industry
174.	SSINA	Specialty Steel Industry of North America
175.	SSPC	SSPC: The Society for Protective Coatings
176.	STI	Steel Tank Institute
177.	SWI	Steel Window Institute
178.	SWRI	Sealant, Waterproofing, & Restoration Institute
179.	TCA	Tile Council of America, Inc.
180.	TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
181.	TMS	The Masonry Society
182.	TPI	Truss Plate Institute, Inc.
183.	TPI	Turfgrass Producers International
184.	TRI	Tile Roofing Institute
185.	UL	Underwriters Laboratories Inc.
186.	UNI	Uni-Bell PVC Pipe Association
187.	USAV	USA Volleyball
188.	USGBC	U.S. Green Building Council
189.	USITT	United States Institute for Theatre Technology, Inc.
190.	WASTEC	Waste Equipment Technology Association

- |      |       |  |
|------|-------|--|
| 191. | WCLIB | West Coast Lumber Inspection Bureau  |
| 192. | WCMA  | Window Covering Manufacturers Association (Now WCSC)   |
| 193. | WCSC  | Window Covering Safety Council<br>(Formerly: WCMA - Window Covering Manufacturers Association)           |
| 194. | WDMA  | Window & Door Manufacturers Association<br>(Formerly: NWWDA - National Wood Window and Door Association) |
| 195. | WI    | Woodwork Institute (Formerly: WIC - Woodwork Institute of California)                                    |
| 196. | WIC   | Woodwork Institute of California (Now WI)  |
| 197. | WMMPA | Wood Moulding & Millwork Producers Association   |
| 198. | WSRCA | Western States Roofing Contractors Association   |
| 199. | WWPA  | Western Wood Products Association  |

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

- |    |         |  |
|----|---------|--|
| 1. | BOCA    | BOCA International, Inc. (See ICC)                             |
| 2. | IAPMO   | International Association of Plumbing and Mechanical Officials |
| 3. | ICBO    | International Conference of Building Officials (See ICC)       |
| 4. | ICBO ES | ICBO Evaluation Service, Inc. (See ICC-ES)                     |
| 5. | ICC     | International Code Council                                     |
| 6. | ICC-ES  | ICC Evaluation Service, Inc.                                   |
| 7. | SBCCI   | Southern Building Code Congress International, Inc. (See ICC)  |
| 8. | UBC     | Uniform Building Code (See ICC)                                |

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

- |     |       |   |
|-----|-------|---|
| 1.  | CE    | Army Corps of Engineers                                 |
| 2.  | CPSC  | Consumer Product Safety Commission                      |
| 3.  | DOC   | Department of Commerce                                  |
| 4.  | DOD   | Department of Defense                                   |
| 5.  | DOE   | Department of Energy                                    |
| 6.  | EPA   | Environmental Protection Agency                         |
| 7.  | FAA   | Federal Aviation Administration                         |
| 8.  | FCC   | Federal Communications Commission                       |
| 9.  | FDA   | Food and Drug Administration                            |
| 10. | GSA   | General Services Administration                         |
| 11. | HUD   | Department of Housing and Urban Development             |
| 12. | LBL   | Lawrence Berkeley National Laboratory                   |
| 13. | NCHRP | National Cooperative Highway Research Program (See TRB) |
| 14. | NIST  | National Institute of Standards and Technology          |
| 15. | OSHA  | Occupational Safety & Health Administration             |
| 16. | PBS   | Public Building Service (See GSA)                       |
| 17. | PHS   | Office of Public Health and Science                     |
| 18. | RUS   | Rural Utilities Service (See USDA)                      |
| 19. | SD    | State Department  |
| 20. | TRB   | Transportation Research Board                           |
| 21. | USDA  | Department of Agriculture                               |
| 22. | USPS  | Postal Service  |

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

1. ADAAG Americans with Disabilities Act (ADA)
2. Architectural Barriers Act (ABA)
3. CFR Code of Federal Regulations
4. DOD Department of Defense Military Specifications and Standards
5. DSCC Defense Supply Center Columbus (See FS)
6. FED-STD Federal Standard (See FS)
7. FS Federal Specification
8. FTMS Federal Test Method Standard (See FS)
9. MIL (See MILSPEC)
10. MIL-STD (See MILSPEC)
11. MILSPEC Military Specification and Standards
12. UFAS Uniform Federal Accessibility Standards

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. CBHF State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation
2. CCR California Code of Regulations
3. CPUC California Public Utilities Commission
4. TFS Texas Forest Service
5. Forest Resource Development

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 42 00

## SECTION 01 45 29

### TESTING LABORATORY SERVICES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for quality-control services.
- B. Testing laboratory services include inspections, tests, and reports performed by independent agencies
- C. These services do not relieve Contractor of responsibility for compliance with the Contract Documents.
- D. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities.

##### 1.03 RESPONSIBILITIES

- A. Contractor Responsibilities: The Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents. Costs shall be paid by Contractor.
  - 1. Retesting: The Contractor is responsible for payment of retesting where results of inspections or tests prove unsatisfactory and indicate noncompliance with Contract Document requirements.
  - 2. The Contractor shall cooperate with the testing agency as follows:
    - a. Provide access to the Work.
    - b. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
    - c. Provide facilities for storage and curing of test samples.
- B. Duties of the Testing Agency: The testing agency shall provide qualified personnel to perform required inspections and tests.
  - 1. The agency shall notify the Owner, Architect, Engineer and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work or perform any duties of the Contractor.
- C. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
  - 1. The Contractor is responsible for scheduling times for tests, taking samples, and similar activities.



#### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. The independent testing agency shall submit a certified written report, in electronic (PDF) format, directly to the Owner, Architect, Structural Engineer and Contractor, of each test, inspection, and similar quality-control service within 2 working days of attaining test results.
  - 1. Report Data: Written reports include, but are not limited to, the following:
    - a. Date of issue.
    - b. Project title and number.
    - c. Name, address, and telephone number of testing agency.
    - d. Ambient conditions at the time of sample taking and testing.
    - e. Complete test data and an interpretation of test results, including professional opinion on whether tested Work complies with requirements.
    - f. Name and signature of laboratory inspector.
    - g. Recommendations on retesting.
- C. Transmit Testing Lab reports to Architect in electronic (PDF) format using Submittal Exchange, a website service designed specifically for transmitting submittals between construction team members.

#### **PART 2 - PRODUCTS (Not Applicable)**

#### **PART 3 - EXECUTION**

##### 3.01 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed for quality-control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 01 45 29

## SECTION 01 50 00

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
  - 1. Water service and distribution.
  - 2. Temporary electric power, light and heat.
  - 3. Sanitary facilities, including drinking water.
  - 4. Storm and sanitary sewer.
- C. Support facilities include, but are not limited to, the following:
  - 1. Field offices.
  - 2. Dewatering facilities and drains.
  - 3. Temporary enclosures.
  - 4. Waste disposal services.
- D. Security and protection facilities include, but are not limited to, the following:
  - 1. Temporary fire protection.
  - 2. Barricades, warning signs, and lights.
- E. See Division 01 Section "Execution" for progress cleaning requirements.
- F. See Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

##### 1.02 DEFINITIONS

- A. Permanent Enclosure: As determined by the Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

##### 1.03 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the Owner, the Architect, and authorities having jurisdiction.
- B. Water Service: Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service: Provide connections and extensions of services as required for construction operations.

#### 1.04 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

#### 1.05 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before the Owner's acceptance, regardless of previously assigned responsibilities.

### **PART 2 - PRODUCTS**

#### 2.01 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

#### 2.02 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Electrical Outlets: Provide properly configured, NEMA-polarized outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters for connection of power tools and equipment.
- C. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress.
- D. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination protected from breakage and moisture.
- E. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association.
- F. Fans: Electric Fans as required for air movement and negative air pressure at all construction and demolition areas.
- G. Temporary Toilet Units: Provide self-contained, single-occupant toilet units.

- H. HVAC Equipment: Unless the Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  3. Permanent HVAC System: If the Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at the end of construction.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION, GENERAL**

- A. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Field Offices: Install insulated, weather tight temporary offices of sufficient size to accommodate required office personnel at the Project Site.
- D. Dewatering Facilities and Drains: Comply with dewatering requirements of applicable Division 2 Sections. Maintain the site, excavations, and construction free of water.
- E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, unauthorized entry, and similar activities. Close openings through floor or roof decks with load-bearing, wood-framed construction.

#### **3.02 TEMPORARY UTILITY INSTALLATION**

- A. General: Install temporary service or connect to existing service.
1. Arrange with utility company, Owner, and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping prior to use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- E. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed and existing construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations, existing construction or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, and capacity during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

### 3.03 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations.
  - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
  - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide on-site parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding the Project or adjoining properties nor endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris.

### 3.04 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing. Where required, outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for the Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Fence: Provide fencing as needed for safety and security.
- G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Prohibit smoking in all areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

### 3.05 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete, or if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of the Contractor.
  - 2. At Substantial Completion, clean and renovate permanent facilities used during the construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 01 50 00

## SECTION 01 60 00

### PRODUCT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. See Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
- C. See Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

##### 1.02 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in the manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by the Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Substitution Requests: Submit three (3) copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use the Contractor's standard form.



2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
  - a. Statement indicating why specified material or product cannot be provided.
  - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will be necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. List of similar installations for completed projects with project names and addresses and names and addresses of the Architects and the Owners.
  - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - h. Research/evaluation reports evidencing compliance with building code in effect for the Project, from a model code organization acceptable to authorities having jurisdiction.
  - i. Detailed comparison of the Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from the manufacturer, on the manufacturer's letterhead, stating lack of availability or delays in delivery.
  - j. Cost information, including a proposal of change, if any, in the Contract Sum.
  - k. The Contractor's certification that the proposed substitution complies with requirements in the Contract Documents and is appropriate for the applications indicated.
  - l. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. The Architect will notify the Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
  - a. Form of Acceptance: Change Order.
  - b. Use product specified if the Architect cannot make a decision on use of a proposed substitution within time allocated.
- C. Comparable Product Requests: Submit three (3) copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  1. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. The Architect will notify the Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
    - b. Use product specified if the Architect cannot make a decision on use of a comparable product request within time allocated.

- D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

#### 1.04 QUALITY ASSURANCE

- A. Compatibility of Options: If the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with the products previously selected, even if the previously selected products were also options.

#### 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with the manufacturer's written instructions.

- B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at the Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the Project site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that the products are undamaged and properly protected.

- C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger the Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to the extent necessary for the period of installation and concealment.
6. Comply with the product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

#### 1.06 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. The manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by the individual manufacturer for a particular product and specifically endorsed by the manufacturer to the Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend the time limit provided by the manufacturer's warranty or to provide more rights for the Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using the appropriate form properly executed.
  - 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

## **PART 2 - PRODUCTS**

### **2.01 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents that are undamaged and unless otherwise indicated, are new at the time of installation.
  - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  - 3. The Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  - 4. Where products are accompanied by the term "as selected," the Architect will make the selection.
  - 5. Where products are accompanied by the term "match sample," the sample to be matched is the Architect's.
  - 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures:
  - 1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with the requirements.
  - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
  - 3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
  - 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
  - 5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
  - 6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on the Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches the Architect's sample. The Architect's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
  - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, the Architect will select color, pattern, density, or texture from the manufacturer's product line that does not include premium items.
  - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, the Architect will select color, pattern, density, or texture from the manufacturer's product line that includes both standard and premium items.

## 2.02 PRODUCT SUBSTITUTIONS

- A. Timing: The Architect will consider requests for substitution if received within 60 days after the 'Notice to Proceed'. Requests received after that time may be considered or rejected at the discretion of the Architect.
- B. Conditions: The Architect will consider the Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, the Architect will return requests without action, except to record noncompliance with these requirements:
  1. Requested substitution offers the Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner's additional responsibilities may include compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner, and similar considerations.
  2. Requested substitution does not require extensive revisions to the Contract Documents.
  3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  4. Substitution request is fully documented and properly submitted.
  5. Requested substitution will not adversely affect the Contractor's Construction Schedule.
  6. Requested substitution has received necessary approvals of authorities having jurisdiction.
  7. Requested substitution is compatible with other portions of the Work.
  8. Requested substitution has been coordinated with other portions of the Work.
  9. Requested substitution provides specified warranty.

## 2.03 COMPARABLE PRODUCTS

- A. Conditions: The Architect will consider the Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, the Architect will return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of the proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that the proposed product provides the specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of the Architects and the Owners, if requested.
  5. Samples, if requested.

### **PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 60 00

## SECTION 01 73 00

### EXECUTION

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. General installation of products.
  - 4. Progress cleaning.
  - 5. Starting and adjusting.
  - 6. Protection of installed construction.
  - 7. Correction of the Work.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.01 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
  - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
  - 2. Furnish location data for work related to the Project that must be performed by public utilities serving the Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.02 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to the Architect. Include a detailed description of the problem encountered, together with recommendations for changing the Contract Documents.

### 3.03 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on the Drawings in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify the Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of the Project.
  2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  3. Inform installers of lines and levels to which they must comply.
  4. Check the location, level and plumb, of every major element as the Work progresses.
  5. Notify the Architect when deviations from required lines and levels exceed allowable tolerances.
  6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

### 3.04 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on the Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

### 3.05 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by the Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to the Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.



### 3.06 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than seven (7) days during normal weather or three (3) days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of the manufacturer or the fabricator of the product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.07 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.08 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with the manufacturer's written instructions for temperature and relative humidity.

### 3.09 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

## SECTION 01 73 29

### CUTTING AND PATCHING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
- C. See Division 07 Section "Penetration Firestopping" for patching fire-rated construction.

##### 1.02 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity which results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

##### 1.03 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

#### PART 2 - PRODUCTS

##### 2.01 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

### **3.03 PERFORMANCE**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.

- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
  3. Floors and Walls: Where walls or partitions that are removed extend from one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
  4. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 73 29

**SECTION 01 77 00**  
**CLOSEOUT PROCEDURES**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Final cleaning.
- B. See Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- C. See Division 01 Section "Photographic Documentation" for submitting Final Completion construction photographs, CD's and negatives.
- D. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- E. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- F. See Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- G. See Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.02 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise the Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives, damage or settlement surveys, property surveys, and similar final record information.
  - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  - 8. Complete startup testing of systems.

9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from the Project site, along with mockups, construction tools, and similar elements.
  11. Advise the Owner of changeover in heat and other utilities.
  12. Submit changeover information related to the Owner's occupancy, use, operation, and maintenance.
  13. Complete final cleaning requirements, including touchup painting.
  14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, the Architect will either proceed with inspection or notify the Contractor of unfulfilled requirements. The Architect will prepare the Certificate of Substantial Completion after inspection or will notify the Contractor of items, either on the Contractor's list or additional items identified by the Architect, that must be completed or corrected before the certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

#### 1.03 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  2. Submit certified copy of the Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report and warranty.
  5. Instruct the Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
  6. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, the Architect will either proceed with inspection or notify the Contractor of unfulfilled requirements. The Architect will prepare a final Certificate for Payment after inspection or will notify the Contractor of construction that must be completed or corrected before certificate will be issued.
  7. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.04 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three (3) copies of list. Include the name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by the Contractor that are outside the limits of construction.
1. Organize the list of spaces in sequential order, starting with exterior areas first and proceeding from the lowest floor to the highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

## 1.05 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Submittal Exchange: Submit all warranty data through Submittal Exchange at least 15 days before final inspection.
- C. Manual: After all warranty sections are reviewed and approved through Submittal Exchange, submit paper copies of each manual, in 3-ring binders, in final form within 15 days of receipt of the Architect's review comments.
  - 1. Submit up to two (2) copies of each corrected manual – per Owner's direction.

## 1.06 WARRANTIES

- A. Submittal Time: Submit written warranties on request of the Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the Table of Contents of the Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of the Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

## **PART 2 - PRODUCTS**

### 2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## **PART 3 - EXECUTION**

### 3.01 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution regulations.



- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to a condition expected in an average commercial building cleaning and maintenance program. Comply with the manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or for a portion of the Project:
    - a. Clean the Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from the Project site.
    - e. Remove snow and ice to provide safe access to the building.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.
    - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - n. Replace parts subject to unusual operating conditions.
    - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    - r. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Project site and dispose of lawfully.

END OF SECTION 01 77 00

## SECTION 01 78 23

### OPERATION AND MAINTENANCE DATA

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Emergency manuals.
  - 2. Operation manuals for systems, subsystems, and equipment.
  - 3. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.
- B. See Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

##### 1.02 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Submittal Exchange: Submit all operation and maintenance data through Submittal Exchange at least 15 days before final inspection.
- C. Manual: After all sections are reviewed and approved through Submittal Exchange, submit paper copies of each manual, in 3-ring binders, in final form within 15 days of receipt of the Architect's review comments.
  - 1. Submit up to two (2) copies of each corrected manual – Review number with Owner's representative.

#### PART 2 - PRODUCTS

##### 2.01 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name, address, and telephone number of Contractor.
  - 6. Name and address of Architect.
  - 7. Cross-reference to related systems in other operation and maintenance manuals.

- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
  - 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  - 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.02 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for fire, flood, gas leak, water leak, power failure, water outage, equipment failure and chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

## 2.03 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.

- B. Descriptions: Include the following:
  1. Product name and model number.
  2. Manufacturer's name.
  3. Equipment identification with serial number of each component.
  4. Equipment function.
  5. Operating characteristics.
  6. Limiting conditions.
  7. Performance curves.
  8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

#### 2.04 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

#### 2.05 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

- B. Source Information: List each system, subsystem, and piece of equipment included in the manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

## **PART 3 - EXECUTION**

### **3.01 MANUAL PREPARATION**

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

## SECTION 01 78 39

### PROJECT RECORD DOCUMENTS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- C. See Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

##### 1.02 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set of marked-up Record Prints.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- D. Record Product Data: Submit one copy of each Product Data submittal.

#### PART 2 - PRODUCTS

##### 2.01 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether the individual or entity is the Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 2.02 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. Note related Change Orders and Record Drawings where applicable.

## 2.03 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders and Record Drawings where applicable.

## 2.04 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.



## **PART 3 - EXECUTION**

### **3.01 RECORDING AND MAINTENANCE**

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

## SECTION 01 79 00

### DEMONSTRATION AND TRAINING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing the Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. See Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections.

##### 1.02 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

##### 1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with the requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Preinstruction Conference: Conduct conference at the Project site. Review methods and procedures related to demonstration and training.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by the Architect.

#### PART 2 - PRODUCTS

##### 2.01 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
  2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
  3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
  4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
  5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
  6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
  7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
  8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

### **PART 3 - EXECUTION**

#### **3.01 INSTRUCTION**

- A. Engage qualified instructors to instruct the Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
1. Schedule training with the Owner, through the Architect, with at least fourteen days' advance notice.

END OF SECTION 01 79 00

**SECTION 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes for the following:
  - 1. Footings, curbs and foundation walls.
  - 2. Interior floor slabs on grade.
  - 3. Concrete topping on precast concrete structural members.
  - 4. Colored concrete floor slabs on grade.
  
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 1 Section "Quality Requirements" and "Testing Laboratory Services" specifies procedural requirements for testing of concrete.
  - 2. Division 7 Section "Joint Sealants".
  - 3. Division 9 Section "Epoxy Concrete Floor Paint".
  - 4. Division 32 Section "Concrete Paving" for exterior concrete.

1.02 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated.
- C. Design Mixtures: For each concrete mixture.
- D. Shop Drawings: For steel reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete".
- E. Samples: Submit selection and verification samples for finishes, colors and textures.
- F. Material test reports and certificates.
- G. Certificates: Product certificates signed by pigment manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
  
- B. References:
  - 1. ASTM C979 Standard Specification for Pigments for Integrally Colored Concrete.

- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

## **PART 2 - PRODUCTS**

### **2.01 FORM-FACING MATERIALS**

- A. Exposed finished concrete surfaces shall be formed using plywood or metal. Provide continuous, straight, smooth, exposed surfaces and furnish forms in largest possible sizes to minimize the number of joints and that conform to joint system shown on plans.
1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form, Class 1"
  2. Round columns shall be formed with Sonotube concrete forms.
- B. Unexposed finished concrete surfaces shall be formed using plywood or metal. Provide lumber dressed on at least two (2) edges and one side for tight fit.
- C. Form Coatings shall be commercial formulation form-coating compounds with a minimum VOC of 350 mg/L that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- D. Form Ties shall be factory fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal.
1. Provide ties that will leave no metal closer than 1-½ inches to exposed surface.
  2. Provide ties that will leave holes not larger than 1-inch diameter in concrete surface.

### **2.02 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets. Rolled sheets are not permitted.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

### **2.03 CONCRETE MATERIALS**

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
1. Portland Cement: ASTM C 150, Type I or III. Cement may be supplemented with the following:
    - a. Fly Ash: ASTM C 618, Class C.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag IP, portland-pozzolan I (PM), pozzolan-modified Portland I (SM), slag-modified portland cement.
- B. Normal-Weight Aggregates: ASTM C 33, graded, 3/4-inch and 1-1/2-inch nominal maximum coarse-aggregate size.
1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94 and potable.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494, Type A.
  2. Retarding Admixture: ASTM C 494, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

#### 2.04 PIGMENTS FOR INTEGRALLY COLORED CONCRETE

- A. Contact: LANXESS Corporation, 100 Bayer Road, Pittsburgh, PA 15205-9741; Telephone: (800) 526-9377, (412) 777-2000; Fax: (412) 777-7626; website: [www.Bayferrox.com](http://www.Bayferrox.com).
- B. Product(s): Bayferrox synthetic iron oxide color pigments.
- C. Color: Color to be selected by Architect from manufacturer's standard range of colors.
1. Note: Colors Slate Green 6446 and Celery GN will not be used.
- D. Material Standard: Comply with ASTM C979.
- E. Product Testing: Comply with ASTM C979.
- F. Materials: Pigments shall contain pure, concentrated mineral pigments especially processed for mixing into concrete and complying with ASTM C979.
- G. Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

#### 2.05 VAPOR BARRIERS

- A. Vapor Barrier Membrane must meet the following requirements:
1. Water vapor transmission rate: 0.006 WVTR or lower as per ASTM E 96;
  2. Water vapor barrier: Meet or exceed Class A (Plastics), ASTM E 1745;
  3. Permeance Rating: 0.01 Perms or lower as per ASTM E96.
- B. Acceptable Manufacturers:

1. Stego Wrap 15-mil Vapor Barrier by STEGO INDUSTRIES LLC, San Juan Capistrano, CA (877) 464-7834 [www.stegoindustries.com](http://www.stegoindustries.com)
2. Premoulded Membrane with Plasmatic Core by W.R. Meadows.
3. Zero-Perm by Alumiseal.
4. Viper VaporCheck 16

C. Accessories: Seam tape, mastic and pipe boots as recommended by manufacturer and with a water vapor transmission rate of 0.3 Perms or lower as per ASTM E 96.

## 2.06 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.07 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: Sonneborn Sonoflex F or equal.
- B. Granular Fill: Sand-gravel leveling course conforming to State of Nebraska Department of Roads Class 47-B.
- C. Patching Compound: Cement-based compound for applications from one inch thick to feathered edge.
- D. Bonding Compound: Polyvinyl acetate or acrylic base.
- E. Concrete Sealer: Pigmented, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pigmented, Solvent Borne, Membrane-Forming Curing and Sealing Compound: Sonneborn – Kure-N-Seal 25-ES
    - b. Refer to Room Finish Schedule on drawings for areas to receive sealed concrete for final finish.

## 2.08 CONCRETE MIXTURES

- A. . Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Proportion normal-weight concrete mixture for footings and foundation walls:
  1. Minimum Compressive Strength: 3000 psi at 28 days.

2. Sand-gravel mix.
  3. Maximum Water-Cementitious Materials Ratio: 0.51.
  4. Fly ash, blast furnace slag or other pozzolans not to exceed 30 percent of cement content by weight.
  5. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
  6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4 nominal maximum aggregate size.
- B. Proportion normal-weight concrete mixture for columns and walls:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Limestone mix with 3/4 inch coarse-aggregate size.
  3. Maximum Water-Cementitious Materials Ratio: 0.48.
  4. Fly ash, blast furnace slag or other pozzolans not to exceed 30 percent of cement content by weight.
  5. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
  6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4 nominal maximum aggregate size.
- C. Proportion normal-weight concrete mixture for interior concrete slabs-on-grade as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Limestone mix with 3/4 inch coarse-aggregate size.
  3. Maximum Water-Cementitious Materials Ratio: 0.48.
  4. Fly ash, blast furnace slag or other pozzolans not to exceed 15 percent of cement content by weight.
  5. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
  6. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
- D. Proportion normal-weight concrete mixture for concrete topping on structural precast concrete members as follows:
1. Minimum Compressive Strength: 3500 psi at 28 days.
  2. Limestone mix with 1/2 inch coarse-aggregate size.
  3. Maximum Water-Cementitious Materials Ratio: 0.50.
  4. Fly ash, blast furnace slag or other pozzolans not to exceed 15 percent of cement content by weight.
  5. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
  6. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
- E. Proportion normal-weight concrete mixture for concrete topping on structural stoops as follows:
7. Minimum Compressive Strength: 4000 psi at 28 days.
  8. Limestone mix with 3/4-inch coarse-aggregate size.
  9. Maximum Water-Cementitious Materials Ratio: 0.48.
  10. Fly ash, blast furnace slag or other pozzolans not to exceed 30 percent of cement content by weight.
  11. Slump Limit: 3 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).



12. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4 nominal maximum aggregate size.

#### 2.09 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to the Concrete Reinforcing Steel Institute's (CRSI) "Manual of Standard Practice."

#### 2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
  1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

### PART 3 - EXECUTION

#### 3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

#### 3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

#### 3.03 VAPOR BARRIERS

- A. Vapor Barrier: Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions.
  1. Unroll vapor barrier over subgrade and under granular fill with the longest dimension parallel with the direction of the pour.
  2. Lap vapor barrier over footings and seal to foundation walls.
  3. Overlap joints 6 inches and seal with manufacturer's recommended tape.
  4. Seal all penetrations, including pipes, per manufacturer's recommendations with mastic or tape or both.
  5. No penetration of vapor barriers is allowed except for reinforcing steel and permanent utilities.
  6. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

#### 3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor barriers. Repair damage and reseal vapor barrier before placing concrete.
- B. Clean reinforcement of loose rust, earth, ice, and other materials that reduce bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by bolsters, chairs or other devices. Do not secure reinforcement to rebar driven into ground or on rocks, dirt clods or other debris. Do not "float in" reinforcement.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric of flat sheet stock in as large pieces as practicable. Rolled stock is not permitted. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.05 PIGMENTS FOR INTEGRALLY COLORED CONCRETE

- A. For work associated with colored concrete pigment, follow manufacturer's current written recommendations.

### 3.06 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows: Contraction joints to be spaced no more than 30 times the slab thickness and the aspect ratio of the long side of a panel to the short side shall be 1:1 and not exceed 1.5:1.
  1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8-inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- E. Provide joint fillers and sealant at all isolation and expansion joints but not at contraction joints.

### 3.07 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of vapor barriers, compacted granular fill, formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

### 3.08 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces exposed to public view.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.09 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for consolidating, screeding, restraightening, and finishing operations for concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
  - 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic tile.
  - 2. Finish and measure surface to conform to Ff 25 - Fl 20 tolerances.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to pavement surfaces. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

### 3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. NOTE: Coordinate curing and sealing work with Division 9 Section "Epoxy Concrete Floor Paint". Do not install curing and sealing compound on floor areas that will receive floor paint until floor paint work is complete.
- C. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
    - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
  4. Curing and Sealing Compound:
    - a. Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application.
    - b. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades. Mix, place, and cure concrete to blend with in-place construction.
- C. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and slope using a template. Correct low and high areas as herein specified.

1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects include crazing and cracks in excess of 0.01-inch wide or that penetrate to reinforcement, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete.
4. Repair defective areas, except random cracks and single holes not exceeding 1-inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete.

### 3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
  1. Testing Services: Tests shall be performed according to ACI 301.
- B. Sampling and testing for quality control during placement of concrete include the following. Additional tests may be required as directed by Architect.
  1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
    - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
    - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
    - c. Compression Test Specimen: ASTM C 39; one set of 4 standard cylinders for each day's pour, plus additional sets for each 50 cu. yds.; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
- C. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
- D. Report test results in writing to Owner, Architect, Structural Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests.
- E. Additional Tests: Make additional tests of in-place concrete when test results indicate specified strengths and other characteristics have not been attained. Conduct tests by cored cylinders complying with ASTM C 42, or other methods as directed by the Architect.
- F. Concrete trucks shall not be rinsed on Owner's property nor on adjacent property.

END OF SECTION 03 30 00

03 30 00 - CAST-IN-PLACE CONCRETE 10



## SECTION 03 41 00

### PRECAST STRUCTURAL CONCRETE

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section includes precast structural concrete members:
  - 1. Precast/Prestressed Concrete Twin Tees.
  - 2. Insulated Precast/Prestressed Concrete Wall Panels.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 03 Section "Cast-In-Place Concrete" for concrete footings and foundations and topping slab.
  - 2. Division 05 Section "Metal Embed Plates."
  - 3. Division 07 Section "Caulking and Sealants."

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
  - 1. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated.
- C. Design Mixtures: For each precast concrete mixture.
- D. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.
- E. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- F. Welding certificates.
- G. Material certificates.
- H. Material test reports.
- I. Source quality-control reports.
- J. Field quality-control and special inspection reports.

#### 1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  - 1. Participates in Precast/Prestressed Concrete Institute (PCI's) Plant Certification Program at time of bidding and is designated a PCI-certified plant as follows:
    - a. Group C, Category C3 - Prestressed Straight Strand Structural Members.
- B. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products", and PCI MNL 117 "Manual for Quality Control for Plants and Production of Architectural Precast Concrete".
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Preinstallation Conference: Conduct conference at Project site.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on non-staining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- C. Lift and support units only at designated points shown on Shop Drawings.

#### 1.07 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.



## **PART 2 - PRODUCTS**

### **2.01 REINFORCING MATERIALS**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

### **2.02 PRESTRESSING TENDONS**

- A. Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, 7-wire, low-relaxation strand.
  - 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.6 and sheath with polypropylene tendon sheathing complying with ACI 423.6. Include anchorage devices and coupler assemblies.

### **2.03 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
- B. Supplementary Cementitious Materials:
  - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
  - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- D. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

### **2.04 STEEL CONNECTION MATERIALS**

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

- C. Carbon-Steel Plate: ASTM A 283/A 283M.
- D. Malleable-Iron Castings: ASTM A 47/A 47M.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- I. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.
- J. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M) or ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563 (ASTM A 563M); and hardened carbon-steel washers, ASTM F 436 (ASTM F 436M).
  - 1. Do not zinc coat ASTM A 490 (ASTM A 490M) bolts.
- K. Zinc-Coated Finish: For exterior steel items[, steel in exterior walls,] and items indicated for galvanizing, apply zinc coating by [hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M electrodeposition according to ASTM B 633, SC 3, Types 1 and 2.
  - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
- L. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

## 2.05 BEARING PADS

- A. Provide bearing pads for precast structural concrete units as recommended by precast fabricator for application.

## 2.06 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

## 2.07 INSULATED FLAT WALL PANEL ACCESSORIES

- A. Molded-Polystyrene Board Insulation: ASTM C 578, [Type I, 0.90 lb/cu. ft. ] [Type VIII, 1.15 lb/cu. ft. ] [Type II, 1.35 lb/cu. ft. ]; [square] [ship-lap] edges; with R-value of and thickness of.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, [Type IV, 1.60 lb/cu. ft.] [Type X, 1.30 lb/cu. ft. ] [Type VI, 1.80 lb/cu. ft.]; [square] [ship-lap] edges; with R-value of and thickness of.
- C. Polyisocyanurate Board Insulation: ASTM C 591, [Type I, 1.8 lb/cu. ft.] [Type IV, 2 lb/cu. ft.] [Type II, 2.5 lb/cu. ft.] unfaced, with R-value of and thickness of.
- D. Wythe Connectors: Glass-fiber connectors [Galvanized welded wire trusses manufactured to connect wythes of precast concrete panels.

## 2.08 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
  - 1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
  - 2. Limit use of fly ash to 25 percent replacement of portland cement by weight and granulated blast-furnace slag to 40 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  - 1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

## 2.09 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
- J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.
- K. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- L. Comply with PCI MNL 116 procedures for hot-weather concrete placement.
- M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that will not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

## 2.10 CASTING INSULATED WALL PANELS

- A. Cast and screed wythe supported by mold.
- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.

C. Cast and screed top wythe to meet required finish.

#### 2.11 FABRICATION TOLERANCES

A. Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product dimension tolerances.

#### 2.12 COMMERCIAL FINISHES

A. Grade A Finish: Fill surface blemishes with the exception of air holes 1/16 inch in width or smaller, and form marks where the surface deviation is less than 1/16 inch. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.

B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

C. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

D. Apply roughened surface finish according to ACI 318 (ACI 318M) to precast concrete units that will receive concrete topping after installation.

#### 2.13 SOURCE QUALITY CONTROL

A. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements.

B. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups.

### **PART 3 - EXECUTION**

#### 3.01 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.

B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.

1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
2. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
3. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.

- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Field cutting of precast units is not permitted without approval of the Architect.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- H. Grouting: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled.

### 3.02 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

### 3.03 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Erection of precast structural concrete members.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Field welds will be visually inspected and nondestructive tested according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

### 3.04 REPAIRS

- A. Repair precast structural concrete units if permitted by Architect.
  - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units has not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between

original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

### 3.05 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 41 00

## SECTION 05 12 00

### STRUCTURAL STEEL FRAMING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes structural steel.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
  - 2. Division 5 Section "Metal Fabrications" for loose steel bearing plates and miscellaneous steel framing.
  - 3. Division 9 Section "Painting" for final painting.

##### 1.02 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, AISC's "Manual of Steel Construction, Allowable Stress Design," Part 4.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Provide erection drawings and show fabrication of structural steel components.
  - 1. Include erection drawings showing location of individual members and components.
  - 2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 3. Include welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
  - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip critical, direct-tension, or tensioned shear/bearing connections.
- D. Welding certificates.

##### 1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.



- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- C. Comply with applicable provisions of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty prior to use.
  - 2. Do not store materials on structure or in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

Supply anchorage items to be embedded or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions as required for installation.

## PART 2 - PRODUCTS

#### 2.01 STRUCTURAL STEEL MATERIALS

- A. W-Shapes: ASTM A 992.
- B. Channels and Angles: ASTM A 36.
- C. Plate and Bar: ASTM A 36.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53, Type E or S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

#### 2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
  - 2. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type with plain finish.

- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
  - 1. Finish: Plain.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
  - 1. Finish: Plain.
- E. Threaded Rods: ASTM A 193 or ASTM A 36.
  - 1. Finish: Plain.

#### 2.03 PRIMER

- A. Primer: SSPC-Paint 25, Type II, iron oxide, zinc oxide, raw linseed oil, and alkyd.
- B. Primer: Fabricator's standard lead and chromate-free, non-asphaltic, rust-inhibiting primer.

#### 2.04 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

#### 2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".
- B. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
- C. Complete structural steel assemblies, including welding of units, before starting shop priming operations.
- D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- E. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

#### 2.06 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

## 2.07 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  2. Surfaces to be field welded.
  3. Surfaces to be high-strength bolted with slip-critical connections.
  4. Surfaces to receive sprayed fire-resistive materials.
  5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
  2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- D. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

## 2.08 SOURCE QUALITY CONTROL

- A. Contractor will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports. Comply with testing and inspection requirements of Part 3, Article "Field Quality Control."
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding.

## PART 3 - EXECUTION

### 3.01 ERECTION

- A. Examination: Verify elevations of concrete and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design". Add leveling plates to first paragraph below if required. Delete options in paragraph and subparagraphs if no bearing plates.

- C. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of base plate.
  3. Snug-tighten or Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
  4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

### 3.02 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

### 3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### 3.04 CLEANING

- A. Touch-up painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
  - 1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.
- B. Galvanized surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 05 12 00

## SECTION 05 40 00

### COLD-FORMED METAL FRAMING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Metal roof framing.
  - 2. Interior non-load bearing metal framing.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 09 Section "Gypsum Board Assemblies" for metal stud framing of interior walls.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated if contractor chooses to modify sizes indicated on structural plans.
  - 1. Design Loads: As indicated on drawings.
  - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following: 1/240

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product and accessory indicated.
- C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding certificates.

##### 1.05 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."

- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
  - 1. Grade: 33 ksi unless noted otherwise on drawings.
  - 2. Coating: G60.

### 2.02 ROOF JOIST FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0713 inch (14 ga.)
  - 2. Flange Width: 1-5/8 inches.
  - 3. Lip: 1/2-inch.
    - a. 6" stud or as indicated on drawings.
    - b. Sizes: As otherwise indicated on Drawings.
  - 4. Grade: 50 ksi.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
  - 1. Minimum Base-Metal Thickness: 0.0713 inch (14 ga.)
  - 2. Flange Width: 1-1/4 inches.
  - 3. Sizes: As indicated on Drawings.
  - 4. Grade: 33 ksi.

### 2.03 INTERIOR NON-LOAD BEARING WALL METAL FRAMING

- A. Steel Studs where shown: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows at interior shear walls:
  - 1. Minimum Base-Metal Thickness: 0.0346 inch (20 ga.)
  - 2. Flange Width: 1-5/8 inches.
  - 3. Lip: 1/2-inch.
    - a. 3-5/8" stud or as indicated on drawings.
    - b. Double 6" stud at non-load bearing wall headers with spans less than 7'-0".

05 40 00 - COLD-FORMED METAL FRAMING 2

- c. Sizes: As otherwise indicated on Drawings.
- 4. Grade: 33 ksi.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.
  - 1. Minimum Base-Metal Thickness: 0.0346 inch (20 ga.)
  - 2. Flange Width: 1-1/4 inches.
  - 3. Sizes: As indicated on Drawings.
  - 4. Grade: 33 ksi.

#### 2.04 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36, Grade 105 zinc coated by hot-dip process according to ASTM A 123.
- C. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

#### 2.05 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

### PART 3 - EXECUTION



### 3.01 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

### 3.02 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation, specified in Division 7 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8-inch in 10 feet and as follows:
  - 1. Space individual framing members no more than plus or minus 1/8-inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.03 EXTERIOR WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: 16 inches or as indicated on the Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Connect vertical deflection clips to bypassing studs and anchor to primary building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated but not more than 48 inches apart. Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges. Blocking not to exceed spacing of 8 feet.
  3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable exterior-wall-framing system shown.

#### 3.04 FIELD QUALITY CONTROL

- A. The screw connections shall be visually observed for general compliance with structural drawings.
- B. Remove and replace work where test results indicate that it does not comply with specified requirements.

#### 3.05 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

**SECTION 05 50 00**  
**METAL FABRICATIONS**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following metal fabrications:
  - 1. Miscellaneous framing and support.
  - 2. Stainless steel corner guards.
  - 3. Steel cover plates at interior of precast concrete wall panels.
  - 4. Pipe Bollards.
  - 5. Steel Curbs.
  - 6. Bent Steel Plates at Overhead Doors.

1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop drawings showing plan locations, sections, details, anchorages, etc.

1.04 QUALITY ASSURANCE

- A. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel," and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.05 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of metal fabrications by accurate field measurements before fabrication. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements.

**PART 2 - PRODUCTS**

2.01 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- B. Ferrous Metals:
  - 1. Steel Plates, Shapes, and Bars: ASTM A 36.
  - 2. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
  - 3. Steel Tubing: ASTM A 500, cold-formed steel tubing.

4. Steel Pipe: ASTM A 53, standard weight (Schedule 40 and Schedule 80), unless another weight is indicated or required by structural loads.
5. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

## 2.02 FASTENERS

- A. General: Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153.

## 2.03 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI #79.
- B. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
  1. Products:
    - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
    - b. Carboline Company; Carbozinc 621.
    - c. ICI Devoe Coatings; Catha-Coat 313.
    - d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
    - e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
    - f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.
    - g. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- C. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for regalvanizing welds in steel.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

## 2.04 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide steel framing and supports for applications indicated as required to complete the Work.

## 2.05 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 80 steel pipe, with hot-dipped galvanized finish. Fill pipe bollards with concrete and dome the concrete at the top of bollard.
  1. 8" diameter steel pipe bollards.

## 2.06 STAINLESS STEEL CORNER GUARDS

- A. Stainless steel corner guards shall be 3 1/2" x 3 1/2" x 4'-0" tall - 16 gauge 'L' shape. Type 304 with brushed finish. Buff edges to remove burrs. Break 1/2" edge at top, bottom, and side edges back to wall slightly to ensure a tight fit to wall. Ease cut edges and cut corners.
- B. Adhesive: Field applied heavy duty adhesive

## 2.07 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.
- B. Steel and Iron Finishes:
  - 1. Hot-dip galvanize items as indicated to comply with ASTM A 123 or ASTM A 153 as applicable.
  - 2. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below for environmental exposure conditions of installed metal fabrications:
    - a. Exteriors SSPC Zone 1B and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
    - b. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
  - 3. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting," for shop painting.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, and templates for installing anchorages.

### 3.02 INSTALLATION

- A. General: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true.
  - 1. Fit exposed connections accurately together. Weld connections that are not to be left as exposed joints but cannot be shop welded. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication.
  - 2. Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
  - 3. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- B. Set bearing and leveling plates on cleaned surfaces using wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts and pack solidly with nonshrink, nonmetallic grout.
- C. Bollards:
  - 1. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout.
  - 2. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
  - 3. Fill bollards solidly with concrete, mounding top surface to shed water.

D. Corner Guards

1. Mount bottom edge of corner guards 4" above finish floor.
2. Attach corner guards with construction adhesive.

E. Touch up surfaces and finishes after erection.

1. Painted Surfaces: Clean field welds, bolted connections, and abraded areas and touch up paint with the same material as used for shop painting.
2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

## SECTION 05 50 13

### METAL EMBED PLATES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Miscellaneous steel embed plates.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 03 Section "Cast-In-Place Concrete" for concrete footings and foundations.
  - 2. Division 09 Section "Painting" for painting of embed plates after welding is completed.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings: Include plans and details of metal embed plates and their locations.

#### PART 2 - PRODUCTS

##### 2.01 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- B. Ferrous Metals:
  - 1. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Headed Anchor Bolts:
  - 1. Headed Anchor Studs (HAS): ASTM A 108, Grades 1015 through 1020, headed stud type, cold finished carbon steel; AWS D1.1, Type B.
  - 2. Deformed Bar Anchor (DBA): Cold-worked deformed steel bars with a minimum yield strength of 70,000 psi, manufactured in conformance with ASTM A 496. Anchors shall conform to AWS D1.1, Table &.1, Type C.
- D. Welding Materials: AWS D1.1; type required for materials being welded.

## 2.02 FABRICATION

- A. General: Preassemble items in the shop. Use connections that maintain structural value of joined pieces.
- B. Equip embed plates with integrally welded steel studs at spacings detailed. Cut and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Do not prime paint metals in the shop. Embed plates will be field painted.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Set metal embed plates accurately in location, with edges and surfaces level, plumb, and true.
  - 1. Provide temporary bracing or anchors in formwork for items that are to be built into concrete construction.
- B. Field finishing of exposed surfaces after installation and welding of precast wall panels is required.
  - 1. Painted Surfaces: Clean abraded areas and paint as specified in Division 09 Section "Painting".

END OF SECTION 05 50 13



**SECTION 06 10 00**  
**ROUGH CARPENTRY**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:

- 1. Rooftop equipment bases and support curbs.
- 2. Wood blocking and nailers.
- 3. Wood furring and grounds.
- 4. CDX Plywood.
- 5. MDO Plywood wall sheathing.
- 6. Glass-mat gypsum soffit at entry canopy.

- B. Related Sections include the following:

- 1. Division 9 Section "Gypsum Board Assemblies" for plywood substrate and plaster finish at soffit.

1.03 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

- 1. NELMA - Northeastern Lumber Manufacturers Association.
- 2. NLGA - National Lumber Grades Authority.
- 3. WCLIB - West Coast Lumber Inspection Bureau.
- 4. WWPA - Western Wood Products Association.

1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

- 1. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

- C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee Board of Review.

- D. Fastener Patterns: Templates for fasteners in exposed wall sheathing.
- E. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
  - 1. Power-driven fasteners.
  - 2. Powder-actuated fasteners.
  - 3. Expansion anchors.
  - 4. Metal framing anchors.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.
  - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Wood Structural Panels:
  - 1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
  - 2. Oriented Strand Board: DOC PS 2.
    - a. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
  - 3. Comply with "Code Plus" provisions in APA Form No. E30K, "Design/Construction Guide: Residential & Commercial."
  - 4. Factory mark panels according to indicated standard.

### 2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWWA C31 with inorganic boron (SBX).
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - 2. Wood floor plates that are installed over concrete slabs-on-grade.
  - 3. Wood thermal break at walk-in coolers/freezers.

## 2.03 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Miscellaneous Dimension Lumber: As follows for 2-inch nominal thickness:
  - 1. Spruce - Pine - Fir, No. 2 Grade:
    - a.  $E = 1,400,000$  psi
    - b.  $F_b = 875$  psi
    - c.  $F_v = 135$  psi
    - d.  $F_c = 1150$  psi
- C. Joists, Rafters, and Other Framing Not Listed Above: Any species and grade with a modulus of elasticity of at least 1,400,000 psi and an extreme fiber stress in bending of at least 875 psi for 2-inch nominal thickness for single-member use.

## 2.04 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
  - 1. Rooftop curbs.
  - 2. Blocking.
  - 3. Cants.
  - 4. Nailers.
  - 5. Furring.
  - 6. Grounds.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade SPF lumber with 19 percent maximum moisture content.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
  - 1. Spruce-pine-fir (south) or Spruce-pine-fir, Construction or 2 Common grade; NELMA, NLGA, WCLIB, or WWPA.

## 2.05 CANOPY SOFFIT

- A. Glass-Mat Gypsum at Canopy Soffit: ASTM C 1177/1177M.
  - 1. Provide where noted on Drawings.

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. CertainTeed Corporation; GlasRoc.
  - b. G-P Gypsum Corporation; Dens-Glass Gold.
  - c. National – eXP Exterior Sheathing.
  - d. Temple-Inland Inc.; GreenGlass
  - e. United States Gypsum Co.; Securock Exterior Sheathing.
3. Type and Thickness Type X, 5/8 inch (15.9 mm) thick.
4. Size: 48 by 96 inches (1219 by 2438 mm for vertical installation).

## 2.06 PLYWOOD FINISHED WALL SURFACE

- A. MDO Plywood: Shall be of exterior type with one face of Medium Density Overlay as described in Voluntary Products Standard PS-1. Bonded with 100% waterproof glue. B grade face veneer and C-grade inner plies.
  1. Provide where noted on Drawings.
  2. Thickness: 3/4-inch.

## 2.07 PLYWOOD SHEATHING AND BACKING

- A. Plywood Exterior Grade Roof Sheathing: Exposure 1 meeting requirements of DOC PS2.
  1. Span Rating: Not less than 48/24.
  2. Thickness: Nominal 3/4-inch (not less than 23/32-inch).
- B. Plywood Exterior Grade Wall Sheathing at Interior Vertical Wall Conditions: Exposure 1 meeting requirements of DOC PS2.
  1. Span Rating: Not less than 48/24.
  2. Thickness: Nominal 3/4-inch (not less than 23/32-inch).
- C. Plywood backing at walls, Toilet Grab Bar Blocking, and Misc. Locations: Exposure 1 meeting requirements of DOC PS2.
  1. Span Rating: Not less than 48/24.
  2. Thickness: Nominal 3/4-inch (not less than 23/32-inch).

## 2.08 MISCELLANEOUS MATERIALS

- A. Roof Felts (Building Felt): Asphalt-saturated organic felt complying with ASTM D 4869, Type II (30-lb asphalt felt), unperforated.

## 2.09 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: CABO NER-272.

- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A, Property Class 4.6; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Headed Anchor Bolts at Sill Plates: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six (6) times the load imposed when installed in unit masonry assemblies and equal to four (4) times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION, GENERAL**

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. CABO NER-272 for power-driven fasteners.
  - 2. Published requirements of metal framing anchor manufacturer.
  - 3. Table 2304.9.1, "Fastening Schedule", in the 2006 International Building Code.
  - 4. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; pre-drill as required.
  - 5. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

#### **3.02 MDO PLYWOOD**

- A. General: Comply with manufacturer's current written recommendations.
  - 1. Attach MDO plywood to metal studs.
  - 2. Attach exposed MDO plywood with countersunk flat head screws at 16" on center each way and at each edge. Maintain consistent screw spacing for screw alignment at adjacent panels.
  - 3. Install plywood with long dimension running horizontally. Install plywood level and plumb.

4. Install plywood with panels stacked so joints aligning vertically.
5. Include 1/8" space between floor and bottom plywood panel.
6. Include 1/8" space at horizontal joint 8' above finished floor.
7. Include 1/8" space at each vertical joint. Coordinate with furring locations or cut panels as needed.
8. Horizontal joints are to be butted tight.

### 3.03 PLYWOOD PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of panels and applications indicated.

1. Wall Sheathing:

- a. Screw to metal studs or furring
- b. Space panels 1/8 inch (3 mm) apart at edges and ends.

### 3.04 WOOD GROUND, SLEEPER, BLOCKING, CURBS AND NAILER INSTALLATION

- A. Install continuous solid blocking in walls, etc. as required to anchor all casework, toilet accessories, display boards, shelves, accessories, equipment, etc. shown, whether called out to be in the contract, by others, or not in contract.
- B. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- C. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.
- D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2-inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.05 WOOD FRAMING INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

### 3.06 CANOPY SOFFIT INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  2. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
  3. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

### 3.07 BUILDING FELT APPLICATION

- A. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Cover upstanding flashing with 4-inch overlap.
  1. Fasten to sheathing with galvanized staples or roofing nails through tin discs.
  2. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction to shed water. Lap ends of felt not less than 6 inches over self-adhering ice and water sheet underlayment.

END OF SECTION 06 10 00

## SECTION 06 41 16

### PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

A. This Section includes the following:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware.

B. Related Sections:

1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips.
2. Division 12 Section "Plastic-Laminate-Clad Countertops".
3. Division 12 Section "Manufactured Plastic-Laminate-Clad Casework".

##### 1.02 SUBMITTALS

A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of product and process specified.

C. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

D. Samples for initial selection of the following in the form of manufacturer's color charts consisting of actual units showing the full range of colors, textures, and patterns available.

1. Plastic laminates.

##### 1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing countertops similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.

B. Single-Source Responsibility for Fabrication and Installation: Engage a qualified firm to assume undivided responsibility for fabricating and installing casework and countertops.

C. Quality Standard: Except as otherwise indicated, comply with the following standard:

1. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for architectural countertops and other requirements.

D. Fire-Test-Response Characteristics: Provide materials with the following fire-test-response characteristics.

1. Surface-Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for standard time period (ten (10) minutes).

- a. Flame Spread: 75.



- b. Smoke Developed: 450.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect products of this Section during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver products of this Section until painting and similar operations that could damage, soil, or deteriorate the products have been completed in installation areas. If products must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

#### 1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Obtain and comply with fabricator's and installer's coordinated advice for optimum temperature and humidity conditions during storage and installation. Do not install products of this Section until these conditions have been attained and stabilized.
- B. Field Measurements: Where products of this Section are indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Verify locations of concealed framing, blocking, reinforcements, and furring that support products of this Section by accurate field measurements before being enclosed. Record measurements on final shop drawings.
  - 2. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating without field measurements. Provide allowance for trimming at site and coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

#### 1.06 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work to ensure that products of this Section can be supported and installed as indicated.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIAL STANDARDS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of product and quality grade indicated and with requirements of the referenced product standards that apply to product characteristics indicated.
  - 1. Hardboard: AHA A135.4.
  - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue
  - 3. Particleboard: ANSI A208.1, Grade M-2.
- B. Thermoset Decorative Overlay: Particleboard or medium density fiberboard as specified above with surfaces of thermally fused, melamine-impregnated decorative paper complying with LMA SAT

- C. High-Pressure Decorative Laminate: NEMA LD 3, General Purpose .028" laminate plastic. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
  - 1. Formica – Color as selected by Architect from standard range.
  - 2. Wilsonart – Color as selected by Architect from standard range.
- D. Adhesive for Bonding Plastic Laminate: Contact cement.

## 2.02 CABINET HARDWARE AND ACCESSORY MATERIALS

- A. Hardware Standard: Comply with BHMA A156.9.
- B. Exposed Hardware Finishes: For exposed hardware, provide the following finish:
  - 1. Satin Chrome: US26D
- C. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of BHMA A156.9.

## 2.03 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements.
  - 1. For metal framing supports, provide screws as recommended by metal-framing manufacturer.
- C. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
- D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

## 2.04 FABRICATION, GENERAL

- A. Quality Standard: Comply with AWI Section 400 requirements for cabinets and countertops. Provide cabinets and countertops complying with the referenced quality standard and of the following grade:
  - 1. Grade: Premium.
- B. Complete fabrication, including assembly and finishing before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Trial fit assemblies at the fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved shop drawings before disassembling for shipment.

- C. Shop-cut openings, to maximum extent possible, to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

## 2.05 PLASTIC-LAMINATE-CLAD CABINETS ARCHITECTURAL CABINETS

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate-clad cabinets.
  - 1. Grade: Premium.
- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Exposed surfaces: 1" or 3/4" particleboard (as shown on drawings and as required by size of doors) with VGS - General Purpose .028" laminate plastic faces and matching 3 mm PVC exposed edges.
- D. Semi-exposed Surfaces (includes members behind opaque doors): 3/4" particle board with CLS .020" cabinet liner with matching 1 mm PVC applied to semi-exposed edges.
- E. Doors and Drawer Panels:
  - 1. Front panel: 3/4" VGS .028" laminate plastic faces with cabinet liner and matching 3-mm PVC edges.
  - 2. Semi-exposed portions: 3/4" particle board with CLS .020" cabinet liner and matching 3-mm PVC edges.
- F. Drawer Construction: 1/2" lumber or hardwood plywood panel products for drawer sides, backs and subfronts; 1/4" hardwood plywood panel product for drawer bottoms.
- G. Adjustable Shelves:
  - 1. Exposed: 3/4" particle board with VGS -General Purpose .028" laminate plastic faces and matching 3-mm PVC at exposed edge. Unless noted otherwise.
  - 2. Semi-exposed: 3/4" particle board with CLS .020" cabinet liner and matching 1 mm PVC applied to front edge. Unless noted otherwise.
- H. Backs:
  - 1. Exposed: 3/4" - VGS -General Purpose .028" laminate plastic faces.
  - 2. Semi-exposed: 3/8" with CLS .020" cabinet liner.
- I. Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets, as follows:
  - 1. Bolts, Nuts, Washers, Lags and Screws: Size and type to suit application.
  - 2. Door and Drawer Locks: National NL C8-051 or pre-approved substitution. Keying to be verified with Owner prior to delivery.
  - 3. Hinges: Grass or Blum, European style, 110 degree opening.
  - 4. Drawer Guides: Typical box drawer - K & V 1300; File Drawers (full extension) K & V 8500.
  - 5. Pulls: Equal to Stanley 4483 US26D - 4" wire pull.
  - 6. Metal Support Brackets at Countertops: Knape and Vogt - 208 - Ultimate L Bracket.
    - a. Size: 21 1/2" D x 14 1/4" H at counters over 24" deep.
    - b. Size: 19 1/2" D x 12 7/8" H at 24" deep counters.

- c. Color: To be selected by Architect from manufacturer's standard range of colors.
  - 7. Grommets: Provide and install 1 1/2" clear opening plastic grommets and grommet cover at each 'Hole Through Counter' (HTC) noted on drawings by Doug Mockett and Co., Inc., or equal.
    - a. Color: To be selected by Architect from manufacturer's standard range of colors.
  - 8. File Drawers: Include 2 metal rails from front to back of each file drawer for hanging files.
  - 9. Cabinet Shelf Hardware: Metal shelf supports or nylon with steel pin for line bored cabinets.
- J. Fillers and Scribes:
- 1. All cabinets, where wall to wall conditions occur, will have fillers (scribes) to allow for variance in field conditions. These fillers shall be the color of the front of the cabinets.
  - 2. In general, fillers will not be used for cabinets that abut walls on only one side – provide fillers if required for clearance at doors adjacent to walls.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Condition products of this Section to average prevailing humidity conditions in installation areas before installing.
- B. Before installing, examine shop-fabricated work for completion and complete work as required.

#### **3.02 INSTALLATION**

- A. Quality Standard: Install products of this Section to comply with AWI Sections 400 and 1700 for the same grade specified in Part 2 of this Section.
  - 1. Install cabinets level, true, and straight with no distortions. Shim as required with concealed shims. Install cabinets with no more than 1/8-inch in 96-inch sag, bow, or other variation from a straight line.
- B. Scribe and cut to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- C. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

#### **3.03 PROTECTION**

- A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that products are without damage or deterioration at the time of Substantial Completion.
- B. Repair damaged and defective work where possible to eliminate functional and visual defects; where not possible to repair, replace. Adjust joinery for uniform appearance.

END OF SECTION 06 41 16

**SECTION 07 21 00**  
**THERMAL INSULATION**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
  - 1. Rigid insulation beneath grade at perimeter of foundations – Vertical applications as shown.
  - 2. One-component sealing spray foam insulation.
  - 3. Sound attenuation insulation.

1.03 RELATED SECTIONS

- A. Division 9 Section “Gypsum Board Assemblies” for sound sealants.
- B. Division 13 Section “Metal Building Systems” for metal building insulation.

1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of insulation product specified.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response: Provide materials with the fire-test-response characteristics indicated below:
  - 1. Surface-Burning Characteristics: ASTM E 84.
  - 2. Fire-Resistance Ratings: ASTM E 119.
  - 3. Combustion Characteristics: ASTM E 136.
- B. Recycled Content: Provide glass-fiber insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 50 percent.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation from damage by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver to Project site before installation time.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:
  1. Extruded-Polystyrene Board Insulation:
    - a. Amoco Foam Products Company.
    - b. Owens-Corning Fiberglas Corporation.
    - c. Dow Chemical Co.
    - d. UC Industries, Inc.;
  2. Glass-Fiber Insulation:
    - a. CertainTeed Corporation.
    - b. Guardian Building Products
    - c. Knauf Fiber Glass GmbH.
    - d. Owens-Corning Fiberglas Corporation.
    - e. Schuller International, Inc.
  3. One-component, Sealing Foam: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
    - a. Dow Chemical Co.
    - b. Foam Power, Handi-Seal
    - c. Touch n Foam by Chemtrec

### **2.02 INSULATING MATERIALS**

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
- B. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C 578 for type and with other requirements indicated below:
  1. Type IV, 1.60-lb/cu. ft. minimum density, unless otherwise indicated.
    - a. Insulation Values:
      - i. Minimum 2" R-10 at perimeter foundations.
      - ii. Minimum 1" R-5 at slab edges
      - iii. As shown at other locations indicated on the Drawings.
  2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.
  3. Recycled Content: Not less than 50 percent blend of post-consumer and recovered polystyrene resins.

- C. Sound Insulation - Unfaced Glass-Fiber Blanket Insulation: Thermal insulation combining glass fibers with thermosetting resins to comply with ASTM C 665, Type I and ASTM E 136 with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
  - 1. Insulation Values:
    - a. Minimum 6" R-19 concealed in exterior walls and as otherwise shown.
    - b. Minimum 3-1/2" R-13 concealed in walls as shown.
    - c. Sound Insulation at interior walls: Minimum 3-1/2" R-11 at all sound walls indicated on drawings.
- D. One-Component, Minimum Expanding Sealing Spray Foam Insulation: One component, polyurethane foam, low-pressure expansion, with an R-Value of approximately of 4 to 5 per inch. Provide one of the following products, or equal:
  - 1. Dow Chemical "Great Stuff Window and Door".
  - 2. Foam Power "Handi-Seal Window & Door Seal Foam".
  - 3. Chemtrec "Touch n Foam Minimal Expanding Sealant".

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products indicated.
- B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply single layer of insulation, unless multiple layers are required to make up total thickness.
- E. Water-Piping Coordination: If water piping is shown to be located within insulated exterior walls, contact Architect and review conditions before proceeding with work.

#### **3.03 INSTALLATION OF PERIMETER FOUNDATION INSULATION**

- A. On vertical surfaces, set insulation units and hold units in place until supporting construction is installed. Tightly abut insulation units edge to edge. Where adhesives can be used, use adhesive recommended by insulation manufacturer.
  - 1. If not otherwise indicated, extend vertical insulation a minimum of 24-inches below exterior grade line.

### 3.04 INSTALLATION OF CONCEALED BUILDING SOUND INSULATION

- A. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
  - 1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
  - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members or attach as required for applications shown on drawings.
  - 3. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to produce airtight installation after concealing finish material is in place. Staple blanket flanges per manufacturer's written instructions.
  - 4. Install blanket insulation at all walls noted to receive sound insulation.

### 3.05 SPRAY-APPLIED, EXPANDING FOAM INSULATION

- A. Apply spray-applied foam insulation in hollow metal frames for sound control at sound control (high STC) walls.

### 3.06 PROTECTION

- A. General: Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00



## SECTION 07 53 23

### EPDM SINGLE-PLY MEMBRANE ROOFING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

##### 1.02 SUMMARY

- A. This Section includes single-ply membrane roofing systems and roof insulation, including the following:
  - 1. Fully adhered, ethylene propylene diene monomer (EPDM) single ply membrane systems.
  - 2. Polyisocyanurate tapered roof insulation systems.
  - 3. EPDM flashings.
- B. Related Sections include the following:
  - 1. Division 7 Section "Sheet Metal Flashings, Trim, Gutters and Downspouts" for metal copings, flashings, gutters, downspouts, etc.
  - 2. Division 13 Section "Metal Building Systems" for metal building roof and insulation.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data, installation instructions, and manufacturer's recommendations for each product listed.

##### 1.04 QUALITY ASSURANCE

- A. Manufacturer: Provide secondary materials as recommended by manufacturer of primary materials.
- B. Installer: Installer must be acceptable to or licensed by manufacturer of primary roofing material.
  - 1. Work associated with single ply membrane roofing, including (but not limited to) insulation, flashing and counterflashing, expansion joints, and joint sealers, is to be performed by Installer of this work.
- C. UL Listing: Provide "Class A" labeled materials that have been tested and listed by UL or by other nationally recognized testing laboratory.
- D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals' markings.

1. Fire/Windstorm Classification: Class 1A-75

#### 1.05 PROJECT CONDITIONS

- A. Weather: Proceed with roofing work only when existing and forecasted weather permit work to be performed in accordance with manufacturer's recommendations.
- B. Substrate Conditions: Do not begin roofing installation until substrates have been inspected and are determined to be in satisfactory condition.

#### 1.06 WARRANTY

- A. Standard Roofing Manufacturer's Warranty: Submit a written warranty, without monetary limitation (NDL – no dollar limit), signed by roofing system manufacturer agreeing to promptly repair leaks in the roof membrane resulting from defects in materials or workmanship for the following warranty period:
  1. Warranty Period: 15 years.
- B. Roofing Installer's Warranty: Submit roofing Installer's warranty covering Work of this Section, including membrane roofing, base flashing, roofing insulation, and fasteners, for the following warranty period:
  1. Warranty Period: 2 years from date of Substantial Completion.
- C. Warranty/Manufacturer Inspection: Give Owner and Architect 48 hours notice prior to manufacturer's roof inspection to determine acceptance and warranty requirements.

## PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. Compatibility: Provide products that are recommended by manufacturers to be fully compatible with indicated substrates.

#### 2.02 EPDM MEMBRANE

- A. General: Ethylene propylene diene monomers formed into uniform, reinforced, flexible sheets, complying with ASTM D 4637, Type 1.
  1. Thickness: 60 mils, nominal, reinforced - at field areas.
  2. Thickness: 60 mils, nominal, reinforced - at all flashing areas.
  3. Exposed Face Color: Black.
- B. Fully Adhered EPDM Membrane: Manufacturer's standard installation.
  1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
    - a. Carlisle Syntec Systems
    - b. Firestone Building Products Inc.

## 2.03 AUXILIARY MATERIALS

- A. Sheet Seaming System: Manufacturer's standard materials for sealing lapped joints, including edge sealer to cover exposed spliced edges.
- B. Adhesive for Bonding Membrane: Type recommended by manufacturer.
- C. Flashing Accessories: Types recommended by membrane manufacturer, including flashing strips, cements, termination bars, fasteners and sealants.
- D. Flashing Material: Manufacturer's standard system compatible with flexible sheet membrane.

## 2.04 WALKWAYS

- A. Flexible Walkways: 30 inch x 30 inch x approximately 3/16 inch thick, factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, and acceptable to membrane roofing system manufacturer. Complying with ASTM D 2137 and ASTM D 2240.

## 2.05 COVER BOARD – (ONLY IF REQUIRED BY ROOF MANUFACTURER FOR WARRANTY)

- A. Wood Fiber Cover Board: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch thick and additional coverboard material.

OR:

- B. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate.
  - 1. Fiberglass-Mat Faced Gypsum Roof Board: Georgia Pacific DensDeck Prime or approved equal.
    - a. Thickness: as required by manufacturer.
    - b. Width: 4 feet.
    - c. Length: 8 feet.
    - d. Weight: as needed.
    - e. Surfacing: Fiberglass mat.
    - f. Finish: Factory Primed.
    - g. Flexural Strength, Parallel (ASTM C473): 40 lbf, minimum.
    - h. Flute Span (ASTM E661): 2-5/8 inches min.
    - i. Permeance (ASTM E96): Not more than 50 perms.
    - j. Water Absorption (ASTM C1177): Less than 10 percent of weight.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening cover boards to roof deck.

## 2.06 INSULATING MATERIALS

- A. General: Provide insulating materials to comply with requirements indicated in sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Polyisocyanurate Board Roof Insulation: Rigid, cellular thermal insulation with polyisocyanurate closed-cell foam core and manufacturer's standard facing laminated to both sides; complying with FS HH-I-1972/2, Class 1.
  - 1. Include a 4" base layer insulation as shown.
  - 2. Provide tapered insulation at drainage cricket areas.

3. Provide tapered insulation crickets around all roof mounted equipment field verify location. Slope at 1/4" minimum for proper drainage.

## 2.07 AUXILIARY INSULATION MATERIALS

- A. Mechanical Fasteners or Adhesive for Fully Adhered Insulation System: Type recommended by manufacturer of insulation.
- B. Mastic Sealer: Type recommended by manufacturer for edge joints and voids.

## PART 3 - EXECUTION

### 3.01 PREPARATION OF SUBSTRATE

- A. General: Comply with manufacturers' instructions for preparation of substrate.
  1. Verify that penetrations, expansion joints, and blocking are in place and secured and that roof drains properly.
- B. Clean substrate of dust, debris, and other substances detrimental to the work. Remove sharp projections.
- C. Install flashings and accessory items as shown, and as recommended by manufacturer if not shown.
- D. Prime substrate where recommended by manufacturer of materials being installed.
- E. Prevent compounds from entering and clogging drains and conductors.

### 3.02 INSULATION INSTALLATION

- A. General: Extend insulation full thickness in single or multiple layers over entire surface, cutting and fitting tightly around obstructions. Form crickets, and tapered areas as required for proper drainage of membrane.
  1. Stagger joints in one direction for each course. For multiple layers, stagger joints in both directions between courses with no gaps, to form a complete thermal envelope.
- B. Do not install more insulation each day than can be covered with membrane before end of day or before start of inclement weather.

### 3.03 COVER BOARD INSTALLATION – (ONLY IF REQUIRED BY ROOF MANUFACTURER FOR WARRANTY)

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
  1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
  2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

### 3.04 MEMBRANE INSTALLATION

- A. Fully Adhered Membrane: Install membrane by unrolling over prepared substrate, lapping adjoining sheet as recommended by manufacturer. Apply adhesive to surfaces to be bonded and roll into place when adhesive has properly cured. Treat seams with special adhesive and apply sealant to exposed sheet edges, tapering application as recommended by manufacturer. Install mechanical fasteners, flashing and counterflashings, and accessories at locations shown, as needed and as recommended by manufacturer.

### 3.05 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.06 PROTECTION OF ROOFING

- A. Protect roofing during remainder of construction period.
- B. Repair or replace (as required) deteriorated or defective work found at time of final inspection to a condition free of damage and deterioration in accordance with requirements of specified warranty.

END OF SECTION 07 53 23

## SECTION 07 62 00

### SHEET METAL FLASHING, TRIM, GUTTERS AND DOWNSPOUTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following categories:
  - 1. Miscellaneous prefinished sheet metal flashings and trim.
  - 2. Gutters and downspouts.
  - 3. Precast concrete splash blocks.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 7 Section "Joint Sealants".
  - 2. Division 7 Section "EPDM Roofing".

##### 1.03 PERFORMANCE REQUIREMENTS

- A. General: Install the work of this Section to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
- C. Shop Drawings including plans, elevations, sections and details showing shapes, dimensions, gauges, joint types, expansion joint locations, types and spacing of fasteners, and all other accessories.

##### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project.
- B. Quality Standards: Comply with SMACNA's Architectural Sheet Metal Manual, latest edition.

## PART 2 - PRODUCTS

### 2.01 METALS

- A. Prefinished Metal Trim and Flashings: 24-gauge, hot-dipped G-90 galvanized steel, with a 2 coat factory installed 70% KYNAR 500 based fluoropolymer finish. Color selected by Architect and Owner from manufacturer's standard range of colors. Provide metal with a strippable plastic coating to protect finish.
- B. Gutters: Pre-finished - 24 gauge, hot-dipped G-90 galvanized steel, with a 2 coat factory installed 70% KYNAR 500 based fluoropolymer finish. Provide 7" wide x 7" deep at front edge, Type 'Box Gutter' as shown on drawings - min. 96" long sections with sloped front edge at 10 deg angle (see drawings for profile). Provide straps and hangers at 35" max. o.c., end plates, trim, and other accessories required for a complete installation.
1. Color of Box Gutters: As selected by Architect from Manufacturer's standard range of colors.
- C. Downspouts: Pre-finished - 24 gauge, hot-dipped G-90 galvanized steel, with a 2 coat factory installed 70% KYNAR 500 based fluoropolymer finish. Provide 4" x 5" pre-finished downspouts - fabricated to required lengths. Provide outlet tubes, extensions, and other accessories required for a complete installation.
1. Color of Downspouts: As selected by Architect from Manufacturer's standard range of colors.
  2. Include 3' long downspout extensions at each downspout.
- D. Gutter Apron: Provide 24 gauge hot dipped G-90 galvanized steel with a 2 coat factory installed 70% KYNAR 500 based fluoropolymer finish. Profile as shown on drawings.
1. Color: As selected by Architect from Manufacturer's standard range of colors.
- E. Gutter Support: 1" wide x 1/8" thick bent steel bar – hot-dipped G-90 galvanized.
- F. Gutter Bracket: 22 gauge, hot-dipped G-90 galvanized steel, with a 2 coat factory installed 70% KYNAR 500 based fluoropolymer finish. Approximately 1 1/2" to 2" wide with 1/2" hemmed edges.
- G. Downspout Bracket: 22 gauge, hot-dipped G-90 galvanized steel, with a 2 coat factory installed 70% KYNAR 500 based fluoropolymer finish. Approximately 1-1/2" to 2" wide with 1/2" hemmed edges.
- H. Prefinished Metal Wall Copings and Flashings: 24-gauge, hot-dipped G-90 galvanized steel, with a 2-coat factory installed 70% KYNAR 500 based fluoropolymer finish. Provide metal with a strippable plastic coating to protect finish.
1. Color: As selected by Architect from Manufacturer's standard range of colors.
  2. Continuous Concealed Fascia Clips at Wall Copings: Provide 24 gauge zinc coated sheet continuous clip at coping fascia at roof edges with no gutter.
  3. Seams at Coping Caps: Fabricate nonmoving seams with flat-lock seams.
    - a. Use 'Drive Cleat' or 'S&D Cleat' seams at wall coping cap flashings.
    - b. No exposed fasteners.

- I. Non-Visible Flashings, Reglets and Counterflashings: 24-gauge, hot-dipped G-90 galvanized steel.

## 2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Provided prefinished heads to match sheet metal flashing color.
  - 1. Stainless steel or hot dipped galvanized fasteners.
- B. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."
- C. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; non-corrosive; size and thickness required for performance.
- D. Precast Concrete Splash Blocks: 18 inch x 32 inch precast concrete splash blocks.

## 2.03 FABRICATION, GENERAL

- A. General: Shop-fabricate work to the greatest extent possible. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work.
- B. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- C. Comply with details shown to fabricate sheet metal flashing and trim that fits substrates and results in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- D. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- E. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- F. Sealant Joints: Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric silicone sealant, in compliance with SMACNA Standards.
- G. Expansion Provisions: Fabricate running lengths to allow controlled expansion not only for movement of metal components in relationship to one another, but also to adjoining dissimilar materials, including wall materials, flashing and roofing membrane materials, in a manner sufficient to prevent water leakage, deformation or damage.

## 2.04 SHEET METAL FABRICATIONS

- A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements.



## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install prefinished steel trim and accessories at locations as shown or as required. Install preformed trim or field break to clean, straight lines. Use full 180 degree crimp edges where abutting dissimilar materials or at other exposed cut edges.
- B. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
- C. Separations: Separate metal from non-compatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
- D. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed watertight with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- E. Downspouts: Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
- F. Precast Concrete downspouts: Install with a slope to drain. Adjust grade as needed to accommodate proper slope.

### **3.03 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07 62 00

## SECTION 07 84 13

### PENETRATION FIRESTOPPING

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes
  - 1. Penetration firestopping for fire-rated construction and smoke walls.
  - 2. Openings include, both blank (empty) and those accommodating penetrating items such as cables, conduits, pipes, ducts, etc.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
  - 1. Division 7 Section "Joint Sealants"
  - 2. Division 9 Section "Gypsum Board Assemblies"

##### 1.02 QUALITY ASSURANCE

- A. Firestopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local building code as tested by nationally accepted test agencies per ASTM E-814 or UL 1479 fire tests. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated. The T rating, when required by code authority, shall be based on measurement of the temperature rise on the penetrating items. The fire test shall be conducted with minimum positive pressure differential of 0.01-inches of water column.
- B. Firestopping material shall be asbestos free, free of any PCB's and lead free.
- C. Do not use any product containing solvents or that requires hazardous waste disposal.
- D. Firestopping shall be performed by a contractor trained or approved by firestop manufacturer.
- E. Equipment used shall be in accordance with firestop manufacturer's written installation instructions.
- F. The use of a brand name item is to set a standard of quality and is not intended to restrict the contractor from offering an equal item from other sources of supply.
  - 1. If submitting for pre-approval of a product not listed in this specification during bidding, submittal must be in accordance with Division 1 Sections.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Submit manufacturer's product literature for each type of firestop material to be installed. Literature shall indicate product characteristics, typical uses, performance and limitation criteria, and test data.
- C. Material safety data sheets (MSDS): Submit MSDS for each firestop product.

- D. Shop drawings: Show typical installation details for methods of installation. Indicate which firestop materials will be used and their locations.
- E. Submit manufacturer's installation procedures for each type of product.
- F. Installer documentation: General Contractor shall engage a single firestop Contractor to perform all firestopping. Submit document from firestop manufacturer wherein manufacturer recognizes, i.e. approves installer for said manufacturer's firestop products.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in the manufacturer's original, unopened containers or packages with manufacturer's name, product identification, lot numbers, UL-labels, and mixing and installation instructions, as applicable.
- B. Store materials in the original, unopened containers or packages, and under conditions recommended by manufacturers.
- C. All firestop materials shall be installed prior to expiration of shelf life.

#### 1.05 PROJECT CONDITIONS

- A. Conform to Manufacturer's printed instructions for installation and when applicable, curing in accordance with temperature and humidity. Conform to ventilation and safety requirements.

#### 1.06 WARRANTY

- A. Firestop Contractor shall warrant that firestopping systems used meet firestopping requirements as herein specified.

#### 1.07 SEQUENCING

- A. Coordinate this work as required with work of other trades.
- B. Firestopping shall precede gypsum board finishing.

#### 1.08 PROTECTION

- A. Where firestopping is installed at locations which will remain exposed in the completed work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage from other construction activities.

### **PART 2 - PRODUCTS**

#### 2.01 GENERAL

- A. Firestopping shall meet the specified requirements.

#### 2.02 FIRESTOPPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

- 1. Acceptable manufacturers:

- a. Bio Fireshield (whose products are listed as a standard).

- b. RectorSeal, Metacaulk.
  - c. 3M, Fire Protection Products.
- 2. Firestop Mortars:
  - a. Bio Fire Rated K-10 Firestop Mortar.
  - b. Metacaulk Mortar.
  - c. 3M Fire Barrier Mortar
- 3. Firestop Sealants and Caulks:
  - a. Biotherm 100 and Biotherm 200SL Firestop Sealants.
  - b. Biostop 500+ Intumescent Firestop Caulk.
  - c. Metacaulk 950, 835, 1000, 1100 & 1200 Sealants and Intumescent Firestop Caulks.
  - d. 3M Fire Barrier CP25WB+ Caulk.
  - e. 3M Fire Barrier Silicone Sealant 2000+.
- 4. Firestop Putty:
  - a. Biostop Moldable Putty & Putty Pads
  - b. Metacaulk Putty & Putty Pads.
  - c. 3M MPS-2 Moldable Putty Stix.
  - d. 3M MMP-4S Moldable Putty Pads.
- 5. Firestop Collars:
  - a. Biostop Plastic Pipe Collar.
  - b. Metacaulk Plastic Pipe Collar
  - c. 3M Fire Barrier PPD, Plastic Pipe Device.
- 6. Firestop Mastic
  - a. Biostop 700 Intumescent Firestop Mastic.
  - b. Metacaulk 1100 Firestop Mastic.
- 7. Wrap Strips
  - a. Bio Fireshield BIOSTOP Intumescent Wrap Strips.
  - b. Metacaulk Intumescent Wrap Strips.
  - c. 3M Fire Barrier FS-195+ Wrap Strip.
- 8. Accessories:
  - a. Forming/Damming Materials: Mineral fiberboard or other type recommended by manufacturer's tested system.
  - b. Primer, Sealant and Solvent Cleaner: As recommended by manufacturer.
  - c. Fire Safing Insulation.

## **PART 3 - EXECUTION**

### **3.01 INSPECTION**

- A. Examine the area and conditions where Firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work until unsatisfactory conditions have been corrected by the Contractor in manner acceptable to the Architect.
- B. Verify that environmental conditions are safe and suitable for installation of Firestop products.

C. Provide labels at each location which state:

1. Firestop System: Do Not Disturb
2. Manufacturer's name \_\_\_\_\_
3. System Number \_\_\_\_\_

### 3.02 CONDITIONS REQUIRING FIRESTOPPING

A. General:

1. Provide firestopping for conditions specified whether or not firestopping is indicated, and, if indicated, whether such material is designated as insulation, safing, or otherwise.
2. Insulation types specified in other Sections shall not be installed in lieu of firestopping material specified herein.

B. Interior Walls and Partitions:

1. Where the top edge of a fire-rated wall or partition abuts and is at right angles to fluted-type metal decking, and the construction is such that would otherwise leave the flute spaces open, provide firestopping.
2. Provide firestopping whether or not there are any clips, angles, plates or other members bridging or interconnecting the wall and floor systems, and whether or not such items are continuous.
3. Where the top edge of a fire-rated wall or partition abuts and is at right angles to fluted-type metal decking, and the construction is such that would otherwise leave the flute spaces open, provide firestopping.

C. Penetrations:

1. Penetrations include conduit, cable, wire, pipe, duct, or other elements which pass through one or both outer surfaces of a fire rated floor, wall, or partition.
2. Where penetrations occur at fire-rated walls or partitions of solid-type construction, provide fire-stopping to completely fill spaces around the penetrations, in accordance with ASTM E-814.
3. Where penetrations occur at fire-rated walls or partitions of hollow-type construction, provide fire-stopping to completely fill spaces around the penetration, on each side of the wall or partition. In accordance with ASTM E-814.
4. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, firestop annular space - if any - between sleeve and wall of opening.

D. Provide firestopping to fill miscellaneous voids and openings in fire-rated construction in a manner essentially the same as specified.

### 3.03 INSTALLATION

A. General

1. Installation of Firestops shall be performed by specialty Contractor specializing in Firestop application, with experience in similar applications and projects with installers qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
2. Apply Firestops in accordance with fire test reports, for resistance requirements, acceptable sample installation, and manufacturer's recommendations.

3. Coordinates with plumbing, mechanical, electrical and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire related construction have been permanently installed prior to installation of Firestops, schedule and sequence the work to assure that partitions and other construction, which would conceal penetrations, are not erected prior to the installation of Firestops.

B. Dam Construction

1. Install dams when required to properly contain Firestopping materials within openings and as required to achieve required fire resistance rating. Combustible damming material must be removed after appropriate curing. Incombustible damming materials may be left as a permanent component of the Firestop system.

C. Field Quality Control

1. Prepare and install firestopping systems in accordance with manufacturer's printed instructions and recommendations.
2. Follow safety procedures recommended in the Material Safety Data Sheets.
3. Finish surfaces of firestopping which is to remain exposed in the completed Work to a uniform and level condition.
4. All areas of Work must be accessible until inspection by the applicable Code authorities.
5. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification at no additional cost.
6. Manufacturer's representative must make periodic visits to verify proper materials.

3.04 Cleaning

- A. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
- B. Leave finished Work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.

END OF SECTION 07 84 13

## SECTION 07 92 00

### JOINT SEALANTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes joint sealants for the following locations:
  - 1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as indicated below:
    - a. Joints in precast concrete wall panels.
    - b. Perimeter joints between precast concrete and dissimilar materials.
    - c. Joints between precast concrete building and metal building.
    - d. Perimeter joints between exterior concrete and metal wall surfaces and frames of doors and windows.
    - e. Perimeter joints of window sill flashing.
    - f. Joints between metal trim and dissimilar material.
    - g. Other joints as indicated.
  - 2. Exterior joints in horizontal traffic surfaces as indicated below:
    - a. Expansion joints between slabs on grade and building.
    - b. Expansion joints between slabs on grade and back of curbs.
    - c. Expansion joints between slabs on grade and columns.
    - d. Expansion joints between slabs on grade and exterior, structural stoops.
    - e. Expansion joints in concrete slabs on grade (including sidewalks, drives, parking lots, etc.).
    - f. Saw-cut control joints in cast-in-place concrete slabs on grade (including sidewalks, drives, parking lots, etc.). Sealant is not required if the control joints are tooled with radiused edges.
    - g. Other joints as indicated.
  - 3. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:
    - a. Joints in precast concrete wall panels
    - b. Perimeter joints between countertop and sidesplashes, perimeter joints between wall and top of backsplashes and perimeter joints between wall and top of sidesplashes.
    - c. Perimeter joints between window sills and walls and between window sills and window frames.
    - d. Perimeter joints between wall surfaces and frames of interior and exterior doors and windows.
    - e. Perimeter joints between walls and top of mop sinks and between mop sink and floor finish.
    - f. Perimeter joints of plumbing fixtures.
    - g. Other joints as indicated.

4. Interior joints in horizontal traffic surfaces as indicated below:
  - a. Pistol Range 105: Control and expansion joints in cast-in-place concrete slabs.
  - b. All Other Areas: Expansion joints in cast-in-place concrete slabs and expansion joints between cast-in-place concrete and columns.
  - c. Other joints as indicated.

#### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Samples for color selection purposes in form of manufacturer's standard bead samples.
- C. Product data from manufacturers for each joint sealant product required.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

#### 1.05 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
  1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer or below 40 deg F.
  2. When joint substrates are wet.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

#### 1.06 SEQUENCING AND SCHEDULING

- A. Sequence installation of joint sealants to occur not less than 21 days nor more than 30 days after completion of waterproofing, unless otherwise indicated.

## **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Dow Corning Corp.
  2. General Electric Company
  3. Pecora Corporation.



4. Sonneborn / ChemRex, BASF Building Systems.
5. Sika Corporation.

## 2.02 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates.
  1. Provide compatibility testing results by manufacturer.
  2. Provide field testing by installer and submit written reports.
- B. Colors: Provide color of exposed joint sealants to comply with the following:
  1. Typical joints: Provide selections made by Architect from manufacturer's full range of standard colors.

## 2.03 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and ASTM C 920 classifications for Type, Grade, Class, and Uses.

## 2.04 LATEX JOINT SEALANTS

- A. General: Provide manufacturer's standard one-part, non-sag, mildew-resistant, paintable latex sealant.
- B. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
- C. Silicone Emulsion Sealant: Comply with ASTM C 834 and ASTM C 920 to accommodate joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.

## 2.05 JOINT SEALANT BACKING

- A. Plastic Foam Joint Fillers: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding strips of flexible plastic foam of closed-cell non-absorbing, non-outgassing, polyethylene foam or proprietary material of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  1. Provide Sonneborn Soft Backer-Rod or equal.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.06 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, formulated to promote optimum adhesion of sealants with joint substrates.
  - C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces.
- 2.07 VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- A. Architectural Sealants: Not more than 250 g/L.
  - B. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.
  - C. Sealant Primers for Porous Substrates: Not more than 775 g/L.

### **PART 3 - EXECUTION**

#### **3.01 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer. Confine primers to areas of joint sealant bond.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces. Remove tape immediately after tooling without disturbing joint seal.

#### **3.02 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Sealant Installation Standard: ASTM C 1193.
- C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
  - 1. Install joint fillers to provide support of sealants during application.
  - 2. Install bond breaker tape between sealants where backer rods are not used.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- E. Tooling of Non-sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Remove excess sealants from surfaces adjacent to joint.

1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

### 3.03 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

### 3.04 PROTECTION

- A. Protect joint sealants during and after curing period. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that any installations with repaired areas are indistinguishable from original work.

### 3.05 JOINT SEALANT SCHEDULE

#### A. EXTERIOR JOINT SEALANTS

1. Polyurethane Sealant: Type M or S, Grade P, Class 25, Uses T and M. Provide NR-200 or NR-201 Urexpan by Pecora; or Sonolastic SL1 or SL2 by Sonneborn or equivalent product of other approved manufacturers.
  - a. Exterior joints in horizontal traffic surfaces as noted in Part 1 above.
2. Polyurethane Sealant: Type M or S, Grade NS, Class 25, Uses NT, T, G, A, M and O. Provide Dynatrol II or I XL by Pecora; or Sonolastic NP1 or NP2 by Sonneborn or equivalent product of other approved manufacturers.
  - a. Exterior joints in vertical surfaces as noted in Part 1 above.

#### B. INTERIOR JOINT SEALANTS

1. Polyurethane Sealant: Type M or S, Grade P, Class 25, Uses T and M. Provide NR-200 or NR-201 Urexpan by Pecora; or Sonolastic SL1 or SL2 by Sonneborn or equivalent product of other approved manufacturers.
  - a. Interior joints in horizontal traffic surfaces as noted in Part 1 above.
2. Polyurethane Sealant: Type M or S, Grade NS, Class 25, Uses NT, T, G, A, M and O. Provide Dynatrol II or I XL by Pecora; or Sonolastic NP1 or NP2 by Sonneborn or equivalent product of other approved manufacturers.
  - a. Interior joints in vertical surfaces of precast concrete wall panels; between gyp board and concrete; between metal and concrete; perimeter joints of door and window frames in concrete walls; other joints between concrete and dissimilar materials.
3. Siliconized Acrylic Latex: ASTM C834.. Provide AC-20 + Silicone by Pecora; or Sonolac by Sonneborn or equivalent product of other approved manufacturers.
  - a. Interior vertical joints in field-painted surfaces at perimeter of metal window and door frames; in gypsum drywall; and all other non-traffic interior joints not indicated otherwise.
4. Mildew Resistant Silicone Sealant: Type S, Grade NS, Class 25, Uses NT, G and A. Provide 864 Silicone by Pecora; or OmniPlus by Sonneborn or equivalent product of other approved manufacturers.

- a. Interior joints around plumbing fixtures, and at countertops, backsplashes and sidesplashes.

END OF SECTION 07 92 00

## SECTION 08 11 00

### METAL DOORS AND FRAMES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes:
  - 1. Steel doors and frames.
  - 2. Bullet resistant steel doors and frames.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 8 Section "Flush Wood Doors" for solid-core wood doors installed in steel frames.
  - 2. Division 8 Section "Door Hardware" for door hardware and weather stripping.
  - 3. Division 8 Section "Glazing" for glass in doors and sidelights.
  - 4. Division 9 Section "Painting" for field painting primed doors and frames.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of door and frame specified.
- C. Shop Drawings showing fabrication and installation of steel doors and frames.
- D. Certification of bullet resistant doors and frames meeting UL752-1995 test requirements.
- E. Schedule: Prepared by or under supervision of supplier. Use same reference numbers for openings as those on drawings.

##### 1.04 QUALITY ASSURANCE

- A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.
- B. Fire-Rated Door Assemblies: Provide doors and frames complying with NFPA 80, tested for fire-test-response characteristics per ASTM E 152, and are labeled.
- C. Provide bullet resistant doors and frames tested in accordance with UL 752-1995.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

- B. Inspect doors and frames on delivery for damage. Remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking.

#### 1.06 CODE INFORMATION

- A. The specified door system unit is required to have the following values:
  - 1. Assembly U value: .157

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide products of the following:
  - 1. Steel Doors and Frames:
    - a. Ceco Door Products.
    - b. Curries Co.
    - c. Republic Builders Products.
    - d. Steelcraft.

#### 2.02 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569.
- B. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366, commercial quality, or ASTM A 620, drawing quality.
- C. Steel plates as needed for bullet resistant doors and frames tested in accordance with UL 752-1995.
- D. Supports and Anchors: Fabricated from not less than 0.0478-inch- thick steel sheet.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.
- F. Insulation at exterior doors: Manufacturer's standard extruded polystyrene core insulation.

#### 2.03 DOORS

- A. Steel Doors: Provide 1-3/4-inch- thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:
  - 1. Interior Doors: Grade II, heavy-duty, Model 2, seamless design, minimum 18 gage- thick steel sheet faces. Provide flush slab design as shown.
  - 2. Exterior Doors: Grade II, heavy duty, Model 2, seamless design, minimum 16 gage-thick galvanized steel sheet faces, with rigid insulation. Provide flush slab design as shown.
  - 3. Provide manufacturer's standard glass light frames and stops.

- B. Bullet Resistant Steel Doors where shown: Provide 1-3/4-inch- thick doors of materials and grades and models specified below:
1. Provide SDI level 4 – Maximum Duty – Performance Level A.
  2. Provide UL-752 Level 1 doors – designed for 9 mm ammunition with full metal copper jacket.
  3. Include G90 hot dipped galvanized coating at exterior doors.
  4. Flush top channel at exterior doors.
  5. Insulated polystyrene core.
  6. Seamless vertical edges.

## 2.04 FRAMES

- A. Provide metal frames for doors and sidelights according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 16-gauge-thick cold-rolled steel sheet for interior frames and 14-gauge for exterior frames.
1. Bullet Resistant Steel Doors where shown:
    - a. Provide frames that meet SDI level 4 – Maximum Duty – Performance Level A.
    - b. Provide frames that meet UL-752 Level 1 doors – designed for 9 mm ammunition with full metal copper jacket.
  2. Provide G-90 galvanized steel sheet, welded frames with mitered or coped corners at all exterior door frames.
- B. Door Silencers: Drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

## 2.05 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Comply with ANSI/SDI 100.
1. Clearances: Not more than 1/8-inch at jambs and heads, except not more than 1/4-inch between non-fire-rated pairs of doors. Not more than 3/4-inch at bottom.
    - a. Fire Doors: Provide clearances according to NFPA 80.
- B. Fabricate exposed faces of doors and panels from only cold-rolled steel sheet.
- C. Thermal-Rated (Insulating) Assemblies: At exterior locations, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C976.
- D. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- E. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- F. Galvanized Steel Doors, Panels, and Frames: At exterior locations, fabricate doors and frames from galvanized steel sheet according to SDI 112. Close top and bottom edges of doors flush as an integral part of door construction or by addition of galvanized steel channels. Seal joints in top edges of doors.

- G. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- H. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for preparation for hardware.
- I. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- J. Locate hardware according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- K. Fabricate doors and frames to receive glass lights as shown with manufacturer's standard glass stops and frames.

## 2.06 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual" and SSPC-PA 1 "Paint Application Specification No. 1," for steel sheet finishes.
- B. Apply primers and organic finishes to doors and frames after fabrication.
- C. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.
  - 1. Galvanized Finish: G-90 coating as per ASTM A924.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Bullet Resistant doors and frames: Install bullet resistant doors and frames per manufacturer's current written recommendations and as required to meet UL-752 requirements.
- C. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. Install fire-rated frames according to NFPA 80.
- D. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100 and, for fire-rated doors, within clearances specified in NFPA 80.

### 3.02 ADJUSTING AND CLEANING

- A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08 11 00



**SECTION 08 14 16**  
**FLUSH WOOD DOORS**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
  - 1. Solid core doors with wood veneer faces.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 8 Section "Metal Doors and Frames" for frames.
  - 2. Division 8 Section "Door Hardware".
  - 3. Division 8 Section "Glazing"
  - 4. Division 9 Section "Painting" for stain and finish.

1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of door.
- C. Shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, and other pertinent data.
- D. A copy of door warranty proposed to be furnished.

1.04 QUALITY ASSURANCE

- A. Quality Standard: Comply with the following standard:
  - 1. NWWDA Quality Standard: I.S.1-A, "Architectural Wood Flush Doors," of the National Wood Window and Door Association.
  - 2. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grade of door, core, construction, finish, and other requirements.
- B. Fire-Rated Wood Doors: Provide doors that comply with NFPA 80; and are labeled and listed by UL, Warnock Hersey, or another testing and inspection agency acceptable to authorities having jurisdiction.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's instructions.
- B. Identify each door with individual opening numbers as designated on shop drawings, using temporary, removable, or concealed markings.
- C. Store doors flat, in a dry area, and maintain humidity between 30 and 60 percent.

#### 1.06 PROJECT CONDITIONS

- A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized to comply with the following requirements applicable to Project's geographical location:
  - 1. AWI quality standard Section 100-S-11 "Relative Humidity and Moisture Content."

#### 1.07 WARRANTY

- A. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) or that show telegraphing of core construction in face veneers or do not conform to tolerance limitations of referenced quality standards.
  - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
  - 2. Warranty shall be in effect during the following period of time after date of Substantial Completion.
    - a. Solid Core Interior Doors: Life of installation.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide doors by one of the following:
  - 1. Solid Core Doors:
    - a. Algoma Hardwoods Inc.
    - b. Eggers Industries
    - c. Graham Manufacturing Corp.
    - d. V-T Industries Inc.
    - e. Weyerhaeuser Co.

#### 2.02 INTERIOR FLUSH WOOD DOORS

- A. Solid Core Doors for Transparent Finish: Comply with the following requirements:
  - 1. Faces: Red oak, plain sliced.
  - 2. Grade: Premium with 'A' face.
  - 3. Quality Standard: WDMA IS 1-A, Custom Grade

4. Thickness: 1- $\frac{3}{4}$ "
  5. Construction: WDMA 5 or 7-ply.
  6. Core: PC (Particleboard) or SCL (Structural Composite Lumber); mineral core at 45-90 minute rated doors.
  7. Edges: Provide manufacturer's standard laminated edge construction with improved screw-holding capability and split resistance over edges composed of a single layer of treated lumber.
    - a. Pairs: At rated doors, provide fire retardant stiles which are labeled and listed for kinds of applications indicated without steel edges and astragals.
  8. Cross Band: Nominal 1/16" thick
  9. Stiles: Two-ply (min) laminated, species to match face veneer; mfr's standard at 45-90 minute rated doors.
  10. Top and Bottom Rails: Not required for SCLC; provide 1-1/8" minimum hardwood or softwood rails for PC.
  11. Hardware Blocking: Not required for SCLC; provide 5" top and bottom rail reinforcing and lock block reinforcing for all surface mounted hardware.
  12. Face Assembly Adhesive: Type II (water-resistant)
  13. Core Assembly Adhesive: Type II (water-resistant)
  14. Security Rating: Class 40. Class 30 at 45-90 min fire rated doors.
- B. Fire-Rated Solid Core Doors: Comply with the following requirements:
1. Faces and Grade: Provide faces and grade to match non-fire-rated doors in same area of building, unless otherwise indicated.
  2. Construction: Manufacturer's standard core construction as required to provide fire-resistance rating indicated.
  3. All rated doors (of 30 minute rating or higher) shall have intumescent seals concealed under the veneer at the sides and top door edges (not required at the door bottom).

## 2.03 FABRICATION

- A. Fabricate flush wood doors to comply with following requirements:
1. In sizes indicated for job-site fitting.
    - a. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements of NFPA 80 for fire-resistance-rated doors.
- B. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
1. Light Openings: Trim openings with moldings of material and profile indicated.
    - a. Shape: to be selected from manufacturer's standard range of shapes.
    - b. Rated Doors: Manufacturer's standard, primed metal molding. Provide moldings to meet rating requirements on rated doors.
    - c. Non-Rated Doors: Wood molding – style to be selected by Architect from manufacturer's standard range of styles.

## PART 3 - EXECUTION

### 3.01 FIELD FINISHED DOORS

- A. Field-Finished Doors: Refer to Division 9 Section "Painting" for finish requirements.

08 14 16 – FLUSH WOOD DOORS 3

### 3.02 FABRICATION AND PRE-MACHINING

- A. Fabricate all wood doors in strict accordance with the referenced standards specified herein. For fire rated and labeled doors, pre-machine doors for hardware, glass openings, etc. as required by NFPA 8 Standard for Fire Doors and Windows.

### 3.03 EXAMINATION

- A. Examine installed door frames prior to hanging door:
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
  - 2. Reject doors with defects.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.04 INSTALLATION

- A. Hardware: For installation see Division 8 Section "Door Hardware."
- B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and referenced quality standard and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to requirements of NFPA 80.
- C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
  - 1. Fitting Clearances for Non-Fire-Rated Doors: Provide 1/8-inch at jambs and heads, and 1/8-inch from bottom of door to top of decorative floor finish or covering.
  - 2. Fitting Clearances for Fire-Rated Doors: Comply with NFPA 80.
  - 3. Bevel non-fire-rated doors 1/8-inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
  - 4. Bevel fire-rated doors 1/8-inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.

### 3.05 ADJUSTING AND PROTECTION

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at the time of Substantial Completion.
- C. Replace or repair (to the Architect's satisfaction) any door that is damaged.
- D. Replace warped doors.

END OF SECTION 08 14 16

**SECTION 08 33 13**  
**COILING COUNTER DOORS**

**PART 1 - GENERAL**

1.01 SUMMARY

- A. Section includes:
  - 1. Coiling counter doors.
- B. Related Section:
  - 1. Division 09 Section "Gypsum Board Assemblies" for associated wall.
  - 2. Division 12 Section "Plastic Laminate Clad Countertops" for sill condition.

1.02 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type and size of coiling counter door and accessory.
- C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
- D. Samples: For each exposed product and for each color and texture specified.
- E. Maintenance Data.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

**PART 2 - PRODUCTS**

2.01 COILING COUNTER DOORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Overhead Door Corporation, or comparable product by one of the following:
  - a. Alpine Overhead Doors, Inc.
  - b. Amstel Manufacturing.
  - c. Cookson Company.
  - d. Cornell Iron Works, Inc.
  - e. Mahon Door Corporation.
  - f. McKeon Rolling Steel Door Company, Inc.
  - g. Metro Door.
  - h. Raynor.

- i. Wayne-Dalton Corp.
  - j. Windsor Door.
- B. Model Numbers and Mounting Condition:
  - 1. Non-fire rated coiling counter doors: Overhead Door Corp. "652 Series" rolling counter doors.
  - 2. Mounting Conditions: Face-of-wall mounting.
- C. Door Curtain Material:
  - 1. Non-fire rated: Interlocking slats, Type FE-138, aluminum with endlocks; Finish: Clear anodized.
- D. Curtain Jamb Guides:
  - 1. Non-fire rated: Extruded aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise
- E. Hood:
  - 1. Match curtain material and finish
  - 2. Shape: Square.
  - 3. Mounting: Face of wall.
- F. Sill Configuration for Counter Door: Plastic laminate counter by others.
- G. Locking Devices: Standard interior slide bolts.
- H. Manual Door Operator: Push-up operation.
- I. Bottom Bar for Counter Doors: Manufacturer's standard continuous channel or tubular shape, fabricated from metal to match curtain slats and finish.
- J. Push/Pull Handles: Equip each push-up-operated door with lifting handles on each side of door, finished to match door
- K. Counterbalance: Manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
  - 1. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

- B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer.

3.02 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 08 33 13

**SECTION 08 33 23**  
**OVERHEAD COILING DOORS**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes:
  - 1. Exterior overhead coiling door.
  - 2. Electric motor operator for overhead coiling door.
- B. Related Sections include the following:
  - 1. Division 13 Section "Metal Building Systems" for substrate.
  - 2. Division 26 Section "Electrical" for power to door operator.

1.03 PERFORMANCE REQUIREMENTS

- A. Operation-Cycle Requirements: Design overhead coiling door components and operator to operate for not less than 20,000 cycles.

1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of door.
- C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- D. Samples: For each exposed product and for each color and texture specified.
- E. Maintenance Data.
- F. A copy of door warranty proposed to be furnished.



## 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the overhead coiling door manufacturer for both installation and maintenance of units required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 1.06 WARRANTY

- A. Furnish 2 year warranty from the Date of Substantial Completion, against defects in workmanship and materials.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Overhead Door Corporation, or comparable product by one of the following:
  - 1. Alpine Overhead Doors, Inc.
  - 2. Atlas Door Corp.; Div. of Clopay Building Products Co.
  - 3. Cookson Company
  - 4. Cornell Iron Works Inc.
  - 5. Mahon Door Corp.
  - 6. McKeon Rolling Steel Door Company, Inc.
  - 7. Overhead Door Corporation.
  - 8. Pacific Rolling Door Co.
  - 9. Raynor Garage Doors.
  - 10. Roll-Lite Door Corp.; Div. of Clopay Building Products Co.
  - 11. Southwestern Steel Rolling Door Co.
  - 12. Wayne-Dalton Corp.
  - 13. Windsor Door; A United Dominion Company.

### 2.02 DOOR ASSEMBLY

- A. Overhead Coiling Doors:
  - 1. Basis of Design – Provide the following product or equal product of one of the approved manufacturers subject to compliance with the documents:
    - a. 625 Series Stormtite Insulated Service Doors by Overhead Door Corporation.
- B. Materials:
  - 1. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
    - a. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm) and as required to meet requirements.

- i. Interior and exterior face slats to be 24 gage.
    - b. Finish: Galvanized Steel: Slats and hood shall be galvanized steel in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester (powder coated) top coat. Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
    - c. Color: As selected by Architect from Manufacturer's full range.
  - 2. Windload Design: 20 PSF.
  - 3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
    - a. R Value: 7.2 minimum.
  - 4. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.
  - 5. Weatherseals: Vinyl bottom seals, exterior guide and internal hood seals.
  - 6. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
  - 7. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from manufacturer's standard hot-dip galvanized steel, to match curtain slats and finish.
  - 8. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent over-travel of curtain, and a continuous bar for holding wind-locks.
    - a. Three (galvanized) structural steel angles with minimum thickness of 3/16". Guides shall be weatherstripped with a vinyl weather seal at each jamb, on the exterior curtain side.
  - 9. Brackets: Hot rolled steel Galvanized steel to support counterbalance, curtain and hood.
  - 10. Counterbalance: Helical torsion spring type designed for standard 50,000 cycle life design. Counterbalance shall be housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03" per foot of span. Counterbalance shall be adjustable by means of an adjusting tension wheel.
  - 11. The barrel shall be steel tubing of not less than 4" in diameter. Oil tempered torsion springs shall be capable of correctly counter balancing the weight of the curtain. The barrel shall be designed to limit maximum deflection to .03" per foot of opening width. The barrel shall receive one (1) coat of bronze rust-inhibiting prime paint.
  - 12. Wall Mounting Condition: Face-of-wall mounting.
- C. Hood:
- 1. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

- a. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
- b. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

## 2.03 ELECTRIC MOTOR

- A. Basis of Design – Provide the following product or equal product of one of the approved manufacturers subject to compliance with the documents:
  1. The electric door operator shall be the standard-duty Model RSX™ door control system for a rolling steel door as manufactured by Overhead Door Corporation and suitable for the type and size of door specified.
  2. The electric operator shall be single phase, 115 Volt.
  3. All components to have corrosion resistant coatings.
  4. The operator shall be suited for NEMA ICS 6 Type 1 environment.
- B. Motor:
  1. 3/4 horsepower single phase with manual reset thermal overload.
  2. Motor frame shall comply with NEMA 56 for 1/2 three phase, 3/4 & 1hp all phases;pen drip-proof construction.
- C. Reduction:
  1. Primary reduction is Super Belt™, an auto tensioning poly-V flex belt that does not require adjustment. Secondary reduction is by chain and sprocket.
- D. Duty Cycle:
  1. Duty cycle shall accommodate standard duty usage up to 60 cycles per hour during peak usage periods.
- E. Brake:
  1. Brake shall be a DC Disc type with selectable Progressive Braking for smooth stopping.
- F. Clutch:
  1. Clutch shall be adjustable friction disc type standard on all versions.
- G. Limit System:
  1. The Limit Lock limit system shall be magnetic type providing absolute positioning with push to set and remote setting capabilities. The Limit System shall remain synchronized with the door during manual operation and supply power interruptions.
- H. Control System:
  1. Microprocessor based with relay motor controls on a single board. This system will incorporate Einstein Logic™, with a 16 character Liquid Crystal Display (LCD) to display the system status. This system shall be capable of monitoring and reporting on a variety of operating conditions, including: Current operating status, Current command status, Motor movement status, Current error status (if applicable), Hoist Interlock status (if applicable), External Interlock status, 24VDC status.
  2. The control system shall feature a delay-on-reverse operating protocol.

3. Include maximum run timers in both directions of travel that limit motor run time in the event the clutch slips or some other problem occurs.
  4. Include provisions for the connection of a 2-wire monitored photocell system as well as standard 2-wire sensing edges, photocells or other entrapment protection devices.
  5. Include provisions for connection of single and/or 3-button control stations.
  6. Include provisions for connection of an external 3-wire radio controls and related control devices.
  7. The control system shall include on board open, close and stop control keys for local operation.
  8. The control system will include a CodeDodger® radio receiver that is dual frequency cycling at 315Mhz and 390Mhz capable of storing 250 single button and/or 250 Open-Close-Stop transmitters with the ability to add and/or delete transmitters individually, identify and store activating transmitter ID(s).
- I. Mounting:
1. Front of hood and chain/sprocket coupling to door.
  2. Mounting for Hoist models – Verify side of hood with Architect. Location shall be coordinated with electrical power location.
- J. Release:
1. Release shall be a pull and hold type mechanism with single cable operation and an integrated interlock switch on hoist units.
- K. Hoist:
1. Chain hoist shall consist of chain pocket wheel, chain guard and smooth hand chain on hoist units.
- L. Secondary Reversal:
1. Rolling Steel versions shall be designed to accept an optional external reversing device.
- M. Limit Switches: Adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- N. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
1. Pressure-Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Provide pneumatically actuated automatic bottom bar.
      - 1) Self-Monitoring Type: Four-wire configured device.
- O. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
1. Provide full-guarded, surface-mounted, heavy-duty-type interior unit with general-purpose, NEMA ICS 6, Type 1 enclosure at interior locations indicated on Drawings or if not shown, as directed by Architect..

- P. Radio Control: Radio control system consisting of the following:
1. Three-channel, universal coaxial receiver to open, close, and stop door; two (2) per operator.
  2. Multifunction remote control.
  3. Remote antenna mounting kit.
- Q. Exterior Key Switch:
1. Exterior key switch including key cylinder – keyed to Owner's keying system.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. General: Install doors, guides, hood and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.
- B. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.
- C. Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

### **3.02 ADJUSTING AND CLEANING**

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion.
- B. Test rolling doors for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- C. Touch-up damaged coatings and finishes and repair minor damage. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.

### **3.03 DEMONSTRATION**

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Owner's maintenance personnel as specified below:
1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.
  3. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data." Refer to Division 1 Section "Project Closeout."
  4. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 08 33 23

## SECTION 08 41 13

### ALUMINUM-FRAMED ENTRANCES AND WINDOWS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Aluminum exterior entrance doors.
  - 2. Aluminum interior entrance doors.
  - 3. Aluminum window, sidelight and transom storefront window systems.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 7 Section "Joint Sealants".
  - 2. Division 8 Section "Glazing".
  - 3. Division 8 Section "Door Hardware".
- C. Note: A portion of hardware for aluminum doors is provided by hardware supplier and installed by aluminum door installer. See hardware schedule for extent.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each product specified.
- C. Shop Drawings: For entrance door and storefront systems, show plans, elevations, sections, details, finishes, hardware, etc.

##### 1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field measurements.

##### 1.05 WARRANTY

- A. Finish Warranty: Submit written agreement on aluminum system manufacturer's standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective aluminum finishes.

1. Warranty shall be in effect during the following period of time after date of Substantial Completion.

- a. Ten (10) years.

#### 1.06 CODE INFORMATION

- A. The specified window system unit is required to have the following values:
  1. Assembly U value: .44
  2. Glazing U value: .35
  3. Solar Heat Gain Coefficient (SHGC): .44
  4. Tinted, Low E glazing.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Drawings are based on the following manufacturer. Another manufacturer's system of a similar and equivalent nature will be acceptable if, and as specifically approved by Architect  
The drawings are based on the following:
  1. Exterior door frames, sidelight and transom framing: Kawneer 451T framing (Center Plane); EFCO S403.
  2. Interior door frames, sidelight and transom framing: Kawneer TRIFAB II 450 framing (Center Plane); EFCO framing equal to Kawneer TRIFAB II 450.
  3. Exterior and interior doors: Kawneer 350 Medium-Stile Door design; EFCO door equal to Kawneer 350 Medium-Stile Door.
- B. Subject to compliance with requirements, equivalent systems of the following manufacturers are acceptable:
  1. EFCO Corporation
  2. Kawneer Company

#### 2.02 COMPONENTS

- A. Doors: Provide manufacturer's standard 1-3/4-inch- thick glazed doors with minimum 0.125-inch- thick, extruded tubular rail and stile members.
- B. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing.
- F. Weather Stripping: Manufacturer's standard replaceable weather.

- G. Transom, Sidelight and Door Framing: At exterior locations, provide manufacturer's standard fixed glass, thermally broken glass holding assembly, 2" wide x 4-1/2" deep, with center glass position. At interior locations, thermally broken assemblies are not required.
- H. Windows: Provide manufacturer's standard fixed glass, thermally broken glass holding assembly, 2" wide x 4-1/2" deep, with center glass position.
- I. Window Sill Flashing: Manufacturer's standard extruded aluminum, thermally broken window sill flashing at each exterior aluminum window and exterior door sidelight.
  - 1. Size window sill to accommodate window set-back. Kawneer 450-037 and as detailed.
  - 2. Style: To be verified with Architect.
  - 3. Color shall match window.
- J. Metal Flashing: Manufacturer's aluminum flashing finished to match window:
  - 1. Metal Aluminum Flashing: Manufacturer's standard 1/16-inch thick extruded aluminum shapes. Custom bent as needed for application.
- K. Sill End Dams: Provide manufacturer's standard extruded aluminum end dams at ends of each window sill.

## 2.03 HARDWARE

- A. See hardware schedule on Drawings for hardware supplied by others.
  - 1. See hardware schedule for hardware finish color.

## 2.04 FABRICATION

- A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- B. Prepare components to receive concealed fasteners and anchor and connection devices.
- C. Entrances: Fabricate door and window framing in profiles indicated. Reinforce as required to support imposed loads. Factory-assemble window, door and frame units and factory install hardware to greatest extent possible. Reinforce window, door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
  - 1. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
- D. Construct exterior window and door frames to allow for 1/4" to 3/8" shim space for backer rod and sealant around entire perimeter of window or door frame.

## 2.05 ALUMINUM FINISHES

- A. Class I finish - Finish shall match: Kawneer No. 14 Clear Anodized, AA-M12C22A41.



## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing window, entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints. Seal joints watertight.
- B. Metal Protection: Where aluminum will contact dissimilar metals, paint contact surfaces with primer or by apply sealant or tape recommended by manufacturer. Where aluminum will contact concrete, paint contact surfaces with bituminous paint.
- C. Install components to drain water and condensation occurring within the system to the exterior.
- D. Set continuous sill members and flashing in a full sealant bed to provide weather-tight construction, unless otherwise indicated.
- E. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- F. Install framing plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
  - 1. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
- G. Install glazing to comply with requirements of Division 8 Section "Glazing."
- H. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
  - 1. Variation from Plane: 1/8-inch in 12 feet; 1/4-inch over total length.
  - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16-inch. Where surfaces meet at corners, limit offset from true alignment to 1/32-inch.
  - 3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8-inch.
- I. Install exterior window and door frames with 1/4" to 3/8" shim space for backer rod and sealant.

### **3.02 ADJUSTING AND CLEANING**

- A. Adjust doors, windows and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.
- B. Remove excess sealant and glazing compounds, and dirt from surfaces.

### **3.03 PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure entrance, windows and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08 41 13

## SECTION 08 71 00

### DOOR HARDWARE

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

##### 1.02 SUMMARY:

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
  - 1. Door hardware for wood and hollow metal doors.
  - 2. Door hardware for other doors indicated.
- B. Related work specified elsewhere:
  - 1. Division 12 Section "Manufactured Plastic-Laminate-Clad Casework" for cabinet hardware.
  - 2. Division 8 Section "Hollow Metal Doors and Frames".
  - 3. Division 8 Section "Wood Doors".
  - 4. Division 8 Section "Aluminum-Framed Entrances and Windows".
- C. Intent of Hardware Groups
  - 1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
  - 2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

##### 1.03 SUBMITTALS:

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.
- C. Product Data: Manufacturer's specifications and technical data including the following:
  - 1. Detailed specification of construction and fabrication.
  - 2. Manufacturer's installation instructions.
  - 3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
  - 4. Submit catalog cuts with hardware schedule.

- D. Shop Drawings - Hardware Schedule: Submit detailed hardware schedule in a vertical format.
1. List groups and suffixes in proper sequence.
  2. Completely describe door and list architectural door number.
  3. Manufacturer, product name, and catalog number.
  4. Function, type, and style.
  5. Size and finish of each item.
  6. Mounting heights.
  7. Explanation of abbreviations and symbols used within schedule.
  8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.
- E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.
- F. Samples: (If requested by the Architect)
1. 1 sample of Lever and Rose/Escutcheon design, (pair).
  2. 3 samples of metal finishes
- G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated. Furnish in electronic (PDF) format according to the Conditions of the Contract and Division 1 Specification Sections.
1. Operating and maintenance manuals: Submit the following.
    - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
    - b. Catalog pages for each product.
    - c. Name, address, and phone number of local representative for each manufacturer.
    - d. Parts list for each product.
  2. Copy of final hardware schedule, edited to reflect, "As installed".
  3. Copy of final keying schedule.
  4. As installed "Wiring Diagrams" for each piece of hardware connected to power, both low voltage and 110 volts.
  5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

#### 1.04 QUALITY ASSURANCE

- A. Comply with Division 1 and submit the following:
1. Statement of qualification for distributor and installers.
  2. Statement of compliance with regulatory requirements and single source responsibility.
  3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
    - a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
    - b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
  5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
    - a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
    - b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
  6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.
- B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Packing and Shipping: Comply with Division 1.
1. Deliver products in original unopened packaging with legible manufacturer's identification.
  2. Package hardware to prevent damage during transit and storage.
  3. Mark hardware to correspond with "reviewed hardware schedule".
  4. Deliver hardware to door and frame manufacturer upon request.
- B. Storage and Protection: Comply with manufacturer's recommendations.
- 1.06 PROJECT CONDITIONS:
- A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.
- 1.07 WARRANTY:
- A. Refer to Conditions of the Contract
- B. Manufacturer's Warranty:
1. Closers: Ten years
  2. Exit Devices: Three Years
  3. Locksets & Cylinders: Three years
  4. All other Hardware: Two years.
- 1.08 OWNER'S INSTRUCTION:
- A. Instruct Owner's personnel in operation and maintenance of hardware units.

## PART 2 - PRODUCTS

### 2.01 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" on the Drawings. Products are identified by using hardware designation numbers of the following:
1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or the comparable product of one of the other approved manufacturers that complies with requirements.

### 2.02 MATERIALS:

#### A. Hinges:

1. Template screw hole locations.
2. Equip with easily seated, non-rising pins.
3. Sufficient size to allow 180-degree swing of door.
4. Furnish hinges with five knuckles and flush [concealed] bearings.
5. Provide hinge type as listed in schedule.
6. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
7. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
8. UL10B listed for Fire

#### B. Locks and Latches:

1. Functions and design as indicated in the hardware groups.
2. Latchbolt to extend into the case a minimum of 3/8-inch (9.5 mm) when fully extended.
3. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
4. Provide sufficient curved strike lip to protect door trim.
5. Lock shall have self-aligning, thru-bolted trim.
6. Core face must be the same finish as the lockset.
7. All locksets shall be keyed to owners existing keying system.

#### C. Exit Devices shall:

1. Tested and approved by BHMA for ANSI 156.3, Grade 1.
2. Exposed components shall be of architectural metals and finishes.
3. Lever design shall match lockset lever design.
4. Provide strikes as required by application.
5. Fire exit devices to be listed for UL10C.
6. UL listed for Accident Hazard.

#### D. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

E. Door Closers:

1. Shall be tested and approved by BHMA for ANSI 156.4, Grade 1.
2. Shall be UL10C certified.
3. Shall include extra-duty arms and knuckles.
4. Shall conform to ANSI 117.1.
5. Shall include a maximum 2-7/16 inch case projection with non-ferrous cover.
6. Shall include separate adjusting valves for closing and latching speed, and backcheck.
7. Shall include adapter plates, shim spacers and blade stop spacers as required by frame and door conditions.
8. Mount closers on non-public side of door, unless otherwise noted in specification.
9. Contractor to check and adjust all closers when mechanical systems are in operation.
10. Closers shall be non-handed, non-sized and multi-sized 1 through 6.

F. Kickplates: Provide with four beveled edges, height as shown by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

G. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

2.03 FINISH

- A. Designations used in Schedule of Finish Hardware on Drawings, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products.
- B. Powder coat door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.04 KEYS AND KEYING

- A. Cylinders keyed to Owner's masterkey system.
- B. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner.
- C. Furnish keys in the following quantities:
  1. 1 each Grand Masterkeys
  2. 4 each Masterkeys
  3. 2 each Change keys each keyed core
- D. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
  - 1. Do not proceed until unsatisfactory conditions have been corrected.

### **3.02 HARDWARE LOCATIONS**

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
  - 1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
  - 2. NWWDA Industry Standard I.S.1.7, Hardware Locations for Wood Flush Doors.

### **3.03 INSTALLATION:**

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.
- C. ADA Standard: Conform to ANSI A117.1 for positioning requirements for disabled.
- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

### **3.04 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT**

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.
  - 1. Check and adjust closers to ensure proper operation.
    - a. Adjust closer to complete full closing cycle in less than 4 to 6 seconds without abrupt change of speed between "Sweep" and "Latch" speeds.
    - b. Adjust "Backcheck" according to manufacturer's instructions.
    - c. Set exterior doors closers to have 8.5 lbs maximum pressure to open, interior non-rated at 5 lbs, rated openings at 12 lbs
  - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
    - a. Verify levers are free from binding.
    - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.
  - 3. Report findings, in writing, to architect and hardware supplier outlining corrective actions and recommendations.

3.05 SCHEDULE OF FINISH HARDWARE:

a. Manufacturer's Abbreviations:

1. MK - McKinney
2. RO - Rockwood
3. SA - Sargent
4. YA - Yale
5. PE - Pemko

**Hardware Schedule**

**Set: 1.0**

Doors: 101A

Description: Exterior Alum Doors

2 Continuous Hinge	MCK-12HD	EN	MK
1 Removable Mullion	L980A		SA
1 Rim Exit Device	10 AD8504		SA
1 Exit Device	AD8510	US32D	SA
2 Pull	RM221 Mtg-Type 1XHD	US32D	RO
2 Door Closer	351 PSH 351D 581-2	EN	SA
1 Threshold	171A		PE
2 Sweep	3452CNB		PE

Notes: Weatherstrip furnished by alum. door supplier

**Set: 2.0**

Doors: 101B

Description: Vestibule Alum Doors

2 Continuous Hinge	MCK-12HD	CL	MK
2 Push Bar	8893	US32D	SA
2 Pull	RM221 Mtg-Type 1XHD	US32D	RO
2 Door Closer	351 PSH 351D 581-2	EN	SA

**Set: 3.0**

Doors: 102

Description:

6 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
2 Exit Device	10 NB8713 ETJ	US32D	SA
2 Door Closer	351 PSH	EN	SA
2 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO



**Set: 4.0**

Doors: 103A, 104

Description: Door w/ Sound Seal

3 Hinge	TA2714 4-1/2" x 4-1/2"		MK
1 Classroom Lock	10 8237 LNJ		SA
1 Door Closer	351 O	EN	SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Wall Stop	409	US32D	RO
1 Gasketing	332CR		PE
1 Door Bottom	412CPKL		PE

**Set: 5.0**

Doors: 103B

Description: Door w/ Sound Seal

3 Hinge	TA2714 4-1/2" x 4-1/2"		MK
1 Passage Set	8215 LNJ	US26D	SA
1 Door Closer	351 PSH	EN	SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Gasketing	332CR		PE
1 Door Bottom	412CPKL		PE

**Set: 6.0**

Doors: 105A

Description: Exterior Bullet Resistant Door

1 Continuous Hinge	MCK-14HD 83"		MK
1 Dormitory Lock	10 8225 LNJ		SA
1 Door Closer	351 PSH		SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Threshold	171A		PE
1 Gasketing	294AV		PE
1 Rain Guard	346C		PE
1 Sweep	3452CNB		PE

**Set: 7.0**

Doors: 105B

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lock	10 8237 LNJ	US26D	SA
1 Wall Stop	409	US32D	RO

**Set: 8.0**

Doors: 105C

Description: Exterior Exit Only Bullet Resistant Door

1 Continuous Hinge	MCK-14HD 83"		MK
1 Dormitory Lock	8225 LNJ less outside trim		SA
1 Door Closer	351 PSH		SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Threshold	171A		PE
1 Gasketing	294AV		PE
1 Rain Guard	346C		PE
1 Sweep	3452CNB		PE

**Set: 9.0**

Doors: 106, 112, 114, 115

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Office Lock	10 8205 LNJ	US26D	SA
1 Wall Stop	409	US32D	RO

**Set: 10.0**

Doors: 109

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lock	10 8237 LNJ	US26D	SA
1 Surface Overhead Holder/Stop	1548S	US26D	SA

**Set: 11.0**

Doors: 110

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Classroom Lock	10 8237 LNJ	US26D	SA
1 Door Closer	351 PSH	EN	SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Wall Stop	409	US32D	RO

**Set: 12.0**

Doors: 111

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"		MK
1 Storeroom Lock	10 8204 LNJ	US26D	SA
1 Door Closer	351 O	EN	SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Wall Stop	409	US32D	RO
1 Gasketing	S88D		PE

**Set: 13.0**

Doors: 116, 117C, 118B

Description: Exterior Hollow Metal Door

1 Continuous Hinge	MCK-14HD 83"		MK
1 Dormitory Lock	10 8225 LNJ		SA
1 Door Closer	351 PSH		SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Threshold	171A		PE
1 Gasketing	294AV		PE
1 Rain Guard	346C		PE
1 Sweep	3452CNB		PE

**Set: 14.0**

Doors: 117A

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	10 8204 LNJ	US26D	SA
1 Door Closer	351 PS	EN	SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Gasketing	S88D		PE

**Set: 15.0**

Doors: 118A

Description:

6 Hinge	TA2714 4-1/2" x 4-1/2"	US28	MK
1 Dust Proof Strike	570	EN	RO
1 Flush Bolt	2842	US32D	RO
1 Storeroom Lock	10 8204 LNJ		SA
1 Coordinator	L1672	US28	RO
2 Mounting Bracket	1601AB	US28	RO

2 Door Closer	351 PS	EN	SA
2 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Gasketing	S88D		PE

**Set: 16.0**

Doors: 119A, 121A, 122A

Description: Exterior Hollow Metal Doors

1 Continuous Hinge	MCK-14HD 83"		MK
1 Rim Exit Device	10 8804 FSW		SA
1 Door Closer	351 PSH		SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO
1 Threshold	171A		PE
1 Gasketing	294AV		PE
1 Rain Guard	346C		PE
1 Sweep	3452CNB		PE

**Set: 17.0**

Doors: 120

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	10 8204 LNJ	US26D	SA
1 Wall Stop	409	US32D	RO

**Set: 18.0**

Doors: 122B

Description:

3 Hinge	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Exit Device	10 8813 ETJ	US32D	SA
1 Door Closer	351 PSH	EN	SA
1 Kickplate	K1050 10" x 2" LDE 4BE CSK	US32D	RO

**Set: 19.0**

Doors: 122C

Description:

6 Hinge (heavy weight)	T4A3786 5" x 4-1/2"	US26D	MK
1 Dust Proof Strike	570	US26D	RO
2 Flush Bolt	555	US26D	RO
1 Storeroom Lock	10 8204 LNJ	US26D	SA

**Set: 20.0**

Gate: G-1

Description: Exterior Gate w/ Keypad Lock

1

YA

**APPROVED MANUFACTURERS:**

Continous Gear Hinges

Hinges

Locks

Exit Devices

Closers

Flatware, Flush Bolts & Wall Stops

Overhead Stops

Threshold & Weatherstrip

McKinney, Pemko, Hager

McKinney, Hager

Sargent, Corbin Russwin, Schlage

Sargent, Corbin Russwin, Von Duprin

Sargent, Corbin Russwin, Norton

Rockwood, Trimco, Hiawatha

Sargent, Rixson, Rockwood

Pemko, Reese, Zero

END OF SECTION 08 71 00

## SECTION 08 81 00

### GLAZING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  1. Aluminum windows, entrance doors, transoms and sidelights.
  2. Steel framed windows and sidelights at doors.
  3. Glass-lites in metal and wood doors.
  4. Laminated sound glass.
  5. Glass mirrors.
  6. See Alternates Section 01 23 00 for associated alternates.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each glass product and glazing material indicated.
- C. Samples: 12" x 12" samples of each glass type except 1/4" clear glass.

##### 1.04 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  1. "FGMA Glazing Manual," except where more stringent requirements are indicated.
  2. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
  3. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials. Provide safety glass permanently marked with label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

##### 1.05 WARRANTY

- A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: (5) Five years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  1. Warranty Period: (10) Ten years from date of Substantial Completion.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage.

### PART 2 - PRODUCTS

#### 2.01 GLASS PRODUCTS

- A. Heat-Treated Float Glass: Uncoated, Clear, Heat-Treated Float Glass: ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.
  1. Kind: FT (fully tempered) where indicated or required by codes.
  2. Thickness: 1/4-inch unless otherwise indicated.
- B. Tinted Sealed Insulating Glass Units: Preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774.
  1. Interspace content: Dehydrated Air.
  2. Thickness: 1/4" glass, 1/2" air space, 1" overall.
  3. Indoor Lite: Type I (transparent glass, flat) float glass, Class 1 (clear) float glass. Add Comfort Low-E hard coat on No. 3 surface. Tempering requirements shown on drawings or as required by code.
  4. Outdoor Lite: Type I (transparent glass, flat) float glass, Class 2 (tinted, heat absorbing and light reducing). Tempering requirements shown on drawings or as required by code.
  5. Kind: FT (fully tempered) where indicated or required by code.
  6. Tint Color: To be selected by Architect from manufacturer's standard Bronze color.
- C. Clear Glass Mirrors: Clear Float Glass: ASTM C 1503, (Coated, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.
  1. Thickness: 1/4-inch.
  2. Eased edges, seamed and ground smooth for safe radiused edges.
  3. Silvering: Minimum 2 coats.
  4. Clip Mounting: Provide stainless steel clips.
- D. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Total thickness: 1/4" – base bid.
4. Interlayer Color: Clear unless otherwise indicated.
5. Interlayer thickness: .030 inch.
6. By Alternate: Add a second laminated glass pane at each window with laminated glass. The second layer is to be 1/2" thick with a .060 inch interlayer – see window details.

## 2.02 ELASTOMERIC GLAZING SEALANTS AND GLAZING TAPES

- A. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants that comply with ASTM C 920.
- B. Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent, non-staining and non-migrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with AAMA 800.

## 2.03 GLAZING GASKETS

- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.

## 2.04 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking).
- E. Plastic Foam Joint Fillers: Pre-formed, compressible, resilient, non-staining, non-extruding, non-outgassing, strips of closed-cell plastic foam of density, size, and shape to control sealant depth and otherwise contribute to produce optimum sealant performance.

## 2.05 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

# PART 3 - EXECUTION

## 3.01 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.



### 3.02 GLAZING

- A. Comply with combined recommendations of manufacturers of glass, sealants, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass from edge damage during handling and installation.
- C. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide spacers for glass sizes larger than 50 united inches (length plus height).
- F. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.
- G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

### 3.03 TAPE GLAZING

- A. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.
- C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each lite is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.04 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weather-tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- C. Install gaskets so they protrude past face of glazing stops.

3.05 PROTECTION AND CLEANING

- A. Protect glass from contact with contaminating substances resulting from construction operations.
- B. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.
- C. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 08 81 00

## SECTION 09 29 00

### GYPSUM BOARD ASSEMBLIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Steel framing members for non-load bearing gypsum board assemblies.
  - 2. Gypsum board for both normal and wet areas, including accessories and trim; joint taping and finishing.
  - 3. Gypsum board assemblies.
  - 4. Thin-coat plaster at exterior soffits and canopy areas.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 6 Section "Rough Carpentry".
  - 2. Division 9 Section "Painting".

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage. Neatly stack gypsum panels flat to prevent sagging.

##### 1.05 PROJECT CONDITIONS

- A. Establish and maintain environmental conditions to comply with ASTM C 840 requirements and gypsum board manufacturer's recommendations. Maintain not less than 40 deg F for 48 hours before application and continuously after until dry. Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### 2.02 STEEL FRAMING FOR BULKHEADS, WALLS AND PARTITIONS

- A. Protective Coating: ASTM A 653, G 40 hot-dip galvanized coating for framing members in contact with exterior walls and at exterior conditions. Manufacturer's standard corrosion resistant coating elsewhere.
- B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
  - 1. Thickness:
    - a. At 6" metal studs and at walls with plywood on one or both sides: 20-gauge, .0312 inch min.
    - b. At 3 5/8" metal stud walls with no plywood: 25-gauge.
    - c. At 3 5/8" metal stud diagonal bracing: 25-gauge.
    - d. Head and sill runners, jamb, and cripple studs at door and other openings: 20-gauge
  - 2. Depth: 2 1/2-inches, 3-5/8-inches and 6-inches, unless otherwise indicated.
- C. Slip-Type Head Joints: At walls that extend up to structure, provide one of the following:
  - 1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
  - 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - i. The Steel Network Inc.: VertiTrack VTD Series.
      - ii. Superior Metal Trim: Superior Flex Track System (SFT).
      - iii. Dietrich Metal Framing: DoubleTrack TR Series.
- D. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

### 2.03 GYPSUM BOARD PRODUCTS

- A. Available Manufacturers: Subject to compliance with requirements provide products by the following:
  - 1. American Gypsum.
  - 2. CertainTeed Corp.
  - 3. Georgia-Pacific Gypsum LLC.
  - 4. National Gypsum Company.

5. Temple-Inland.
  6. USG Corporation.
- B. Gypsum Wallboard: ASTM C 36 and as follows:
1. Type: X.
  2. Edges: Tapered and featured (rounded or beveled) for pre-filling.
  3. Thickness: 5/8-inch.
  4. Size: 48 by 96 inches min.
- C. Gypsum Wallboard at bulkhead and ceiling conditions: ASTM C 36 and as follows:
1. Type: X.
  2. Edges: Tapered and featured (rounded or beveled) for pre-filling.
  3. Thickness: 5/8-inch.
  4. Size: 48 by 96 inches min.
- D. Glass-Mat Gypsum Sheathing at Exterior Canopy Ceilings for thin-coat plaster finish: ASTM C1177.
1. Approved Products: Subject to compliance with requirements, provide one of the following:
    - a. Georgia Pacific – DensGlass Gold Exterior Sheathing.
    - b. USG – Secure Rock Exterior Sheathing.
    - c. National – eXP Exterior Sheathing.
    - d. Alternate Product: Fiber-Reinforced Gypsum Sheathing: ASTM C 79 or ASTM C 1396 and ASTM C 1278, gypsum sheathing. USG – FIBEROCK Brand Aqua-Tough Sheathing.
  2. Type: X
  3. Edges: Tapered and featured (rounded or beveled) for pre-filling.
  4. Thickness: 5/8-inch.
  5. Size: 48 by 96 inches min.
  6. Verify compatibility of sheathing with associated thin coat plaster product.
- E. Water Resistant Gypsum Wallboard at toilet rooms and bathrooms ASTM C 1396 and as follows:
1. Type: X
  2. Edges: Tapered and featured (rounded or beveled) for pre-filling.
  3. Thickness: 5/8-inch.
  4. Size: 48 by 96 inches min.
  5. Approved Products: Subject to compliance with requirements, provide one of the following:
    - a. Georgia Pacific – Mold-Guard Type X.
    - b. USG – Mold Tough Firecode.
    - c. National – XP Fire-Shield Gypsum Board.

## 2.04 TRIM ACCESSORIES

- A. Accessories: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and zinc coated where used in an exterior application. ASTM A 653, G 40 hot-dip galvanized coating for framing members in contact with exterior walls and at exterior conditions

## 2.05 JOINT TREATMENT MATERIALS

- A. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.
- B. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products, ready-mixed or job-mixed:
  - 1. Taping compound formulated for embedding tape and for first coat over fasteners and trim accessories.
  - 2. Topping compound formulated for fill (second) and finish (third) coats.
  - 3. All-purpose compound formulated for both taping and topping compounds.
- C. Drying-Type Joint Compounds for Exterior Gypsum Board: Factory-packaged vinyl-based products, ready-mixed or job-mixed:
  - 1. Manufacturer's recommended tape and joint compound for exterior applications.

## 2.06 MISCELLANEOUS MATERIALS

- A. Grout: ASTM C 475, setting-type joint compound recommended for grouting hollow metal door frames.
- B. Steel screws complying with ASTM C 1002 for fastening gypsum board to steel members less than 0.033 inch thick or ASTM C 954 for members from 0.033 to 0.112 inch thick.
- C. Sound-Attenuation Blankets: Specified in Division 7 Section "Thermal Insulation".
- D. Acoustical Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Provide product effective in reducing airborne sound transmission through perimeter joints as demonstrated by testing according to ASTM E 90.

## 2.07 THIN-COAT PLASTER SYSTEM AT EXTERIOR CANOPY AREAS

- A. Provide: Sto Corporation – Quick Gold Direct Applied Finish System (or approved equal) – applied to Glass-mat gyp board.
  - 1. Other approved systems: Drivit or Synergy – system equal to above specified Sto - Quick Gold.
  - 2. Verify compatibility of plaster system with selected substrate and notify Architect of any issues before proceeding. Coordinate with other trades.
  - 3. Submittals: Manufacturer's specifications, details, installation instructions, product data, colors and textures.
  - 4. Accessories: Corner bead, casing bead, starter track, expansion and control joint accessories. All accessories shall meet the requirements of ASTM C 1063 and its referenced documents. Accessories shall be vinyl (ASTM D 1784).
  - 5. Base Coat: Sto BTS-PLUS one-component, polymer-modified, cementitious, high-build base coat with less than 33 percent Portland cement content by weight.
  - 6. Standard Mesh for Field Areas: Sto Mesh—nominal 4.8 oz./yd.<sup>2</sup> (163 g/m<sup>2</sup>), symmetrical, interlaced open-weave glass fiber fabric made with minimum 25 percent by weight alkaline resistant coating for compatibility with Sto materials.
  - 7. Specialty Mesh used per manufacturer's recommended areas: Sto Detail Mesh—nominal 4.5 oz/sq yd (153 g/m<sup>2</sup>), flexible, symmetrical, interlaced glass fiber fabric, with alkaline-resistant coating for compatibility with materials (used for standard EIFS back-wrapping and aesthetic detailing).
  - 8. Primer: Acrylic-based primer (for acrylic-based finishes).
  - 9. Finish Coat: Sto acrylic-based textured wall coating.

- a. Sto Essence Finishes.
- b. Color: To be selected by Architect from Manufacturer's standard range of colors.
- c. Texture: selected by Architect from Manufacturer's standard range of textures.
- d. Mixing and Installation: Per Manufacturer's recommendations.

## 2.08 CONTINUOUS VENT AT THIN-COAT PLASTER SYSTEM

- A. Continuous clear anodized aluminum vent at thin-coat plaster system:
  1. FD-5815 vented – by Gordon Interior Specialties Division 1-800-877-8746 or approved equal.
  2. 1 1/2" wide vented area.
  3. F-Reveal Trim.
  4. Recessed.

## PART 3 - EXECUTION

### 3.01 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
  1. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8-inch from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
  1. Where walls are shown to terminate below structural supports, install diagonal 3 5/8" metal stud bracing at 48" on center, at a 45 degree angle, from top of wall to roof structure above.
- D. Install steel studs and furring in sizes and at spacings indicated.
  1. Space studs 16-inches o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs as required at door and window frames to comply with Paragraph 3.03.G.
  1. Install (2) studs at each jamb, unless otherwise indicated.
  2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.

3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
  - G. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.
- 3.02 INSTALLING 2 1/2" STEEL FRAMING
- A. Install as noted in 3.01 above and attach at 4' on center vertically to each horizontal metal building 'Z' girt.
- 3.03 APPLYING AND FINISHING GYPSUM BOARD, GENERAL
- A. Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
  - B. Sound-attenuation blankets: Installation is specified in Division 7 Section Thermal insulation. Insulation is to be installed where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
  - C. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16-inch of open space between panels. Do not force into place.
  - D. Locate both edge or end joints over supports. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible. Stagger abutting end joints of adjacent panels not less than one framing member.
  - E. Attach gypsum panels to framing provided at openings and cutouts.
  - F. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32-inches wide.
  - G. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.
    1. Install control joints at any wall, ceiling, or bulkhead surface at a maximum spacing of 30' on center - coordinate locations with the Architect.
    2. Install one control joint over the hinge jamb of each door in the main corridors.
  - H. Cover both faces of partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally. Fit gypsum panels around ducts, pipes, and conduits.
  - I. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
  - J. Space fasteners in gypsum panels according to referenced application and finishing standard and manufacturer's recommendations. Fasten with screws. Space screws at a maximum of 12-inches o.c.
  - K. On ceilings, apply gypsum panels prior to wall application to the greatest extent possible and at right angles to framing, unless otherwise indicated. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints.



- L. Sound Sealant and Sound Partitions: Where sound sealant, or where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
  - 1. Install a heavy continuous bead of sealant on the floor adjacent to the sill runner and set the gyp board panel into the sealant. Install adequate amount of sealant so that sealant is displaced, so it completely fills the gap of each gyp board layer, so it is visible at finished side of gyp board.
  - 2. Install a heavy continuous bead of sealant at the joint between the wall and the adjacent metal stud before installing the gyp board, so the sealant completely fills the joint between the wall and each layer of gyp board.
  - 3. Install a heavy bead of sealant completely filling gaps around all penetrations though gyp board – typical at each side of wall. This includes but is not limited to outlets, recessed cabinets, ductwork, piping, conduit, etc.
- M. Exterior Ceilings and Soffits: Apply exterior gypsum panels perpendicular to supports, with end joints staggered and located over supports.
  - 1. Fasten with corrosion-resistant screws.

#### 3.04 INSTALLING TRIM ACCESSORIES

- A. For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound.

#### 3.05 FINISHING GYPSUM BOARD ASSEMBLIES

- A. Apply joint tape over gypsum board joints and to flanges of trim accessories.
- B. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
  - 1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies.
  - 2. Level 4 for gypsum board surfaces, unless otherwise indicated.
- C. Use the following joint compound combination as applicable to the finish levels specified:
  - 1. Embedding and First Coat: Ready-mixed or job-mixed, drying-type, all-purpose or taping compound.
  - 2. Fill (Second) Coat: Ready-mixed or job-mixed, drying-type, all-purpose or topping compound.
  - 3. Finish (Third) Coat: Ready-mixed or job-mixed, drying-type, all-purpose or topping compound.
- D. Where Level 4 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener

heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.

1. Extend finish down to within 2" of concrete floor slab.

### 3.06 THIN-COAT PLASTER INSTALLATION

- A. Install plaster coated cement board to meet or exceed current written recommendations of Sto Corporation – Quick Gold Direct Applied Finish System or per recommendations of comparable approved system manufacturer.

1. Verify compatibility of plaster system with selected substrate and notify Architect of any issues before proceeding. Coordinate with other trades.

### 3.07 CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 29 00

## SECTION 09 51 13

### ACOUSTICAL PANEL CEILINGS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes ceilings composed of acoustical panels and exposed suspension systems.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
  - a. Acoustical Panel: Set of 6-inch- (150-mm-) square approximately. Samples of each type, color, pattern, and texture.
  - b. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

##### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fire-Test-Response Characteristics:
  - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
    - a. Smoke-Developed Index: 450 or less.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ceiling panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing ceiling panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle ceiling panels carefully to avoid chipping edges or damaging units in any way.

#### 1.06 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Do not install panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

#### 1.07 COORDINATION

- A. Coordinate layout and installation of ceiling panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

#### 1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
  - 1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 0.5 percent of amount installed for each design pattern or type of panel furnished.

### **PART 2 - PRODUCTS**

#### 2.01 ACOUSTICAL PANELS, GENERAL

- A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of ten (10) percent by weight.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

#### 2.02 LAY-IN CEILING PANELS

- 1. Basis-of-Design Product: Provide non-fire-resistance-rated Class A, non-sag, high humidity resistant, water-felted, mineral-base panels, white in color, reveal edged, non-directional medium fissured pattern as follows:
  - a. Certainteed / Celotex, Hytone Baroque; Item Number BET-194.
  - b. Size: 24" x 24" x 5/8" thick
  - c. Edge Detail: Reveal Edge.
  - d. Mold and Mildew Resistance: BioShield treated.

- e. Warranty: Celotex Ten Year 104/90 Limited Warranty or similar.

## 2.03 METAL SUSPENSION SYSTEMS

- A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- C. Wide-Face, Steel Capped, Double-Web, Steel Suspension System: At ceilings scheduled to be ACS-1 and ACS-3, provide main and cross runners roll formed from pre-painted and electrolytic zinc-coated, cold-rolled steel sheet, with prefinished metal caps on flanges, and with the following characteristics:
  - 1. Width: 15/16-inch.
  - 2. Structural Classification: Intermediate-duty system.
  - 3. Color: White.
  - 4. Manufacturers:
    - a. Chicago Metallic 200 Series Snap-Grid System.
    - b. USG Donn DX System.
    - c. Armstrong 7300 System.
- D. Finishes and Color: Provide manufacturer's standard factory-applied WHITE finish.
- E. Prefabricated Corners: Provide manufacturer's standard prefabricated 90 degree corners.
- F. Attachment Devices: Size for (5) times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Measure each ceiling area and establish the layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and conform to the layout shown on reflected ceiling plans.

### 3.03 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and CISCA "Ceiling Systems Handbook."
- B. Establish layout of acoustical panels to conform to the Reflected Ceiling Plans in the Drawings and to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.

- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
  - 2. Do not attach hangers to steel deck tabs or to steel roof deck.
  - 3. Space hangers not more than 4'-0" O.C. along each member and provide hangers not more than 8-inches from ends.
  - 4. Install a minimum of 2-wire hangers direct to each 2' x 4' grid mounted light fixture. These 2-wire hangers shall be above and beyond the ceiling grid hangers noted in above. No fixtures shall be supported by means of ceiling grid or gypsum board surface only.
  - 5. Install additional wire hangers at ceiling mounted equipment.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
- E. Install prefabricated corners at all outside corners.
- F. No exposed screws will be allowed in the metal grid suspension system. If exposed attachments are required, matching white pre-finished pop rivets are required.
- G. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- H. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

### 3.04 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

## SECTION 09 65 13

### RESILIENT BASE AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Resilient wall base.
  - 2. Resilient flooring accessories.
- B. Related Sections include the following:
  - 1. Division 9 Section "Tile Carpeting."

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product specified.

##### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer with a record of successful performance.
- B. Single-source Responsibility:
  - 1. Obtain all resilient wall base, resilient stair components, and resilient flooring accessories from a single manufacturer with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics.
  - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
  - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened containers.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F.

## 1.06 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F or more than 95 deg F in spaces to receive resilient products for at least 48 hours before installation, during installation, and after installation. After installation period, maintain a temperature of not less than 55 deg F or more than 95 deg F.
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. For resilient products installed on traffic surfaces, close spaces to traffic during installation and for time period after installation recommended in writing by manufacturer.
- D. Install resilient products after other finishing operations, including painting, have been completed.

## 1.07 EXTRA MATERIALS

- A. Furnish extra materials to Owner packaged for storage.
- B. Furnish not less than 10 linear feet for each 500 linear feet installed.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Resilient Flooring Schedule at the end of Part 3.

### 2.02 RESILIENT WALL BASE

- A. Vinyl Wall Base: Products complying with FS SS-W-40A, Type I, and with requirements specified in the Resilient Flooring Schedule at the end of Part 3.

### 2.03 RESILIENT ACCESSORIES

- A. Resilient Accessories: Products complying with FS SS-W-40A, Type I, and with requirements specified in the Resilient Flooring Schedule at the end of Part 3.

### 2.04 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type, acrylic copolymer type as recommended by manufacturer to suit resilient products and substrate conditions indicated.
- C. Finishing Accessories: Provide vinyl carpet to tile adaptor, equal to Johnsonite CTA-XX-A.



## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. General: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Examine areas where installation of resilient products will occur for compliance with manufacturer's requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.
- C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- D. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, or oil. Do not use solvents.
- E. Broom and vacuum clean substrates to be covered immediately before installing resilient products.

### **3.02 INSTALLATION**

- A. General: Install resilient products according to manufacturer's current written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
  - 1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
  - 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
  - 3. Do not stretch base during installation.
  - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
  - 5. Form inside and outside corners on job, from straight pieces of maximum lengths possible.
- C. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive.
- D. Install accessory moldings per manufacturer's recommendations at all applicable locations, including but not limited to all changes in flooring materials. Install reducer strips at edges of flooring that would otherwise be exposed.

### **3.03 CLEANING AND PROTECTING**

- A. Perform the following operations immediately after installing resilient products:
  - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
  - 2. Sweep or vacuum horizontal surfaces thoroughly.
  - 3. Do not wash resilient products until after time period recommended by resilient product manufacturer.
  - 4. Damp-mop or sponge resilient products to remove marks and soil.

- B. Protect resilient products against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by resilient product manufacturer.
- C. Clean resilient products not more than four (4) days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

### 3.04 RESILIENT FLOORING SCHEDULE

- A. Vinyl Wall Base: Where scheduled on Drawings, provide rubber wall base complying with the following:
  - 1. Manufacturers and Colors: As selected by Owner's Interior Designers. See Room Finish Schedule on drawings and verify with Interior Designer.
    - a. Style: Cove with toe – where noted.
    - b. Style: Straight – where noted.
    - c. Minimum Thickness: 1/8-inch (3.2 mm).
    - d. Height at Reception Desk and Kitchen 109: 6"
    - e. Height: 4 inches – at all other areas.
    - f. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet.
    - g. Outside Corners: Job formed.
    - h. Inside Corners: Job formed.
    - i. Surface: Smooth.
- B. Accessory Molding: Where this designation is indicated, provide rubber accessory molding complying with the following:
  - 1. Manufacturers and Colors: To be selected by Owner's Interior Designer. Verify selection with Interior Designer.
  - 2. Product Description: Carpet to Concrete Adapter.
  - 3. Carpet Reducer, Size: 2-1/8" x 1/4" (field verify thickness to work with carpet):
    - a. Equal to Johnsonite, No. EG-XX-H

END OF SECTION 09 65 13

## SECTION 09 68 13

### TILE CARPETING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes:

- 1. Modular carpet tile.

- B. Related Requirements:

- 1. Division 1 Section "Allowances".
- 2. Division 03 Section "Cast in Place Concrete" for concrete substrate.
- 3. Division 09 Section "Resilient Base and Accessories".
- 4. Division 9 Section "Resilient Tile Flooring".
- 5. Division 9 Section "Resilient Sheet Flooring".
- 6. Division 9 Section "Carpeting".

##### 1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
  - a. Review design layout of carpet tiles and color patterns.
  - b. Review ambient conditions and ventilation procedures.
  - c. Review subfloor preparation procedures and testing.

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of carpet material, and installation accessory specified. Submit manufacturer's printed data on physical characteristics, durability, fade resistance, and fire-test-response characteristics. Submit methods of installation for each type of substrate.
- C. Shop Drawings showing columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Indicate the following:
  - 1. Carpet type, color, and dye lot.
  - 2. Pattern of installation for carpet tile.
  - 3. Insets and borders.
  - 4. Edge, transition, and other accessory strips.
  - 5. Transition details to other flooring materials.

- D. Samples: For each color and texture required.
  - 1. Carpet Tile: Full-size sample.
  - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long samples.
- E. Product Schedule: For carpet. Use same designations indicated on Drawings.
- F. Maintenance data for carpet to include in the operation and maintenance manual specified in Division 1. Include the following:
  - 1. Methods for maintaining carpet, including precautions for cleaning materials and methods that could be detrimental to finishes and performance, and recommended cleaning products and procedures.

#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Carpet Fire-Test-Response Characteristics: Provide carpet with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface Flammability: Passes CPSC 16 CFR, Part 1630.
  - 2. Flame Spread: 25 or less per ASTM E 84.
  - 3. Smoke Developed: 450 or less per ASTM E 84.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 5: "Storage and Handling."
- B. Keep materials on Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number until installed.
- C. Store materials on-site in original undamaged packages, inside well-ventilated areas protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, with continuous blocking off ground.

#### 1.07 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions" and Section 7.12, "Ventilation."
- B. Space Enclosure and Environmental Limitations: Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

## 1.08 WARRANTY

A. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fails in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.

1. Warranty Period: Manufacturer's Standard Lifetime Commercial Limited Warranty.

## 1.09 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 1 percent of amount installed for each type indicated, but not less than 10 sq. yd.

## PART 2 - PRODUCTS

### 2.01 TILE CARPET ALLOWANCE

A. Tile Carpet Allowance: Include a unit cost allowance of **\$30.00 per square yard** for the purchase and delivery of carpet tile material only, to be selected by the Architect and the Owner. Contractor shall be responsible for estimating the number of square yards of carpet tile required for the installation and shall include total number of estimated yards on the Bid Form. Cost of labor for installation of carpet tile and cost of carpet tile accessories shall be included in the Base Bid as specified herein.

### 2.02 TILE CARPET (BY ALLOWANCE)

A. Products for Living Units:

1. Manufacturer: To be determined.
2. Style: To be determined.
3. Color: To be selected by Architect.
4. Weight: To be determined.
5. Installation: Direct Glue-Down.

### 2.03 INSTALLATION ACCESSORIES

A. Concrete-Slab Primer: Non-staining type as recommended by carpet manufacturer.

B. Trowelable Underlayments and Patching Compounds: As recommended by carpet manufacturer.

C. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated and to comply with flammability requirements for installed carpet as recommended by carpet manufacturer.

D. Transition Strip: Specified under Division 09 "Resilient Base & Accessories".

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
  - 2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
  - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Test carpet adhesive compatibility with concrete floor sealer prior to commence of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Testing:
  - 1. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - 2. Moisture Testing: Perform tests recommended by floor covering manufacturer and as follows. Proceed with installation only after substrates pass testing.
    - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate acceptable to adhesive and carpet manufacturer.
    - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a relative humidity level measurement acceptable to adhesive and carpet manufacturer.
- C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- D. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.03 INSTALLATION

- A. Direct Glue-Down Tile Carpeting Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions. Modify as recommended by manufacturer.
- B. Comply with carpet manufacturer's recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position. Do not bridge building expansion joints with continuous carpet.
  - 1. Verify direction of carpet and carpet pattern with Owner's Interior Designer before starting work.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

### 3.04 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

## SECTION 09 77 33

### FRP SANITARY WALL PANELS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 DESCRIPTION

- A. Work included: Fiberglass Reinforced Plastic (FRP) sanitary wall panels at locations and heights as indicated on the Drawings.
- B. Related work described elsewhere:
  - 1. Division 9 Section "Gypsum Drywall Systems".

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Manufacturer's data:
  - 1. Complete materials list of all items proposed to be furnished and installed under this Section;
  - 2. Manufacturer's specifications and other data required to demonstrate compliance with the specified requirements;
  - 3. Samples of each item, color, and pattern.
  - 4. Manufacturer's recommended methods of installation which, when approved by the Architect, will become the basis for inspecting and accepting or rejecting actual installation methods used on the Work.

##### 1.04 PRODUCT HANDLING

- A. Delivery and storage: Deliver materials to the job site and store in their original unopened containers with all labels intact and legible at time of use. Store in strict accordance with the manufacturer's recommendations.
- B. Protection: Use all means necessary to protect materials of this section before, during, and after installation and to protect installed work and materials of all other trades.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

#### PART 2 - PRODUCTS

##### 2.01 FIBERGLASS REINFORCED PLASTIC PANELS

- A. General: Where shown on the Drawings, provide Kemlite GLASBORD-P FRP Wall Panels as manufactured by Duratech Industries Inc., Joliet, Illinois.

09 77 33 – FRP SANITARY WALL PANELS 1



1. Or equal product by Marlite Brand FRP Panels.
- B. Panel Size: 4' wide x 0.09" thick x 8' high
- C. Color: To be selected by Architect from Manufacturer's standard range of colors.
- D. Finish Texture: To be selected by Architect from Manufacturer's standard range of textures.
- E. Adhesive for applying panels over gypsum board drywall shall be as manufactured by Dyrotech Industries Inc.
- F. Mouldings: Provide 8 feet long vinyl mouldings in matching color, for all panel termination edges, and joints between panels. Angle trim at outside/inside corners shall be 8 feet long, vinyl mouldings.
- G. Sealant: Provide GE 1100 series silicone sealant. Sealant color shall be white when white panels are selected, or clear when other colored panels are selected.

### **PART 3 - EXECUTION**

#### **3.01 INSPECTION**

- A. Examine the areas and conditions under which work of this Section will be installed. Correct conditions detrimental to the timely and proper completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Install the work of this section where shown on the Drawings, and in strict accordance with the manufacturers' recommendations as approved by the architect, anchoring all components firmly into position for long life under hard usage.
- B. Install panels horizontally with one horizontal seam at the center of the wall.
  1. Where wall areas to be covered are 4' wide or less, install panels vertically with one horizontal seam near the ceiling.
- C. Install sealant with mouldings per manufacturer's current written recommendations.
- D. Install sealant at bottom edge of panels where they abut dissimilar materials.
- E. Replace any damaged panels or trim immediately.

#### **3.03 CLEANING AND PROTECTION**

- A. When the work of this Section is complete, clean all surfaces, including mouldings, with manufacturers' approved cleaning solvent. Remove excess adhesives, sealants, dirt, dust and other stains. Protect installed work from damage until acceptance by Owner.

END OF SECTION 09 77 33

## SECTION 09 91 00

### PAINTING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
  - 1. Exposed interior and exterior items and surfaces.
  - 2. Stain and finish on all wood surfaces including doors.
  - 3. Structural, mechanical and electrical items, where noted to be painted.
- B. Related Requirements:
  - 1. Division 05 through 08 Sections for shop priming of metal substrates ready for finish coatings specified in this Section.
- C. Paint exposed surfaces. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
- D. Do not paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- E. See Drawings for finish schedule of paint colors required.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product. Include preparation requirements and application instructions.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, approximately 8 inches (200 mm) square.
  - 2. Step coats on Samples to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. VOC content.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

#### 1.05 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

#### 1.06 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional (1) percent, but not less than (1) gallon of each material and color applied.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. Diamond Vogel Paint Company.
  - 3. ICI Paints North America.
  - 4. Kwal-HowellsPaint
  - 5. Pittsburgh Paints, PPG Industries, Inc.
  - 6. Sherwin-Williams Company.

#### 2.02 PAINT MATERIALS

- A. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
  - 3. Where paint is to be installed over existing primers, field verify compatibility of paints and notify the Architect immediately of an incompatibility problem.

- B. Colors:
1. Interior: Provide 5 different colors (PT1 through PT 5) as shown on room finish schedule and as selected by Architect.
  2. Exterior: Precast concrete wall panels to be paint color PT-A. Cast in place concrete column and wall to be paint color PT-B. Steel columns to be paint color PT-C. Pipe Bollards to be paint color PT-D. Exterior Doors and Frames to be paint color PT-E.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- D. Proprietary Names: Use of proprietary product names is not intended to imply that products are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data for proposed substitutions.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
  2. Wood: 15 percent.
  3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with finishes and primers specified.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### **3.02 PREPARATION**

- A. Comply with manufacturer's written instructions applicable to substrates indicated.
- B. Remove hardware, covers, plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

09 91 00 – PAINTING 3

- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer but not less than the SSPC-SP 3, "Power Tool Cleaning."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. If possible, allow to weather a minimum of 6 months prior to coating. Clean per SSPC-SP1 using detergent and water or a degreasing cleaner, then prime as required. When weathering is not possible or the surface has been treated with chromate's or silicates, first Solvent Clean per SSPC-SP1 and apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP7 is necessary to remove these treatments.
- H. Aluminum Substrates: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.
- I. Wood Substrates (General):
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- J. Wood (Interior): All finishing lumber and flooring must be stored in dry, warm rooms to prevent absorption of moisture, shrinkage, and roughening of the wood. All surfaces must be sanded smooth, with the grain, never across it. Surface blemishes must be corrected and the area cleaned of dust before coating.
- K. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth. Surfaces must be clean and dry. All fastener heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled fastener heads and tape joints must be sanded smooth and all dust removed prior to painting. Exterior surfaces must be spackled with exterior grade compounds.
- L. Solvent Cleaning: Solvent Cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation. For complete instructions, refer to Steel Structures Paint Council Surface Preparation Specification No. 1. (SSPC-SP1)

- M. Hand Tool Cleaning: Hand Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before hand tool cleaning, remove visible oil, grease, soluble residues, and salts by the methods outlined in SSPC-SP1. For complete instructions, refer to Steel Structures Paint Council Surface Preparation Specification No. 2 (SSPC-SP2) 9) Stucco Must be clean and free of any loose stucco. If recommended procedures for applying stucco are followed, and normal drying conditions prevail, the surface may be painted in 30 days. The pH of the surface should be between 6 and 9, unless the products to be used are designed to be used in high pH environments.
- N. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
  - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- O. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.03 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions.
  - 1. Use applicators and techniques best suited for substrate and type of material being applied.
  - 2. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
  - 3. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 4. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
  - 5. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  - 6. Finish doors on tops, bottoms, and side edges the same as exterior faces.
  - 7. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 8. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration. Allow sufficient time between successive coats to permit proper drying.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturers recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in occupied spaces, **except paint all exposed piping with color coding as required.**
- F. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- G. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.
  - 1. All finish work on wood and hollow metal doors shall be applied before the installation of any finished hardware item (except butts).
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### 3.04 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
  - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

### 3.05 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.06 SCHEDULE

- A. Basis-Of-Design: Subject to compliance with requirements, provide the following Sherwin-Williams products or products by other manufacturers listed in paragraph 2.01 above.
- B. Colors: See finish schedule in Drawings.
- C. Exterior Finishes:
  - 1. Exterior Precast Concrete Wall Panels, CIP Concrete Column and CIP Concrete Wall:
    - a. Primer: A24W00300 - Loxon Concrete And Masonry Int/Ext Latex Primer White
    - b. First Coat: A82W00151 - A-100® Exterior Latex Satin Extra White
    - c. Second Coat: A82W00151 - A-100® Exterior Latex Satin Extra White

2. Ferrous Metal or Galvanized Metal Substrates, including HM doors, metal door frames, pipe bollards, metal closure plates at OH coiling doors, and all other miscellaneous metals exposed to view:
  - a. Primer: B66W00310 - Pro Industrial Pro-Cryl® Universal Primer Off White
  - b. First Coat: B54W00151 - Industrial Urethane Alkyd Enamel Extra White
  - c. Second Coat: B54W00151 - Industrial Urethane Alkyd Enamel Extra White

D. Interior Finishes:

1. Drywall Substrates - Egg-Shell sheen at all walls (except at Kitchen 109, Women 108 and Men 107):
  - a. Primer: – ProMar 200 – Zero VOC Primer
  - b. First Coat: B20-2600 – ProMar 200 – Zero VOC – Interior Latex Eg-Shel
  - c. Second Coat: B20-2600 – ProMar 200 – Zero VOC – Interior Latex Eg-Shel
  
2. Drywall Substrates – Semi-Gloss Epoxy Finish at Kitchen 109, Women 108 and Men 107 (except at Men Fixture wall):
  - a. Primer: Promar 200 Zero Primer B28W2600
  - b. First Coat: Waterbased Catalyzed Epoxy Semi-Gloss B70W211
  - c. Second Coats: Waterbased Catalyzed Epoxy Semi-Gloss B70W211
  
3. Drywall Substrates – Semi-Gloss Epoxy Finish at Men 107 - fixture wall only:
  - a. Primer: Promar 200 Zero Primer B28W2600
  - b. First Coat: Macropoxy 646 Epoxy B58W610 (Solvent Epoxy)
  - c. Second Coats: Macropoxy 646 Epoxy B58W610 (Solvent Epoxy)
  
4. Metal – Exposed Ferrous Metal & Misc. Steel (HM Doors and Frames, Archery 118 Return Air Grill & Misc. Steel):
  - a. Primer: B66W00310 - PRO Industrial Pro-Cryl® Universal Primer Off White
  - b. First Coat: B31W00051 - ProClassic® WaterBorne Interior Acrylic Semi-Gloss Extra White or DTM B66 Series Interior Acrylic Semi-Gloss.
  - c. Second Coat: B31W00051 - ProClassic® WaterBorne Interior Acrylic Semi-Gloss Extra White or DTM B66 Series Interior Acrylic Semi-Gloss.
  
5. Metal – Exposed Galvanized Metal (HM Doors and Frames & Misc. Steel):
  - a. Primer: B66W00310 - PRO Industrial Pro-Cryl® Universal Primer Off White
  - b. First Coat: B31W00051 - ProClassic® WaterBorne Interior Acrylic Semi-Gloss Extra White or DTM B66 Series Interior Acrylic Semi-Gloss.
  - c. Second Coat: B31W00051 - ProClassic® WaterBorne Interior Acrylic Semi-Gloss Extra White or DTM B66 Series Interior Acrylic Semi-Gloss.
  
6. Wood Substrate - Semi-Transparent Finish, including wood doors:
  - a. Stain Coat: A49T00804 - Wood Classics 250 VOC Stain
  - b. First Coat: A68F00090 - Wood Classics® Waterborne Polyurethane Varnish Satin Clear



- c. Second Coat: A68F00090 - Wood Classics® Waterborne Polyurethane Varnish Satin Clear
  - d. Third Coat: A68F00090 - Wood Classics® Waterborne Polyurethane Varnish Satin Clear
7. Wood Substrate - Painted Finish including wood trim, bead-board and any interior wood noted on the Drawings to be painted:
- a. Primer: B28W8101 Premium Interior Wall and Wood Primer
  - b. First Coat: B31W00051 - ProClassic® WaterBorne Interior Acrylic Semi-Gloss Extra White
  - c. Second Coat: B31W00051 - ProClassic® WaterBorne Interior Acrylic Semi-Gloss Extra White

END OF SECTION 09 91 00

## SECTION 09 96 20

### EPOXY CONCRETE FLOOR PAINT

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Surface preparation of concrete.
- B. Epoxy fortified concrete floor paint.

##### 1.02 RELATED SECTIONS

- A. Section 033000 - Concrete Surface coordination and curing provisions.
- B. Section 099100 -. Paints and Coatings.

##### 1.03 REFERENCES

- A. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- B. ASTM D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abrader.
- C. ASTM D 2794 - Resistance of Organic. Coatings to the Effects of Rapid Impact resistance.
- D. ASTM D 522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
- E. ASTM D 4585 - Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- F. ASTM D 3363 - Standard Test Method for Film Hardness by Pencil Test.
- G. ASTM D 2486 - Standard Test Method for Scrub Resistance of Wall Paints.
- H. ASTM C 1028 - Standard Test Method for Determining the Static Coefficient of Friction.

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Application methods.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

#### 1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Product shall comply with federal, state, and local volatile organic compounds (VOC) regulations.
- B. Installer Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this project, whose work has resulted in applications with a record of successful in-service performance.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.
- D. Pre-Installation Meeting:
  - 1. Convene at job site seven calendar days prior to scheduled beginning of construction activities of this section to review requirements of this section.
  - 2. Require attendance by representatives of the following:
    - a. Paint manufacturer.
    - b. Installer of this section.
    - c. Other entities directly affecting, or affected by, construction activities of this section.
  - 3. Notify Architect four calendar days in advance of scheduled meeting date.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep container closed when not in use, protect containers from abuse, protect from extreme temperatures.

#### 1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### 1.08 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver materials to the Owner.
- B. Quantity: Furnish Owner with an addition three percent, but not less than 1 gallon (3.8 l) or one case, as appropriate, of each material and color applied.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Acceptable Manufacturer: Seal-Krete, A Division of Convenience Products, which is located at: 306 Gandy Rd. ; Auburndale, FL 33823; Toll Free Tel: 800-323-7357; Tel: 863-967-1535; Fax: 863-965-2326; Email: request info (sales@seal-crete.com); Web: www.seal-crete.com
- B. Requests for substitutions will be considered in accordance with provisions of Division 1, Section 'Substitutions'.

### **2.02 MATERIALS**

- A. Paint: Seal-Krete Epoxy-Seal. A ready-to-use, water based, acrylic-epoxy blend formulated to resist hot tire pickup, chemicals, oil, grease and gasoline stains.
  - 1. Finish: Premium Satin
  - 2. Colors: Selected from manufacturer's standard.
  - 3. Volume Solids: 35.00 plus or minus 1 percent.
  - 4. Weight Solids: 41.00 plus or minus 1 percent.
  - 5. VOC (EPA method 24): 90 g/l.
  - 6. Odor: Very low.
  - 7. Spread rate (per coat):
    - a. Wet mils: 3.5-4.5.
    - b. Dry mils: 1.5-2.5.
  - 8. Coverage: 300-500 square feet per gallon.
  - 9. Flash Point: >200 degrees Fahrenheit closed cup method.
  - 10. Performance: Meets or exceeds the following ASTM Tests: Based on two coats, 4 mils dry film thickness applied on smooth, bare, etched concrete:
    - a. ASTM D 4541 (adhesion, 570 psi): 100 percent concrete failure.
    - b. ASTM D 4060 (abrasion, CS-11 wheel, 1000 cycles) 30 mg loss.
    - c. ASTM D 2794 (impact resistance) 30 inch pounds.
    - d. ASTM D 522 (flexibility, 180 bend, 1/8 inch (3.2 mm) mandrel) Pass.
    - e. ASTM D 4585 (humidity resistance) 500 hour rating of 10 for blistering.
    - f. ASTM D 3363 (pencil hardness) F very hard.
    - g. ASTM D 2486 (scrub resistance) Passes 1000 cycles.
    - h. ASTM C 1028-96 (slip resistance) 60 minutes minimum static coefficient of friction rating.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 SURFACE PREPARATION**

- A. Bare Concrete: Concrete must have cured for a minimum of 30 days before application. Etch the surface with a concrete etching solution to allow for proper penetration and adhesion.

After etching, rinse the surface thoroughly and let dry. If muratic acid is used, it must be neutralized before proceeding. Test surface for immediate water penetration before proceeding.

1. Note: Adjacent concrete will remain exposed. Protect adjacent concrete areas from any adverse affects of acid.
- B. Previously sealed, stained or painted concrete: Remove loose or peeling paint and degloss surface by sanding with 150-200 grit paper. Follow with a general cleaning. Rinse thoroughly and let dry. The surface should then be coated with a clear acrylic, bonding-primer.
1. Note: Adjacent concrete will remain exposed. Protect adjacent concrete areas from any adverse affects of sanding.

### 3.03 APPLICATION

- A. Apply only when air and surface temperatures are between 55 and 90 degrees F (13 and 32 degrees C). If more than one gallon is used, intermix all product to ensure color uniformity; stir well. Apply a very thin coat as follows:
1. Use a 1/4 inch (6 mm) nap roller for smooth troweled surface.
  2. Use a 3/8 inch (9.5 mm) nap roller for broom-finish surface.
  3. Use a 1/2 inch (12.5 mm) nap roller for rough or textured surface) or nylon-polyester brush.
- B. Paint may be diluted with one pint of water per gallon to improve penetration of the first coat. Wait four to six hours (additional dry time is needed in lower temperatures or when relative humidity is more than 50 percent).
- C. Apply second coat full strength in a direction perpendicular to the first.
- D. Dry time: Dry to touch two hours at 77 degrees F (25 degrees C), 50 percent relative humidity. Dry to light foot traffic in twenty four hours, heavy foot traffic in seventy two hours. Allow a minimum of five days before subjecting to automotive traffic. Premature traffic could cause paint to lift.

### 3.04 CLEAN-UP AND STORAGE

- A. Clean tools with soap and water.
- B. Contact local refuse collection agency for disposal of empty containers and unused paint. Do not flush to sanitary sewer or waterway.
- C. Wait thirty days before rinsing or cleaning surface. To avoid premature paint failure, do not use abrasive cleaners, rotating tip devices or pressure-washers on surface.

### 3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged surfaces before Substantial Completion.

END OF SECTION 09 96 20

## SECTION 10 14 00

### SIGNAGE

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Panel signs at all doors scheduled.

##### 1.03 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- C. Shop Drawings: Show fabrication and installation details for signs.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
  - 3. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- D. Samples: For each sign type and for each color and texture required.
  - 1. Panel Signs: Not less than 12 inches square including border.

##### 1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Manufacturers of Panel Signs:
    - a. Advanced Corporation; Braille-Tac Division.
    - b. A.R.K. Ramos Manufacturing Company, Inc.
    - c. ASI Sign Systems, Inc.
    - d. Gemini, Inc.
    - e. Metal Arts; Div. of L&H Mfg. Co.
    - f. Mills Manufacturing Company.
    - g. Nelson-Harkins Industries.
    - h. The Southwell Company.

### 2.02 DOOR PANEL SIGNS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide wall mounted, curved, polycarbonate, modular wall signs, "Pacific Interior" design by ASI-Modulux, Inc. or equal product from one of the above manufacturers.
  - 1. Sign to include permanent room number and function.
- B. Panel Sign Schedule: Provide one panel sign at each interior door frame.
  - 1. WOMEN – 1 sign – with name and graphic
  - 2. MEN – 1 sign – with name and graphic

### 2.03 MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- B. Steel:
  - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial or forming steel.
- C. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- D. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
  - 1. Impact Resistance: 16 ft-lbf/in. (854 J/m) per ASTM D 256, Method A.
  - 2. Tensile Strength: 9000 lbf/sq. in. (62 MPa) per ASTM D 638.
  - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. (2345 MPa) per ASTM D 790.
  - 4. Heat Deflection: 265 deg F (129 deg C) at 264 lbf/sq. in. (1.82 MPa) per ASTM D 648.
  - 5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
- E. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

- F. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

#### 2.04 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

#### 2.05 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
  - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
  - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
  - 3. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

#### 2.06 FINISHES

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

#### 2.07 ALUMINUM FINISHES

- A. Color Anodic Finish: Manufacturer's standard Class 1 integrally colored or electrolytically deposited color anodic coating, 0.018 mm or thicker, in color selected by Architect applied over a satin (directionally textured) mechanical finish, complying with AAMA 611.

#### 2.08 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

#### 2.09 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
  - a. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
  - b. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.



- c. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
- d. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Locate signs and accessories where indicated or as directed by Architect, using mounting methods of types described and complying with manufacturer's written instructions.
  - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches (75 mm) of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
  - 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
  - 2. Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.
  - 3. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
  - 4. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
  - 5. Shim Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
  - 6. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
  - 7. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

### **3.03 CLEANING AND PROTECTION**

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 10 14 00



## SECTION 10 21 13

### TOILET COMPARTMENTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Floor mounted, overhead braced, solid polymer, plastic resin toilet partitions.
  - 2. The extent of toilet partition work is shown on the Drawings.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 10 Section "Toilet Accessories".

##### 1.03 QUALITY ASSURANCE

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrications to ensure proper fitting of the work. Indicate field measurements on final shop drawings.
- B. Inserts and Anchorages: Furnished inserts and anchoring devices must be built into other work for the installation of toilet partitions and related work. Coordinate delivery with other work to avoid delay.

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Manufacturer's Data: Submit manufacturer's detailed technical data for materials, fabrication, and installation. Include catalog cuts of hardware, anchors, fastenings, and accessories. Transmit copy of installation instructions to the Installer.
- C. Samples for selection purposes in form of manufacturer's color charts consisting including actual solid plastic samples showing full range of colors, textures, and patterns available for each type of partition indicated.
- D. Shop Drawings: Submit shop drawings for the fabrication and erection of toilet partition assemblies which are not fully described by manufacturer's data. Show all anchorage and accessory items and finishes.
  - 1. Submit setting drawing, templates, and instructions for the installation of anchorage devices built into other work.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers offering products to comply with the requirements for polymer resin toilet partitions include the following:
1. Santana Products Co.
  2. Comtec Industries/Capitol Partitions, Inc.
  3. Hadrian

### 2.02 MATERIALS

- A. Toilet Partitions:
1. Doors, Panels, and Pilasters: Manufacturer's standard products fabricated from polymer resin formed under high pressure to produce a single-component homogeneous section which is waterproof, non-absorbent, and has a mark-resistant surface.
    - a. Color and Pattern: To be selected from manufacturer's full range of colors and patterns by Architect.
  2. Pilaster Shoes: AISI Type 302/304 stainless steel, as follows:
    - a. Height: 3-inches, unless otherwise indicated.
    - b. Thickness: Not less than 0.031" (20-gauge).
    - c. Finish: Polished to match hardware.
  3. Continuous Brackets: Manufacturer's standard design for attaching panels to pilaster, as follows:
    - a. Heavy stainless steel, 1-1/2" long, double-ear extrusion with polished finish.
    - b. Provide full length, continuous brackets for attaching panels to pilasters.
  4. Headrail: Stainless steel, 16-gauge, with anti-grip configuration.
  5. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories, as follows:
    - a. Non-ferrous cast alloy with polished chrome finish, where applicable.
    - b. Latches, strikes and keeper.
    - c. Door pull.
    - d. Combination coat hook and bumper.
    - e. Full length, continuous, stainless steel spring loaded hinge with covers.
  6. Wall Attachment: Partitions and pilasters abutting building walls shall be secured to the wall with a continuous channel or double wall flange of stainless steel running the full height of the panel. The channel shall be secured to the wall at approximately 8-inches o.c. Provide wood blocking in framed walls for required anchorage of the wall channel.
  7. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chromium plated steel or brass finished to match hardware. Use theft-resistant (one-way) type heads and nuts for exposed screws. For concealed anchors, use hot-dip galvanized, cadmium-plated, or other rust-resistant protective-coated steel.

## 2.03 FABRICATION

### A. Toilet Partitions:

1. General: Furnish standard doors, panels, screens, and pilasters fabricated for the partition systems, unless otherwise indicated.
    - a. Furnish units with cut-outs, and drilled holes, to receive partition mounted hardware, accessories, and grab bars, as indicated.
  2. Panel and Door Dimensions: Not less than 1-inch thick units.
    - a. Furnish 36-inches wide (clear opening), swing-out doors at stalls for use by the handicapped, unless otherwise indicated.
    - b. Door widths at other stalls 24-inches wide as indicated on the drawings.
  3. Overhead-Braced Pilasters: Not less than 1-inch thick units, with floor supports and leveling bolts. Furnish floor supports as recommended by partition manufacturer to suit floor conditions. Set and secure the brace into the top of each pilaster. Furnish stainless steel shoes at each pilaster.
- B. Hardware and Accessories: Furnish hardware for each compartment in the partition system, as specified above.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Examine areas to receive the partition panels for correct height and spacing of anchorage/blocking that may affect installation of partitions.

### 3.02 INSTALLATION

- A. General: Install partitions, rigid, straight, plumb and level, with the panels laid out as shown. Provide clearances of not more than 1/2-inch between pilasters and panels, and not more than 1-inch between panels and walls. Secure panels to walls with continuous stirrup brackets, attached to both walls and pilasters or panels at 6-inches o.c. Secure panels to supporting walls with manufacturer's recommended anchoring devices, as indicated on final shop drawings or in manufacturer's instructions.
- B. Hardware Adjustments: Adjust and lubricate hardware for proper operation after installation.
1. Set hinges on in-swing doors to hold doors open approximately 30-degrees from the closed position when unlatched.
  2. Set hinges on out-swing doors and entrance swing doors, if any, to return to the fully-closed position.
- C. Protection, Cleaning and Final Adjustments: Protect units so that there will be no indication of use or damage at the time of acceptance.
1. Perform final adjustments to pilaster leveling devices, door hardware, and other operating parts of the partition assembly just prior to final inspection. Clean exposed surfaces of partitions, hardware, fittings, and accessories, using materials and methods recommended by the partition manufacturer.
  2. Replace damaged units which cannot be satisfactorily repaired, as directed by Architect.

END OF SECTION 10 21 13

## SECTION 10 22 26

### OPERABLE PARTITIONS

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the following:
  - 1. Single panel partitions, 3-inch thick panels.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 3 Section "Cast-In-Place Concrete"; concrete tolerances required.
  - 2. Division 5 Section "Structural Steel Framing"; primary structural support, including pre-punching of support members by steel supplier in accordance with template supplied by operable partition supplier's template.
  - 3. Division 6 Section "Rough Carpentry"; wood blocking at head and jambs as required.
  - 4. Division 9 Section "Gypsum Board Assemblies"; gypsum board wall systems adjacent to operable partitions.
  - 5. Division 9 Section "Acoustical Panel Ceilings"; interface at head.
  - 6. Division 13 Section "Metal Building Systems".

##### 1.02 REFERENCES

- A. ASTM E 90 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- B. ASTM E 557 - Standard Practice for the Installation of Operable Partitions.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
- C. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
- D. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
- E. Samples: Color samples demonstrating full range of finishes available to Architect. Verification samples shall be available in same thickness and material indicated for the work.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in accordance with ASTM E 90 test procedure to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
- C. Preparation of Opening: Conform to ASTM E 557.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's instructions and as required to prevent damage.

#### 1.06 WARRANTY

- A. Provide operable partition manufacturer's written warranty agreeing to repair or replace components with manufacturing defects for a period of two years from the date of shipment to the Project.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURER

- A. Acceptable Manufacturer: Modernfold, Inc., which is located at: 215 W. New Rd. ; Greenfield, IN 46140; Toll Free Tel: 800-869-9685; Tel: 317-468-6700; Fax: 866-410-5016; Email: info@modernfold.com; Web: www.modernfold.com
  - a. Product: Model Acousti-Seal - A/S 931 with #17 track.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide the specified product from Modernfold, Inc or equivalent product by one of the following:
  - 1. Advanced Equipment Corporation.
  - 2. Hufcor – Model #11 steel track trimless panel edges
  - 3. Panelfold – Model 610PP preprogrammed #5 all steel track
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00.

#### 2.02 SINGLE PANEL PARTITIONS, THREE INCH THICK PANELS

- A. Panel Construction and STC Rating: Nominal 3 inch thick in manufacturer's standard 48 inch width by height required, with horizontal and vertical framing elements fabricated from 18 gage formed steel with overlapped and welded corners; reinforced top channel to support suspension system components; frame with concealed formed steel at vertical edges.
  - 1. Panel Height: 10'-0"



2. Panel Skin: 0.50 inch tackable moisture resistant gypsum board, class A rated single material or composite layers continuously bonded to panel frame with minimum STC as follows:
    - a. STC: 50 minimum.
  3. Hinges for Closure Panels, Pass Doors and Pocket Doors: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Hinges mounted into panel edge or vertical astragal are not acceptable.
  4. Panel Trim: No vertical trim required or allowed on vertical edges of panels; minimal groove appearance at panel joints.
  5. Panel Weight: As standard with manufacturer for STC selected, 6 to 11 pounds per sq ft.
  6. Pass Doors: Manufacturer's standard pass doors with hardware and size to meet ADA accessibility requirements.
    - a. Matching panel construction and finish.
    - b. Same thickness and appearance as panels. Trimless ADA compliant pass door with friction latch and flush pulls for panic operation. Threshold is not acceptable.
- B. Panel Finish and Exposed Trim: Field applied as follows:
1. Panel Finish: Reinforced vinyl with woven backing weighing not less than 21 oz./lineal yd.
    - a. Color and Texture: To be selected by Architect from manufacturer's standard range of colors and textures.
  2. Exposed Panel Trim Color: To be selected by Architect from manufacturer's standard range of colors.
- C. Sound Seals and Bottom Seals:
1. Vertical Interlocking Sound Seals Between Panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.
  2. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
  3. Horizontal Bottom Floor Seals: Modernfold IA2 Bottom Seal. Automatic operable seals providing nominal 2 inches operating clearance with an operating range of plus 0.50 inches to minus 1.50 inches which automatically drop as panels are positioned without the need for tools or cranks.
- D. Suspension System and Soffits:
1. Suspension System: Modernfold No. 17 Suspension System - 'Smart Track':
    - a. Track: Nominal 11 gage formed steel track, suitable for either direct mounting to wood header or supported by adjustable steel hanger brackets, supporting the load-bearing surface of the track, connected to structural support by pairs of 0.38 inches diameter threaded rods.
    - b. Exposed Track Soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners and pre-painted off-white. Wood or aluminum soffits are not acceptable.
    - c. Carriers: Two all-steel trolleys for each panel with steel tired ball-bearing wheels, with suspension system with automatic indexing of panels into stack area using pre-

programmed switches and trolleys without electrical, pneumatic, or mechanical activation. Non-steel tires are not acceptable.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin installation until supports and substrates have been properly prepared.
- B. Notify Architect in writing of unsatisfactory preparation prior to installation. Do not proceed until unsatisfactory conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and ASTM E 557 installation procedures. Test for proper operation and make necessary adjustments until satisfactory results are obtained.

#### **3.03 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 10 22 26

**SECTION 10 28 00**  
**TOILET ACCESSORIES**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes supplying and installing toilet and bath accessory items as scheduled.

1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each toilet accessory item specified, including mounting method and specified options.

1.04 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices. Coordinate delivery with other work to avoid delay.

1.05 PROJECT CONDITIONS

- A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

**PART 2 - PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:
  - 1. A & J Washroom Accessories.
  - 2. American Specialties, Inc.
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. Bradley Corporation.
  - 5. McKinney/Parker.
  - 6. Or approved equal.

Provide bathroom accessories identical to those scheduled at end of this Section.

## 2.02 MATERIALS, GENERAL

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (0.9 mm) minimum thickness.
- B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16 (ASTM B 16M); Castings, ASTM B 30.
- C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366 (ASTM A 366M), 0.04 inch minimum. Surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 527 G60 (ASTM A 527M Z180).
- E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.
- F. Baked Enamel Finish: Factory-applied, gloss white, baked acrylic enamel coating.
- G. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

## 2.03 FABRICATION

- A. General: Only a maximum 1-1/2-inch diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
- C. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors or access panels with full-length, stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.
- B. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 446.

### 3.02 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

- B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

### 3.03 TOILET AND BATH ACCESSORY SCHEDULE

- A. The product numbers listed below are for ASI Accessories. Equivalent products of other approved manufacturers are acceptable.

- 1. Toilet paper holder: ASI – 7305-S – Supplied and installed by Contractor.
- 2. Paper towel dispenser: ASI – 0210 – Supplied and installed by Contractor.
- 3. Grab Bar: ASI 3800 series – Supplied and installed by Contractor.

- a. Satin stainless steel with snap-on flange covers.

- 4. Unframed mirror: Specified in Glass and Glazing Section 088100.
- 5. Soap Dispenser: Provided and installed by Owner.

END OF SECTION 10 28 00

**SECTION 10 44 16**  
**FIRE EXTINGUISHERS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Provide all fire extinguishers and accessories, complete in place, as shown on the Drawings, specified herein, and needed for a complete and proper installation.

1.02 QUALITY ASSURANCE

- A. Standards: Conform to NFPA 10 requirements for portable fire extinguishers.
- B. Qualifications of manufacturer: Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.
- C. Single manufacturer: Provide fire extinguishers and accessories by a single manufacturer.

1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data: Within 60 calendar days after award of Contract, submit:
  - 1. Complete materials list showing all items proposed to be furnished and installed under this Section.
  - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements;

1.04 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.

**PART 2 - PRODUCTS**

2.01 DESIGN

- A. Design is based on use of products manufactured by Larsen's Manufacturing Company, Minneapolis, MN, and catalog numbers of that manufacturer are given as an indication of the quality and style required. Equal products by J.L. Industries, or other approved manufacturers will be acceptable in accordance with the provisions of Division 1 Section "Substitution Procedures".

## 2.02 FIRE EXTINGUISHERS

- A. Provide Larsen's MP Series (multi-purpose dry chemical type), Model No. MP-5 fire extinguishers, 5 lb. size, 9-1/4 lb shipping weight, 4 1/4 inch cylinder dia, 15-1/4 inch tall, UL rated 2A-10B:C, with pressure indicating gauge and heavy steel container.
- B. At Kitchen, provide Larsen's WC-6L Series – 6 liters, 12-lb shipping weight, 7-inch cylinder dia, 19-inch tall, UL rating 2A-K, with pressure indicating gauge and heavy steel container.

## 2.03 FIRE EXTINGUISHER WALL BRACKET

- A. Provide Larsen's, Model No. B-1 Wall Bracket at locations indicated.

# **PART 3 - EXECUTION**

## 3.01 INSPECTION

- A. Examine the areas and conditions under which work of this Section will be installed. Verify correct rough openings and locations to receive cabinets. Correct conditions detrimental to proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

## 3.02 COORDINATION

- A. Throughout construction of substrate surfaces, use all means necessary to ensure proper and adequate provision for finished openings, to receive the work of this Section.

## 3.03 INSTALLATION

- A. Install the work of this Section in strict accordance with the manufacturer's recommendations, anchoring all components plumb, level and firmly into position. Verify servicing, charging and tagging of all fire extinguishers.
- B. Install wall bracket so that the top of the fire extinguisher is at 47" AFF.

END OF SECTION 10 41 13

## SECTION 12 32 16

### MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

#### PART 1 - GENERAL

##### 1.01 SUMMARY

- A. This Section includes the following:
  - 1. Manufactured plastic-laminate-clad casework.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 06 Section "Rough Carpentry" for wall blocking.
  - 2. Division 12 Section "Plastic Laminate Clad Countertops" for countertops and backsplashes.

##### 1.02 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data in the form of manufacturer's technical data, specifications and installation instructions.
- C. Shop Drawings showing locations, dimensioned plans and elevations and all details.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Quality Standards: Unless otherwise indicated, comply with the following standards:
  - 1. Cabinets: KCMA A161.1.
    - a. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semi-exposed location.

##### 1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for casework shown on Drawings

##### 1.05 PRODUCT HANDLING

- A. Deliver the materials in their original unopened containers with all labels intact and legible at time of use. Store in strict accordance with the manufacturers' recommendations.
- B. Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.
- C. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.



## PART 2 - PRODUCTS

### 2.01 MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

A. Provide manufactured wood casework by Merillat Industries, or approved equal, as follows:

1. Manufactured Casework: Merillat Classic cabinets
  - a. Design: Whitebay II, full overlay, Square door design.
  - b. Cabinet Construction: Merillat "**Deluxe**" wood cabinet construction.
  - c. Counter Height: 34" above finished floor.
  - d. Toe Space: 5" high.
  - e. Color: White.
  - f. Drawer Glides: Merillat "**SoftAction**" System.
  - g. Drawer/Door Pulls: HP134 wire pulls, color as selected by Architect.

### 2.02 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of the work of this Section, including but not limited to scribes, moldings, trim, finished side panels, paneling, etc. shall be as selected by the Contractor subject to the approval of the Architect.

### 2.03 FABRICATION

A. Verify dimensions of all cabinet locations, plumbing and other mechanical rough-ins, etc. before ordering components.

## PART 3 - EXECUTION

### 3.01 DELIVERY

A. Deliver the work of this section to the job site in a timely manner to permit orderly progress of the total Work.

### 3.02 INSTALLATION

- A. Installation shall be performed by trained personnel experienced in the installation of this type of equipment.
- B. Install plumb, level, true and straight with no distortions. Shim as required, using concealed shims.
- C. Base Cabinets: Set cabinets straight, plumb, and level. Adjust sub-tops within 1/16" of a single plane. Fasten each individual cabinet to floor at toe space, with fasteners spaced 24" o.c. Screw continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor, where they do not join other cabinets.
  1. Provide minimum of two fasteners on the upper portion of each cabinet back into wall studs (maximum spacing 24" o.c.).
  2. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16".

- D. Wall Cabinets: Securely fasten to solid supporting material, not wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets. Provide metal finish grommet/washers at all screws thru back of cabinet for clean visual appearance of exposed screw heads.
  - 1. Reinforcement of stud walls to support wall-mounted cabinets will be done during wall erection by trade involved, but responsibility for accurate location and sizing of reinforcement is part of this work.
  - 2. Provide minimum of two fasteners at top and two at the bottom portion of each cabinet back into wall reinforcement (maximum spacing at 24" o.c.).
- E. Adjust cabinets and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- F. Leave cabinetry clean and free from installation residue. Remove all cartons, debris, sawdust, scraps, etc. and leave spaces clean and all cabinets ready for Owner's use.
- G. Repair any defect in surfaces by total replace or other means acceptable to the Architect.

END OF SECTION 12 32 16

## SECTION 12 36 23.13

### PLASTIC LAMINATE CLAD COUNTERTOPS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:

- 1. Plastic-laminate countertops.
- 2. Window sills.

- B. Related Sections:

- 1. Division 6 Section "Plastic-Laminate-Clad Architectural Cabinets".
- 2. Division 7 Section "Joint Sealants".
- 3. Division 12 Section "Manufactured Plastic Laminate-Clad Casework".

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product and process specified.
- C. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Include to-scale drawing of side backsplash.
- D. Samples for initial selection of the following in the form of manufacturer's color charts consisting of actual units showing the full range of colors, textures, and patterns available.
  - 1. Plastic laminates.

##### 1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in producing countertops similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
- B. Single-Source Responsibility for Fabrication and Installation: Engage a qualified firm to assume undivided responsibility for fabricating and installing casework and countertops.
- C. Quality Standard: Except as otherwise indicated, comply with the following standard:
  - 1. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for architectural countertops and other requirements.

- D. Fire-Test-Response Characteristics: Provide materials with the following fire-test-response characteristics.
  - 1. Surface-Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for standard time period (ten (10) minutes).
    - a. Flame Spread: 75.
    - b. Smoke Developed: 450.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect products of this Section during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver products of this Section until painting and similar operations that could damage, soil, or deteriorate the products have been completed in installation areas. If products must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

#### 1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Obtain and comply with fabricator's and installer's coordinated advice for optimum temperature and humidity conditions during storage and installation. Do not install products of this Section until these conditions have been attained and stabilized.
- B. Field Measurements: Where products of this Section are indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Verify locations of concealed framing, blocking, reinforcements, and furring that support products of this Section by accurate field measurements before being enclosed. Record measurements on final shop drawings.
  - 2. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating without field measurements. Provide allowance for trimming at site and coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

#### 1.07 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work to ensure that products of this Section can be supported and installed as indicated.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIAL STANDARDS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of product and quality grade indicated and with requirements of the referenced product standards that apply to product characteristics indicated.
  - 1. Particleboard: ANSI A208.1, Grade M-2.

- B. High-Pressure Decorative Laminate: NEMA LD 3, Premium Grade, GP-50 (0.050-inch nominal thickness). Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
  - 1. Formica – Color as selected by Architect from standard range.
  - 2. Wilsonart – Color as selected by Architect from standard range.
- C. Adhesive for Bonding Plastic Laminate: Contact cement.

## 2.02 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements.
  - 1. For metal framing supports, provide screws as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

## 2.03 FABRICATION, GENERAL

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops. Provide countertops complying with the referenced quality standard and of the following grade:
  - 1. Grade: Premium.
- B. Complete fabrication, including assembly and finishing before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Trial fit assemblies at the fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved shop drawings before disassembling for shipment.
- C. Shop-cut openings, to maximum extent possible, to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

## 2.04 COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
  - 1. Grade: Premium.
  - 2. Deck shall consist of two layers of 3/4" particle board at the front edge and all other exposed edges providing a total thickness of 1-1/2".

- B. Kitchen 109 - Type of Top: 3/4" particleboard post-formed with 1-1/2" high "Waterfall" front edge. Include 1-1/2" high square edge at exposed sides. Provide Grade HGP - Postforming .039" plastic laminate.
  - 1. Integral Backsplash: Provide 3/4" thick x 4" tall integral covered backsplash with square edge at top of backsplash. Provide Grade HGP - Postforming .039" plastic laminate.
- C. Reception Desk at Spectator 102 - Type of Top: 3/4" particleboard post-formed with 1/4" x 1/4" chamfered top edge at exposed edges. Provide NEMA LD 3, Premium Grade, GP-50 (0.050-inch nominal thickness) plastic laminate.

## 2.05 SIDE BACKSPLASHES

- A. Quality Standard: Comply with AWI Section 400 requirements for backsplashes.
  - 1. Grade: Premium.
- B. Type of Side Backsplash: 3/4" thick, 4" high particleboard. Provide square edge at top and at exposed outside corners. Provide Grade HGP .039" plastic laminate to match the laminate at the countertop and integral backsplash. Extend side backsplash from face of backsplash to front edge of counter. Include curved bottom edge to fit covered backsplash and waterfall front edge.

## 2.06 WINDOW SILLS

- A. Quality Standard: Comply with AWI Section 400 requirements for backsplashes.
  - 1. Grade: Premium.
  - 2. Sill to be one layer of 3/4" particle board – built up with 2<sup>nd</sup> layer of 3/4" particle board at the front edge and all other exposed edges providing an edge thickness of 1-1/2".
- B. Type of Window Sills: 3/4" particleboard post-formed with 1-1/2" high "Waterfall" front edge. Include 1-1/2" high square edge at exposed sides. Provide Grade HGP - Postforming .039" plastic laminate.
- C. Extend window sill beyond face of wall 1" and extend ends of window sill 1" beyond window gyp board returns.

## 2.07 HARDWARE

- A. Metal Support Brackets at Countertops: Knappe and Vogt - 208 - Ultimate L Bracket.
  - a. Size: 21 1/2" D x 14 1/4" H at counters over 24" deep.
  - b. Size: 19 1/2" D x 12 7/8" H at 24" deep counters.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Condition products of this Section to average prevailing humidity conditions in installation areas before installing.
- B. Before installing, examine shop-fabricated work for completion and complete work as required.

### 3.02 INSTALLATION

- A. Quality Standard: Install products of this Section to comply with AWI Sections 400 and 1700 for the same grade specified in Part 2 of this Section.
- B. Install countertops level, true, and straight with no distortions. Shim as required with concealed shims. Install countertops with no more than 1/8-inch in 96-inch sag, bow, or other variation from a straight line.
- C. Scribe and cut to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- D. Tops: Anchor securely to base units and other support systems as indicated.
  - 1. Install countertops with no more than 1/8-inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Sealant at backsplashes is specified in Division 7 Section "Joint Sealants".
- E. Metal Support Brackets: Install per AWI 400 requirements for countertops.

### 3.03 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that products are without damage or deterioration at the time of Substantial Completion.
- B. Repair damaged and defective work where possible to eliminate functional and visual defects; where not possible to repair, replace. Adjust joinery for uniform appearance.

END OF SECTION 12 36 23.13

## SECTION 13 34 19

### METAL BUILDING SYSTEMS

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Design, fabricate and erect the metal building, including
  - 1. Structural steel main building frames.
  - 2. Secondary framing including purlins and girts.
  - 3. Roof and wall panels and trims.
  - 4. Gutter and downspouts.
  - 5. Insulation.

##### 1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.03 RELATED SECTIONS

- A. Division 08 – Section 'Hollow Metal Doors and Frames'.
- B. Division 08 – Section 'Aluminum Framed Entrances and Windows'.
- C. Division 08 – Section 'Door Hardware'.

##### 1.04 REFERENCES

- A. AISI-S100 – North American Specification for the Design of Cold-Formed Steel Structural Members - 2010 Edition.
- B. ANSI/AISC 360-05 - Specification for Structural Steel Buildings, ASD 2005, 13th Edition, and Steel Design Guide Series 3 - Serviceability Design Considerations for Low-Rise Building – second edition 2003.
- C. ASTM A36 - Specification for Carbon Structural Steel
- D. ASTM A123 – Specification for Zinc Coatings on Iron Steel Products
- E. ASTM A307 – Specification for Carbon Steel Bolts
- F. ASTM A325 - Specification for Structural Bolts, Steel, Heat Treated
- G. ASTM A475 - Specification for Zinc-Coated Steel Wire Strand
- H. ASTM A500 Grade B – Specification for Carbon Steel Tube Stock
- I. ASTM A501 – Specification for Hot Formed Welded Seamless Carbon Steel Structural Tubing
- J. ASTM A529 - Specification for High-Strength Carbon-Manganese Steel of Structural Quality
- K. ASTM A572 - Specification for High Strength Low-Alloy Columbium-Vanadium Steel

13 34 19– METAL BUILDING SYSTEMS 1



- L. ASTM A653 – Specification for Sheet Steel, Zinc Coated by the Hot Dip Process.
- M. ASTM A792 - Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot Dip Process
- N. ASTM A924 – Specification for Sheet Steel, Metallic Coated by the Hot Dip Process.
- O. ASTM A992 - Specification for Structural Steel Shapes
- P. ASTM A1011 - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
- Q. ASTM D2244 - Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates
- R. ASTM D4214 - Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
- S. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials
- T. ASTM E283 - Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
- U. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
- V. ASTM E1592 - Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
- W. ASTM E1646 - Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
- X. ASTM E1680 - Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems
- Y. AWS A2.4 - Standard Welding Symbols
- Z. AWS D1.1 - Structural Welding Code – Steel
- AA. AWS D1.3 - Structural Welding Code - Sheet Steel
- BB. FM4471 – Factory Mutual Research Corporation Standard 4471 Class 1
- CC. IAS AC472- International Accreditation Service, Inc. - Criteria for Inspection Programs for Manufacturers of Metal Buildings
- DD. MBMA Metal Building Systems Manual - 2012 Edition
- EE. NAIMA 202 - Standard for Flexible Fiberglass Insulation Systems in Metal Buildings
- FF. UL 580 - Underwriters Laboratory -Tests for Uplift Resistance of Roof Assemblies
- GG. SSPC SP-2 - Steel Structures Painting Council, Surface Preparation Specification No. 2, Hand Tool Cleaning
- HH. SSPC Paint 15 – Steel Joist Shop Primer/Metal Building Primer

## 1.05 SYSTEM DESCRIPTION

- A. The building shall include all primary and secondary structural framing members, connection bolts, roof and wall covering, trim, fasteners, closures, sealer, canopies, roof extensions, windows, doors, skylights, insulation, gutters, downspouts, louvers, ventilators and other miscellaneous items as stated in the specifications and/or shown or called for on the drawings.
- B. Primary framing shall consist of transverse rigid frames of rafters and columns with solid webs. The rigid frame shall be fabricated of shop-welded steel plate and designed for erection by field bolting. Frames shall be:
  - 1. Clear span or modular with intermediate columns.
  - 2. Gabled or single sloped.
  - 3. With tapered or uniform depth exterior columns.
- C. Secondary framing shall consist of purlins, girts, eave struts, flange braces and other braces as required by design by field bolting or screwing.
- D. Horizontal loads not resisted by main frame action shall be resisted by
  - 1. Standard cable or rod x-bracing in the roof
  - 2. Panel diaphragm, standard cable or rod x-bracing, fixed base columns, rigid portal frames, or shearwall by others in the sidewalls
  - 3. Panel diaphragm, standard cable or rod x-bracing, fixed base columns, rigid portal frames, or shearwall by others in the endwalls
- E. Roof and Wall System consists of preformed steel panels, trim, accessories, sealants and fasteners as required for a complete installation.
- F. Building overall dimensions, bay spacing, post spacing, eave height, clear dimensions and roof pitch shall be as indicated on the drawings and as defined here.
  - 1. The building "Width" shall be the measurement from outside face to outside face of the sidewall girts.
  - 2. The building "Length" shall be the measurement from outside face to outside face of the endwall girts.
  - 3. "Eave" to be determined as the line along the sidewall formed by the intersection of the planes of the outside face of the roof purlins and the outside face of the sidewall girts.
  - 4. "Eave Height" is defined as the vertical dimensions as measured from the finished floor to the intersection of the planes of the roof and sidewall.
  - 5. The "Bay Spacing" shall be the distance between the centerlines of frames for interior bays and the distance from the outside face of endwall girt to the centerline of the adjacent interior frame for end bays.
  - 6. The "Module Spacing" shall be measured between the centerlines of interior columns for interior modules and the distance from the outside face of sidewall girts to the centerline of the adjacent interior column.
  - 7. "Roof Pitch" shall be the inches of vertical rise per inches of horizontal run, expressed as inches of rise per 12 inches of run.

## 1.06 DESIGN REQUIREMENTS

- A. Design primary and secondary structural members and exterior covering materials for applicable load and combinations of loads in accordance with the edition of the International Building Code. Design loads shall be combined to produce maximum stresses within the structure in accordance with AISC and/or AISI as they apply. The Building Use Category shall be.

- B. The design loads plus Dead Load shall be used in the structure design.
1. Roof Live Load shall be a minimum of 20 PSF and shall be applied on the horizontal projection of the roof. Live Load reduction shall be applied according to the code specified above.
  2. Wind Load shall be based on a wind speed of 90 MPH and applied as pressure and suction in accordance with the code specified above.
  3. The Ground Snow Load shall be 25 PSF; the Snow Exposure Factor,  $C_e$ , shall be 1.0; the Snow Thermal Factor,  $C_t$ , shall be 1.0 and used to determine the Roof Snow Load.
  4. The Roof Snow Load shall be applied on the horizontal projection of the roof.
  5. The metal building system shall be designed for snowdrift conditions if required based on the building geometry and location of the facility in accordance with the code specified above.
  6. Collateral loads shall be those other than the basic design loads for which the building must be adequately designed. Loads of this type include, but shall not be limited to, suspended ceilings, sprinkler, electrical or mechanical systems, or any suspended or roof mounted HVAC units.
- C. The building components shall be designed to the following minimum deflection requirements, unless a specific deflection is required by the building code. Deflection based on wind shall be based on a 10 year mean reoccurrence interval, or 75% of the design pressure for a 50 year mean reoccurrence interval.
1. Frame rafters – L/180
  2. Frame sidesway – H/60
  3. Purlins – L/150
  4. Girts – L/120
  5. Endwall posts – L/120
  6. Roof panel – L/150
  7. Wall panel – L/120

## 1.07 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Erection Drawings including:
1. Anchor Bolt setting plan, base plate details and column reactions.
  2. Roof framing plan.
  3. Wall framing elevations.
  4. Transverse cross sections.
  5. Panel layout.
  6. Exact location of factory located openings.
  7. Approximate location of field located openings.
  8. Framing details.
  9. Flashing details.
  10. Accessory details.
- C. Design calculations shall be submitted, stamped by a Professional Engineer registered in the state where building will be erected, including:
1. Stress analysis.
  2. Deflection analysis.
  3. Column base reactions for each loading case.
  4. Column base reactions for governing load combination.

- D. Letter of Certification, prepared and signed by a Professional Engineer, verifying that building design meets indicated loading requirements and building code as requested.

#### 1.08 QUALIFICATIONS

- A. The company manufacturing the products specified in this Section shall:
  - 1. Be a member of MBMA.
  - 2. Be in compliance with the International Accreditation Service, Inc., Accreditation Criteria for Inspection Programs for Manufactures of Metal Building Systems (IAS AC472).
  - 3. Have a minimum of 20 years' experience in the manufacture of steel building systems.
  - 4. Basis-of-Design Product: Subject to compliance with requirements, provide the specified product from Behlen Building Systems or equivalent product by one of the following:
    - a. American Buildings Company; Division of Magnatrx Corp.
    - b. Butler Manufacturing Company; a BlueScope Steel Company.
    - c. Ceco Building Systems; Division of NCI Building Systems, L.P.
    - d. Star Building Systems; an NCI Company.
    - e. VP Buildings; a United Dominion company.
- B. Erector's Qualifications
  - 1. Minimum of 5 years' experience in this or similar trade.
  - 2. Five similar installation references in past 3 years.

#### 1.09 WARRANTY

- A. The metal building manufacturer shall warrant for 5 years that components fabricated by the manufacturer are free from defects in composition of material and workmanship and in accordance with industry standards for such components.
- B. Unpainted Galvalume® panels shall be warranted by the metal building manufacturer to the extent warranted by the steel supplier for 25 years against rupture, perforation, or structural failure as a result of corrosion caused by exposure to normal atmospheric conditions.
- C. The exterior color finish of factory coated roof panels shall be warranted by the metal building manufacturer to the extent warranted by the paint supplier for 30 years against peeling, cracking, checking, and flaking. The panel shall not color change more than 7 NBS units as per ASTM D2244. Chalking shall not exceed a number 8 rating when measured per ASTM D 4214, method A.
- D. The exterior color finish of factory coated wall panels shall be warranted by the metal building manufacturer to the extent warranted by the paint supplier for 30 years against peeling, cracking, checking, and flaking. The panel shall not color change more than 5 NBS units as per ASTM D 2244. Chalking shall not exceed a number 8 rating when measured per ASTM D 4214, method A.
- E. Provide the owner with a copy of all warranties.

## PART 2 - PRODUCTS

### 2.01 MATERIALS – STRUCTURAL FRAMING

#### A. General

1. Structural steel members shall be sheared, plasma cut, formed, punched, welded and painted in the plant of the manufacturer. All shop connections shall be welded in accordance with the AWS "Standard Code for Welding in Building Construction".
2. All structural members shall be designed for the minimum yield and tensile strength specified for the specific grade referenced in the appropriate ASTM Specification; higher yield or tensile strengths listed in the material test reports shall only be used to verify compliance with the ASTM physical properties requirements.
3. All structural framing members shall be prepared according to SSPC SP-2 and given one coat of shop primer formulated to meet the requirements of SSPC-15.
4. All framing members shall carry an easily visible identifying mark to aid the erector in the erection of the building.
5. Field connections shall be bolted with high strength or carbon steel bolts and nuts.

#### B. Primary Structural Members

1. The primary structural members shall be rigid frames manufactured of solid web members having tapered or uniform depth rafters rigidly connected to tapered or uniform depth columns.
2. Steel used to fabricate built up framing members shall be 55,000 PSI minimum yield point material and shall conform to the physical characteristics of ASTM A1011, ASTM A572 or ASTM A529, Grade 55.
3. Steel used for interior columns, if required, shall conform to ASTM A500, Grade B, 42,000 PSI minimum yield point material.
4. The building manufacturer shall have on file certified mill test reports that verify that these requirements have been met.

#### C. Secondary Structural Members

1. Secondary structural framing shall distribute the loads to the primary structural system and shall include endwall columns and rafters, purlins, girts, eave struts, base support, headers, jambs, flange bracing, clips, and other miscellaneous structural framing.
2. Steel used for cold-formed members shall be 55,000 PSI minimum yield point material and shall conform to the physical characteristics of ASTM A653 and ASTM A924 Grade 55, Coating Designation G40.
3. Light gauge cold-formed sections shall be manufactured by precision roll or brake forming. All dimensions shall be true, and the formed member shall be free of fluting, buckling or waviness.
4. Endwall rafters shall be manufactured from built-up or hot rolled sections of adequate size and thickness as determined by the design criteria.
5. Endwall columns shall consist of built-up, hot rolled or cold formed "C" sections of adequate size and thickness as determined by the design criteria.
6. Steel used for hot rolled sections shall conform to ASTM A992 Grade 50 steel
7. Purlins and girts shall be precision roll-formed 8" or 10" deep "C" sections or "Z" sections of adequate size and thickness as determined by the design criteria, minimum 16 gauge. Purlins and girts shall be either simple span or continuous span members.
8. Eave struts shall be precision roll-formed and/or press brake formed "C" sections, minimum 14 gauge. The upper flange shall slope with the normal roof slope, and the web shall be vertical and free to receive the sidewall covering.

9. Base support shall consist of a continuous base angle, base "C", or an 18 gauge one piece base member to which the base of the wall covering shall be attached. The base support shall be securely fastened into the concrete by the erector.
10. Headers and jambs shall be precision roll-formed "C" sections of the same depth as the girts.
11. Flange bracing shall consist of angle members connected to the web of the purlin or girt and to the rigid frame web adjacent to the compression flange of the primary structural member.
12. Clips shall be fabricated from 55,000 PSI minimum yield point material and be factory punched for field bolted connections.

#### D. Bracing

1. Horizontal load resisting bracing shall be accomplished by diagonal cable bracing, rod bracing, portal frames, fixed-base columns and/or diaphragm action of the roof and wall covering.
2. All cables for diagonal bracing shall be fabricated from extra high strength Grade-7 wire Class A coating, left hand lay, galvanized steel strand, conforming to the provisions of ASTM A475. Adjustment shall be provided by an eyebolt assemble.
3. Rod bracing shall be fabricated from minimum 1/2" diameter steel rod conforming to the provisions of ASTM A572 Grade 50.
4. Portal frames and fixed-base columns shall be fabricated of built-up sections and conform to the same specifications as primary framing.

## 2.02 MATERIALS – ROOF SYSTEM

### A. Roof panel shall be one of the following types.

1. Standing Seam Roof System
  - a. Panels shall have an interlocking seam with 3 1/16" deep trapezoidal rib spaced at 24" on center, with minor ribs between major ribs. Each panel shall provide a net coverage width of 24".
  - b. High ribs shall be sealed with factory-applied non-skinning, non-hardening mastic sealant and shall be manually roll and locked into place or and mechanically seamed as required by the plan documents to achieve the required wind uplift resistance.
  - c. Panels shall be manufactured from 24 gauge, 50,000 PSI material.
  - d. The trapezoidal rib standing seam roof system shall have concealed clips. Clips shall be floating (sliding) to allow for a 3 1/2" total thermal movement.
  - e. Panels shall be one piece for slope lengths less than 52'-0". The panel endlap, if required, shall have tape sealer sandwiched between the top and bottom panel with a rigid metal backer plate.
  - f. Provide roof panel assemblies with UL Class 90 uplift rating in accordance with UL 580 "Tests for Uplift Resistance of Roof Assemblies".
  - g. Roof system must have been tested according to the procedures in ASTM E 1592 (structural performance by uniform static air pressure differential).
  - h. Panel finish shall be acrylic coated Galvalume® AZ55 coating in accordance with ASTM A792.

## 2.03 MATERIALS – WALL SYSTEMS

### A. Wall Panel

1. Rollformed profile shall be the manufacturer's architectural panel configuration (ribs pointing in or reverse roll configuration). Panels shall have 1 3/16" deep major ribs spaced at 12" on center, with minor ribs between major ribs. Each panel shall provide a net coverage width of 36".
2. Manufactured from 26 gauge 80,000 PSI material. Provide wall panel assemblies (when installed with mastic in the walls) with permanent resistance to air leakage through assembly of not more than 0.006 cfm/sf of fixed wall area when tested according to ASTM E283 at a static pressure differential of 6.24 psf.
  - a. Include mastic at wall panel seams.
3. Provide wall panel assemblies (when installed with mastic in the walls) with no water penetration as defined in the test method when tested according to ASTM E331 at a static pressure differential of 12.0 psf.
  - a. Include mastic at wall panel seams.
4. Substrate shall be Galvalume® AZ50 coating in accordance with ASTM A792
5. Sheets shall be coated with a silicone-modified polyester (SMP) over primer. The reverse side shall be coated with pigmented polyester. Exterior color to be selected from the manufacturer's standard color choices.
6. The wall panels shall be 2 colors with the low color extending up to 4'-0" above finished floor and the high color extending from 4'-0" AFF up to the top of wall.
7. Color selections to be from manufacturer's standard colors.
8. Panels shall be two (2) pieces from base to eave. Include wainscot flashing trim piece between panels.

## 2.04 MATERIALS – TRIM

- A. Trim shall be 26 gauge with a silicone-modified polyester (SMP) or fluoropolymer topcoat containing not less than 70% polyvinylidene fluoride (PVDF). The reverse side shall be coated with pigmented polyester. Exterior color to be selected from manufacturer's standard color choices.
- B. Provide all trim pieces necessary to achieve a finished appearance. Provide corner boxes to transition from gable trim to eave trim or gutter.
- C. Provide trim at all corners of the building and for all sides of framed openings. Provide trim for base of building if required.
- D. Provide two piece sculptured jamb trim to enhance appearance and durability.
- E. Metal flashing closures shall be used to close off wall to roof flashing.
- F. Gutter shall have a nominally horizontal bottom leg and the front leg shall not project above the bottom of roof panel.
  1. Include high capacity 26 gauge prefinished galvanized steel gutter.
  2. Gutter Size: 7" tall x 8 1/2" wide at the top – tapering to 6" wide at the bottom
- G. Downspouts shall terminate with an elbow at approximately 75°.
  1. Include high capacity 24 gauge prefinished galvanized steel downspouts.
  2. Downspout Size: 5 1/4" x 3 7/8".

## 2.05 INSULATION

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the specified products from Guarding Building Products, or equivalent product
- B. Wall and Roof Insulation: Fiberglass blankets, thickness as indicated, meeting ASTM C 991 (Unfaced) and ASTM 136, with a FHC 25/50 rating of 25 or less flame spread rating and 50 or less smoked developed rating in accordance with ASTM E84. Insulation shall meet the 2009 International Energy Conservation Code (IEEC) requirements.
  - 1. Wall Insulation R Value: 25, 8" thick, single layer, Guarding Building Products, or equal; Guardian ES – Energy Saver.
  - 2. Roof Insulation R Value: 26, 8" thick, double-layer system, Guarding Building Products, or equal: Guardian Purlin Glide FP.
- C. Fabric Vapor Barrier: Woven, reinforced, high-density polyethylene yarns coated on both sides with a continuous polyethylene film.
  - 1. Wall Insulation Vapor Barrier: Guardian Energy Saver FP Fabric, Bright White in color.
  - 2. Roof Insulation Vapor Barrier: Guardian Purlin Glide FP Fabric, Bright White in color.

## 2.06 METAL PERSONNEL DOORS AND FRAMES

- A. Metal personnel doors and hardware to be provided and installed by others.
- B. Door Subframing shall consist of two 16 gauge galvanized steel C-channels to match the specified girt depth.
- C. Door Trim: Provide manufacturer's standard prefinished metal trim around door frames for a water tight condition.

## 2.07 WINDOWS

- A. Windows to be provided and installed by others.
- B. Window Subframing shall be manufacturer's standard subframing to match the specified girt depth.
- C. Window Trim: Provide manufacturer's standard prefinished metal flashings around door frames for a water tight condition.

## 2.08 ACCESSORIES

- A. Fasteners shall be manufacturer's standard plated/painted or long life fasteners. Exposed fastener heads shall be factory colored to match the panel color. Self-drilling fasteners shall be used throughout. Structural screws shall be used to secure panels to structural components. Stitch screws shall be used to secure panel to panel connections and trim screws shall be used at trim endlaps.
- B. Closed cell foam closure strips, die cut to match ribbed panel configuration. Metal closures shall be used to close off wall to roof flashing. High density corrugation closures shall be used with trapezoidal standing seam roof panels.
- C. Mastic for roof sidelaps and endlaps to shall be a non-hardening butyl tape, non-corrosive to the substrate, of 100% solids. Tape size to shall be minimum 5/32" x 1/4" supplied in rolls – or manufacturer's standard mastic tape.
  - 1. Flashing endlaps shall use Gun Grade urethane.



- D. Caulk shall be manufacturer's standard product as appropriate for the applications.
- E. Thermal spacer blocks of expanded polystyrene shall be supplied with standing seam roof systems when required for the requested insulation thickness. The thickness of the thermal spacer block shall be compatible with the clip height and insulation thickness.
- F. Roof curbs shall be used at all roof penetrations except pipes 13" diameter and less. Roof curbs shall have a structural subframes. Curbs and subframes shall be designed to support the weight of the roof top units. Curbs shall be designed specifically for the model numbers of the roof top units. Curbs shall be supplied with rib covers and all necessary fasteners and mastic for a weathertight installation. The roof curbs shall be two piece floating curbs when required by building conditions.
- G. Roof Jacks shall be used at all 13" diameter and less pipes that penetrate the roof. Roof jacks shall be EPDM with a flexible aluminum bases to form weathertight seals at the roof panels.
- H. Include optional roof and wall flange brace attachments for insulation.
- I. Include base channel with depth to match wall girt depth.

## 2.09 FABRICATION

- A. Fabricate built-up members in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.
- B. Fabricate hot rolled members in accordance with AISC Specification for pipe, tube, and rolled structural shapes.
- C. Fabricate cold formed members in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.
- D. Provide factory drilled or punched framing members for field bolted connections.
- E. All framing members shall be prepared according to SSPC SP-2 and given one shop coat of shop primer formulated to meet the requirements of SSPC Paint 15.
- F. Clearly and legibly mark each piece to correspond with previously prepared erection drawings.

## PART 3 - EXECUTION

### 3.01 ERECTION – FRAMING

- A. Erect framing in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.
- B. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads, such as wind loads acting on the exposed framing and seismic forces, as well as loads due to erection equipment and erection operation, but not including loads resulting from the performance of work by others. Bracing furnished by the manufacturer for the metal building system shall not be assumed to be adequate during erection. Temporary guys, braces, falseworks and cribbing shall remove them immediately upon completion of erection.

- C. Structural members shall not be field cut or altered without the written approval of the metal building manufacturer.
- D. After erection, all welds, abrasions, and surfaces not shop primed shall be field primed.

### 3.02 ERECTION – WALL AND ROOFING SYSTEM

- A. Wall and roofing materials shall be installed in accordance with manufacturer's current written instructions.
- B. Care shall be exercised when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Cladding systems shall be fastened to structural supports and shall be aligned level and plumb.

### 3.03 ERECTION – GUTTER AND DOWNSPOUTS

- A. Gutters and downspouts shall be installed in strict accordance with manufacturer's current written instructions.
- B. Install gutters with a slope to drain.

### 3.04 INSTALLATION – INSULATION

- A. Install insulation and vapor barrier in accordance with manufacturer's current written instructions.

### 3.05 INSTALLATION – ACCESSORIES

- A. Accessories shall be installed in accordance with manufacturer's current written instructions.
- B. Wall and roof accessories shall be sealed to be weathertight.

END OF SECTION 13 34 19

## SECTION 13 70 00

### FIRING RANGE SCOPE OF WORK

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE

- A. The firing range scope of work under this section of the project includes construction of systems as follows.

#### PART 2 - PRODUCTS

##### 2.01 DESCRIPTION OF WORK

- A. The work includes, but is not limited to the provisions and installation the major items of firing range equipment as follows:

1. Backstop Rubber Bullet Trap, with provision for steel trap (future).
2. 10 position walk down range.
3. Safety baffle.
4. Redirective guard baffle.
5. Range condition lights system: red, amber, green (RGA) four (4) each. "Range in Use" light sign (1) each.
6. Range air handling power system.
7. Interior range lighting.

- B. The basis of design is based on the Mancom Manufacturing Action Target or Savage Range System line of products. Any manufacturer who can meet the minimum specifications here can bid on this project.

- C. The following are acceptable manufacturers:

1. (Backstop, Targets and Safety Baffles)

Action Target  
PO Box 636  
Provo, UT 84603  
801-377-8033

2. (Booths, Targets and Range Control Systems)

Mancom M.I.  
1335 Osprey Drive  
Amcaster, Ontario, Canada  
905-304-6141

3. (Backstop Targets and Safety Baffles)

Meggitt  
720 Industrial Drive, Suite 112  
Cary, IL 60013  
847-639-7666

4. (Backstop Targets and Safety Baffles)

Savage Range Systems  
100 Springdale Rd.  
Westfield, MA 01085  
413-642-4219

D. The General Contractor is cautioned that the firing range drawings and technical specifications are interrelated and should not be separated and given to the different suppliers and subcontractors. The following specifications and drawings shall not be separated and shall be provided to the range sub-contractor

## 2.02 SPECIFICATIONS

### DIVISION 13

13 70 50 Firing Range Equipment – General  
13 71 50 Shredded Rubber Bullet Trap Backstop  
13 71 60 Modular Bullet Trap and Containment System  
13 73 00 Ceiling Ballistic Protection System  
13 73 10 Firing Range Wall and Acoustical Systems  
13 80 00 Firing Range Ventilation- General Requirements  
13 81 00 Range Ductwork  
13 82 00 Range Air Outlets and Inlets  
13 88 00 Firing Range Air Balancing  
13 94 00 Control Wiring  
13 94 40 Firing Range Condition Lights

### DRAWINGS

#### GENERAL

#### RANGE EQUIPMENT

FR.10 Pistol Range Floor Plan  
FR.11 Pistol Range Sections  
FR.12 Steel Trap Add Alternate And Miscellaneous Details

#### SOUND CONTROL

FR.20 Pistol Range Sound Attenuation Plan  
FR.21 Pistol Range Sound Attenuation Sections  
FR.22 Sound Attenuation Wall Details

## HVAC/FILTRATION

- FR.30 Ventilation Roof Plan
- FR.31 Ventilation Opening Roof Plan
- FR.32 Ventilation Roof Plan Base Bid
- FR.33 Ventilation Ceiling Plan Base Bid
- FR.34 Pistol Range Ventilation Sections
- FR.35 Ventilation Schedule
- FR.36 Ventilation Schedule Base Bid

## ELECTRICAL

- FR.40 Electrical Lighting Plan
- FR.41 Control Power Roof Plan
  
- FR.42 Control and Power Plan
- FR.43 Firing Range Lighting Longitudinal Section
  
- FR.44 Electrical Panel Schedules and Lighting Fixture Schedules
- FR.45 Electrical General Notes And Single Line Diagram

## SIGNAGE

- FR.50 Signage Notes and Details
- FR.51 Firing Range Signage Plan
- FR.52 Firing Range Signage Section

- E. The Contractor is cautioned about the requirements and the provision for equipment and equipment controllers to be provided by the equipment manufacturer that the controllers control and of the requirements of some controllers to control multiple equipment.
- F. The performance specifications shall be enforceable and shall not be waved.

## **PART 3 - PROJECT GENERAL DESCRIPTION**

### 3.01 GENERAL

- A. The project is an indoor Small Arms Firing Range for personnel certification of minimum learning skills in the use of handguns, rifles and shotguns. The range will include 14 firing positions centered on space.

### 3.02 FLOORS, WALLS AND ROOF

- A. See Architectural and Structural Sections
- B. Except as required for forced air ventilation, no door, window or other opening is allowed forward of the firing line and to the target line. All pipes, conduits, etc. on the walls, floor or ceiling forward of firing line, shall be installed bellow, embedded or protected against ballistic damage. Controllars where shown, are expected to be flush-mounted.

### 3.03 EXTERIOR RANGE DOORS

- A. See applicable Architectural Specifications Sections

### 3.04 CEILING BAFFLES

- A. Lights and equipment down range shall be protected by concrete tee's or with ceiling baffles that prevent direct fire into the lighting, etc. by restricting the rounds down range travel.
- B. Baffles, where shown, shall be rifle caliber rated and tested and certified prior to installation. Test shall be performed with 5.56-mm ammunition.

### 3.05 FLOOR REQUIREMENT MARKING AND NUMBERING

- A. Firing positions shall be numbered to correspond with each target. Readily identifiable markers shall be set and/or painted at the center of each position in a left to right ascending order. Adequate space for general circulation and squadding shall be delineated as a ready area behind the firing line as shown.

### 3.06 TARGET SYSTEMS BY OWNER

### 3.07 VISUAL CONTROL

- A. All firing positions to the back of the range shall be visible from the "Range Masters " Control station.

### 3.08 LIGHTING - GENERAL

- A. Provide general, task and special lighting as described herein. General lighting levels from fluorescent source shall be 50 foot-candles at 48-inches above the floor. Direct task and target lighting shall provide light on the turning target and firing lines. Lighting at the target face shall be measured at 100 fc (4-feet) above the floor, with a wavelength of 550 nanometers+ 50 to simulate natural light. Task lighting from behind the shooting lines shall vary and be rehostat controlled 5 to 100 fc from incandescent source.
- B. All lighting shall be installed to be outside the direct line of fire.
- C. The required method for range general lighting is a continuous bank of fluorescent fixtures with supplemental halogen or a combination of these lights running the full width of the range. All fluorescent fixtures shall have PC compatible parabolic lenses to concentrate light on the horizontal plane and reduce glare on wall surfaces. Use fluorescent fixtures to illuminate the area behind the 50-yard firing line.
- D. Where general lighting fluorescent fixtures are used, select lights with a color rendering index of at least 85 and a temperature index of 3500 Kelvin, or install other light sources to balance the colors.
- E. Fluorescent lights shall be installed as shown and behind the bullet trap for maintenance and cleanup.
- F. Direct and target task lighting shall be installed on swivel joints to allow for adjustment. Lights shall be located to provide the required illumination at the target line.
- G. Task lights shall be On/Dim/Off with a minimum dimming luminance to 5 foot candles shall be provided at each shooting line as shown.

- H. Each firing and target line task illumination circuit shall be individually switched and made dimmable by line, to satisfy the training requirements of different light levels.
- I. Range Condition Signal Light System shall be located up and down range at 2 corners of the range. System shall consist of three colored lights, and a range masters switch control from the main console. Lights shall be red, green and amber. System shall be interfaced with the Range Security System to activate the red light when there is a security violation and cease-fire. Green is for a cold range, amber for a range in use.
- J. Range conditions lights shall be interlocked with the ventilation system and that emergency "exit" and "Range in Use" sign lights.

### 3.09 AIR HANDLING SYSTEMS

#### A. Firing Range

- 1. The exhaust and supply pass through system shall be constant airflow, to approximate laminar flow in the firing range at 75-per minute (fpm) + 5 percent, as measured 2ft up range of the 50ft and 7yd firing line.

### 3.10 CONTROL SYSTEM

- A. The firing range master controller shall not be able to operate without confirmation that a portion of the ventilation exhaust system is operating properly. Ventilation system controls shall be operable from the firing range master controller, located at the range control counter.
- B. System shall be alarmed if:
  - 1. Any fan fails to operate.
- C. The firing range supply and exhaust fans shall be electrically interlocked as shown to run at the same time.
- D. The HVAC controls shall monitor all parameters required to properly control the HVAC system and provide automatic control of all manageable devices. The control system shall monitor, record and report electricity consumption.
- E. The control system shall manage a staged startup of mechanical equipment. Coordinate with the electrical shop drawings.
- F. The HVAC control system shall be compatible with other systems.
- G. Provide Operations and Maintenance Manuals with CD-rom containing the software copy of all HVAC items to include but not be limited to, equipment layout schematic, sequence of operations, software programming sheets, graphics, as-built database, and line diagrams.

### 3.11 OTHER EQUIPMENT

- A. Hako minuteman lead vacuums, Model C82985-06 HEPA filter. (by owner)
- B. Vacuum (provide one).
- C. Non-woven, embossed, polyester filter bag provides 50% more filtration area than standard bags. Filter bag is 99.9% efficient at 3.0 microns.
- D. Equipped with HEPA (High Efficiency Particulate Air) Filter, which is 99.99% efficient at 0.12 microns.

- E. State-of-the-art polypropylene lid assembly is acoustically designed to minimize noise...74db
- F. Polyethylene tanks are durably constructed, non-corrosive and dent-proof for years of reliable service.
- G. Patent self-sealing intake ensures a positive vacuum seal which allowing hose to swivel.
- H. The "sure-grip/quick release" mechanism makes it easy to connect and remove hoses.
- I. Convenient 50-ft cord (3-wire/16-3)
- J. All 115 volt
- K. Dry tool kit, which includes:
  - 1. 1¼-in x 8-ft Crush proof hose (3cm x 1.8cm)
  - 2. 1¼-in wand (3cm)
  - 3. 12-in Crevice Tool (30cm)
  - 4. 3-in Round Dust Brush (8cm)
  - 5. 5-in Upholstery Tool (13cm)
  - 6. 110in Combination Floor/Carpet Tool (28cm)
- L. Specifications:
  - 1. Model C82985-06
  - 2. Power 1.25 h.p.
  - 3. Tank Size 6 gallon/22 liters
  - 4. Dry Capacity .46/.01m<sup>3</sup>
  - 5. Airflow 95/2.7m<sup>3</sup> min
  - 6. Waterlift 85"/2159mm
  - 7. Weight 17/8 kg
  - 8. Casters (4) 15/8"/1.13 cm

### 3.12 FIREARMS CLEARING TRAP

- A. A quantity of one (1) Safe-N-Clear trap utilizing a chamber filled with GranTex material shall be provided/ The Safe-N-Clear provides a secure method for checking a firearm when loading or unloading.
- B. A reinforced rubber screen secured across the trap opening provides a slot for muzzle insertion and serves as a protective barrier against backsplatter.
- C. The clearing trap shall be a self-standing /floor model that does not require a stand or special mounting hardware to secure it.
- D. The clearing trap shall accommodate rounds within 2,000 fps and 2,200 ft/bs muzzle energy.
- E. The clearing trap dimensions shall be 35-in H x 13-in W x 18-in D and weight approximately 208lbs. The clearing trap shall utilize safety signage that illustrates its capabilities and limitations.

### 3.13 BRASS BUGGY

- A. Provide one "brass buggy" for range floor brass pick up as manufactured by Southern Belle Brass, PO Box 2165, Cordova, TN 38088-2165, 901-774-9800.
- B. This unique design buggy allows you to simply push forward the lightweight machine over the terrain collecting brass and depositing it into the hopper. Do not pull back on the machine



while there is brass in the wheels. The brass is discharged by pulling on the attached cord. This machine helps cut down on exposure from picking up brass by hand.

### 3.14 WET VACUUM

#### A. Fast USA 7.0 Wet/Dry Vacuum

1. Two 1500 watt motors
2. PE can holds 18.5 gallons
3. Attached drain hose
4. Fixed 50 foot power cord
5. Green light on/off switch
6. For wet use only
7. Sound level: 7.0 dB
8. Air Speed 126 CFM
9. Suction Power: 106.3"
10. Voltage: 115
11. Motor: 2 at 1.95hp
12. Weight: 55lbs.
13. Height 34.5"
14. Diameter: 19.6"
15. Capacity: 18.5 Gallons

### 3.15 MEASUREMENT AND PAYMENT

- A. No additional payment shall be made for the work hereinbefore specified. The Contractor's bid shall constitute full compensation for the work involved for each item.

END OF SECTION 13 70 00

## SECTION 13 70 50

### FIRING RANGE EQUIPMENT GENERAL

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE

- A. The work to be performed under this division consists of the furnishing and installing of all material and equipment and performing all necessary services for a complete, operable installation of the firing range mechanical and control equipment for the indoor shooting range shown and specified in the technical sections following and in strict accordance with the Contract Documents and the approved manufacturer's shop drawings.
- B. Codes and References
  - 1. State Building Code with latest amendments
  - 2. ASHRAE 62-1989
  - 3. SMACNA
  - 4. NFPA 101
  - 5. NFPA 90A
  - 6. NFPA 99
  - 7. AGA

##### 1.03 DESCRIPTION OF WORK

- A. The extent of the firing range equipment is shown on the drawings and specified herein after.
- B. Equipment installation shall be by or under the supervision of the equipment manufacturer.
- C. Any necessary part not specifically shown on the drawings or specified herein but normally provided shall be furnished and installed if the part not shown or specified is regularly and clearly a part of the equipment or service.
- D. All equipment motors and their controls shall be provided by one (1) manufacturer to insure compatibility and product performance capability.
- E. All equipment shall be fully guaranteed against defects in workmanship and materials for a period of one (1) year from the date of substantial completion.
- F. The manufacturer shall instruct the Owner's personnel as to the proper operation and maintenance of the equipment at time prior to the acceptance of the work.

##### 1.04 QUALITY ASSURANCE

- A. Firing range equipment manufacturers shall be: Firms having twenty (20) years or more experience in fabrication installation and experienced in the work of the quality and scope required by the contract documents.

- B. Upon request, equipment manufacturer shall be able to provide a list of fifty (50) representative completed law enforcement type indoor range equipment installations in continuous, successful use for five (5) years or more, with name, address and phone number of the Owner for each project.

#### 1.05 BASIS OF DESIGN

- A. Firing range equipment specifications and details are based on the equipment normally manufactured by the CASWELL DETROIT ARMOR COMPANIES, 720 Industrial Dr. #112, Cary, Illinois 60013, PH# (847) 639-7666 Fax# (847) 639-7694. These specifications and drawings establish the quality of product required by the owner and engineer for this project. Other firing range manufacturers equipment as listed elsewhere is also acceptable.

#### 1.06 SUBSTITUTIONS

- A. Minor variations in design to accommodate other manufacturer's standard products are acceptable as substitutions prior to bidding. No variations are permissible in quality or material specified.
- B. Major variations in design or operation of equipment will not be accepted.

#### 1.07 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Coordination and details on shop drawings of the exact locations for mechanical work installation shall be shown. See individual specifications sections for additional requirements.
- C. Prior to commencing the equipment manufacture, the Contractor shall submit detailed and dimensioned shop drawings, including wiring diagrams, certified factory test reports to the Engineer for approval.
- D. Operations and Maintenance Manuals & Parts Lists: The Contractor shall furnish, for each piece of equipment, six (6) complete, neatly bound sets containing the material listed below:
  - 1. Clear and concise instructions for operation, adjustment, lubrication and maintenance of equipment. A complete lubrication chart shall be included.
  - 2. List of all parts for the equipment with catalog numbers and other data required for ordering replacement parts.
  - 3. Instructions and parts list shall not refer to other sizes, types or models of similar equipment.

#### 1.08 OPERATING INSTRUCTIONS AND PARTS LISTS

- A. The Contractor shall furnish for each piece of equipment, six complete, neatly bound sets giving the information listed below:
  - 1. Clear and concise instructions for the operation, adjustment, and lubrication and other maintenance of the equipment. These instructions shall include a complete lubrication chart.
  - 2. List of all parts for the equipment, with catalog numbers and other data necessary for ordering replacement parts.
- B. Such instructions and parts lists shall have been prepared for the specific equipment furnished and shall not refer to other sizes and types or models of similar equipment.

#### 1.09 MATERIAL TO BE OBTAINED FROM THE MANUFACTURER

- A. The Contractor shall obtain all items named in these specifications or so noted on the plans from the equipment manufacturer and such incidental items as may be required for the safe and proper operation of the equipment for the purpose(s) intended.
- B. Shop drawings will not be approved until all materials are listed along with names and catalog numbers of any units being furnished by separate manufacturers.
- C. Equipment offered contrary to the provision of this paragraph will be subject to rejection.

#### 1.10 PATENTS

- A. General: The Contractor shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated, is not the subject of patent litigation, and that he is not knowingly offering equipment the installation or use of which is likely to result in a patent controversy, in which the Owner as user, is likely to be made the defendant.
- B. License: Where patent infringements are likely to occur, each contractor shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent owner or the controller of the patent, which will permit the use of the specified manner of such mechanical equipment as he may be bidding upon.
- C. Liability: Each Contractor, by submitting his bid, agrees to hold and save the Owner or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of same by the Owner.

#### 1.11 TOOLS

- A. For each type of equipment furnished by him, the Contractor shall provide a complete set of all special tools (including grease guns, or other lubricating devices) which may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment. Tools shall be high grade, smooth, forged, alloy, tool steel.
- B. As directed or approved, the Contractor shall furnish and erect one or more neat and substantial steel wall cases with flat key locks and clips or hooks to hold each tool in a convenient arrangement behind the trap.

#### 1.12 PIPING CONNECTIONS

- A. Equipment shall be oriented and connected as indicated on drawings. Deviations from dimensions and arrangements shown on the drawings caused by equipment characteristics shall be shown on completely dimensioned layouts and submitted by the Contractor to the Design Engineer for approval prior to installation of the equipment. The approved deviation and all related changes in piping, ducts, conduits, supports, etc., shall be made at no additional cost to the Owner.
- B. Electrical connections shall be performed as specified under Division 16, ELECTRICAL.

#### 1.13 MEASUREMENT AND PAYMENT

- A. No separate payment shall be made for the work hereinbefore specified. The lump sum price as set forth in the Contract shall constitute full compensation for the work involved for each item

#### 1.14 DELIVERY, STORAGE AND HANDLING

- A. All range equipment shall be delivered cartoned or crated to provide protection of equipment during transit and job storage.
- B. Inspect equipment upon delivery for damage. Minor damages may be repaired, provided the finish items are equal in all respects to new work and acceptable to the engineer; otherwise, the contractor shall remove and replace damaged items immediately with new equipment.
- C. Store equipment at the site under cover in a secured place. Store equipment off the floor and in a manner to promote air circulation. Avoid the use of non-vented plastic or canvas shelters, which could create a humidity chamber.

### **PART 2 - PRODUCTS**

#### 2.01 BOLTS, ANCHOR BOLTS AND NUTS

- A. All necessary bolts, anchor bolts, and nuts shall be furnished by the Contractor and/or the equipment supplier. Anchor bolts, sleeves and inserts, shall be set in place in forms and cast in the concrete by the general contractor. It shall be the responsibility of the equipment manufacturers under this Contract to furnish such anchor bolts, templates and approved location drawings in proper time to avoid delay, and it shall be his further responsibility to check and approve the location and setting of the anchor bolts, sleeves and inserts, prior to the casting of the concrete. Parts of anchors of metal work that are not built into masonry and concrete shall be coated with approved red primer paint. Anchor bolts for column base drives, motors, fans, blowers and other mechanical equipment shall be of iron. Anchor bolts shall have suitable washers and where so required, their nuts shall be hexagonal. All anchor bolts for setting equipment exposed to the weather shall be of 304 stainless steel.
- B. Expansion bolts shall have malleable iron and lead composition elements of the required number of units and size.
- C. Unless otherwise specified, stud, tap, and machine bolts shall be of the best quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to ASA Standards B1.1 1949 for Unified and American Screw Threads for Screws, Bolts, Nuts, and Other Threaded Parts.
- D. Bolts, anchor bolts, nuts, and washers not specified to be stainless steel shall be zinc coated, after being threaded, by the hot dip process in conformity with the ASTM Standard Specifications for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip, Designation A123 (latest), or the ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153 (latest), as is appropriate.
- E. Anchor bolts and expansion bolts shall be set accurately. If anchor bolts are set before the concrete has been placed, they shall be carefully held in suitable templates of approved design. Where indicated on the drawings, specified, or required, anchor bolts shall be provided with square plates at least 4 in. by 4 in. by 3/8 in. or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. If anchor or expansion bolts are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done at the Contractor's expense, and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.

#### 2.02 CONCRETE INSERTS

- A. Concrete inserts shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts shall be of a type which will permit adjustment of the hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized.

## 2.03 SLEEVES

- A. Unless otherwise indicated on the drawings or specified, openings for the passage of pipes through floors and walls shall be formed of sleeves of standard weight, galvanized steel pipe. The sleeves shall be of ample diameter to pass the pipe and its insulation, if any, and to permit such expansion as may occur. Sleeves shall be of sufficient length to be flush at the walls and the bottom of slabs and to project 1 in. above the finished floor surface. Threaded nipples shall not be used as sleeves.
- B. All sleeves shall be set accurately before the concrete is placed or shall be built in accurately as the masonry is being built.

## 2.04 CUTTING AND PATCHING

- A. The Contractor shall leave all chases or opening for the installation of his own or any other contractor's or subcontractor's work, or shall cut the same in existing work, and shall see that all sleeves or forms are at the work and properly set in ample time to prevent delays. He shall see that all such chases, openings, and sleeves are located accurately and are of proper size and shape and shall consult with the Engineer and the contractors or subcontractors concerned in reference to this work.
- B. In case of his failure to leave or cut all such openings or have all such sleeves provided and set in proper time, he shall cut them or set them afterwards at his own expense, but in so doing he shall confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the write approval of the Engineer.
- C. The Contractor shall carefully fit around, close up, repair, patch, and point around the work specified to the entire satisfaction of the Engineer.
- D. All of this work shall be done by careful workmen competent to do such work and with the proper small hand tools. Power tools shall not be used except where the type of tool proposed can be used without damage to the structure beyond the limits of the work.

## 2.05 EQUIPMENT, FOUNDATIONS, INSTALLATION AND GROUTING

- A. The Contractor shall furnish the necessary materials and construct suitable foundations for all equipment installed by him, even though such foundations may not be indicated on the drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.
- B. All equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.
- C. In setting equipment, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least 1 inch for grout under the equipment bases. Shims used to level and adjust the bases shall be metal. Shims may be left embedded in the grout, in which case they shall be brass or bronze and installed so as to be as inconspicuous as possible in the completed work.

- D. Grout shall consist of one part cement, two parts or less of fine aggregate, and the minimum quantity of water necessary to permit the grout to be properly placed. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation. Where such procedure is impracticable, the method of placing grout shall be as approved. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an approved manner, if necessary, and given a burlap rubbed finish.

## 2.06 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall arrange for a qualified service representative from the company manufacturing or supplying certain equipment as listed below, to perform the duties herein described.
- B. After installation of the listed equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The inspection shall include, but shall not be limited to the following points as applicable:
  - 1. Soundness (without cracked or otherwise damaged parts).
  - 2. Completeness in all details, as specified.
  - 3. Correctness of setting, alignment, and relative arrangement of various parts.
  - 4. Adequacy and correctness of packing, sealing and lubricants.
  - 5. The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.
- C. On completion of his work, the manufacturer's or supplier's representative shall submit in triplicate to the Engineer a complete signed report of the result of his inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified and the suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate that the equipment conforms to the requirements of the contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void. The manufacturer or supplier shall file at this time an equipment warranty guaranteeing his equipment for a period of one (1) year from date of acceptance.
- D. The provisions of this section shall apply to the following equipment:
  - 1. Mechanical Equipment
- E. In addition to the above requirements, the Contractor shall employ the services of a factory service engineer for the special service specified in this division's subsections.

## 2.07 STANDARDIZATION OF GREASE FITTINGS

- A. The Contractor shall ensure that all grease fittings on all pieces of equipment furnished under this Contract are standardized so that only the button head type of fitting is used. Fittings shall be standard or giant size according to the type of service to be performed. Unless otherwise approved, all fittings shall be the product of one manufacturer and be compatible to the Alemite Company fittings existing.

## 2.08 NAMEPLATES

- A. With the exceptions mentioned below, each piece of equipment shall be provided with a substantial nameplate of noncorrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate.
- B. This requirement shall not apply to standard, manually operated hydrants; gate, globe, check and plug valves; or accessories and specialty not having an electrical connection.

2.09 LUBRICANTS

- A. The Contractor shall furnish all lubricants used during testing and prior to acceptance, and, in addition, he shall furnish an estimated six month's supply of all grease and oil necessary for the proper lubrication of all equipment furnished under this contract. Lubricants for this supply shall be furnished in the original sealed containers, each correctly identified as to brand and grade and with reference to the particular piece of equipment for which it is intended.

END OF SECTION 13 70 50



## SECTION 13 71 50

### SHREDDED RUBBER BULLET TRAP BACKSTOP

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE

- A. The Contractor shall furnish, install, test and place in operation the bullet trap system as shown on the drawings and specified herein.

##### 1.03 GENERAL REQUIREMENTS

- A. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 10 years. Equipment service shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the site.
- B. All work shall be of first class condition and constructed in accordance with the manufacture approved shop drawings. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor at no expense to the Owner.
- C. All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified.
- D. Each bullet trap assembly shall have a manufacturer's name plate with name, address, type or style, model or serial number, rated capacity, and catalog number permanently secured to the equipment.
- E. The Contractor shall verify all as-built dimensions in the field, and shall advise the equipment manufacturer of any discrepancy before final ordering of the equipment.

##### 1.04 SUBMITTALS

- A. Prior to ordering of equipment, the Contractor shall submit detailed dimensioned shop drawings, and required factory test reports to the Engineer for approval.
- B. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections containing the material listed below:
  - 1. Clear and concise instructions for maintenance operation, adjustment, and maintenance of equipment.
  - 2. List of all parts for the equipment with catalog numbers and other data required for ordering replacement parts.
  - 3. Instructions and parts list shall not refer to other sizes, types or models of similar equipment.
- C. Approval is required for submittals in accordance with Section 13910 – Firing Range Equipment – General.

- D. Product Data: Data including a complete list of equipment and materials, manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions.
- E. Operation and Maintenance Data: Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set shall be furnished prior to performance testing and the remainder shall be furnished upon acceptance. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and maintenance. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features.
  - 1. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include diagrams of the system as installed.
  - 2. After approval of the detail drawings, and not later than 2 months prior to the date of beneficial occupancy, spare parts data for each different item of material and equipment specified are required. The data shall include a complete list of parts and supplies, with current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 2 year(s) of service.

## **PART 2 - PRODUCTS**

### **2.01 BULLET TRAP**

- A. Bullet traps shall be of the permanent type, and shall have minimum performance characteristics as follows.
  - 1. Pistol, rifle, shotgun, and sub-machine gun bullet traps shall be provided of the self-supporting Granular Rubber Bullet Trap, type. Other types of Bullet Traps Wet Funnel, Escalator, Venetian Blind, rubber composite or angled backstop are not acceptable.
  - 2. The trap shall be rated, for handguns, rifles and shotgun. Any trap steel plate exposed shall be treated to 500+ BHN (Brinell Hardness Number).
  - 3. The trap shall be low maintenance, suitable for high volume of fire use, self-supporting, and prefabricated for on-site assembly.
  - 4. The bullet trap shall not introduce any additive materials, or other compounds or alter the bullet waste product. The raw waste product shall not be rendered less suitable for the recycling process. Introduction of toxic substances is prohibited.
- B. The bullet trap shall be CASWELL DETROIT ARMOR COMPANIES or approved equal.
- C. It shall meet the requirements for a cleaner environment for shooting ranges, by not producing or splatter from lead core projectiles. The design shall utilize specially treated rubber cut pieces made from recycled materials, that safely stops bullets and maintains their basic original shape, thus not creating smaller or broken up lead particles into the environment.
- D. The trap shall be suitable for small arms projectiles to a maximum velocity of 3600 FPS and maximum energy of 3600 ft. lbs. To guarantee these capabilities, the bullet traps base width shall be no less than 12ft- 4in. The overall height of the bullet trap shall be not less than 9-ft or as shown on the drawings.
- E. The trap shall have a sloping front surface and be provided with a rubber cover that each overlaps 6-inches, a steel bed plate and support frame. The space between the cover and bed plate shall be filled with recycled cut rubber. The rubber cover shall allow projectiles to penetrate and be captured by the rubber granules matrix with no fragmentation or back-splatter. The steel bed plate shall provide a safety barrier, beyond but the design of the trap

shall be such that under normal service and maintenance, the steel bed plate is not relied upon to terminate the projectiles travel. The trap shall utilize a sliding plate/access hatch on the step portion in the traps main impact area for periodic, monthly recycling and collection of spent bullets and repositioning of the rubber pieces.

- F. The traps steel bed plates shall be in a stepped configuration. The stepped design shall provide for a greater rubber granule depth and lead retention in the bullet traps primary impact areas.
- G. The trap shall allow the recovery of spent projectiles intact for periodic recycle by shoveling of its compost to the range floor separation and recording of the trap
- H. The trap shall be self-supporting and assembled on site entirely by mechanical fasteners. No on-the-job cutting or welding shall be allowed.
- I. All metal parts not otherwise finished or plated shall be primed and painted. Color as specified elsewhere.
- J. A TrapVac and a collection cart lead separation equipment for the bullet trap maintenance shall be included as specified or shown.
  - 1. Access to the area behind the trap shall be as shown on the drawings and is for limited access.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Installation shall be in strict accordance with the approved manufacturer's installation instructions and approved shop drawings.

#### **3.02 MEASUREMENT AND PAYMENT**

- A. No additional payment shall be made for the work herein before specified. The Contractor's lump sum bid as set forth in the proposal shall constitute full compensation for the work involved.

END OF SECTION 13 71 50

## SECTION 13 71 60

### MODULAR BULLET TRAP AND CONTAINMENT SYSTEM (TCT II)

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE

- A. The Contractor shall furnish, install, test and place in operation the low angle bullet trap system as shown on the drawings and specified herein.

##### 1.03 GENERAL REQUIREMENTS

- A. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 10 years. Equipment service shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the site.
- B. All work shall be of first class condition and constructed in accordance with the manufacturer approved shop drawings. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor at no expense to the Owner.
- C. All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified.
- D. Each bullet trap assembly shall have a manufacturer's name plate with name, address, type or style, model or serial number, rated capacity, and catalog number permanently secured to the equipment.
- E. The Contractor shall verify all as-built dimensions in the field, and shall advise the equipment manufacturer of any discrepancy before final ordering of the equipment.

##### 1.04 SUBMITTALS

- A. Prior to ordering of equipment, the Contractor shall submit detailed dimensioned shop drawings, and required factory test reports to the Engineer for approval.
- B. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections containing the material listed below:
  - 1. Clear and concise instructions for maintenance operation, adjustment, and maintenance of equipment.
  - 2. List of all parts for the equipment with catalog numbers and other data required for ordering replacement parts.
  - 3. Instructions and parts list shall not refer to other sizes, types or models of similar equipment.
- C. Approval is required for submittals in accordance with Section 13910 – Firing Range Equipment – General.

- D. Product Data: Data including a complete list of equipment and materials, manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions.
- E. Operation and Maintenance Data: Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set shall be furnished prior to performance testing and the remainder shall be furnished upon acceptance. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and maintenance. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features.
  - 1. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include diagrams of the system as installed.
  - 2. After approval of the detail drawings, and not later than 2 months prior to the date of beneficial occupancy, spare parts data for each different item of material and equipment specified are required. The data shall include a complete list of parts and supplies, with current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 2 year(s) of service.

## **PART 2 - PRODUCTS**

### **2.01 MODULAR BULLET TRAP AND CONTAINMENT SYSTEM (TCT II)**

#### **A. Bullet Trap**

- 1. The bullet trap and containment system is a self-supporting, self-contained, bullet backstop and containment unit of steel plate construction for heavy use on high-volume ranges both indoor and outdoors, employing a 4-course sloping funnel design with top and bottom impact plates to be constructed of ¼" steel plates (AR500 Brinell minimum).
  - a. Impact plates shall be replaceable with ¼", 3/8" or ½" substitutes.
- 2. Trap shall utilize steel impact plates to direct the bullet into an enclosed, sealed, and fully shielded (solid steel in 360 degrees) chamber where its' velocity is safely removed.
- 3. Containment chamber is of single piece construction, fully welded and airtight.
- 4. Trap may be ordered with any horizontal center-line height from 24" to 72" off the ground. Trap may be ordered with any front aperture height from 48" to 96".

#### **B. Construction:**

- 1. Body of Trap
  - a. Steel panels must be blasted and prepared to be in compliance with painting specification SP-6.
  - b. No ballistic panel shall be subjected to flame cutting (oxygen fuel cutting, such as acetylene, propane or MAPP gas, etc.). All ballistic panel cutting must be done on computer-controlled plasma equipment.
  - c. No projectile impact surface may be constructed of permeable or flammable materials such as rubber, wood, plastics, etc.
  - d. Modular components shall be small enough to be carried through a standard 3.0 doorway.
  - e. No impact plate surfaces shall present a bullet fired straight into the trap with an impact at an angle greater than 15 degrees from parallel with the plate.
  - f. Any vertical joints which interconnect adjacent modules and direct border-line impacts into one containment module or the other shall not be disposed at or near

the front edge of the trap and shall occupy no more than 6% of the total aperture height of the trap. Deflectors shall be installed on all blunt or joined surfaces, facing the firing line in order to deflect the bullet into the trap and to reduce the possibility of the ricochet.

- g. The surface of joints facing shooters shall be made of steel with an AR500 rating. Joints shall have no exposed bolt heads.
- h. No welding shall be permitted on impact plates.
- i. For installation within an existing structure, trap shall not be installed flush with walls, but rather shall be set in at least 36" on the rear and 12" on each side to allow full, unrestricted service and inspection access to all surfaces of the structure, even after complete assembly.

## 2. Containment Canister

- a. Each containment canister shall be connected to the trap by means of an airtight seal. Each canister shall be removed from the trap by means of one or two bolts. Containment canisters shall have a total volume not to exceed 4 gallons.
- b. Containment canister shall be a D.O.T. and EPA approved transportable container.
- c. Each canister shall employ a permanently locking, airtight lid. Once the canister is filled with lead, it may be removed from the trap and the lid secured in place. The canister may then be used to contain the lead permanently, or during transit to recycling.
- d. Containment canister shall be removable and serviceable by one person without the need for mechanical assistance.
- e. Canisters, which have been returned after recycling, shall be able to be reused on the trap.

## C. Performance Criteria:

- 1. Trap shall, without allowing bullet penetration and without sustaining other damage, be capable of stopping and containing the following projectiles (and others of equivalent power factor and penetration factor) when fired at a "point blank" distance from the front aperture of the trap: 9 mm, 40 cal., 45 cal., .223 fmj, 5.56 fmj, .308 fmj, 7.62 fmj, 7 mm Rem Mag, 12 ga buckshot, 12 ga rifled slug.
- 2. Trap shall be capable of stopping and containing 0.50 cal. Hard-ball (green tips and/or 5.56 mm M885) up through and including .223 cal.
- 3. Trap shall be fully modular such that it may be assembled on-site or disassembled and moved. Assembly shall not require "permanent" connection means such as welding, riveting, etc. Assembly shall not require cutting of materials or other sizing operations. Rather, all modules shall be completely prefabricated for simple assembly on site. All modules shall be small enough to be carried through a standard 3.0 doorway.

## D. Options

### 1. Spent Projectile Options:

- a. There shall be an option for employment of a mechanical conveyance system that collects spent rounds and delivers them into an EPA and D.O.T. approved transportable container up to 55-gallons in size, to the right or left side or rear of trap.
- b. There shall be an option for employment of a pneumatic material transfer system that collects spent rounds and delivers them into an EPA and D.O.T. approved transportable container, up to 55-gallons in size, to the right or left side of trap.

### 2. Site Specific Options:

- a. Basic trap shall require no prior construction or site preparation other than an appropriate, flat, concrete pad. Must be capable of being fully self-supported with an appropriate concrete pad.
- b. Basic trap has the option of an overhead support structure capable of bearing an average distributed load of 15 lbs. per sq. ft. and providing attachment means every 4 ft. over the area of the trap.

E. Lead Filtration Options

1. Trap deceleration unit shall employ an active lead accumulation system to capture and remove airborne lead particulates within and surrounding the chamber. This system shall then direct captured bullet components into a containment canister or optional projectile removal system where they can be readily removed for disposal or recycling. Each canister, or system, shall be connected to the accumulation system by means of an airtight seal.
2. Trap shall employ an air collection and filtration system to collect and purify the air within the main deflection aperture/collection chamber. Air shall flow into the mouth of each bullet deceleration chamber at an average rate of at least 150 cfm for 5' of linear trap. The velocity of the air entering each chamber shall be at least 360 fpm through whatever aperture(s) provided.
3. Air collection and filtration system shall be able to balance airflow along length of trap.
4. Said purification apparatus shall process the required airflow at an efficiency exceeding 99.99% on 1-micron particulates and exceeding 99.9% on 0.12-micron particulates.
5. Said purification apparatus shall be self-cleaning. Any filter elements, which are disposable, shall have an average life expectancy of 5000 operating hours.
6. An optional second stage, redundant HEPA grade filtration system shall be available which shall filter all air processed by the primary filtration system. The HEPA filter shall exceed 99.99% efficiency on 0.12-micron particulates.

F. Acceptable Product

1. Acceptable product shall be by Action Target, Savage Range System, Meggitt or approved equal as per Substitutions specification (Sec. I).

**PART 3 - EXECUTION**

3.01 INSTALLATION

- A. Installation shall be in strict accordance with the approved manufacturer's installation instructions and approved show drawings.

3.02 MEASUREMENT AND PAYMENT

- A. No additional payment shall be made for the work herein before specified. The Contractor's lump sum bid as set forth in the proposal shall constitute full compensation for the work involved.

END OF SECTION 13 71 60

## SECTION 13 73 00

### CEILING BALLISTIC PROTECTION SYSTEM

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE

- A. The contractor shall furnish, install, test and place in operation the Ceiling Ballistic Protection System hung off the Twin Tees as shown on the drawings and specified herein.

##### 1.03 GENERAL REQUIREMENTS

- A. All work shall be proved to be in first class condition and constructed in accordance with the drawings and specifications. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor at no expense to the Owner.
- B. All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified.
- C. Impenetrable ceiling baffles shall be provided to protect equipment and conduits, lighting, etc. by restricting the rounds to down range travel. Baffles shall be suspended from the ceiling. The angle, floor Interval and quantity of panels shall be determined by the ceiling height, range length and shooting activity. The baffle located immediately in front of the bullet trap shall be a steel guard to redirect bullets into the trap. The baffles shall be suitable for .22 caliber only.
- D. Lights and equipment down range shall be protected by the Tee's or with ceiling baffles that prevent direct fire into the lighting by restricting the rounds down range travel. Baffles shall be suspended from the ceiling. The angle, interval and quantity of baffles shall be as shown and shall be finally determined in the field, according to the ceiling height, range length and actually constructed.
- E. Baffles, where shown, shall be rifle caliber rated and tested and certified Construct test baffles prior to fabrication and installation of the final baffles. Test baffles shall not be installed in the range.

##### 1.04 SUBMITTALS

- A. Prior to delivery of equipment, the firing range Contractor shall submit in accordance with section 013000 – SUBMITTAL PROCEDURES detailed and dimensioned shop drawings, and required factory test reports to the Engineer for approval.
- B. Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.



## **PART 2 - EQUIPMENT**

### **2.01 CEILING PROTECTION SYSTEM**

- A. The shooting range ceiling protective system shall be Action Target, Meggit or Savage Range System.
- B. The ceiling system is a combination of specially designed protection panels. They are made to fit the range precisely and to maximize the protection. From the firing line forward, there is a 4-ft horizontal section, safety ceiling, of air-space panels and several rows of air-space baffles at a 30o angle to protect lighting, ventilation, and other equipment from direct hits. An air space is created by mounting a 5/8-in plywood panel to a 2-in x 4-in wood frame. A hot-rolled steel backer as specified panel is mounted on the opposite side. On the bottom surface, lay in tile as acoustical material is attached to reduce the sound level in the range. Suspension hardware (chains, S-hooks & turnbuckles) shall be included by the range equipment supplier to hang baffles. After shop drawing review, it is the general contractors, responsibility to provide the support bridging (where necessary) for support of the ceiling system and target supports.
- C. The double Tees shall be protected as shown with 1" Troy Board installed as shown. Refer to Sec. 13731 for Troy Board Specifications

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Installation shall be in strict accordance with the approved manufacturer's installation instructions.

### **3.02 MEASUREMENT AND PAYMENT**

- A. No additional payment shall be made for the work hereinbefore specified. The Contractor's bid shall constitute full compensation for the work involved for each item.

END OF SECTION 13 73 00

## SECTION 13 73 10

### FIRING RANGE WALL & CEILING ACOUSTICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and Supplementary conditions.

##### 1.02 SUMMARY

- A. This section includes:
  - 1. Acoustical wall systems
  - 2. Acoustical insulation

- B. Related sections

##### 1.03 DEFINITIONS AND REFERENCES

- A. NRC: Noise Reduction Coefficient
- B. STC: Sound Transmission Class
- C. American Society for Testing and Materials (ASTM):
  - 1. ASTM C423-90a: Standard Specification for Testing Noise Reduction Coefficient.
  - 2. ASTM E84: Standard Test Method for Surface Burning Characteristic of Building Materials.

##### 1.04 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Comply with Section: Division 1 "LEED Requirements"
  - 1. Section 05 40 00 – Cold Formed Metal Framing
  - 2. Section 05 50 00 – Metal Fabrications
  - 3. Section 06 10 00 – Rough Carpentry
  - 4. Section 06 20 20 – Interior Finish Carpentry
  - 5. Section 07 21 20 – Board and Batt Insulation
  - 6. Section 07 90 00 – Exterior Joint Sealers
  - 7. Section 07 92 00 – Interior Joint Sealers
  - 8. Section 08 34 70 – Sound Control Doors
  - 9. Section 09 26 00 – Gypsum Board Assemblies
  - 10. Section 13 08 50– Acoustical Floor Isolation System
- C. Product Data: For each type of panel edge, core material, and mounting indicated.
- D. Manufacture Coordination Drawings: Show intersections with doors, electrical outlets and switches, lighting fixtures, and other adjacent work. Show operation of doors.

- E. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work.
  - 1. Panel Edge: 12-inch- long Sample showing edge profile, corner, and finish.
  - 2. Core Material: 12-inch- square Sample showing corner.
  - 3. Mounting Device: Full-size Sample.
- F. LEED Submittals: Omitted
- G. Product Certificates: For each type of acoustical wall system, signed by product manufacturer.
- H. Qualification Data: For fabricator and testing agency.
- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of acoustical wall system.
- J. Maintenance Data: For acoustical wall boards to include in maintenance manuals.
- K. Warranty: 5 year defective material and acoustical performance.

#### 1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations: Obtain acoustical wall board through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide acoustical wall system with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Spread Index: 5 or less.
  - 2. Smoke-Developed Index: 0 or less.
- D. Reverberation time for the points reported shall be 1.25 seconds or less.
  - 1. Range Types-Fixed Point: Acoustical Wall System on walls and baffles as shown to front, rear and above shooter.
- E. NRC for the completed facility shall be a minimum NRC value of .95
- F. Waterproof: Provide materials that are impregnable to the exterior elements and will not degrade due to exterior rain, sunlight or humid conditions.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with acoustical wall system manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
- C. Protect panel edges from crushing and impact.

## 1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall system until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install acoustical wall panels until a lighting level of not less than 50 fc is provided on surfaces to receive acoustical wall system.
- C. Air-Quality Limitations: Protect acoustical wall system from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify locations of acoustical wall boards by field measurements.

## 1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall system that fail in performance or materials within specified warranty period.
  - 1. Failure in performance includes, but is not limited to, acoustical performance.
  - 2. Failures in materials include, but are not limited to, distorting or releasing from panel edge; or warping of core.
  - 3. Warranty Period: Five (5) years from shipment date.

## 1.09 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Wall System Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than 5 attachment devices.
  - 2. Acoustical Insulation: 1 bale.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Troy Acoustics Corporation 26330 Diamond Pl. #150 Santa Clarita, CA 91350

Telephone: 1-800-987.3306 818.376.8490

Fax: 1-818-376-8495

Website: [www.troysoundwalls.com](http://www.troysoundwalls.com)

E-mail: [info@troysoundwalls.com](mailto:info@troysoundwalls.com)

### 2.02 MANUFACTURED UNITS

- A. Cement Wood Fiber Board: ASTM C 612, Type IA or Types IA and IB; density of not less than 4.5 lb/square foot with an one inch section, unfaced, dimensionally stable 2" thick x 24" wide x 96" long, saw cut rigid board, paintable, impact resistant, bullet absorptive, with maximum flame-spread and smoke-developed indexes of 5 and 0, respectively.

B. Mineral Wool Insulation: 1 ½" thick x 24" wide x 48" high, maximum flame-spread and smoke-developed indexes of 5 and 0, respectively.

C. System Performance

1. Sound Absorption Coefficients: Type B and A mountings, ASTM C423-90a.

Frequencies (Hz)	125	250	500	1,000	2,000	4,000	NRC
2" thick w/ 1.5" wool	1	1.14	0.91	0.82	1	.93	0.95

2. Fire Rating: The system shall be considered noncombustible per ASTM C 136 & complies with ASTM C 665 Type I. Surface burn characteristics per ASTM E 84.

3. Water Proof: The system shall maintain acoustical performance requirements in exterior applications in adverse weather conditions, rain, humidity, snow, or extreme heat.

4. Bullet Absorption: In acute or near-acute angle strikes, system shall allow bullets to penetrate or pass without ricochet or splash back, and without noticeable deformation of system.

2.03 ACCESSORIES

A. Acoustic Caulking: Non-toxic, nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.

**PART 3 - EXECUTION**

3.01 EXAMINATION

A. Examine substrates, blocking, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical wall system in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other boards, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations. Boards to be saw cut and fastened to metal furring strips with #14 x 3" self tapping hex head screws with washers at 12" O.C., 4"-6" from sides and edges. Minimum of 8 fasteners per sheet. Insulation to be knife cut and installed within 'z'-channel furring strips fastened to wall at 24" O.C.

1. Cut units to be at least 50 percent of unit width, with facing material extended over cut edge to match uncut edge. Scribe acoustical wall panels to fit adjacent work. Butt joints tightly.

B. Comply with acoustical wall system manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.

C. Installation Tolerances: As follows:

1. Variation from Level and Plumb: Plus or minus 1/16 inch.

2. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

D. Finish by others. Coordinate with Architect.

3.03 CLEANING

- A. Clean adjacent surfaces and remove unused product and debris from site.
- B. After installation is completed, clean soiled surfaces of materials.
- C. Remove and reinstall improperly installed material.
- D. Remove damaged or discolored material, or material that cannot be properly cleaned, and install new material.

3.04 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace acoustical wall boards that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 13 73 10

## SECTION 13 80 00

### FIRING RANGE VENTILATION – GENERAL REQUIREMENTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 CONTRACTOR PRE-QUALIFICATION REQUIREMENTS.

- A. The Range Ventilation Contractor shall have licensed professional engineer on staff.
- B. The Range Ventilation Contractor shall have designed, installed, and successfully tested at least twenty (20) Indoor shooting range ventilation systems.
- C. The Range Ventilation Contractor shall provide a guarantee that the completed installation will pass performance testing by the local governing authority.
- D. The Range Ventilation Contractor shall provide detailed shop drawings that clearly meets the design and performance requirements herein specified.

##### 1.03 PUBLICATIONS

- A. The system shall meet all the requirements of new publications no. (NIOSH) 76-130 dated December 1975 entitled "Lead Exposure Design Consideration For Indoor Firing Ranges," with the following exception:
  - 1. The airborne inorganic lead concentration limits shall not exceed 50 ug/m<sup>3</sup> of air over a time weighted average (TWA) of eight hours as measured at the respiration zone of the shooters and the range officer when firing from the firing booths per OSHA 29 CFR 1910.1025 and 29 CFR 1926.62.
  - 2. Exhaust lead levels must meet EPA 40 CFR 50.12 (1.5 ug/m<sup>3</sup> quarterly) and carbon monoxide levels must not exceed 25 parts per million (PPM) when tested in the environment directly behind the firing positions.
  - 3. Testing for lead and CO concentrations shall be in strict conformance with the equipment procedures and format used by NIOSH, and to the following publications:
    - a. For lead: S341 lead and inorganic lead.
    - b. For CO: sampling data sheet 1.01, class D latest, using sampling meter only.
- B. The firing range ventilation and environmental control system manufacturer/installing contractor must state in their written proposal that in the event the installed system does not provide the minimum performance and levels required by this performance specifications, as determined by a certified industrial hygienist's report, they shall at their own expense:
- C. Bring the firing range ventilation and environmental control system into compliance, or:
- D. Replace equipment with that which will meet the performance specification.
- E. Components of the range ventilation and control system shall conform to the specific specification requirements hereinafter specified for each type of component.

- F. All items required by this specification are deemed necessary and shall be furnished in order for the proposal to be considered responsive to these specifications.
- G. Unless exceptions to this performance specification are specifically listed and submitted in writing by the prospective bidder, and received by the engineer not less than (10) ten days before the bid due date, it is understood that the bidder, if successful, will furnish equipment in strict accordance with this performance specification.

#### 1.04 VENTILATION CONTROL PANEL.

- A. The firing range ventilation and environmental control system manufacturer/installing contractor shall provide a range ventilation control panel to control the range ventilation equipment. The panel shall be equipped with a photohelic gauge to monitor the relative differential pressure between the range and an adjacent hallway. The panels shall be equipped with a "loss of negative" pressure alarm indicator light. The panel shall be equipped with general equipment operating lights including system on/off status, supply fan status, and exhaust fan status. The panel shall also be equipped with all interlocks and safeties.
- B. The firing range ventilation and environmental control system manufacturer/installing contractor shall provide the necessary controls to maintain the specified constant exhaust CFM needed, regardless of the static pressure drop across the 3-stages of filtration, or door opening and closing.

#### 1.05 RADIAL DIFFUSER

- A. A radial diffuser distribution system shall deliver the required CFM across the entire firing line cross/sectional area with an average velocity of 75 FPM.

#### 1.06 START UP

- A. Start-up and commissioning by factory technician. Test and balance report.

#### 1.07 O&M MANUALS

- A. Mechanical & control drawings as well as operations/maintenance manuals.

#### 1.08 WORK BY OTHERS AND COORDINATED BY

- A. Work that needs to be provided by others.
- B. The electrical contractor shall furnish and install all necessary line voltage wiring and conduit to all electrical motors, motor starters, and control panels which are furnished by the firing range ventilation contractor. The electrical contractor shall install all necessary service disconnects as well.
- C. The facilities mechanical contractor shall furnish and install all necessary gas piping to the ventilation systems make up air unit.
- D. The masonry contractor/steel contractor/carpentry contractor shall provide any necessary penetrations, openings, mechanical chaseways, patching and structural reinforcement openings as necessary.
- E. The painting contractor shall provide all necessary final patching and painting.
- F. An acoustical drop ceiling at 7' 9 <sup>3</sup>/<sub>4</sub>" above the finished floor in the space between the shooting range firing line and control room dividing wall.



1. (Important shop drawings design check – the use of the radial diffuser for the ventilation systems supply air, requires a drop ceiling. When locating the ceiling height, please note that this height is based upon the window frames between the shooting range area and control room/observation room area not exceeding an elevation of 7'-9 ¾". Should the window frames exceed this height, the previously mentioned drop ceiling height will have to be adjusted up accordingly to accommodate the 24" radial diffuser component.

## **PART 2 - PRODUCT**

### **2.01 GENERAL**

- A. The Indoor Firing Range ventilation system shall be a complete package provided by one manufacturer. The system shall consist of an air handling unit along with integrated controls, a range remote control panel with indicator lights, diffusers, exhaust grilles, electric duct heater and chilled water coil. The manufacturer shall provide a complete ductwork design for fabrication and installation by the contractor.

### **2.02 AIR HANDLING UNITS**

- A. The ventilation system will consist of 2 air-handling units. The first will be the filtration air-handling unit (FAU). The FAU shall be factory manufactured consisting of two sections, the fan section and the filter section. The fan section shall consist of the exhaust fan, exhaust outlet with motorized exhaust damper and supply outlet with manual balancing damper. The filter section shall consist of the return inlet and three stages of filtration. The casing shall be designed to withstand an internal static pressure of 10" Wg.Sp. and shall be fabricated of rectangular steel tubing frame, with steel side, top and floor panels. The casing shall contain a prepainted G60 Galvanized steel exterior and shall have R-13 injected foam insulation. The casing panels shall be sealed with silicone caulk and painted with weather resistant style enamel. Acceptable manufacturers: McQuay - any substitutions must be approved prior to equipment purchase.
- B. Each section off the casing shall be provided with access by means of access "doors on each of the unit side. The doors shall be fully gasketed so as to be weather tight and shall be equipped with a minimum of two latches per door. Latches shall be operable from both sides on any section into which someone can enter for inspection or servicing.
- C. Fans shall be belt driven centrifugal fans, selected for quiet operation. Drives shall be selected for 150% of the connected motor horsepower. Bearings shall be ball or spherical roller bearings, selected for a minimum L-1 0 life of 100,000 hours. Bearings shall be grease lubricated and include fittings for renewing the lubricant.

### **2.03 MAKE-UP AIR UNIT**

- A. The second unit shall be a make-up air unit (MAU). The MAU shall be a standard factory packaged roof top unit consisting of an air-cooled condenser section, dx cooling, gas heat section, outside air filter rack, outside air economizer, and hot gas reheat. Packaged rooftop units shall be UL/ETL Listed. Acceptable manufacturers: McQuay. Any substitutions must be approved prior to equipment purchase.

### **2.04 RADIAL DIFFUSER**

- A. The parallel flow diffuser shall be one piece manufactured painted surface with an easily cleaned material and have no movable parts. It shall distribute the air in an even manner across the face of the firing range. The diffuser shall be mounted just above the door or window frame on the rear wall behind the firing line, and shall not obstruct vision from behind

the diffuser. Acceptable Manufacturers: Carey's - any substitutions must be approved prior to equipment purchase.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Installation shall be in strict accordance with the approved manufacturer's installation instructions.

#### **3.02 MEASUREMENT AND PAYMENT**

- A. No additional payment shall be made for the work hereinbefore specified. The Contractor's lump sum bid as set forth in the PROPOSAL shall constitute full compensation for the work involved for each item.

END OF SECTION 13 80 00

**SECTION 13 81 00**  
**RANGE DUCTWORK**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SCOPE OF WORK

- A. Sheet metal plenums and associated devices, accessories and work items shall be provided as shown the drawings and as specified hereinafter.
- B. Ductwork, materials, construction, reinforcing and installation shall conform to SMACNA HVAC Duct Construction Standards, latest edition and other applicable standards. In addition, duct systems and components shall comply with applicable provision of NFPA 90A, 96 and 255, and UL 181.F.
- C. A copy of each of the applicable current SMACNA Standards manuals shall be on the job site during the progress of the work.
- D. Refer to the drawings for the schedule of duct systems and corresponding SMACNA classifications for static pressure construction and sealing requirements of transverse joints and longitude seams.
- E. Refer to the drawings for the schedule of ductwork, which is to be internally lined. Ductwork shall not be internally lined unless so noted.
- F. Refer to space Firestopping for requirements related to non-fire dampered ductwork penetrating fire rated walls and partitions.

1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.

**PART 2 - PRODUCTS**

2.01 GENERAL

- A. Sheet metal shall be lock-forming quality galvanized steel, 24-gauge minimum, except as otherwise noted or specified. Other materials and construction for special applications required are as shown the drawings and specified below.
- B. Ductwork, as noted on the drawings, which will remain exposed in finished area which will be painted shall be fabricated of sheet metal with galvanized or bonderized (phosphated) coating.

## 2.02 RECTANGULAR DUCTWORK

- A. Elbows shall have an inside radius equal to the duct width. 90° elbows may be square with double wall turning vanes. Elbows less than 90° shall be radiused. Non-radiused elbows less than 90° with or without turning vanes are not permitted.
- B. Offsets and transitions shall conform to SMACNA Figure 2-7. Transition angles shall be limited to 30-degrees on converging transitions and 20-degrees on diverging transitions.
- C. Branch take-offs, where not detailed otherwise, shall be with a static boot (45° clinch collar) per SMACNA Figure 2.6. Straight tap take-offs are not permitted.

## 2.03 DOUBLE WALL DUCTWORK

- A. Double wall duct shall be factory or shop formed spiral lock seam equal to United McGill Air Products "Uni-Seal" or "Uni-Rib".
- B. Acoustically lined duct, where indicated on the drawing, shall be double wall spiral lock seam duct equal to United McGill Air Products "Acousti-k27" Type P with perforated liner and 2-in(R-8) fiberglass insulation. Fittings shall be double wall insulated of construction similar to single wall fittings.
- C. In lieu of the above, round duct, fitting and connectors may be Lindab "SPIRO Safe" duct system with fitting ends factory equipped with double lipped "U" profile EPDM gasket. Spiral ducts shall conform to Lindab standards and shall be calibrated to publish dimensional tolerances of Lindab.
- D. Elbows and fittings for spiral lock seam ductwork shall be factory or shop formed and welded, equal to United McGill Air Products "Uni-Form" with beaded sleeve transverse joint connectors. Elbows shall be long radius style type. Branch take-offs shall be streamlines conical type with T or Y branches to minimize pressure losses.
- E. Manufactured duct connectors equal to Ductmate Industries "25" and "35" may be used on rectangular ductwork except where weld or brazing is specifically required. Adhere, strictly to manufacturer's instructions. SMACNA duct gauge thickness shall be maintained when using this joining method or additional cross bracing and stiffeners shall be utilizing to prevent duct "oil canning".
- F. Duct connectors for round duct branch connection to rectangular sheet metal duct shall be equal to Flexmaster Series Florida, straight side, with manual damper, as described on the drawings. Connectors installed on interior lined rectangular duct shall have an integral insulation guard sleeve. Rectangular tap-to-round branch connection with static boot configuration shall be equal to Flexmaster Type STO. Buckley "Air-Tite" Bellmouth BM and BM-D firings with neoprene gasket and adhesive facing may be used for duct taps to rectangular sheet metal duct which is not internally lined.
- G. Duct sealant materials shall be:
  - 1. Water base duct sealer equal to United McGill "Water Based Duct Sealer".
  - 2. Mineral impregnated fiber tape with polyvinyl acetate activator/adhesive equal to that manufactured by Hardcast, Inc.
  - 3. Aluminum silicone based sealant.

## 2.04 DUCT ACCESS DOORS

- A. Access doors shall be factory fabricated constructed of the same material as the ductwork (except galvanized sheet metal for fiberglass duct), complete with hinged door, cam lock latches, frame and neoprene gasket between door and frame. Doors in insulated ductwork (internal and external) shall have double wall insulated doors. Access doors shall be 16" x 16" minimum except where duct size will not permit such size.
- B. Access doors and panels shall be designed to provide tight seal commensurate with the duct pressure. Apply duct sealer or rubber gasket frame and duct. On ducts of 3: S.P. and higher construction class, mechanical fastening of the frame and rubber gasket shall be provided.
- C. Where sufficient clearance is not available to allow the door to swing open 90 degrees, an access panel with neoprene gasket, frame and cam lock latches on all four sides shall be provided in lieu of the hinged door.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Duct thickness, construction, reinforcing, support and installation shall conform to SMACNA HVAC Duct Construction Standards, latest edition and other applicable SMACNA standards.
- B. Transverse joints and longitude seams shall be assembled with sealant to conform to SMACNA Class B seal, except where Class A or continuous welding is specified. Selection of sealant materials shall be compatible with the application. Sealants shall be applied in accordance with manufacturer's recommendations.
- C. Attachment of hangers and straps to the structure shall be with:
  - 1. Pre-set concrete inserts in concrete construction of 4" minimum depth.
  - 2. After-set concrete inserts in 4" minimum depth concrete, set in drilled holes. Powder actuated driven fasteners are not permitted.
  - 3. Beam clamps in steel construction. Provide anchoring where clamps are attached to sloping surfaces of beam flanges and where otherwise required to insure permanent attachment.
  - 4. Unistrut type channel support system may be utilized. Channel shall be pre-set or attached to the structure with inserts or clamps.
  - 5. Attachment to steel deck is prohibited. Span from steel structural members with supplementary steel shapes where direct attachment to structural members is not practical. This does not apply to steel deck with concrete slab poured on the deck. Refer to A and B above.
  - 6. Attachment to manufactured trusses and other engineered structural members and supports shall be done in strict accordance with the structural manufacturers recommendations. Refer to the architectural and structural drawings for type of engineered structural systems being used. Connections to these structural members shall be made with connection devices and methods approved by the structural manufacturer. Provide additional supports with supplemental steel shapes when spacing between structural members exceeds specified distances.
- D. Ductwork outside shall be sealed with mineral impregnated fiber tape. Ductwork shall be supported as noted or detailed on the drawings.

- E. Ductwork with galvanized or bonderized coating shall be wiped clean to remove dirt, dust, oil and other contaminates in the shop before delivery to the jobsite. Care shall be taken in storage and installation to maintain cleanliness of the surfaces. Prior to painting, again wipe the surface clean. Painting will be done/by the General Contractor.
- F. Flexible duct shall not be installed.
- G. Duct and plenum connections to air supply, return or exhaust units and fans (other than power roof ventilators) shall be made with a 4" wide intervening section of flexible incombustible fabric equal to Ventfabrics "Ventglas", to prevent the transmission of fan noise and vibration to the ductwork. Fastening shall consist of angle clamps and bolts made up to be air-tight similar to Ventfabrics "Metaledge".
- H. Duct access doors shall be provided for access to equipment, damper operators, devices and instruments inside the duct, at each fire damper, smoke damper and duct smoke detector (refer to Electrical drawings) and where otherwise shown. A wall or ceiling access panel shall be provided where duct access is required thru a wall or inaccessible ceiling. Refer to 15050 Basic Mechanical Materials and Methods for such access panels.
- I. Coordinate openings required for the passage of ductwork thru walls, partitions, floors and roofs with the General Contractor. Sleeves are not required except as stated below.
- J. Access door and fire damper shall be so arranged and located such that the spring catch and fusible link are accessible when the damper is closed. The door shall be sized to permit entry of arms or body in resetting of the damper. Special consideration must be given for larger damper and spring loaded horizontal dampers.
- K. Sheet metals sleeves in conjunction with fire dampers shall be placed in walls and floors to pass ductwork. Floor sleeves shall project 4-in above the finished floor in equipment rooms and areas of similar usage, and shall form a waterproof seal. Exceptions shall be at locations where the opening is protected from drainage falling thru by means of concrete curbs with beveled edges to protect floor opening related to this work in equipment rooms or providing an equal effective waterproofing metal curb, if not specifically included in the General Contract.
- L. Where a fire damper is not required in a duct penetrating a fire rated wall or partition the opening shall be fitted with a sleeve conforming to the requirements of the firestopping assembly. Refer to 15058 Firestopping.
- M. Open ends of duct shall be capped or covered with visqueen secured with duct tape before the end of each day's work to preclude contamination or entry of foreign materials.
- N. Where duct surfaces can be seen thru grilles, registers and diffusers, the inside of the duct shall be coated with flat black paint before the device is installed, to eliminate obtrusive appearances.
- O. Ductwork and piping shall not be run above electrical switchgear or panelboards, nor above the access space in the immediate vicinity of the equipment in accordance with NEC.
- P. Coordinate duct layout carefully with other trades to avoid conflict with structural elements, lighting and plumbing-heating piping. Flattening of ductwork and offsets to fit ductwork in available space is generally shown. In the absence of such, the Contractor shall arrange the ductwork to maintain concealment and allow ceilings and lights to be installed as intended. Do not hang ductwork until possible interference with electrical and mechanical trades have been resolved. Having ductwork fabricated and delivered in advance shall not be justification for interference with other trades.

- Q. Provide a complete set of  $\frac{1}{4}$ " = 1'-0 sheet metal fabrication drawings. The drawings shall be used for overall coordination with the other trades. Meet with the other trades prior to developing and finalizing these drawings.
- R. No additional payment shall be made for the work hereinbefore specified. The Contractor's lump sum bid as set forth in the PROPOSAL shall constitute full compensation for the work involved for each item.

END OF SECTION 13 81 00

## SECTION 13 82 00

### RANGE AIR OUTLETS AND INLETS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE OF WORK

- A. Air outlet and inlet devices include grilles, registers, diffusers, louvers and special air diffusion devices associated with ceiling and lighting systems.
- B. Refer to the schedule on the drawings for description, catalog numbers, materials, finishes, accessories, mounting and other details of the devices required,

##### 1.03 SUBMITTALS

- A. Prior to delivery of equipment, the Contractor shall submit in accordance with section 01300 – SUBMITTAL PROCEDURES detailed and dimensioned shop drawings including wiring diagrams, and require factory test reports to the Engineer for approval.
- B. The Contractor shall furnish, for each piece of equipment, electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
  - 1. Clear and concise instructions for operation, adjustment, and maintenance of equipment.
  - 2. List of all parts for the equipment with catalog numbers and other data required for ordering replacement parts.
  - 3. Instructions and parts list shall not refer to other sizes, types or models of similar equipment.

#### PART 2 - PRODUCTS

##### 2.01 GENERAL

- A. Air distribution devices other than louvers and specialty products shall be Titus, Tuttle and Bailey, Kreuger, Price, Carnes, Metal Aire and Anemostat. All devices of a common type shall be by the same manufacturer.
- B. Air outlet and inlet devices shall be equal to those specified by catalog number and description in the schedule of the drawings. Dampers shall be galvanized steel, unless otherwise noted, opposed blade configuration. Damper operators shall be concealed screw type. An auxiliary mounting frame shall be furnished with each grille and register except those mounted on exposed ducts or in lay-in application. Lay-in devices shall be designed to fit in the grid.
- C. Linear "T" bar air supply shall be slotted diffusers with fixed air pattern control complete with a galvanized sheet metal supply plenum having a round or oval duct connection and 0.50"



neoprene coated fiberglass insulation on the interior. The unit shall be designed to mount on or along side the ceiling "T" bar and shall include flanges on both sides of the diffuser to support the ceiling tiles. Additional "T" bars matching those of the ceiling system shall be provided by the HVAC Contractor if the diffuser does not have these flanges. Units shall have a center notch where required to accommodate intervening "T" bars. Linear diffuser manufacturer shall be same as the other air devices.

- D. Louvers shall be exterior weatherproof type equal to those scheduled and shown on the drawings. Louvers shall be assembled entirely by welded. Louvers shall withstand uniform wind loading pressure of 20 psf. Performance data indicating pressure loss and water penetration, derived from AMCA 500 testing, shall be included with submittals.
  - 1. Aluminum louvers shall be 12 ga. Extruded aluminum with R1 caustic etch and finished with clear anodize. Color is to be selected by the Architect from the manufacturer's standard colors.
  - 2. Bird screen shall 0.50" mesh aluminum wire on the interior face of the louver attached at 12" centers on the perimeter.
  - 3. Louvers shall be manufactured by Aiolite or Ruskin.
  - 4. Door louvers are to be provided by the General Contractor.

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. The Contractor shall be responsible for compatibility of ceiling mounted devices with the ceilings and suspension systems (lay-in, concealed spline, plaster, drywall, etc.) Verify with the architectural drawings.
- B. Carefully align square and rectangular devices with the vertical and horizontal building lines. Diffusers shall be attached rigidly to the ductwork. Where connected by flexible ducts, special supports shall be provided as required from the ceiling suspension system or by independent suspension wires or rods from the building structure.
- C. Inside of ducts behind grilles, registers and diffusers shall be painted flat black, as needed, to eliminate the sight of shiny surfaces.
- D. Exterior louvers shall be installed by the HVAC Contractor. Install louver assemblies in strict accordance with manufacturer's recommendations. Louvers to be installed plumb, square, level and true. Blank off all unused portions of the louver with 14 ga. Aluminum and insulate blank off with 1" rigid foil faced insulation. Seal blank areas air tight.
- E. No additional payment shall be made for the work hereinbefore specified. The Contractor's lump sum bid as set forth in the PROPOSAL shall constitute full compensation for the work involved for each item.

END OF SECTION 13 82 00

## SECTION 13 88 00

### FIRING RANGE AIR BALANCING

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Air balancing of the systems / new systems shall be performed as a part of the range HVAC subcontract. Balancing work shall be performed by qualified personnel of an independent member firm of the Associated Air Balance Council (AABC) / or / a member firm of the National Environmental Balancing Bureau (NEBB) who has no affiliation with the HVAC Contractor or any of its Subcontractors.
- B. Methods, procedures, equipment, certifications, report forms and reporting information shall be in accordance with the standards of AABC or NEBB.
- C. During the bid period, the Balancing Contractor shall call the range HVAC Contractor's attention to any requirements for additional balancing dampers and valves which are deemed necessary in addition to those shown on the drawings so that proper balancing can be performed. Prior to installation of the systems, the Balancing Contractor shall verify that the proper number and location of balancing devices are adequate for completion of the balancing work.

#### PART 2 - PRODUCTS

##### 2.01 RANGE AIR HANDLING SYSTEM PERFORMANCE ASSESSMENT

- A. Firing Range
  - 1. The supply air side make-up shall be constant airflow, to provide laminar airflow in the firing range at 75-feet per minute (fpm)  $\pm 5$  percent, as measured 2-ft up range of the 25-yard firing line, and halfway between the firing line and the rubber bullet trap (only if the system has been designed with tactical baffles.) The exhaust air shall be balanced to provide a negative pressure (-0.05 $\pm$ .02-inches w.p.) in the firing range space.
  - 2. Smoke test: At the firing line, smoke test each firing point at the 25-yard line from the 1-ft to the five feet above finish floor level. The smoke shall move down range parallel to the floor. Document the flow pattern and any unusual smoke patterns. If an approximate laminar flow is not achieved, adjust the ventilation system and retest. Conduct smoke tests at mid-range and target line to ensure adequate air patterns are maintained down range towards the bullet trap.
  - 3. Ventilation Volumetric flow: Use a properly calibrated shortridge velgrid meter: At the firing line at each firing point, place the meter perpendicular to the floor. In the center of each firing station take a measurement at three locations from the floor (approximately one foot, three feet and five feet above the floor) This will result in three readings for each firing position. Average the three readings. Compare the average at each shooting station to the design criteria of 75-feet velocity  $\pm 5$  percent. Any individual reading less than 50 fpm per minute is unacceptable.

## 2.02 CONTROL SYSTEM

- A. Test the range control system with electric or electronic operators for dampers and valves.
- B. Air system control console shall be located on the range control station. Target control system shall be interlocked with the air system and not operate without confirmed proper operation of the appropriate exhaust fans.
- C. Review alarm conditions for:
  - 1. Any fan fails to operate.
  - 2. Range pressure is in the upper limit (greater than negative 0.01" water column)
  - 3. Filters are past runtime set points
  - 4. Supply static pressure is below limit
  - 5. Range doors open for longer than setpoint
- D. Demonstrate the firing range supply and exhaust fans are electrically interlocked to run at the same time.
- E. Demonstrate that the control system manages a staged startup of mechanical equipment.
- F. Demonstrate the range ventilation control system is interlocked with target control system and light controls.
- G. Review Operations and Maintenance Manuals with CD-rom containing the software copy of all range ventilation items to include but not be limited to, showing equipment layout schematic, sequence of operations, software programming sheets, graphics, as-built database, and line diagrams.

## PART 3 - EXECUTION

### 3.01 AIR BALANCE

- A. Each air supply, return and exhaust system, when installation is completed, including the installing of clean filters, shall be set in operation for balancing. Each air outlet and inlet device, items of equipment (fans, air control units, etc) and system shall be balanced to the quantities listed on the drawings within plus or minus 10%. Intended pressure relationships in areas requiring such by recognized standards and practice shall be attained. Range pressure relationship must be maintained at all occupied times.
- B. Drive pulleys shall be adjusted to attain fan speed required for the installation condition. Pulleys and belts not having sufficient adjustment range shall be changed out by the range ventilation subcontractor, at the direction of the Balancing Contractor, to obtain fan speed required for the installed condition.
- C. The report shall include, but not be limited to, both actual and design fan cfm, rpm, brake HP, entering and leaving static pressures, motor data, voltage and amperage and drive information.
- D. Range Testing; Perform ventilation assessments as follows:
  - 1. Smoke Test: At the firing line, each firing point from 1-ft above the floor to five feet above floor level. The smoke shall move down range parallel to the floor to demonstrate uniform downstream flow. Document any unusual smoke patterns. If a non-eddy downstream flow is not achieved, adjust the ventilation system and retest. Conduct additional smoke measurements down range at mid-range and 7-yard line to ensure adequate air velocities and patterns are maintained down range towards the bullet trap.

2. Ventilation Volumetric flow: Use a properly calibrated shortridge velgrid meter; at the firing point, place the meter perpendicular to the floor. In the center of each firing station take a measurement at three location from the floor (approximately one foot, three feet and five feet above the floor). This will result in three readings for each firing position. Average the three readings. Compare the average at each shooting station to the design criteria of 75-ft velocity +/-5 percent. Any reading less than 50 fpm per minute, anywhere is unacceptable and will require rebalancing.
  3. Static pressure measurement. A monometer or magnahelic gauge shall be used to check the pressure relation to the range master control room outside the range and demonstrate the required pressure increase of +0.05 + .02 increase.
- E. After completion of the balancing work, a full report shall be prepared in pencil and two copies (only) submitted to the Engineer for preliminary review. After review, additional balancing, adjustments, drive replacements, readings and recordings deemed necessary shall be done and the report revised. Six typed copies of the final report shall be submitted thru the range HVAC subcontractor and general contractor and to the Engineer for review and approval. An approved copy of the report shall be included in each set of operating and maintenance manuals.

END OF SECTION 13 88 00

## SECTION 13 94 00

### CONTROL WIRING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE OF WORK

- A. All electrical wiring, both line voltage and low voltage, which is required to perform the automatic control functions described shall be included in this contract.
- B. The Electrical Contractor will provide a power source to motors through his starters only. Where power sources are required beyond these starters, or beyond sources explicitly shown on the electrical drawings, these shall be provided by the Controls Contractor. Where auxiliary contacts are required on starters to perform the required functions these, too, shall be provided by the Controls Contractor. Where not provided under Electrical Contract auxiliary external relays may be provided in lieu of auxiliary contacts.
- C. Wiring, both line and low voltage, shall comply with NEC and shall be subject to approval of the local code enforcing authorities.
- D. Low voltage wiring for digital systems includes but is not limited to: control power wiring, network communication wiring, zone bus communication wiring and remote device wiring between controllers and devices.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.

#### PART 2 - PRODUCTS

- 2.01 Wire, conduit and installation methods shall conform to applicable provisions of Division 16 – Electrical except that wiring smaller than No. 12 are permitted as appropriate for the application.

#### PART 3 - EXECUTION

##### 3.01 GENERAL

- A. All wiring shall be run in conduit.
- B. All communication bus wiring shall be run in dedicated conduits above ground.

- C. Electrical circuits serving direct digital panels, transformers and other control equipment and devices shall be from the nearest appropriate electrical panel. Coordinate with the Electrical Contractor.
- D. Circuits serving control panels and transformers for low voltage service shall be independent and used for no other purpose. These shall originate from the nearest appropriate electrical panel. Circuit wiring from the electrical panel shall be included in this contract. These circuits shall be clearly identified at the panels.

END OF SECTION 13 94 00

## SECTION 13 94 40

### FIRING RANGE CONDITION LIGHTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SCOPE

- A. The contractor shall furnish, install, test and place in operation the range status signal lights as shown on the drawings and specified herein.

##### 1.03 GENERAL REQUIREMENTS

- A. All work shall be proved to be in first class condition and constructed in accordance with the drawings and specifications. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor at no expense to the Owner.
- B. All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified.

##### 1.04 SUBMITTALS

- A. Prior to delivery of equipment, the Contractor shall submit detailed and dimensioned shop drawings, including wiring diagrams, and require factory test reports to the Engineer for approval.
- B. The Contractor shall furnish, for each piece of equipment, electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
  - 1. Clear and concise instructions for operation, adjustment, and maintenance of equipment.
  - 2. List of all parts for the equipment with catalog numbers and other data required for ordering replacement parts.
  - 3. Instructions and parts list shall not refer to other sizes, types or models of similar equipment.

##### 1.05 MANUFACTURER

- A. The acceptable Manufacturer is Mancom Manufacturing, Inc., 1335 Osprey Drive, Ancaster, Ontario, Canada L9G 4V5, 888-762-6266, [www.mancom.com](http://www.mancom.com)

## **PART 2 - EQUIPMENT**

### **2.01 GENERAL**

- A. The firing line signal light system shall be an integrated part of the Range Master Control System. The lights will activate to alarm the system (e.g. photo of safety beam tripped) or by the condition set at the master control. The master control can enable all the available operational functions. The firing line signal lights system shall be wall-mounted in good sight line of the shooters. The light system will operate in a common mode operation (all lights operate together). There shall be three colored lights (red, yellow and green). The lamps shall be easily replaceable from the front of the assemblies.

### **2.02 DISPLAY**

- A. The range status signal lights shall be bright colored lights easily seen by the shooter.
- B. The Edwards Machlight, Series 113 or equal Status Indicators are Pre-Assembled three high stacking designed to be used for machine and process control multi-status indication. Lens colors are arranged in the following top to bottom order: red, amber and green. 120VAC steady indication, pipe mounting. The pipe mount supplied complete with a 10" mounting pole with the hardware necessary to side-mount the light to a vertical wall.
- C. The indicator lights shall utilize a diffusion fresnel lens for increased viewing area while maintaining a small, 2" lens diameter. Lenses can be easily rearranged by removing the top retaining screw and simply sliding the lens assemblies off the stack.
- D. Indicators shall be particularly effective in high noise areas where ear protection must be worn and audible signals may not be heard or understood. They shall advise personnel in range controlled areas when range is starting or stopping or to signal a malfunction or alarm.
- E. Integrated into Touch Plus control system.
- F. Mounted in good sight line of shooter.
- G. Bright easily seen lamp assemblies
- H. Common mode operation (all operate together)
- I. Easy lamp replacement from front of assembly
- J. Integrated into total ranges control system

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Installation shall be in strict accordance with the approved manufacturer's installation instructions.

### **3.02 MEASUREMENT AND PAYMENT**

- A. No additional payment shall be made for the work hereinbefore specified. The Contractor's bid shall constitute full compensation for the work involved.

END OF SECTION 13 94 40



## SECTION 22 11 13

### FACILITY WATER DISTRIBUTION PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated to be used on project.
- C. Field quality-control test reports.

##### 1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water, including tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

##### 1.05 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of water-distribution service without Architect's written permission.

##### 1.06 COORDINATION

- A. Coordinate connection to water main with the City of Lincoln.

## **PART 2 - PRODUCTS**

### **2.01 PIPE AND FITTINGS**

- A. Service line and connections shall be Type K- Soft Copper meeting City of Lincoln Plumbing Code requirements.

### **2.02 PIPING SPECIALTIES**

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
  - 1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.
    - a. Standard: AWWA C219.

### **2.03 WATER METERS**

- A. See Mechanical Plans regarding water meter type and location.

### **2.04 TRACER WIRE**

- A. Use tracer wire with PVC & push joint ductile iron pipe: No. 12 AWG solid copper conductor with Type THHN insulation. Tracer wire shall be installed directly above new water line.
- B. Splices: All splices shall be made in valve boxes where the splice can be reached and repaired if necessary. If intermediate splices are necessary, a surface mount splicing terminal box will be required. Splicing terminal box must be approved by City of Lincoln.
- C. Ground rod: copperweld, or equal.

## **PART 3 - EXECUTION**

### **3.01 EARTHWORK**

- A. Refer to Section 31 "Earth Moving" for excavating, trenching, and backfilling.

### **3.02 PIPING APPLICATIONS**

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

### **3.03 PIPING INSTALLATION**

- A. Install pipe and appurtenances in accordance with AWWA C600 and C605.

- B. Lay pipe to slope gradients noted on drawings.
- C. Do not displace or damage pipe when compacting.
- D. Handling: Handle pipe and appurtenances in such a manner as to ensure delivery to the trench in a sound, undamaged condition. Use of web slings or end hooks not allowed.
- E. Inspection for defects: Before installation, inspect pipe and appurtenances for defects and, when applicable, tap the pipe with a light hammer to detect cracks. Reject defective, damaged, or unsound pipe and appurtenances.
- F. Cutting: Cut pipe, when necessary, in a neat and workmanlike manner without damage to the pipe, interior lining, and exterior coating. Perform cutting with an approved mechanical cutter, using a wheel cutter when applicable and practicable.
- G. Beveling: Grind smooth and bevel cut ends and rough edges using methods recommended by the manufacturer and approved by the Engineer.
- H. Pipe joints: pipe joints in accordance with AWWA C600 and C605 and as recommended by manufacturer; use minimum amount of gasket lubricant; apply to gasket only; do not apply lubricant to inside of bell.
- I. Cleaning and protection of pipelines: Clean pipe interior of foreign material before lowering into trench; keep clean at all times; when pipe laying is not in progress, including lunch breaks, nights, weekends, and other non-working periods, securely close open ends of pipe and fittings with watertight plugs.
- J. Pipe deflections:
  - 1. Deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed the manufacturer's recommendations for the type and size of pipe and joint being used.
  - 2. If the alignment requires deflections in excess of the manufacturer's limitations, then bend fittings or a sufficient number of shorter lengths of pipe shall be utilized to provide angular deflections within the limits set forth.
- K. Pipe gradient:
  - 1. In certain instances, it may be required that a positive gradient be maintained for pressure lines. All such locations are noted on the drawings.
  - 2. Where changes from positive to negative grades occur, air release or combination air release and air/vacuum valves and manholes required as shown on the drawings.
- L. Separation between water mains and sewer lines:
  - 1. When a water main crosses a sewer, a vertical separation of 18 inches between the sewer and the water main shall be maintained. If there is not 18 inches of separation between the water main and the sewer, approval from Nebraska Health and Human Services is required.
  - 2. Water mains shall be laid at least 10 feet horizontally from any sewer. Where this separation is not possible, approval from Nebraska Health and Human Services is required.
  - 3. Care shall be taken in compacting the backfill beneath the sewer and any misalignment of the sewer or joints loosened shall be corrected before proceeding with the backfill.
  - 4. Any sewers damaged by the operation of the Contractor shall be repaired in accordance with the detail on the drawings.

- M. Depth of cover: The depth of cover over water mains from the top of the pipe to the ground surface shall be sufficient to prevent freezing. The minimum depth shall be 5.0 feet, or otherwise as shown on the drawings.
- N. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
  - 1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

### 3.04 CONNECTIONS

- A. Connect water-distribution piping to existing water main as indicated in the plans.

### 3.05 RESTRAINT

#### A. Anchorage

- 1. Provide anchorage lugs for flanged or bell and spigot fittings and/or socket clamps in interconnecting tie rods where there is a possibility of pulling of the joint under pressure.

#### B. Concrete thrust blocks

- 1. Provide concrete thrust blocks at bends, tees, and dead ends placed against undisturbed soil.
- 2. Concrete thrust blocks shall be constructed in such a way, that when complete, bolts on fittings can be reached without disturbing the thrust block.

### 3.06 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

### 3.07 CLEANING

#### A. Clean and disinfect water-distribution piping as follows:

- 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
- 2. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

END OF SECTION 22 11 13

## SECTION 22 05 00

### COMMON WORK RESULTS FOR PLUMBING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Grout.
  - 7. Plumbing demolition.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Concrete bases.
  - 10. Supports and anchorages.

##### 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

##### 1.04 SUBMITTALS

- A. Welding certificates.

## 1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## PART 2 - PRODUCTS

### 2.01 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.02 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.

## 2.03 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

## 2.04 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.05 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.06 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated and rough brass, verify with Architect.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated and rough brass, verify with Architect.

## 2.07 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.01 PLUMBING DEMOLITION

- A. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.



### 3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve.

Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
  2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.06 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

### 3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.09 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 22 05 00

## SECTION 22 05 29

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Thermal-hanger shield inserts.
  - 4. Fastener systems.
  - 5. Pipe positioning systems.
  - 6. Equipment supports.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

##### 1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

##### 1.06 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## **PART 2 - PRODUCTS**

### **2.01 METAL PIPE HANGERS AND SUPPORTS**

#### **A. Carbon-Steel Pipe Hangers and Supports:**

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

#### **B. Stainless-Steel Pipe Hangers and Supports:**

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

#### **C. Copper Pipe Hangers:**

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

### **2.02 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### **2.03 THERMAL-HANGER SHIELD INSERTS**

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.04 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.05 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.06 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.07 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely

- cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.



- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to as close as possible to support.

### 3.05 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

- 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

## SECTION 22 05 53

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.

##### 1.03 ACTION SUBMITTAL

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: White.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.02 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.03 PIPE LABEL INSTALLATION**

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
  - 1. Coordinate all colors with Owner/Engineer prior to ordering, the following are default colors.
  - 2. Domestic Water Piping:
    - a. Background Color: White.
    - b. Letter Color: Blue.
  - 3. Sanitary Waste Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.
  - 4. Storm Drainage Piping:

- a. Background Color: Green.
- b. Letter Color: Black.

END OF SECTION 22 05 53



## SECTION 22 07 19

### PLUMBING PIPING INSULATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. Section includes insulating the following plumbing piping services:
  - 1. Domestic hot-water piping.
  - 2. Domestic recirculating hot-water piping.
  - 3. Sanitary waste piping exposed to freezing conditions.
  - 4. Storm-water piping exposed to freezing conditions.
  - 5. Roof drains and rainwater leaders.
  - 6. Supplies and drains for handicap-accessible lavatories and sinks.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

##### 1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.05 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive,

mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

## **PART 2 - PRODUCTS**

### **2.01 INSULATION MATERIALS**

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Special-Shaped Insulation: ASTM C 552, Type III.
  2. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  3. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
  4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
- H. Mineral-Fiber, Preformed Pipe Insulation:
1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.02 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

## 2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

2.05 SEALANTS

- A. Joint Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Permanently flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
  - 4. Color: White or gray.
  - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: Aluminum.
  - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: White.
  - 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

## 2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. Adhesive: As recommended by jacket material manufacturer.
  - 2. Color: White.
  - 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - 1. Finish and thickness are indicated in field-applied jacket schedules.
  - 2. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - 3. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.

4. Factory-Fabricated Fitting Covers:
  - a. Same material, finish, and thickness as jacket.
  - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
  - c. Tee covers.
  - d. Flange and union covers.
  - e. End caps.
  - f. Beveled collars.
  - g. Valve covers.
  - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
  
- D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

## 2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
  
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
  
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.
  
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.

## 2.11 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  - 1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
  - 1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.



P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

### 3.03 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.04 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange

cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.05 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.07 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  - 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
  - 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.08 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.09 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
  - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. See schedule on plans.

### 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. None.

### 3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. Aluminum, Smooth: 0.024 inch thick.

### 3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 22 07 19

## SECTION 22 11 16

### DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. Section includes under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

##### 1.04 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

#### PART 2 - PRODUCTS

##### 2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

##### 2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.



- F. Copper Unions:
  1. MSS SP-123.
  2. Cast-copper-alloy, hexagonal-stock body.
  3. Ball-and-socket, metal-to-metal seating surfaces.
  4. Solder-joint or threaded ends.
  
- G. Copper Pressure-Seal-Joint Fittings:
  1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
  
- H. Copper Push-on-Joint Fittings:
  1. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
  2. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

## 2.03 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
  1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
  
- B. Standard-Pattern, Mechanical-Joint Fittings:
  1. AWWA C110/A21.10, ductile or gray iron.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
  
- C. Compact-Pattern, Mechanical-Joint Fittings:
  1. AWWA C153/A21.53, ductile iron.
  2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

## 2.04 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
  
- B. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
  
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

## 2.05 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.06 TRANSITION FITTINGS

- A. General Requirements:
1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.

## 2.07 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
1. Standard: ASSE 1079.
  2. Pressure Rating: 125 psig minimum at 180 deg F.
  3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Standard: ASSE 1079.
  2. Factory-fabricated, bolted, companion-flange assembly.
  3. Pressure Rating: 125 psig minimum at 180 deg F.
  4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Nonconducting materials for field assembly of companion flanges.
  2. Pressure Rating: 150 psig.
  3. Gasket: Neoprene or phenolic.
  4. Bolt Sleeves: Phenolic or polyethylene.
  5. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F 1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

## **PART 3 - EXECUTION**

### **3.01 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install domestic water piping level without pitch and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install PEX piping with loop at each change of direction of more than 90 degrees.

- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump.
- R. Install thermostats in hot-water circulation piping.
- S. Install thermometers on outlet piping from each water heater.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.02 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.03 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

### 3.04 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.05 HANGER AND SUPPORT INSTALLATION

- A. See schedule on plans.

### 3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.07 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

### 3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

- 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
  - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.09 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
    - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    - b. Adjust calibrated balancing valves to flows indicated.
  5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. See schedule on plans.

END OF SECTION 22 11 16

## SECTION 22 13 16

### SANITARY WASTE AND VENT PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

##### 1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

#### PART 2 - PRODUCTS

##### 2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

##### 2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.



## 2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and CISPI 310.
  - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and ASTM C 1540.
  - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.04 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.05 ABS PIPE AND FITTINGS

- A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.
- B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.
- C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.
- D. Solvent Cement: ASTM D 2235.
  - 1. ABS solvent cement shall have a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.06 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
  - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Solvent Cement: ASTM D 2564.
  - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.07 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
  - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 3. Unshielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C 1173.
    - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
  - 4. Shielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C 1460.
    - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

## PART 3 - EXECUTION

### 3.01 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- L. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- M. Install aboveground ABS piping according to ASTM D 2661.
- N. Install aboveground PVC piping according to ASTM D 2665.

- O. Install underground ABS and PVC piping according to ASTM D 2321.
- P. Plumbing Specialties:
  - 1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.02 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- E. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.03 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

### 3.04 VALVE INSTALLATION

- A. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
  2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
  3. Install backwater valves in accessible locations.
  4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

### 3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting[, valve,] and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. See schedule on plans for hanger spacing and rod size.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  - 5. Install horizontal backwater valves as described on plans.
  - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.07 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.08 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

### 3.09 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. See schedule on plans.

END OF SECTION 22 13 16

## SECTION 22 33 00

### ELECTRIC, DOMESTIC-WATER HEATERS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Commercial, electric, storage, domestic-water heaters.
  - 2. Domestic-water heater accessories.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater indicated.
- B. Shop Drawings:
  - 1. Wiring Diagrams: For power, signal, and control wiring.

##### 1.04 INFORMATIONAL SUBMITTALS

- A. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

##### 1.05 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

##### 1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.



- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

#### 1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Periods: From date of Substantial Completion.
    - a. Commercial, Electric, Storage, Domestic-Water Heaters:
      - 1) Storage Tank: Five years.
      - 2) Controls and Other Components: Five years.

### PART 2 - PRODUCTS

#### 2.01 COMMERCIAL, ELECTRIC, domestic-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
  - 1. Standard: UL 1453.
  - 2. Storage-Tank Construction: ASME-code, steel vertical arrangement.
    - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
    - b. Pressure Rating: 150 psig.
    - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
  - 3. Factory-Installed Storage-Tank Appurtenances:
    - a. Anode Rod: Replaceable magnesium.
    - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    - c. Insulation: Comply with ASHRAE/IESNA 90.1.
    - d. Jacket: Steel with enameled finish.
    - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
    - f. Temperature Control: Adjustable thermostat.
    - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
    - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total

relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.

2.02 DOMESTIC-WATER HEATER ACCESSORIES

- A. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- C. Heat-Trap Fittings: ASHRAE 90.2.
- D. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.
- J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.03 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.01 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete or plastic base.
  - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  - 2. Maintain manufacturer's recommended clearances.
  - 3. Arrange units so controls and devices that require servicing are accessible.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains.
- F. Install thermometers on outlet piping of electric, domestic-water heaters.
- G. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters.
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill electric, domestic-water heaters with water.
- J. Charge domestic-water compression tanks with air.

### 3.02 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.03 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. Prepare test and inspection reports.

END OF SECTION 22 33 00

## SECTION 23 05 00

### COMMON WORK RESULTS FOR HVAC

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 23 and as hereinafter specified in this Section.
- B. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Grout.
  - 7. HVAC demolition.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Concrete bases.
  - 10. Supports and anchorages.

##### 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

##### 1.04 SUBMITTALS

- A. Welding certificates.

## 1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## PART 2 - PRODUCTS

### 2.01 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.02 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
  - 1. CPVC Piping: ASTM F 493.
  - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

### 2.03 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

#### 2.04 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### 2.05 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.06 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated and rough brass, verify with Architect.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated and rough brass, verify with Architect.

## 2.07 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.01 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.



- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
  2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
  2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.06 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

### 3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.09 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 23 05 00

## SECTION 23 05 53

### IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 23 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.

##### 1.03 ACTION SUBMITTAL

- A. Product Data: For each type of product indicated.

#### PART 2 - PRODUCTS

##### 2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch Stainless steel, 0.025-inch Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: White.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  7. Fasteners: Stainless-steel rivets or self-tapping screws.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

#### 2.04 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware or semi ridged plastic.
- B. Letter Color: Black (default). Coordinate color with Owner/Engineer.
- C. Background Color: White (default). Coordinate color with Owner/Engineer.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws or self-adhesive.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

### **PART 3 - EXECUTION**

#### 3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### 3.02 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.03 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
1. Coordinate colors with Owner/Engineer prior to ordering. The following are shown as default colors only.
  2. Refrigerant Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.

### 3.04 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes, coordinate color with Owner/Engineer prior to ordering:
1. Blue: For cold-air supply ducts.
  2. Yellow: For hot-air supply ducts.
  3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 23 05 53



## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 22 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Balancing Air Systems:
    - a. Constant-volume air systems.

##### 1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

##### 1.04 APPROVED CONTRACTORS

- A. Air and Fluid Management, 217 S Wilson St, Wilber, NE 68465
- B. Balcon Air and Water Balancing, 7905 L St, Omaha, NE 68358
- C. Systems Management and Balancing, 925 SE Olson DR, Waukee, IA 50263.

##### 1.05 ACTION SUBMITTALS

##### 1.06 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

## 1.07 QUALITY ASSURANCE

- A. TAB Contractor (Supervisor and Technician) Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
- B. Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## **PART 2 - PRODUCTS (Not Applicable)**

## **PART 3 - EXECUTION**

### 3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to

rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or ASHRAE 111 or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental

Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

### 3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.06 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### 3.07 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor name plate data.

### 3.08 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
1. Entering- and leaving-water temperature.
  2. Water flow rate.
  3. Water pressure drop.
  4. Dry-bulb temperature of entering and leaving air.
  5. Wet-bulb temperature of entering and leaving air for cooling coils.
  6. Airflow.
  7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
  2. Airflow.
  3. Entering- and leaving-air temperature at full load.

4. Voltage and amperage input of each phase at full load and at each incremental stage.
  5. Calculated kilowatt at full load.
  6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Airflow.
  3. Air pressure drop.
  4. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.
  3. Airflow.
  4. Air pressure drop.
  5. Refrigerant suction pressure and temperature.

### 3.09 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 percent or minus 10 percent.
  2. Air Outlets and Inlets: Plus 5 percent or minus 10 percent.
  3. Heating-Water Flow Rate: Plus 5 percent or minus 10 percent.
  4. Cooling-Water Flow Rate: Plus 5 percent or minus 10 percent.

### 3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.11 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
  - a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Notes to explain why certain final data in the body of reports vary from indicated values.
13. Test conditions for fans and pump performance forms including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Face and bypass damper settings at coils.
  - e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.



### 3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

## SECTION 23 07 13

### DUCT INSULATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 23 and as hereinafter specified in this Section.
- B. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, concealed supply and return.
  - 8. Outdoor, exposed supply and return.

##### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

##### 1.04 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

##### 1.05 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive,

mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## **PART 2 - PRODUCTS**

### **2.01 INSULATION MATERIALS**

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### **2.02 FIRE-RATED INSULATION SYSTEMS**

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1 or 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

### **2.03 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

#### 2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

#### 2.05 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: Aluminum.

5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

## 2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

## 2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White.

- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Finish and thickness are indicated in field-applied jacket schedules.
  2. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  3. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
- E. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white or stucco-embossed aluminum-foil facing.

## 2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Insulation Pins and Hangers:
  - 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    - b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - 3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive-backed base with a peel-off protective cover.
  - 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, stainless steel.

## 2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.



3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor

- insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.04 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or

field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.05 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.06 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### 3.07 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

### 3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.09 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
  - 7. Outdoor, concealed supply and return.
  - 8. Outdoor, exposed supply and return.
- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. See schedule on plans.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.
- D. Ducts and Plenums, Exposed:
  - 1. None.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.
- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
  - 1. Aluminum, Smooth: 0.024 inch thick.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
  - 1. Aluminum, Smooth with 1-1/4-Inch- Deep Corrugations or 2-1/2-Inch- Deep Corrugations or 4-by-1-Inch Box Ribs: 0.032 inch thick.

END OF SECTION 23 07 13

## SECTION 23 11 23

### FACILITY NATURAL-GAS PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 23 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 100 psig minimum unless otherwise indicated.

##### 1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

##### 1.05 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

##### 1.06 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **PART 2 - PRODUCTS**

### **2.01 PIPES, TUBES, AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
  - 1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
  - 2. Coating: PE with flame retardant.
    - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      - 1) Flame-Spread Index: 25 or less.
      - 2) Smoke-Developed Index: 50 or less.
  - 3. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
  - 4. Striker Plates: Steel, designed to protect tubing from penetrations.
  - 5. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
  - 6. Operating-Pressure Rating: 5 psig.
- C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K.
  - 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  - 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
  - 3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- D. PE Pipe: ASTM D 2513, SDR 11.



1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
  - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
  - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
  - c. Aboveground Portion: PE transition fitting.
  - d. Outlet shall be threaded or suitable for welded connection.
  - e. Tracer wire connection.
  - f. Ultraviolet shield.
  - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Transition Service-Line Risers: Factory fabricated and leak tested.
  - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
  - b. Outlet shall be threaded or suitable for welded connection.
  - c. Bridging sleeve over mechanical coupling.
  - d. Factory-connected anode.
  - e. Tracer wire connection.
  - f. Ultraviolet shield.
  - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

## 2.02 PIPING SPECIALTIES

### A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

### B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

### C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller.
  3. Strainer Screen: 60 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.03 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.04 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  1. CWP Rating: 125 psig.
  2. Threaded Ends: Comply with ASME B1.20.1.
  3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
  1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated brass.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE; blowout proof.
  5. Packing: Separate packnut with adjustable-stem packing threaded ends.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated bronze.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE; blowout proof.
  5. Packing: Threaded-body packnut design with adjustable-stem packing.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
  2. Ball: Chrome-plated bronze.
  3. Stem: Bronze; blowout proof.
  4. Seats: Reinforced TFE.
  5. Packing: Threaded-body packnut design with adjustable-stem packing.
  6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. CWP Rating: 600 psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Bronze Plug Valves: MSS SP-78.
1. Body: Bronze, complying with ASTM B 584.
  2. Plug: Bronze.
  3. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  4. Operator: Square head or lug type with tamperproof feature where indicated.
  5. Pressure Class: 125 psig.
  6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. PE Ball Valves: Comply with ASME B16.40.
1. Body: PE.
  2. Ball: PE.
  3. Stem: Acetal.
  4. Seats and Seals: Nitrile.
  5. Ends: Plain or fusible to match piping.
  6. CWP Rating: 80 psig.
  7. Operating Temperature: Minus 20 to plus 140 deg F.
  8. Operator: Nut or flat head for key operation.
  9. Include plastic valve extension.
  10. Include tamperproof locking feature for valves where indicated on Drawings.
- H. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

## 2.05 MOTORIZED GAS VALVES

### A. Electrically Operated Valves: Comply with UL 429.

1. Pilot operated.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
6. NEMA ICS 6, Type 4, coil enclosure.
7. Normally closed.
8. Visual position indicator.

## 2.06 PRESSURE REGULATORS

### A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

### B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: See plans.

### C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.

5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: Verify with manufacturer.

## 2.07 DIELECTRIC UNIONS

### A. Dielectric Unions:

1. Description:
  - a. Standard: ASSE 1079.
  - b. Pressure Rating: 125 psig minimum at 180 deg F
  - c. End Connections: Solder-joint copper alloy and threaded ferrous.

## 2.08 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## PART 3 - EXECUTION

### 3.01 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
  1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
  1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
  1. Apply joint cover kits over tubing to cover, seal, and protect joints.
  2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.

### 3.02 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.

- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors.

### 3.03 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install anode for metallic valves in underground PE piping.

### 3.04 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  2. Cut threads full and clean using sharp dies.
  3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
  1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  2. Bevel plain ends of steel pipe.
  3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. See schedule on plans.

### 3.06 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.07 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.08 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.09 OUTDOOR PIPING SCHEDULE

- A. See schedule on plans.

### 3.10 INDOOR PIPING SCHEDULE

- A. See schedule on plans.



3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL per local code.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.

END OF SECTION 23 11 23

## SECTION 23 31 13

### METAL DUCTS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 23 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Rectangular ducts and fittings.
  - 2. Round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.
  - 6. Seismic-restraint devices.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
  - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
  - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
  - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

##### 1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

**PART 2 - PRODUCTS**

2.01 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular

Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.02 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 3 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
  - 1. General: Single-component, acid-curing, silicone, elastomeric.
  - 2. Type: S.
  - 3. Grade: NS.

4. Class: 25.
  5. Use: O.
  6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.05 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to

size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.02 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.03 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.04 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.



- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.05 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.06 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.07 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  - 1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.
- B. See schedule on plans.
- C. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
  - 2. PVC-Coated Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
  - 3. Stainless-Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
  - 4. Aluminum Ducts: Aluminum.
- D. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.

- 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
  - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- c. Velocity 1500 fpm or Higher:
- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
- a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.
- E. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

## SECTION 23 74 13

### PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 23 and as hereinafter specified in this Section.
- B. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
  - 1. Direct-expansion cooling.
  - 2. Electric-heating coils.
  - 3. Gas furnace.
  - 4. Economizer outdoor- and return-air damper section.
  - 5. Integral, space temperature controls.
  - 6. Roof curbs.

##### 1.03 DEFINITIONS

- A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- D. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

#### 1.04 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

#### 1.05 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.
- B. Warranty.

#### 1.06 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.07 QUALITY ASSURANCE

- A. ARI Compliance:
  - 1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
  - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
  - 1. Comply with ASHRAE 15 for refrigerant system safety.
  - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  - 3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from shipment.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from shipment
3. Whole unit warranty – 1 year from shipment

## **PART 2 - PRODUCTS**

### **2.01 CASING**

- A. General Fabrication Requirements for Casings: Unit casing shall be constructed of zinc coated, 20 gauge galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and painted with a weather resistant baked enamel finish. Cabinet construction shall allow for all maintenance on one side of the unit. Hinged service panels shall be used for servicing.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  1. Exterior Casing 20 gauge.
- C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
  1. Materials: ASTM C 1071, Type I.
  2. Thickness: 1/2 inch foil faced insulation.
- D. Condensate Drain Pans: Formed sections of plastic, dual sloped and complying with ASHRAE 62.1.
- E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

### **2.02 FANS**

- A. Direct-Driven Plenum Supply-Air Fan with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Forward curved shaft mounted on permanently lubricated motor.

### **2.03 COILS**

- A. Supply-Air Refrigerant Coil:
  1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
  2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
  3. Coil Split: Interlaced.
  4. Condensate Drain Pan: Plastic with dual sloping or stainless steel.
- B. Outdoor-Air Refrigerant Coil:

1. Aluminum plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

#### 2.04 REFRIGERANT CIRCUIT COMPONENTS

- A. Number of Refrigerant Circuits: One.
- B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- C. Refrigeration Specialties:
  1. Refrigerant: R-407C or R-410A.
  2. Expansion valve with replaceable thermostatic element.
  3. Refrigerant filter/dryer.
  4. Manual-reset high-pressure safety switch.
  5. Automatic-reset low-pressure safety switch.
  6. Minimum off-time relay.
  7. Automatic-reset compressor motor thermal overload.
  8. Brass service valves installed in compressor suction and liquid lines.

#### 2.05 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
  1. Pleated: Minimum 90 percent arrestance, and MERV 7.

#### 2.06 GAS FURNACE

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.
  1. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners: Stainless steel.
  1. Fuel: Natural gas.
  2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
- C. Heat-Exchanger and Drain Pan: galvanized steel.
- D. Venting: Gravity vented.
- E. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
- F. Safety Controls:
  1. Gas Control Valve: Single stage.
  2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

## 2.07 DAMPERS

- A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
  - 1. Damper Motor: Modulating with adjustable minimum position.
  - 2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

## 2.08 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch control-circuit transformer with built-in overcurrent protection.

## 2.09 CONTROLS

- A. Basic Unit Controls:
  - 1. Control-voltage transformer.
  - 2. Wall-mounted thermostat or sensor with the following features:
    - a. Heat-cool-off switch.
    - b. Fan on-auto switch.
    - c. Fan-speed switch.
    - d. Automatic changeover.
    - e. Adjustable deadband.
    - f. Exposed set point.
    - g. Exposed indication.
    - h. Degree F indication.
    - i. Unoccupied-period-override push button.
    - j. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.

## 2.10 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- C. Hail guards of galvanized steel, painted to match casing.

## 2.11 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
  - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    - a. Materials: ASTM C 1071, Type I or II.
    - b. Thickness: 1 inch.



2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
  - a. Liner Adhesive: Comply with ASTM C 916, Type I.
  - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
  - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
  - d. Liner Adhesive: Comply with ASTM C 916, Type I.

## 2.12 CAPACITIES AND CHARACTERISTICS

- A. See schedule on plans:

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Equipment Mounting:
  1. Install RTUs on cast-in-place concrete equipment base(s).
- B. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.
- D. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- E. Install piping adjacent to RTUs to allow service and maintenance.
  1. Gas Piping: Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- F. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  1. Install ducts to termination at top of roof curb.
  2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  3. Install return-air duct continuously through roof structure.

### 3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- C. Tests and Inspections:
  - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
  - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

### 3.03 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

END OF SECTION 23 74 13

## SECTION 26 05 00

### COMMON WORK RESULTS FOR ELECTRICAL

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Sleeves for raceways and cables.
  - 2. Sleeve seals.
  - 3. Grout.
  - 4. Common electrical installation requirements.

##### 1.03 SUBMITTALS

- A. Product Data: For sleeve seals.

#### PART 2 - PRODUCTS

##### 2.01 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

##### 2.02 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Plastic. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.03 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.03 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.04 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 05 00

## SECTION 26 05 19

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Sleeves and sleeve seals for cables.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### PART 2 - PRODUCTS

##### 2.01 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

##### 2.02 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## 2.03 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## 2.04 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Plastic. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- K. Control wiring not installed in raceways shall be plenum rated.

### 3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. No push-in type wire connectors shall be used.
  - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- J. Wires shall not be spliced using push-in type wire connectors.

### 3.04 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.



- D. Cut sleeves to length for mounting flush with both wall surfaces.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

### 3.05 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.06 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### 3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

## SECTION 26 05 26

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. This Section includes methods and materials for grounding systems and equipment.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

#### PART 2 - PRODUCTS

##### 2.01 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

## 2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.03 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

## PART 3 - EXECUTION

### 3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
  - 3. Connections to Structural Steel: Welded connectors.

### 3.02 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 3/0 AWG minimum, or as noted on plan, insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-20 or 1/4-by-2-by-14-inch grounding bus.
  - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.03 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
  - 2. For grounding electrode system, install at least [**three**] rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

### 3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
  3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

## SECTION 26 05 29

### HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. Section includes:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

##### 1.04 SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Equipment supports.
- C. Welding certificates.

## 1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 5. Toggle Bolts: All-steel springhead type.
  - 6. Hanger Rods: Threaded steel.

### 2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.



- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

### **PART 3 - EXECUTION**

#### **3.01 APPLICATION**

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

#### **3.02 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To New Concrete: Bolt to concrete inserts.
  - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 3. To Existing Concrete: Expansion anchor fasteners.
  - 4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 5. To Light Steel: Sheet metal screws.
  - 6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- D. Chamfer edges of concrete.

### 3.05 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

## SECTION 26 05 33

### RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- C. Raceways shall be located and routed such that they are perpendicular and parallel to walls, ceilings and structures. They shall not be run diagonally or at obtuse angles if at all possible. Engineer shall be notified and made aware of possible unforeseen situations deviating from this requirement.
- D. No conduit shall be run within 1-1/2" of roof decking.
- E. Conduit bodies shall not be used in place of junction boxes. They shall only be used sparingly and only when necessary and allowed by code.
- F. Control system wiring shall be installed in 3/4" conduit and this shall be provided & installed by the controls contractor.

##### 1.03 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## **PART 2 - PRODUCTS**

### **2.01 METAL CONDUIT AND TUBING**

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Fittings for EMT: Steel, compression type. Steel set screw fittings may be used for all sizes of EMT.

### **2.02 NONMETALLIC CONDUIT AND TUBING**

- A. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- B. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

### **2.03 SURFACE RACEWAYS**

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

### **2.04 BOXES, ENCLOSURES, AND CABINETS**

- A. Galvanized Steel Sheet Metal Outlet and Device Boxes: NEMA OS 1, 4 inch square by 2-1/8 inch deep minimum.
- B. Plaster Rings shall be galvanized steel.
- C. Metal Floor Boxes: Galvanized steel, fully adjustable, rectangular.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1, 4 inch square by 2-18 inch deep minimum.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

### **PART 3 - EXECUTION**

#### **3.01 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.
  2. Concealed Conduit, Aboveground: Rigid steel conduit.
  3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or 4.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  4. Damp or Wet Locations: Rigid steel conduit.
  5. Raceways for Optical Fiber or Communications Cable: EMT.
  6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel or nonmetallic in damp or wet locations.
- C. Raceways in general (except where otherwise indicated) may be electrical metallic tubing, 3/4" minimum size. Such tubing shall be galvanized on the outside and coated on the inside with a smooth hard finish of lacquer, varnish or enamel.
- D. In the rare occasions that a device, such as a relay, control device, or sensor, etc., does not accept a 3/4" conduit a 1/2" conduit is acceptable as long as the 1/2" conduit is kept to a length no longer than 6'-0" in length. At no time shall the National Electrical Code conduit fill requirements be exceeded.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

#### **3.02 INSTALLATION**

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.

- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- K. Raceways for Communications Cable: Install as follows:
  - 1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
  - 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
  - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where otherwise required by NFPA 70.
- M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
  - 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

- a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
  - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
  - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
- 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
  - 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- N. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures. Equipment subject to vibration, noise transmission, or movement; and for transformers and motors, shall have a maximum length of 30 inches for flexible conduit.
- 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Only one (1) extension box shall be permitted. No conduit shall be installed into extension box.
- R. Use gangable boxes only where conduit is to be "fished" into existing partitions..

### 3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
- 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
  - 2. Install backfill as specified in Division 31 Section "Earth Moving."
  - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
  - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
  - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

- b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

#### 3.04 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 05 33



## SECTION 26 05 53

### IDENTIFICATION FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Underground-line warning tape.
  - 5. Warning labels and signs.
  - 6. Instruction signs.
  - 7. Equipment identification labels.
  - 8. Miscellaneous identification products.

##### 1.03 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

##### 1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### PART 2 - PRODUCTS

##### 2.01 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Legend: Indicate voltage.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

## 2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

## 2.03 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

## 2.04 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.
- C. Tag: Type ID:
  - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
  - 2. Overall Thickness: 5 mils.
  - 3. Foil Core Thickness: 0.35 mil.
  - 4. Weight: 28 lb/1000 sq. ft.
  - 5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf , and 4600 psi.

## 2.05 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.06 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

## 2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

### 3.02 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
    - a. Color shall be factory applied.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
  - I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
  - J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
  - K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification. Label switchboards and panelboards (new and existing), with switchboard/panel designation, voltage, and phase.
    1. Labeling Instructions:
      - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
      - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
      - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
      - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 26 05 53

## SECTION 26 09 23

### LIGHTING CONTROL DEVICES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. This Section includes the following lighting control devices:
  - 1. Indoor occupancy sensors.
- C. See Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

##### 1.04 WARRANTY

- A. Provide 5 year manufacturer certified warranty for all parts and labor. All devices that do perform as intended, per manufacturer specifications, they shall be replaced and re-tested.

##### 1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### PART 2 - PRODUCTS

##### 2.01 INDOOR OCCUPANCY SENSORS

- A. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
- B. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1200 sq. ft. when mounted on a 96-inch- high ceiling.
- C. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches
  2. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
  3. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 144-inch- high ceiling.

## 2.02 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## **PART 3 - EXECUTION**

### **3.01 SENSOR INSTALLATION**

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose. Contractor shall perform all sensor adjustments for all locations per owner requirements and per manufacturer recommendations.
- C. Do not locate within 5ft of air handling supply diffusers, exhaust fans, or similar equipment (mechanical or otherwise) that will affect the general operation of sensors and cause them to be unreliable and non-functioning due to improper location. Locate per manufacturer's recommendations.

### **3.02 WIRING INSTALLATION**

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### **3.03 IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches with a unique designation.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work and shall be replaced.

END OF SECTION 26 09 23



## SECTION 26 24 16

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.
- C. Field quality-control reports.
- D. Panelboard schedules for installation in panelboards.
- E. Operation and maintenance data.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

## 1.05 WARRANTY

1. Warranty Period: Standard manufacture warranty from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
  1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus Configured Terminators: Mechanical type.
  4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

### 2.02 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- C. Mains: Refer to plans.
- D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Refer to plans.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Two-pole or three-pole breakers should be common trip. Single pole breakers with handle ties for common tripping are not allowed.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable Magnetic trip setting for circuit-breaker frame sizes 100 A and larger.
  - 2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  - 3. Micro-Adjustable electronic trip breakers for circuit-breaker frame sizes 100 A and larger.
  - 4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    - e. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    - f. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
    - g. Micro-adjustable electronic trip

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- C. Mount top of trim 72 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges per manufacturer recommendations.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- I. Comply with NECA 1.

### 3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Wall-box motion sensors.
  - 3. Snap switches and wall-box dimmers.
  - 4. Wall-switch and exterior occupancy sensors.
  - 5. Communications outlets.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### PART 2 - PRODUCTS

NOTE: DEVICES WITH PUSH-IN TYPE WIRE CONNECTORS ARE NOT ALLOWED.

##### 2.01 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6

configuration 5-20R, and UL 498. Specification grade.

- B. Use Leviton 5362 or 5342 as standard.
- C. Self-Grounding receptacles are not allowed

## 2.02 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped. Specification grade.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.
- C. Use Leviton 8899 as standard.

## 2.03 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20. Specification grade.
- B. Use Pass & Seymour PS 20AC1 as standard.
- C. Switches, 120/277 V, 20 A.
- D. Pilot Light Switches, 20 A:
  - 1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
  - 2. Pilot light switches to be installed in all tunnels and mechanical/electrical equipment rooms.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

## 2.04 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
  - 1. Description: Passive-infrared & ultrasonic type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.

## 2.05 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

- C. Dedicated 4-plex receptacle at each resident living room near bed shall have a Red faceplate with Red devices and shall indicate panel and circuit information. Self adhesive labels are not acceptable. All other receptacles, toggle switches, and faceplates shall have the designated finishes and colors as noted in 2.06.
- D. Acceptable Manufacturers: Hubbell or Pass & Seymour, unless noted otherwise in plans and specifications.

## 2.06 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  - 1. Dedicated 4-plex receptacle at each resident living room near bed shall have a Red faceplate with Red devices and shall indicate panel and circuit information. Self adhesive labels are not acceptable.
  - 2. All other wiring devices shall have ivory finish with ivory faceplates. Final color to be selected by owner.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:



1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtailed that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtailed for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

H. Install the receptacles and telephone/data boxes at 18" AFF, and the wall switches at 48" AFF unless otherwise indicated on the drawings.

I. Do not install/locate outlets back-to-back even if associated with different systems.

### 3.02 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 26 27 26

## SECTION 26 28 16

### ENCLOSED SWITCHES AND CIRCUIT BREAKERS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Receptacle switches.
  - 4. Shunt trip switches.
  - 5. Molded-case circuit breakers (MCCBs).
  - 6. Enclosures.

##### 1.03 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

##### 1.04 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

## 1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.01 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 4. Lugs: Suitable for number, size, and conductor material.
  - 5. Service-Rated Switches: Labeled for use as service equipment.

### 2.02 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Lugs: Suitable for number, size, and conductor material.

### 2.03 RECEPTACLE SWITCHES

- A. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240-V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- B. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

## 2.04 MOLDED-CASE CIRCUIT BREAKERS

- A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- B. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- C. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 5. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
  - 6. Alarm Switch: One NO and NC contact that operates only when circuit breaker has tripped.

## 2.05 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.
  - 3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
  - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

### 3.02 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- C. Tests and Inspections:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 28 16

## SECTION 26 29 13

### ENCLOSED CONTROLLERS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
  - 1. Full-voltage manual.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

#### PART 2 - PRODUCTS

##### 2.01 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  - 1. Configuration: Nonreversing.

2. Surface mounting.
  3. Pilot light.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Configuration: Nonreversing.
  2. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 20 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  3. Surface mounting.
  4. Pilot light.

## 2.02 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1.
  2. Outdoor Locations: Type 3R.
  3. Other Wet or Damp Indoor Locations: Type 4.

## 2.03 ACCESSORIES

- A. Push Buttons, Pilot Lights, and Selector Switches: NEMA ICS 5; heavy-duty type; factory installed in controller enclosure cover unless otherwise indicated.
- B. Control Relays: Auxiliary and adjustable time-delay relays.
- C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in each fusible-switch enclosed controller.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- F. Comply with NECA 1.



### 3.02 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.

### 3.03 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  - 3. Test continuity of each circuit.
  - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
  - 5. Test each motor for proper phase rotation.
  - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.05 ADJUSTING

- A. Set field-adjustable switches and overload-relay pickup and trip ranges.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

### 3.06 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 26 29 13

## SECTION 26 43 13

### TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. Section includes field-mounted TVSS for low-voltage (120 to 600 V) power distribution and control equipment.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Field quality-control reports.
- C. Operation and maintenance data.
- D. Warranties: Sample of special warranties.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- C. Comply with NEMA LS 1.
- D. Comply with UL 1283 and UL 1449.
- E. Comply with NFPA 70.

##### 1.05 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 SERVICE ENTRANCE SUPPRESSORS**

- A. Surge Protection Devices:
  - 1. Non-modular.
  - 2. LED indicator lights for power and protection status.
  - 3. Comply with UL 1449.
  - 4. Fuses, rated at 200-kA interrupting capacity.
  - 5. Fabrication using bolted compression lugs for internal wiring.
  - 6. Integral disconnect switch.
  - 7. Redundant suppression circuits.
  - 8. Arrangement with copper bus bars and for bolted connections to phase buses, neutral bus, and ground bus.
  - 9. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  - 10. LED indicator lights for power and protection status.
- B. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.
- C. Minimum single impulse current ratings, using 8-by-20-mic.sec waveform described in IEEE C62.41.2
  - 1. Line to Neutral: 70,000 A.
  - 2. Line to Ground: 70,000 A.
  - 3. Neutral to Ground: 50,000 A.
- D. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120 V, 3-phase, 4-wire circuits shall be as follows:
  - 1. Line to Neutral: 400 V for 208Y/120 V.
  - 2. Line to Ground: 400 V for 208Y/120 V.
  - 3. Neutral to Ground: 400 V for 208Y/120 V.

### **2.02 ENCLOSURES**

- A. Indoor Enclosures: NEMA 250 Type 1.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install TVSS devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install TVSS devices for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
  - 1. Provide multiple, 30-A circuit breaker as a dedicated disconnecting means for TVSS unless otherwise indicated.

### **3.02 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.
  2. After installing TVSS devices but before electrical circuitry has been energized, test for compliance with requirements.
  3. Complete startup checks according to manufacturer's written instructions.
- C. TVSS device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- 3.03 STARTUP SERVICE
- A. Do not energize or connect service entrance equipment to their sources until TVSS devices are installed and connected.
  - B. Do not perform insulation resistance tests of the distribution wiring equipment with the TVSS installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.
- 3.04 DEMONSTRATION
- A. Train Owner's maintenance personnel to maintain TVSS devices.

END OF SECTION 26 43 13

## SECTION 26 51 00

### INTERIOR LIGHTING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. This Section includes the following:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Lighting fixture supports.
- C. See Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
- D. See Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays and occupancy sensors.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Provide shop drawings for all lamps.
- C. Field quality-control test reports.
- D. Provide manufacturer standard warranty of parts and labor.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.01 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. All light fixtures shall be Painted After Fabrication. Manufacturer shall provide proof in submittals that fixtures are in compliance with this requirement.
- G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metallized Film: 90 percent.
- H. Plastic Diffusers, Covers, and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.

### 2.02 BALLASTS

- A. Electronic Ballasts for Linear Fluorescent Lamps: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
  - 1. Sound Rating: A.
  - 2. Total Harmonic Distortion Rating: Less than 10 percent.
  - 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
  - 4. Operating Frequency: 20 kHz or higher.
  - 5. Lamp Current Crest Factor: 1.7 or less.
  - 6. BF: 0.85 or higher.
  - 7. Power Factor: 0.95 or higher.

- B. Ballasts for Temperatures Minus 20 Deg F and Higher for Linear Fluorescent Lamps: Electromagnetic type designed for use with indicated lamp types.
- C. Ballasts for Compact Fluorescent Lamps: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
  - 1. Lamp end-of-life detection and shutdown circuit.
  - 2. Automatic lamp starting after lamp replacement.
  - 3. Sound Rating: A.
  - 4. Total Harmonic Distortion Rating: Less than 20 percent.
  - 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
  - 6. Operating Frequency: 20 kHz or higher.
  - 7. Lamp Current Crest Factor: 1.7 or less.
  - 8. BF: 0.95 or higher, unless otherwise indicated.
  - 9. Power Factor: 0.95 or higher.
  - 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
  - 11. Ballast Case Temperature: 75 deg C, maximum.

## 2.03 EXIT SIGNS

- A. Internally Lighted Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
  - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

## 2.04 LAMPS

- A. Low-Mercury Fluorescent Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 32 W maximum, nominal length 48 inches, 2900 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours, unless otherwise indicated.
- C. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.
  - 1. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
  - 2. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
  - 3. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).

## 2.05 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.



- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  - 4. Fluorescent troffers in suspended ceilings shall be attached to grid and have two (2) wires minimum installed at diagonal corners to structure.
- D. Adjust aimable lighting fixtures to provide required light intensities.
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

#### **3.02 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal. Coordinate a test time with Owner and Engineer.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 51 00

## SECTION 26 56 00

### EXTERIOR LIGHTING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. The work covered under this Section of the Specifications is intended to include the furnishing of all equipment, materials and labor or reasonably incidental to the complete operating installation of systems as shown on the plan and of related equipment all as indicated on the drawings, as hereinbefore specified under Division 26 and as hereinafter specified in this Section.
- B. This Section includes the following:
  - 1. Exterior luminaires with lamps and ballasts.
- C. See Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

##### 1.03 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Include anchor-bolt templates keyed to specific poles and certified by manufacturer.

##### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

#### PART 2 - PRODUCTS

##### 2.01 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel Luminaires: Color as selected by Architect. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

## 2.02 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
  - 1. Relay with locking-type receptacle shall comply with NEMA C136.10.
  - 2. Adjustable window slide for adjusting on-off set points.

## 2.03 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction average life. Include the following features, unless otherwise indicated:
  - 1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
  - 2. Minimum Starting Temperature: Minus 22 deg F.
  - 3. Normal Ambient Operating Temperature: 104 deg F.
  - 4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
- B. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
  - 1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
    - a. Restrike Range: 105- to 130-V ac.
    - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
  - 2. Minimum Starting Temperature: Minus 40 deg F.

## 2.04 HID LAMPS

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.
- B. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.

## 2.05 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  - 1. Materials: Shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
  - 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

## **PART 3 - EXECUTION**

### **3.01 LUMINAIRE INSTALLATION**

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
  - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming.

### **3.02 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### **3.03 GROUNDING**

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole, unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 1. Install grounding electrode for each pole.
  - 2. Install grounding conductor and conductor protector.
  - 3. Ground metallic components of pole accessories and foundations.

### **3.04 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal. Coordinate a test time with Owner and Engineer.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 56 00

## SECTION 31 10 00

### SITE CLEARING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Site clearing, including removal rubble, removal of existing foundation, etc.
  - 2. Stripping of upper sub-soils as required, and separating and storing approved top-soils to be used for fine grading.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 00 Section "Geotechnical Data" for recommendations of site preparation.
  - 2. Division 31 Section "Earth Moving" for cutting and filling of site.

#### PART 2 - MATERIALS – Not used.

#### PART 3 - EXECUTION

##### 3.01 GENERAL SITE PREPARATION

- A. Keep project site free from drainage ponding due to construction operations during progress of Work. Make arrangements for disposal of all water and sewage received on the site from temporary connections or stoppages. Do not discharge any water or sewage onto private property outside the construction right-of-way.
- B. Strip top soil and separately store to provide depth of top soil replacement as specified.

##### 3.02 EXISTING UTILITIES

- A. Contractor is responsible for liaison with utility companies and for repairing utilities and services which are not in direct conflict with the Work, and is responsible for damage during construction at no expense to the Owner, unless indicated otherwise on the Drawings.
- B. Utilities shown on drawings, in direct line and grade, which conflict with (the new piping systems) the Work, shall be relocated by others at no expense to the Contractor, unless indicated otherwise on the Drawings.
- C. For utilities not shown on the Drawings and which are in direct conflict with the Work, the Contractor shall notify the Engineer of the conflict. When directed, the Contractor shall perform the Work. The Contractor shall be entitled to payment for any extra work in accordance with the General Conditions.

- D. Utility removal. Before the Contractor begins Work, he shall confer with the owners of any underground or overhead utilities which may be on or in close proximity to the Work areas and shall arrange for the necessary disconnection of the utilities in accordance with the utility company regulations. The utility company or owner of the utility shall perform the work of removing, repairing, reconditioning, or revising the utility unless otherwise specified or indicated on the Drawings. The Contractor shall cooperate with the utility companies so that Work can be expedited to the best interests of all concerned.

### 3.03 TREE REMOVAL

- A. Tree removal shall consist of only those shown on the Drawings or as authorized by the Owner and the Engineer. Do not remove any tree not designated for removal.
- B. Fell, cut and remove trees together with down timber, stumps, roots, and brush. Backfill and dispose of debris.

### 3.04 PAVEMENT REMOVAL

- A. Remove pavement to a minimum of 1' - 0" from edge of trench. No undercutting will be permitted. Remove pavement on straight lines approximately parallel to the center line of the trench. Cut pavement and drives with a concrete saw and provide a minimum vertical cut of 1 inch.
- B. Remove asphalt pavement in the same manner as concrete pavement. Cut all edges neatly.
- C. Remove sidewalk pavement to the nearest joint beyond a minimum distance of 1' - 0" from edge of trench.

### 3.05 ACCESS TO STREETS AND HIGHWAYS

- A. Contractor shall maintain access to all streets and highways involved in construction.
- B. Whenever construction is stopped due to inclement weather, on weekends and holidays, or for other reasons, suitable access shall be provided for all property owners.
- C. The CONTRACTOR shall conduct his operations in such a manner as to leave all streets and access roads open to traffic at all times except as noted on the PLANS. He shall place and maintain proper barricades, lights, and other required safeguards around obstructions in or adjacent to existing streets. All barricades, lights, and warning signs shall conform to the Omaha Public Works "Barricading Standards, Specifications, Methods and Materials" and the "Manual on Uniform Traffic Control Devices 2003 edition".

### 3.06 DISRUPTION OF UTILITY SERVICE

- A. Contractor shall maintain utility service to all property owners or customers of utilities throughout the construction period unless repairs or improvements are authorized. In the event of repairs, replacements or improvements to utility service lines, the Contractor shall give the property owner or customer 24-hour notice of the upcoming disruption. Disruption of service shall be for as brief a period as possible so as not to cause undue inconvenience to the affected property owner or customer.

### 3.07 DISPOSAL OF DEBRIS AND REFUSE

- A. Contractor shall dispose of surface materials, construction debris and trees in accordance with local ordinances and at a site approved by the Owner. Burning of refuse will not be permitted.

### 3.08 REMOVAL OF EXISTING BUILDING STRUCTURE

- A. Contractor shall remove existing building foundation complete as shown on the plans completely including but not limited to footings, foundations, pavement, concrete floors, all building materials, metal, trees, shrubs, tires and dispose of all debris and materials to a licensed landfill. Removal shall include all fees and incidentals for the complete removal of the building. Contractor shall provide suitable fill and compacted according to the specifications for Earthmoving, no ponding will be allowed and burning or use of explosives is not allowed. Contractor shall obtain all permits for the removal and disposal of the building.

END OF SECTION 31 10 00



## SECTION 31 20 00

### EARTH MOVING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Division 31, Section "Site Clearing".

##### 1.02 DESCRIPTION OF WORK

- A. Work covered under this section shall consist of the reworking of the soils and the construction of the building pad in accordance with the recommendations of the Geotechnical Engineering Report prepared by Benesch, dated March 22, 2013. The Work shall include all excavation, shaping and sloping of all cut areas; all placing, compacting, shaping and finishing of all embankments in fill areas necessary for the completion of all site and roadway regrading; including subgrades, shoulder slopes, intersections, approaches, and entrances. The Work consists of all fine grading of the site to conform to the grades, lines and contours shown on the Drawings. Trench excavation and backfill for utility trenches is also included.

##### 1.03 REFERENCES

- A. ASTM D698 Standard Proctor, ASTM D1557 Modified Proctor Tests for Moisture Density Relations of soils and soil aggregate mixture.
- B. Incorporated by reference as part of these specifications is the Site Exploration and Geotechnical Engineering Report prepared by benesch, Lincoln, NE; dated March 22, 2013 and made a part of these plans and specifications. **If any conflicts arise between these specifications and the Geotechnical Engineering Report, the Geotechnical Engineering Report shall take precedence.**

##### 1.04 QUALITY ASSURANCE

- A. Soil testing shall be arranged and paid for by the Contractor. The Contractor shall be responsible for the cost of all retests due to initial tests failing to meet specifications. The Contractor shall also be responsible for scheduling soil testing at least 72 hours prior to needing the testing.
- B. In general, the services of the soils engineer shall include, but are not limited to the following:
  - 1. Perform classification tests and determine moisture density relations for materials used for fill and backfill.
  - 2. Test and approve subgrades under foundations, floor slabs and pavements.
  - 3. Perform soil density tests, including observation and testing during compaction of fill and preparation of subgrade to check suitability of soils, proper moisture content and degree of compaction.
- C. The following minimum number of compaction and moisture tests, in accordance with appropriate ASTM procedures, shall be made, where directed, in the designated areas:

DESIGNATED AREA	NUMBER OF TESTS
All lifts of fill	1 test per 3000 square feet or per smaller separate area prepared.
Completed subgrade below slabs on grade	1 test per 1000 square feet or per smaller separate area prepared.
Completed subgrade for streets and drives and parking areas	1 test per 3000 square feet of large areas or per 100 lineal feet of area less than 50 feet in width or per smaller separate area prepared.
Completed subgrade for walks	1 test per every 100 lineal feet
Backfill for foundations	1 test horizontally every 100 feet and for every one-foot of vertical fill.

D. Backfill for utility trenches:

Depth Over Top of Pipe	Location of Test	Frequency of Test
0-5 Feet	Every foot	Every 100 Lin. Feet
5-12 Feet	Every 2 feet	Every 100 Lin. Feet
Over 12 Feet	Every 2 feet	Every 100 Lin. Feet

1.05 PROTECTION

- A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn by the Contractor. Data are made available for convenience of Contractor.
  - 1. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
- B. The Contractor shall carefully maintain all bench marks, monuments, stakes, and other reference points and replace same if disturbed or destroyed.
- C. Contractor shall exercise extreme care to protect all existing underground and overhead utilities. Contractor shall be responsible for repairing all utilities damaged or destroyed during construction.
- D. Contractor shall protect trees, shrubs, lawns, and other features which are to remain after construction is completed.
- E. Properly dispose of all waste materials. On-site burial will not be allowed.

- F. Protect all excavations from the action of the elements. Keep all excavations free of water or snow at all times during the entire progress of construction, regardless of the cause, source or nature of the water. Temporarily grade areas adjacent to excavations to prevent excessive moisture from entering excavations. If water enters excavations, or other construction areas, dewater promptly using means which will ensure dry excavations and the preservation of all lines and grades. Provide ample means and devices at all times during construction to ensure prompt and adequate removal of water. Where soil has been softened or eroded by actions of the elements remove all damaged areas, replace soil and recompact as required by these specifications.
- G. Provide for surface drainage during construction of the project so at all times there is positive drainage away from the building area. Soils in the building area, under paving and walks, and within 20 feet of the building perimeters, shall be protected against moisture content increase throughout the construction period.
- H. The contractor shall guard against any movement, settlement or collapse of all excavations, buildings, structures, paved areas, drives, sidewalks, streets, utility items or any other item adjacent to or within the construction limits of this project. The contractor shall adequately brace all walls and other construction during backfilling and compacting operations so movement does not occur.
- I. Protect bottoms of all excavations for foundations and soil under slabs, as needed, from frost.
- J. The contractor shall repair, at his expense, all damage occurring to the owner's property or any other property, on or off the premises, that has resulted from a lack of adequate protection. All repair or replacement shall be approved by the Architect.

#### 1.06 DEFINITIONS

- A. Suitable materials include material that is free of debris, roots, organic matter, frozen matter, and which is free of stones or foreign material which any dimension greater than 2 inches. Excavated site soils will not be suitable for reuse as structural fill. All proposed fill material shall be approved by Soils Engineer at least 2 weeks prior to fill placement.
- B. Unsuitable materials include all material that contains debris, roots, organic matter, frozen matter, stone with any dimension greater than 2 inches, or other materials that are determined by the Engineer or Soil Engineer as too wet or otherwise unsuitable for providing a stable subgrade.

### **PART 2 - PRODUCTS**

#### 2.01 FILL (EMBANKMENT) AND BACKFILL MATERIAL

- A. All fill and backfill materials shall be cohesive soils, free of rubble and organics. The fill material shall consist of low-plasticity, cohesive material with a liquid limit of less than 50 and a plasticity index less than 30. Per the soils report the onsite lean clays are suitable to be used on this project and may require the addition of water to achieve the required moisture content. When unsuitable materials are encountered, the Contractor shall notify the Engineer, in accordance with the General Conditions. If directed by the Engineer, the Contractor shall excavate and replace with suitable material. Suitable material for backfill shall be obtained from off-site borrow as approved by the Engineer and Soil Engineer.

- B. Top soil shall be clean, fertile, friable soil. Topsoil shall be a mixture of soil and organic matter and shall be free of stones over one-half inch in diameter, hard clay clumps, refuse, plant material or their roots, sticks, noxious weeds, salts, soil sterilants or other material that is detrimental to plant growth. The ph range shall be 6.0 to 7.5, 5% organic material minimum as determined by loss on ignition of moisture free samples dried at 100 degrees centigrade. Topsoil shall conform to ASTM D 5268. Obtain from naturally well drained sites free of flooding where topsoil occurs at least 4 inches deep. Do not obtain from bogs or marshes. Topsoil shall not be delivered or used while in a frozen or saturated condition. The contractor shall submit a certified analysis of the topsoil from a testing lab to the Owner and Engineer prior to beginning work.
  - 1. Submit testing laboratory certified analysis of proposed topsoil to Engineer.
- C. Granular fill material under floor slabs shall be a clean, pervious material, which will prevent capillary action and conforms to the following requirements:
  - 1. 100 percent passing the 1 inch sieve.
  - 2. Less than 70 percent passing the #4 sieve.
  - 3. Less than 2 percent passing the #200 sieve.

### **PART 3 - EXECUTION**

#### **3.01 EQUIPMENT**

- A. All equipment shall be adequate for the purpose for which it is to be used and shall be kept in satisfactory working order. Equipment shall be adequate to perform all excavation, hauling, placement of embankment, compaction, trimming, and shaping.

#### **3.02 FILL AND COMPACTION**

- A. Strip topsoil and vegetation to a depth of 6 to 9 inches or below the root crown. The Contractor shall consult the Engineer during stripping operations to avoid removing more topsoil than is necessary.
- B. Prior to the placement of any new fill; the top twelve (12) inches of the existing fill material shall be scarified and recompacted before placement of any fill if required. The reworked soil shall be compacted to minimum of 95 percent of the maximum dry density as recommended by ASTM D698. The site shall be proofrolled in the presence of a the soils testing representative. Unsuitable areas observed at this time shall be improved by scarification and recompaction or by undercutting and placement with structural fill. Proofrolling shall be accomplished with a fully loaded tadem-axel dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 25 tons is required for the proofrolling equipment.
- C. Following proofrolling and removal of unsuitable soils, the exposed soils shall be scarified to a minimum depth of 9 inches prior to adding at least 9 inches of additional newly compacted fill soils to form the minimum 18 inches of newly compacted lean clay fill below all floor slabs. The fill soils shall be compacted according to the specifications. All new fill shall be placed in 9 inch maximum lifts and compacted as specified hereinafter. Prior to placement of any fill, floor slabs or pavement construction, stripped subgrades shall be observed by the Soils Engineer to verify all unsuitable materials have been removed. Bench all slopes steeper than 5H:IV.

- D. Compaction of Fill; All fill and backfill shall be wetted or dried by aeration, and then compacted to the following percentage of maximum density at a moisture content within the limits specified above or below optimum moisture content, as determined by Testing Procedure ASTM D 698, (Standard Proctor) and ASTM D1557 (Modified Proctor), unless otherwise noted:

<b>Material</b>	<b>Percent of Maximum (Cohesive Soil Only)</b>	<b>ASTM</b>	<b>Percent Above or Below Optimum Moisture Content</b>	
Recompacted Materials	97% minimum	D698	2%	
Structural Fill, below foundations	97% minimum	D698	2%	
Structural Fill, within 10 ft of all structures	100% minimum	D698	2%	
Upper 12" of subgrade beneath concrete pavement	100% minimum	D698	2%	
Upper 12" of subgrade beneath floor slab	97% minimum	D698	2%	
Random Fill	90% minimum	D698	2%	
Upper 6" of subgrade beneath sidewalks	100% minimum	D698	2%	
Trench Backfill under floor slabs & paving	98% minimum	D698	2%	
Trench Backfill grass areas	92% minimum	D698	2%	
Interior Backfill	98% minimum	D698	2%	

- E. Extend compaction requirements for all pavements to 3 feet beyond pavement perimeter. Extend compaction requirements for all sidewalks to 18 inches beyond sidewalk perimeter.
- F. Compact cohesive soils by the use of sheepsfoot or pneumatic type compactors under optimum moisture conditions.

### 3.03 EXCAVATION

- A. Perform excavation to dimensions and elevations indicated on Drawings or required for footings, and all work incidental thereto. Excavation shall extend a sufficient distance from footings to allow for forming and inspection, except for spread footings and continuous trench beam footings where concrete may be deposited directly against earth surfaces, when approved by Architect and governing authorities. Care shall be taken during excavation and site work to avoid unnecessarily disturbing soils at the greater depth excavations.

- B. Trench excavations within the limits of the building and under paving or walks shall be carefully excavated, maintaining a minimum width and in no way impairing the bearing value of any footing or foundation. Excavations should not extend below an imaginary plane projecting out and down from the bottom edge of the existing footing of a 3H:1V. Even with these criteria, excavations that extend below the level of existing foundations shall be backfilled the same day they are excavated. If deeper excavations are required adjacent to existing foundations, the contractor shall provide shoring design drawings and calculations designed by an Engineer in the State of Nebraska.
- C. Excess excavation shall be avoided.
- D. All excavated material not suitable for filling, backfilling as approved by the Soils Engineer and all excess earth or other material shall be removed from the site.
- E. The bottoms of all excavations for foundations shall be hand trimmed and free of all loose material.
- F. Cut footing excavations vertically from the widest part of the footing. Undercutting for footing projections will not be permitted.
- G. Pour footings immediately after excavation for footings is completed. Concrete for footings which bear on earth shall be placed on undisturbed soil and as shown on drawings. When footings are inadvertently over-excavated below elevations shown on the drawings, the footings shall be filled to the proper level with concrete. All footing excavations shall be observed by the soils engineer before any concrete is placed so that adjustments to footing depths and sizes may be made, if necessary, to provide bearing on stable, uniform soil. Contractor shall allow time for soils engineer to obtain density samples at the bottom of the footing excavation to determine if low-density loess soils are present. Where otherwise suitable, low-density loess is encountered, excavation shall extend to the depth of these materials or 2 feet below the footings, whichever is less. The overexcavation shall then be backfilled up to the footing base elevation with approved cohesive fill placed in lifts of 8 inches or less in loose thickness and compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D698).
- H. Unexpected Subsurface Condition. Where suitable bearings are encountered at different elevations from those indicated on the drawings, the Soils Engineer shall direct, in writing, that the excavation be carried to elevations above or below those indicated on the Drawings. Adjustment in payment shall be made in accord with the terms of the General Conditions.
- I. On the public roadways the soils from 6 inches below pavement to 15 inches below pavement shall compacted subgrade. The upper 6 inches below pavement shall be crushed concrete or limestone 1 inch minus, proof rolled with a vibratory smooth roller to achieve compaction. For driveways and the sidewalks leading to the front of the units, the soils from 12 inches below pavement to 18 inches below pavement shall compacted using a vibratory hand held compaction equipment or other approved means until no significant further consolidation occurs and approved by the soils engineer. For the rear patios the upper 12 inches below pavement shall be limestone screening on crushed concrete or limestone 1 inch minus and placed using vibratory hand held compaction equipment or other approved means until no significant further consolidation occurs and approved by the soils engineer. Unless the Engineer considers the material in the excavation area unsatisfactory for use in the subgrade, the contractor shall perform all Work required, including the application of water if necessary, to facilitate compaction.

- J. During construction of roadways and parking areas, the roadbed shall be maintained in such condition that it will be adequately drained at all times. Side ditches emptying from cuts to embankments shall be constructed so as to avoid damage to embankments by erosion. The finished roadway shall be free from waves and true to the lines, grades and cross sections shown on the Drawings.
- K. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
- L. Finish surfaces free from irregular surface changes, and as follows:
  - 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.
  - 2. Walks: Shape surface of areas under walks to line, grade and cross section, with finish surface not more than 0.10' above or below required subgrade elevation.
  - 3. Pavements: Shape surface of areas under pavement to line, grade and cross section, with finish surface not more than 1/2" above or below required subgrade elevation.
- M. All excavations should comply with the requirements of OSHA'S "Construction Standards for Excavations".

3.04 EXCAVATION FOR UTILITY STRUCTURES AND APPURTENANCES

- A. Excavate as required for manholes and other appurtenances until firm, undisturbed soil is reached. If excavation is carried below bottom of foundations as
- B. When unstable material is encountered which will not provide suitable bearing (as determined by the soils engineer), fill with 3,000 psi concrete or stabilizing material specified herein, or as directed by Soils Engineer. Contractor shall be entitled to payment for this extra work in accordance with the General Conditions.

3.05 TRENCHING

- A. Perform trenching operations to the depth indicated on the Drawings or as specified.
- B. Pile excavated material suitable for backfill in an orderly manner sufficient distance back from edge of excavation to avoid rollbacks, slides, or cave ins.
- C. Remove soil not suitable for backfill and waste at a disposal area designated by the Architect.
- D. Where new construction crosses or closely parallels existing utilities or utility services, excavate in advance of pipe laying to determine location and crossing arrangement, including exact construction line and grade.
- E. Excavate by open cut under existing streets, utilities, and structures, except as noted on the Drawings or as directed by the Architect.
- F. Keep width of trench as narrow as possible, but provide adequate room for backfilling and jointing. Keep sides of the trench as nearly vertical as practical within the limits of excavation codes and maintain vertical walls of excavation below top of pipe. Trench widths shall be as follows:

Pipe Size	Trench Width
3/4" to 3"	12"
4" to 8"	24"
10" to 16"	36"
18" to 24"	48"

30" and Greater      Pipe size plus 18" each side

- G. Excavate to full depth by machine and level trench bottom to provide uniform bearing and support for full length of pipe. Trench bottom shall be continuous, relatively smooth, and free of rocks.
- H. Do not use granular backfill in exterior trenches.
- I. Bed trench bottom as shown on the Drawings or as directed by the Soils Engineer.
- J. Provide bell holes at each pipe joint and allow access completely around circumference of pipe for proper jointing operations.
- K. Install pipe and provide a minimum pipe envelope consisting of compacted backfill completely around the pipe and a distance of 12 inches above the top of the pipe.
- L. When unstable material is encountered which may not provide a suitable foundation for pipe, notify the Soils Engineer immediately. If determined by the Soils Engineer upon his investigation that the material is unsuitable for foundations, the Soils Engineer may specify and authorize remedial measures. If removal of unsuitable material is authorized, replace it with a stabilizing material consisting of three fourths inch to one and one half inch (3/4" to 1 1/2") size, coarse, sharp, and clear crushed stone or other approved material. Provide a minimum of four inches (4") of bedding material on top of the stabilizing material to prevent point load.
- M. Excavate by hand under and around utilities, where overhead clearance prevents use of machine, and under trees and shrubs where shown on the Drawings.
- N. Construct sheeting, shoring, and bracing required to hold walls of excavation, to provide safety for workmen, to protect existing utilities or structures, and to permit construction in the dry. If wood sheeting is driven below the level of pipe, it shall be left in place to a level 5 feet below finished grade. Steel sheeting shall be pulled upon completion unless indicated otherwise on the Drawings. When a movable trench shield is used below the spring line of the pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.
- O. If dewatering is necessary, obtain the Soils Engineer's approval of proposed methods of dewatering. When dewatering is necessary, provide for handling of water encountered during construction. Lay no pipe in and pour no concrete on excessively wet soil. Prevent surface water from flowing into the excavations and remove water as it accumulates. Divert stream flow away from areas of construction.
- P. Do not pump water onto adjacent property without approval of Soils Engineer and adjacent property owner. Do not use sanitary sewers for disposal of trench water. The cost of dewatering shall be included in the original Bid Price for construction. No additional remuneration for dewatering shall be permitted.

### 3.06 GRANULAR FILL

- A. Granular fill for slab on grade shall be placed in uniform depths and compacted by vibratory hand held compaction equipment or other approved means until no significant further consolidation occurs and approved by the soils engineer. Do not use granular backfill in exterior trenches or around foundation elements.



### 3.07 BACKFILLING

- A. Place the backfill for structures in horizontal uniform layers not to exceed 8 inches. Bring each layer up uniformly on all sides of the structure and thoroughly compact using pneumatic compaction or other methods as approved by the Soils Engineer. Granular backfill shall not be used in exterior areas.
- B. Employ a placement method that will not disturb or damage foundation waterproofing.
- C. When embankments are constructed on sidehill slopes steeper than 4 to 1, the area of the original slope on which embankment is to be placed shall be stepped to a vertical depth of at least twelve inches (12") in order to integrate the embankment and the slope.
- D. Place all embankments to the grades, lines, and contours shown on the Drawings. Place embankment systematically, as early as possible, to allow maximum time for natural settlement. The hauling of embankment material shall be distributed over the entire embankment areas to assist in compacting the material.
- E. Do not place embankments over porous, wet, or spongy subgrade surfaces. If necessary, remove such unsuitable material and replace with satisfactory stabilizing materials, as directed by the Engineer.
- F. The Contractor shall be responsible for the stability of all embankment and excavation areas and shall replace, at Contractor's own expense, any portions which become displaced or unstable prior to the expiration of the warranty period.
- G. Remove excess backfill material from site.

### 3.08 BACKFILL FOR TRENCHES

- A. Back fill trenches immediately after the location of all lines, connections, and appurtenances are recorded, or at the Soils Engineer's direction.
- B. Construct manholes and appurtenances and perform backfilling as Work progresses.
- C. Backfill with material removed from excavation except where sand backfill may be specified. Backfill material shall be as specified herein and shall not contain any debris, frozen earth, large clods, stones, or other unsuitable material.
- D. Place backfill simultaneously on both sides of the pipe to prevent displacement. Place backfill into the trench at an angle so that the impact on the installed pipe is minimized. Install a cushion of four feet (4') of backfill above the pipe envelope before using heavy compaction equipment.
- E. Hand place backfill in the pipe envelope and compact finely divided material to twelve inches (12") over the top of the pipe.
- F. Backfill remainder of trench with excavated material up to the bottom of the specified surface restoration.
- G. Backfill top twelve inches (12") of the trench with soil equivalent to adjacent topsoil.
- H. Do not use granular backfill in interior trenches.

3.09 BACKFILL FOR STRUCTURES AND APPURTENANCES

- A. Backfill after concrete or masonry has cured for seven (7) days and has been inspected and approved by Soils Engineer. Backfill with material removed from excavation except where sand backfill is specified. Backfill material shall be as specified herein and shall not contain any debris, frozen earth, large clods, stones, or other unsuitable material. Backfill simultaneously on all sides of the structure to prevent damage at all times. Brace walls of structures as required.
- B. Compact backfill at structures to a density not less than specified in Section 3.02.
- C. Terminate backfill at finish grade as shown on the Drawings and dispose of excess excavation material as directed by the Soils Engineer. Prepare backfill for surface restoration as specified for adjacent trench.
- D. Do not use granular backfill material around foundation elements.

3.10 TOPSOIL AND FINISH GRADING

- A. Upon completion of rough grading, the Contractor shall spread topsoil over all areas graded under this Contract and not receiving other surfacing or in the building area. Before spreading topsoil, graded areas shall be scarified for a depth of 3 inches, and all settlements and washes shall be repaired. Finish grade shall be held 1 inch below adjacent sidewalks, curbs and pavement. Topsoil shall be free of rocks, rubble, wood and other undesirable material.
- B. Perform finish grading of topsoil adequately for sod, seed or whatever material is placed in each area. Finished surface shall be reasonably smooth, compacted and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade grader operations, except as otherwise needed. Finished surface shall be not more than 0.10 feet above or below established grade or approved cross section. All swales shall be finished so as to drain readily. Prior to the installation of seeding or sod, a final walk thru of the site shall be conducted and any modifications to the site grading shall be made to ensure the entire site has positive drainage. These grading modifications shall be conducted by the Contractor at no additional cost to the Owner.
- C. Manually place topsoil around trees, plants, and buildings to prevent damage. No more than 6 inches of fill shall be placed to the original grade elevation under trees or plants. Assure positive drainage away from buildings and structures.
- D. Lightly compact placed topsoil. Settle topsoil with a fine spray of water to avoid separation of ingredients. Do not jet or flood topsoil.
- E. Hand rake as necessary around trees, plants, buildings, and structures. Maintain sufficient topsoil reserve to regrade as necessary after initial settlement. Upon regrading, remove surplus topsoil and subsoil from the site.
- F. Final topsoil thickness shall be as follows:

Location	Thickness (Inches)
Seeded Grass Areas	4 min.

3.11 PROTECTION AND RECONDITIONING

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re establish grades in settled, eroded, and rutted areas to specified tolerances.

- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re shape, and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 31 20 00

**SECTION 31 25 00**  
**EROSION CONTROL**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.
  - 1. 31 10 00 -- Site Clearing
  - 2. 31 20 00 – Earth Moving
  - 3. 32 90 00 – Planting
- B. Provide erosion control in accordance with the following references:
  - 1. Nebraska Department of Environmental Quality Standards for Construction Site Erosion & Sediment Control and the Environmental Protection Agency (EPA).

1.03 SUBMITTALS

- A. The Lead Contractor will submit the following to the A/E:
  - 1. Contractor shall mark-up of the Erosion Control Plan that is included in these documents showing additional or alternate erosion control measures as needed due to the Contractors means and methods throughout all phases of construction. The Contractor may also be required to submit calculations and backup information showing the proposed measures meet applicable regulations.
  - 2. Contractor shall submit weekly inspection reports and inspection reports after every ½ inch rain event.
  - 3. Submittals for materials used to implement the erosion control plan.
- B. Submit shop drawings for the following erosion control features:
  - 1. Erosion Control Materials including but not limited to SWPPP sign, erosion control fence, straw mattes, construction entrance materials, wattles and concrete washout materials

1.04 EROSION CONTROL PLAN

- A. The A/E has prepared an erosion control plan included in these documents for the project. The erosion control plan is in accordance with the local department of environmental quality and national requirements. The Contractor will provide additional or alternate erosion control measures as needed due to the contractors' means and methods throughout all phases of construction. The Owner has submitted a Notice of Intent (NOI) to the local approving agency for the NPDES Construction Site Stormwater Discharge Permit.
- B. Contractor shall comply with all the requirements of the erosion control plan, and the requirements of the General Permit to Discharge under the NPDES.

- C. Erosion control and storm water management practices shall be installed and maintained throughout construction in accordance with the NPDES permit.
- D. Contractor shall provide all erosion control practices necessary to protect property and the environment. Erosion control and storm water management practices shall be installed and maintained in accordance with the NPDES permit. The contractor shall update and modify the erosion control plan as needed for phasing of work. A copy of the current erosion control plan shall be maintained at the project site and a copy of changes shall be sent to Engineer.
- E. **Contractor shall not begin grading operations until NOI permit has been approved.**
- F. At the completion of the project, the contractor shall remove all erosion control measures in accordance with the plans and specification and notify the Owner. The Owner shall complete the Notice of Termination (NOT) for the project and send to the proper agency.

## **PART 2 - MATERIALS**

### 2.01 GENERAL

- A. The Contractor shall install all erosion and storm water control measures in accordance with the plans and specifications and after completed grading operations.

### 2.02 STRAW BALE BARRIERS

- A. Rectangular bales of hay or straw, tightly bound with twine, not wire. Anchor stakes shall be "T" or "U" steel posts, or hardwood, 2.0 by 2.0 inches nominal. Rebar shall not be used to anchor bales.

### 2.03 SILT FENCE

- A. Fence fabric, support posts and support cord shall comply with the requirements of the plans and specifications.

### 2.04 EROSION MAT

- A. Erosion mat and type shall comply with the requirements of plans and specifications.

### 2.05 STAPLES

- A. Use biodegradable staples in accordance with manufacturer's recommendations for materials being anchored. Wood and metal staples are not allowed.

### 2.06 RIPRAP

- A. Riprap shall be the class specified and shall conform to Standard Specifications for Highway Construction.

### 2.07 TRACKING PAD STONE

- A. The aggregate for tracking pads shall be 3 to 6 inch clear or washed stone. All material shall be retained on a 3-inch sieve.

### 2.08 SOIL STABILIZERS

- A. Soil stabilizers shall be non-asphalt-based products of the type specified.

## 2.09 SOIL TACKIFIERS

- A. Soil tackifiers shall be non-asphalt-based products of the type specified.

## 2.10 POLYMERS

- A. Polymers used to settle suspended sediment shall meet the requirements.

## 2.11 ANIONIC POLYACRYLAMIDE

- A. Water soluble anionic polyacrylamide (PAM) used as temporary soil binding agents to reduce erosion shall meet the NPDES requirements.

# **PART 3 - EXECUTION**

## 3.01 GENERAL

- A. Install and maintain erosion control measures as required by the erosion control plan throughout phases of the project. Notify Construction Representative of modifications to the erosion control plan as dictated by Contractor's means and methods, construction phasing or by differing site conditions.
- B. Contractor shall provide all erosion control measures necessary to prevent and manage polluted runoff from the construction site and discharge of sediment onto adjacent property, into storm sewers or waters of the state.
- C. Perform all work in accordance with manufacturer's instruction where these specifications do not specify a higher requirement.

## 3.02 GRADING AND EARTHWORK

- A. Install temporary or permanent erosion control measures applicable to each phase of grading or land disturbance prior commencing on that phase.
- B. Following all soil disturbances, permanent or temporary seeding for stabilization shall be completed within 14 calendar days including all surface of the perimeter controls, topsoil, stockpiles and any other disturbed areas.
- C. Clear only those areas designated for the placement of improvements or earthwork before placement of the final cover. Perform stripping of vegetation, grading, excavation, or other land disturbing activities in phases to minimizing exposure of bare soil. Do not clear the site of topsoil, trees, and other natural ground covers before the commencement of construction. Retain natural vegetation and protect until the final ground cover is placed.
- D. Do not stockpile soil within 25 feet of any roadway, parking lot, paved area, or drainage structure or channel. Provide temporary stabilization and erosion control measures on disturbed areas and soil stockpiles which will remain for a period of more than 7 consecutive calendar days.
- E. Remove surplus excavation materials from the site immediately after rough grading.

## 3.03 DRAINAGE

- A. Divert roof drainage and runoff from all undisturbed areas upslope of the site around disturbed areas. Minimize runoff on exposed soil. Provide measures to remove sediment, and debris.

- B. Convey clean or treated runoff to the nearest adequate stormwater facility. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving stormwater facility.
- C. Protect storm sewer inlets and catch basins with inlet protection devices meeting NPDES requirements.
- D. Provide ditch checks to in swales or ditches to reduce the velocity of water in the channel. Construct in accordance with NPDES specifications.
- E. Dewatering discharge shall be routed to a sedimentation basin or sedimentation vessel to reduce the discharge of sediments. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving stormwater facility.

### 3.04 TRACKING CONTROL

- A. Construct and maintain Tracking Pads in accordance with the plans and specifications. Provide each entrance to the site with a stone tracking pad at least 70 feet in length with a minimum thickness of 12 inches, placed on top of geotechnical fabric. The tracking pad shall be the full width of the egress point. Inspect tracking pads on a daily basis and replace aggregate when no longer effective.
- B. If necessary, provide a crushed aggregate paved parking area.
- C. If applicable, wash water shall be discharged to sedimentation basins, sedimentation vessels, or other such control areas. Untreated wash water shall not be routed to storm sewers or waters of the state.

### 3.05 MAINTENANCE

- A. Contractor shall inspect all erosion control measures within 24 hours of the end of each rainfall event that exceeds 0.5", or daily during periods of prolonged rainfall, or weekly during periods without rainfall. Provide copy of completed inspection report to Owner, Engineer and Architect within 2 working days. Immediately repair and/or replace any and all damaged, failed, or inadequate erosion control measures.
- B. Re-apply soil stabilizers, tackifiers, polymers and anionic polyacrylamides as needed to prevent erosion of exposed soil.
- C. Maintain records of all inspections and any remedial actions taken on-site.
- D. Remove any sediment reaching a public or private roadway, parking lot, sidewalk, or other pavement. Do not remove tracked sediments by flushing. Completely remove any accumulations not requiring immediate attention at least once daily at the end of the workday.
- E. Frequently dispose of all waste and unused construction materials in licensed solid waste or wastewater facilities. Do not bury, dump, or discharge, any garbage, debris, cleaning wastes, toxic materials, or hazardous materials on the site, on the land surface or in detention basins, or otherwise allow materials to be carried off the site by runoff onto adjacent lands or into receiving waters or storm sewer systems.

END OF SECTION 31 25 00

**SECTION 32 13 13**  
**CONCRETE PAVING**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes exterior Portland Cement Concrete pavement for the following:
  - 1. Driveways and approaches.
  - 2. Parking lots.
  - 3. Curbs and gutters.
  - 4. Walkways, public walks, and patios.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 1 Section "Testing Laboratory Services" specifies procedural requirements for testing of concrete.
  - 2. Division 03 Section "Cast-In-Place Concrete" for footings, foundations, floor slabs, toppings, structural stoops, etc..
  - 3. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated to be used on project.
- C. Design Mixtures: For each concrete pavement mixture.
- D. Shop Drawings: For steel reinforcement.
- E. Material test reports and certificates.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."



- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 318, "Building Code Requirements for Reinforced Concrete"
  2. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
  3. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
  4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice".
- C. Concrete Testing Service: The Contractor will retain an independent testing laboratory as specified in Division 1 Section, "Testing Laboratory Services" to perform quality tests on concrete. Materials and work may require testing or re-testing at any time during the progress of the work. Contractors shall pay for any re-testing required due to inferior work.
- D. Sampling and Testing requirements during construction:
1. Sampling Fresh concrete as per ASTM C172; except as modified for slump to comply with ASTM C94.
  2. Slump as per ASTM C143; one test at point of discharge for each day's pour of each type of concrete and when consistency seems to have changed.
  3. Air Content as per ASTM C173 and ASTM C231; one test for each day's pour of each type of air entrained concrete.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Compression Test Specimens as per ASTM C39; one set of four (4) standard cylinders for each day's pour, plus additional sets for each 50 cubic yards; one specimen will be tested at 7 days, two will be tested at 28 days and one will be reserved for later testing if required.
  6. Additional tests as directed by the Architect or Engineer.
- E. Strength level of Concrete will be considered satisfactory if averages of sets of three consecutive strength tests results equal or exceed specified compressive strength and no individual strength test results falls below the specified compressive strength by more than 500 psi.
- F. Additional tests of in-place concrete will be required when test results indicate that specified strengths and other characteristics have not been attained. Conduct tests by cored cylinders complying with ASTM C42 or other methods as directed by the Architect or Engineer.
- G. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- H. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- I. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

## **PART 2 - PRODUCTS**

### **2.01 PORTLAND CEMENT**

- A. Shall comply with ASTM C150 and shall be Type I, IA, II, or IIA.
  - 1. Type I cement and an air-entraining admixture or Type IA shall be used for all concrete except where noted.
  - 2. Type II cement and an air entraining admixture or Type IIA shall be used only where noted in the plans or special specifications.

### **2.02 AGGREGATE**

- A. The aggregate mix used shall meet the requirements of ASTM C33, except for aggregate mixes listed in the NDOR Construction Specification.

### **2.03 ADMIXTURES**

- A. Any admixtures to be used in the concrete for this project shall not contain more than 0.1 percent chloride ions and conform to the following:
  - 1. Air-Entraining Admixture: ASTM C260 and certified by the manufacturer to be compatible with other required admixtures.
  - 2. Water-Reducing Admixture: ASTM C494, Type A
  - 3. High-Range Water Reducing Admixture: ASTM C494, Type F or Type G
  - 4. Water Reducing, Accelerating Admixture: ASTM C494, Type E
  - 5. Water Reducing, Retarding Admixture: ASTM C494, Type D

### **2.04 WATER**

- A. Water used in mixing concrete shall be clean (drinkable) and free from injurious amounts of oils, acid, alkali, salts, organic materials or other materials that may be deleterious to either the concrete or the reinforcement.

### **2.05 REINFORCING MATERIALS**

- A. Reinforcing Bars shall conform to either ASTM A615 or ASTM A617, Grade 60, deformed bars.
- B. Welded Wire Fabric shall conform to ASTM A185, smooth wire or ASTM A497, deformed wire.
- C. Supports for reinforcement shall include bolsters, chairs and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place.
  - 1. For slabs on grade use supports with sand plates or horizontal runners where base material will not support chair legs.

### **2.06 FORM MATERIALS**

- A. Exposed finished concrete surfaces shall be formed using plywood or metal. Use of aluminum forms is prohibited. Provide continuous, straight, smooth, exposed surfaces and furnish forms in largest possible sizes to minimize the number of joints.

- B. Form Coatings shall be commercial formulation form-coating compounds with a minimum VOC of 350 mg/L that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

## 2.07 OTHER MATERIALS

- A. Granular Base shall be an evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade. Conform to the requirements of the Soils Report and to Division 31 Section "Earth Moving"
- B. Curing Compound shall be a liquid type membrane forming curing compound complying with ASTM C309, Type 1, Class A or Class B.
- C. Patching Compound shall be a cement based compound for application from one inch thick to feathered edges.
- D. Bonding Compound shall be polyvinyl acetate or acrylic base.
- E. Chemical Hardener shall consist of fluosilicates combined with a wetting agent. Provide Sonneborn Lapidolith or equal.
- F. Joint Filler: BASF Expansion Joint Filler, polyethylene closed-cell backing joint filler to extend full depth of joint by joint width shown, or 1/2" thick minimum.
- G. Joint Sealant: Joint sealants are specified under Division 7 Section 'Joint Sealants'.
- H. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 45 minutes.
  - 1. Color: To be selected by Architect from Manufacturer's standard range of colors.

## 2.08 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mix such that ratio of course aggregate to fine aggregate is as specified for NDOR 47B aggregate mix.
- B. Submit written reports to the Engineer of proposed mix. Do not begin concrete production until the Engineer has reviewed and approved proposed mix designs.
- C. Design mixes to provide normal weight concrete with the following properties, unless otherwise indicated on the drawings or specifications:
  - 1. All concrete shall be a 47B mix and have a 28-day strength of 4,000 psi.
- D. Slump Limits shall be as follows:
  - 1. Not less than 1 inch nor more than 4 inches for all other concrete
- E. Mix design adjustments may be requested when characteristics of materials, job conditions, weather, or other circumstances warrant, as accepted by the Engineer.
- F. Admixtures in mix design:
  - 1. Use water-reducing admixture concrete, as required for placement and workability.
  - 2. Use air-entraining admixture concrete in all concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1 percent of 5 percent.

3. Use admixtures for water and set accelerating or retarding in strict compliance with manufacturer's directions.

## 2.09 CONCRETE MIXING

- A. Ready-mixed concrete shall comply with the requirements of ASTM C94, and as specified.
  1. When air temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C), reduce mixing and delivery time from 1 ½ hours to 75 minutes, and when air temperature is above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes.
  2. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

## PART 3 - EXECUTION

### 3.01 FORMS

- A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
  1. Provide Class A tolerances for concrete surfaces exposed to view.
  2. Provide Class C tolerances for other concrete surfaces.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joists to prevent cement paste from leaking.

### 3.02 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as specified.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete. Do not secure reinforcement to re-bar driven into ground or on rocks, dirt clods or other debris. Do not "float in" reinforcement.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect or Engineer.
- D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

- E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.03 JOINTS

- A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to ARCHITECT OR ENGINEER. Contractor to provide proposed layout of construction joints to Owner and Architect for approval before slab can be poured.
- B. Provide keyways at least 1 1/2 inches deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.
- C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.
- D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.
- E. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- F. Contraction (Control) Joints in Slabs-on-Ground: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Contractor to provide proposed layout of contraction joints to Owner and Architect for approval before slab can be poured. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
  - 3. If joint spacing not indicated, lay out joints to form square panels. When this is not practical, rectangular panels can be used if the long dimension is no more than 1.25 times the short side. In 4" slabs, the long side should not exceed 10 feet. Spacing: Not to exceed 30 x slab thickness (in inches) or 15 feet, whichever is less.
- G. Expansion Joints: If spacing is not indicated, construct expansion joints in slabs-on-grade at 40 foot maximum intervals and at points of contact between slabs-on-ground and vertical surfaces, such as columns, foundations, curbs and elsewhere as indicated.
  - 1. Include joint filler material at expansion joints.

### 3.04 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

- B. Forms for Slabs: Set edge forms, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

### 3.05 PREPARING FORM SURFACES

- A. General: Coat contact surfaces of forms with an approved, non-residual, low-VOC, form-coating compound before placing reinforcement.
- B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.
  - 1. Coat steel forms with a non-staining, rust-preventative material. Rust-stained steel formwork is not acceptable.

### 3.06 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304 "Guide for Measuring, Mixing, Transporting, and Placing Concrete", and as specified.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.
- D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
  - 1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
  - 2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
  - 3. Maintain reinforcing in proper position on chairs during concrete placement.
- E. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical-damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.
- F. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Architect or Engineer.

### 3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and finish and other projections exceeding 1/4 inch in height rubbed down or chipped off.

### 3.08 MONOLITHIC SLAB FINISHES

- A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.
  1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly shape surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- B. Non-slip Broom Finish: Apply a non-slip broom finish to exterior concrete paving.
  1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
    - a. At handicap ramps, roughen concrete surface with a rough-broom finish.

### 3.09 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete slabs for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.
- B. Curbs: Provide monolithic finish to curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

### 3.10 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control materials. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
  - 1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- B. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture retaining cover curing, or by combining these methods, as specified.
- C. Provide moisture curing by the following methods:
  - 1. Keep concrete surface continuously wet by covering with water.
  - 2. Use continuous water-fog spray.
  - 3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.
- D. Provide moisture-retaining cover curing as follows:
  - 1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- E. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
  - 1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - 2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
- F. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.
  - 1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

### 3.11 REMOVING FORMS

- A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.
- B. Form-facing material shall be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.



### 3.12 REUSING FORMS

- A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or other wise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Architect.

### 3.13 PAVEMENT MARKING

- A. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
- D. See Plan Details for additional information.

### 3.14 INSTALLATION OF JOINT SEALANTS

- A. Joint sealant work is in Division 07 – Sealants.

### 3.15 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Architect.
- B. Mix dry-pack mortar, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
  - 1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
  - 2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- C. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
  - 1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01-inch side or that penetrates through to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
  - 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Architect.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
5. Repair methods not specified above may be used, subject to acceptance of Architect.

END OF SECTION 32 13 13

## SECTION 32 31 13

### CHAIN-LINK FENCES AND GATES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Security fencing - Height as shown on the Drawings.
- B. Related Sections:
  - 1. Division 03 Section "Cast-In-Place Concrete" for footings.

##### 1.03 SUBMITTALS

- A. General: Submit electronic (PDF) format submittals according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data in the form of Manufacturer's Technical Data, Specifications and installation instruction for fence and gate posts, fabric, gates and accessories.
- C. Shop drawings showing location of fence, gates, each post, and details of post installation, extension arms, swinging gates, sliding gates, hardware and accessories.

##### 1.04 QUALITY CONTROL

- A. Installer Qualifications: Engage an experienced installer who has at least four years experience and has completed at least eight chain link perimeter security fence projects with same material and of similar scope to that indicated for this project with a successful construction record of in-service performance.
- B. Single-Source Responsibility: Obtain chain link fences and gates including accessories, fittings, and fastenings, from a single source Manufacture: Company specializing in commercial quality chain link fencing.
- C. Installation and materials must comply with the Chain Link Manufactures Institute (CLFMI).

##### 1.05 REFERENCES

- A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
- B. ASTM A 116 (2000) Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
- C. ASTM A 153/A 153M (2000) Zinc-Coating (Hot Dip) on Iron and Steel Hardware
- D. ASTM A 176 (1999) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

- E. ASTM A 392 (1996) Zinc-Coated Steel Chain-Link Fence Fabric
- F. ASTM A 478 (1997) Chromium-Nickel Stainless Steel Weaving and Knitting Wire
- G. ASTM A 491 (1996) Aluminum-Coated Steel Chain-Link Fence Fabric
- H. ASTM A 666 (2000) Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- I. ASTM A 702 (1989; R 1994e1) Steel Fence Posts and Assemblies, Hot Wrought
- J. ASTM A 780 (2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
- K. ASTM A 824 (1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
- L. ASTM C 94/C 94M (2000) Ready-Mixed Concrete
- M. ASTM D 4541 (1995e1) Pull-Off Strength of Coatings Using Portable Adhesion Testers
- N. ASTM F 626 (1996a) Fence Fittings
- O. ASTM F 668 (1999a) Poly(Vinyl Chloride) (PVC)-Coated Steel Chain-Link Fence Fabric
- P. ASTM F 883 (1997) Padlocks
- Q. ASTM F 900 (1994) Industrial and Commercial Swing Gates
- R. ASTM F 1043 (2000) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Frame-work
- S. ASTM F 1083 (1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- T. ASTM F 1184 (1994) Industrial and Commercial Horizontal Slide Gates
- U. ASTM G 23 (1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
- V. ASTM G 26 (1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
- W. ASTM G 53 (1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials
- X. FS FF-C-450 (Rev D) Clamps, Wire Rope
- Y. ASTM A 36 (1990) Structural Steel
- Z. ASTM A 307 (1990) Carbon Steel Externally Threaded Standard Fasteners
- AA. AWS D1.1 (1992) Structural Welding Code – Steel.

## PART 2 - PRODUCTS

### 2.01 FENCE FABRIC MATERIALS

- A. Chain Link Fence Fabric: 9 gauge galvanized wire, woven in 2-inch mesh Fabric height shall be 8 feet. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage. Tie shall be galvanized.
- B. Tension Wire: 9 gauge galvanized tension wire at bottom of fence fabric.

### 2.02 GATES

- A. ASTM F 900 and/or ASTM F 1184 and shall be and shall be galvanized. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.
  - 1. Slide gate operator shall be Slide Driver 40 by HySecurity with key pad located as per the plans.

### 2.03 POSTS

- A. ASTM F 1083, galvanized. Group II, roll-formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184. Posts shall be schedule 40 and galvanized, see plans and details for specific sizes.
  - 1. Top and bottom Rail: 2" OD.
  - 2. Corner Posts: 3-1/2" OD.
  - 3. End Posts: 3-1/2" OD.
  - 4. Line Posts: 2-7/8" OD

### 2.04 BRACES AND RAILS

- A. ASTM F 1083, galvanized, Group II, formed steel sections, size 1-5/8-inch schedule 40 and shall be galvanized.

2.05 WIRE

- A. Tension Wire: 9 gauge galvanized, Type I or Type II, Class 2 coating, in accordance with ASTM A 824.02821-3.

2.06 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

- A. Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored with 3/8 inch diameter plain pin rivets or, at the Contractor's option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Studs driven by an explosive-actuated tool shall not be used with gray iron or other material that can be fractured. A minimum of two studs per support arm shall be used. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

2.07 ACCESSORIES

- A. ASTM F 626. Ferrous accessories shall be galvanized. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.08 CONCRETE

- A. ASTM C 94, using 3/4-inch maximum size aggregate, and having minimum compressive strength of 3500 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.09 PADLOCKS

- A. Padlocks shall be provided by owner.

**PART 3 - EXECUTION**

3.01 FENCE INSTALLATION:

- A. Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.02 WELDED BRACE RAILS

- A. Welded brace rails shall be installed as per the plans and AWS D1.1 at corner end (gate) and pull posts. Damage to the galvanized surface due to welding, shall be repaired with repair sticks of zinc-cadmium alloys or zinc-tin lead alloys as per AWS WZC.

3.03 EXCAVATION:

- A. Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 2-inch clearance between the bottom of the fabric and finish grade.

### 3.04 POST INSTALLATION:

- A. Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings, or as a minimum: 9" diameter x 24" deep post hole. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock.
- B. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted.
- C. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4-inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and re-tested at the Contractor's expense.

### 3.05 BRACES AND TRUSS RODS

- A. Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height. A center brace or 2 diagonal truss rods shall be installed on 12 foot fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

### 3.06 TENSION WIRES

- A. Tension wires shall be galvanized 9 gauge wire and installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 4 inches of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

### 3.07 CHAIN LINK FABRIC

- A. Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 24-inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 2-inches plus or minus 1/2-inch above the ground. For high security fence,

after the fabric installation is complete, the fabric shall be exercised by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be re-secured and re-tested at the Contractor's expense.

### 3.08 GATE INSTALLATION

- A. Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Slide gates shall be installed as recommended by the manufacturer. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

### 3.09 SLIDE GATE OPERATOR

- A. Install slide gate operator (Driver 40 by HySecurity) per manufacturer's current written instructions, with key pad located as per the plans.

END OF SECTION 32 31 13



## SECTION 32 92 00

### TURF AND GRASSES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

##### 1.02 SUMMARY

- A. This Section Includes the following:
  - 1. Seeding.
  - 2. Hydroseeding.
- B. Soil preparation, fertilizing and watering.
- C. Extent of seed and hydroseed: Provide seed and hydroseed at all unpaved areas on the site and at any disturbed areas on the adjacent site. See Drawings for extent of seeded and hydroseeded lawn areas.
- D. Related work described elsewhere:
  - 1. Division 31 Section "Earth Moving" for subgrade and fine grading with topsoil.

##### 1.03 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Hydraulic Growth Medium: A hydraulically applied matrix containing at least 20% volume of prepackaged decomposed/composted organic fibers accepted as growth mediums, such as compost or peat moss that may or may not contain other materials to include soil stabilization chemicals. Used to provide a growth medium for seed germination, plant growth/establishment and soil building characteristics in conditions of marginal or extremely poor soils and where erosion control is required.
- D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- F. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

- G. Planting Soil: Soil that is modified with soil amendments and fertilizers to produce a soil mixture best for plant growth.
- H. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- I. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
  - 1. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

#### 1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of turf and grasses.
  - 1. Certification of each seed mixture for turfgrass.
- C. Product certificates.

#### 1.05 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 1. Pesticide Applicator: State licensed, commercial.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
  - 1. The soil-testing laboratory shall oversee soil sampling.
  - 2. Report suitability of tested soil for turf growth.
    - a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    - b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

#### 1.07 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Maintenance work will be provided by the Owner.

## **PART 2 - PRODUCTS**

### **2.01 SEED (BUFFALO)**

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with Nebraska Department of Roads Standard Specifications, for purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species as follows:
  - 1. Meet Nebraska Department of Roads Standard Specifications.
- C. Grass Seed Mix:
  - 1. Products: Subject to compliance with requirements, provide the following products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Seed mix shall meet the requirements of the Nebraska Department of Roads, Standard Specifications.

### **2.02 INORGANIC SOIL AMENDMENTS**

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  - 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
  - 2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

### **2.03 ORGANIC SOIL AMENDMENTS**

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

#### 2.04 FERTILIZERS

- A. Fertilizer shall meet the requirements of Section 230 and 735 of the Nebraska Department of Roads, Standard Specifications, Version

#### 2.05 PLANTING SOILS

- A. Planting Soil: as defined in Subsections 2.02 and 2.03 of this specification. Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

#### 2.06 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.
- C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.
- E. Mulch matting such as jute or excelsior blanket, wheat straw, oat straw or wood chips 8-12 ton per acre shall be used on slopes greater than 4:1, contractor shall mechanically crimp materials into the slope.

#### 2.07 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.01 TURF AREA PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Apply superphosphate fertilizer directly to subgrade before loosening.
  - 2. Thoroughly blend planting soil off-site before spreading, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
  - 3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
  - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
  - 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 6 inches of soil. Till soil to a homogeneous mixture of fine texture.
    - a. Apply superphosphate fertilizer directly to surface soil before loosening.
  - 3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
  - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.02 SEEDING

- A. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 2 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8-inch (3 mm) of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. (Erosion Control Blanket or equal. Contact Roy Nelson of Erosion Control Blanket at 1-970-875-1158) Spread uniformly at a minimum rate of 1-½ tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- E. Protect seeded areas from hot, dry weather or drying winds by applying straw within 24 hours after completing seeding operations. Soak areas, scatter straw uniformly at one and a half tons per acre.

### 3.03 HYDROSEEDING

- A. Prepare soils at areas of hydroseeding by applying a Hydraulic Growth Medium or equal. (Contact Roy Nelson of Erosion Control Blanket at 1-970-875-1158.)
- B. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
  2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
  3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

### 3.04 TURF MAINTENANCE

- A. Turf maintenance will be provided by the Owner.

### 3.05 SATISFACTORY TURF

- A. Turf Maintenance will be provided by the Owner.

END OF SECTION 32 92 00

# GEOTECHNICAL ENGINEERING REPORT

**Helen Boosalis Park Indoor Shooting Range**  
**NW of 44<sup>th</sup> and Superior Streets**  
**Lincoln, Nebraska**

PREPARED FOR

**Lincoln Parks and Recreation**  
c/o Architectural Design Associates P.C.  
7501 "O" Street  
Suite 105  
Lincoln, NE 68510

March 22, 2013

March 22, 2013

Lincoln Parks and Recreation  
c/o Mr. Dick Bergt  
Architectural Design Associates P.C.  
7501 "O" Street  
Suite 105  
Lincoln, NE 68510

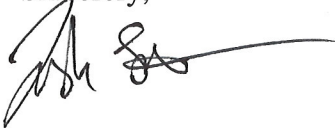
**REFERENCE:** Geotechnical Engineering Report  
Helen Boosalis Park Indoor Shooting Range  
NW of 44<sup>th</sup> and Superior Streets  
Lincoln, Nebraska

Dear Mr. Bergt:

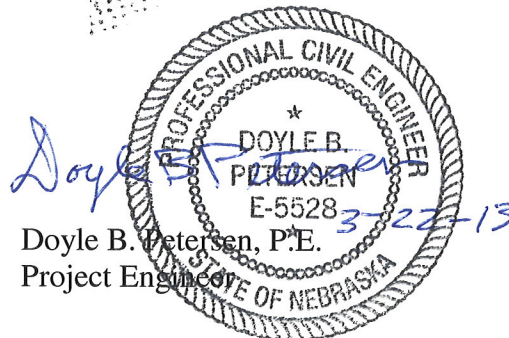
Alfred Benesch & Company (Benesch) is pleased to submit the enclosed report that summarizes the findings of a geotechnical engineering study and provides recommendations related to the design and construction of the foundation for the referenced project.

If any questions arise concerning this report or if additional information is needed about soil conditions at this site, please contact Benesch for assistance.

Sincerely,



Joshua M. Letts  
Engineering Geologist



Enclosures

Orig. & 2 pc.: Architectural Design Associates P.C.



# TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY .....	1
2.0	SUBSURFACE EXPLORATION .....	2
3.0	LABORATORY ANALYSES .....	3
4.0	GEOLOGY AND SITE CONDITIONS .....	4
5.0	DISCUSSION AND RECOMMENDATIONS .....	5
1.	Suitable Floor, Pavement and Foundation Subgrade Material .....	5
2.	Minimum Depth of Footings .....	6
3.	Allowable Bearing Pressure .....	6
4.	Settlement .....	6
5.	Vertical Modulus of Subgrade Reaction .....	7
6.	Preparation of the Building Area and Areas to be Paved .....	7
7.	OSHA Excavation Requirements .....	7
8.	Protective Slopes Around the Building .....	8
9.	Types of Soils to be Used as Fill and Backfill .....	8
10.	Placement of Fill and Backfill .....	8
11.	Pavement Thickness .....	9
12.	Grading Observation .....	10
14.	Subgrade Observation .....	10
15.	Applicability of Recommendations .....	10
6.0	CONCLUSIONS .....	11
	APPENDIX A. VICINITY MAP AND BORING LOCATION PLAN .....	
	APPENDIX B. DUTCH FRICTION-CONE PENETRATION DIAGRAMS .....	
	APPENDIX C. BORING LOGS .....	
	APPENDIX D. CRITERIA USED FOR SOIL CLASSIFICATION .....	

## 1.0 EXECUTIVE SUMMARY

### PROJECT OVERVIEW

Architectural Design Associates (ADA) has indicated that the proposed project will consist of the following:

<b>Structure Type:</b>	150-ft by 125-ft, single-story, slab-on-grade, metal building with an attached 90-ft by 30-ft, single story, slab-on-grade, masonry block building
<b>Type of Foundation(s) Being Considered:</b>	Shallow Footings and Grade Beams
<b>Estimated Maximum Column Load:</b>	24 kips (Dead Load) + 36 kips (Live Load)
<b>Estimated Maximum Wall Load:</b>	4 kips/ft (Dead Load) + 0.7 kips/ft (Live Load)
<b>Finished Floor Elevations:</b>	First Floor: To Be Determined
<b>Estimated Fill Height at Boring Locations:</b>	B-1 2.5 feet B-2 2.0 feet B-3 3.0 feet B-4 8.5 feet B-5 2.5 feet

1 kip = 1,000 lbf

### FACTORS AFFECTING SITE PREPARATION

- Unsuitable floor and pavement subgrade materials extend to depths of 0.5 to 1.2 feet.
- Low-moisture-content (moist) soils were encountered to depths of 4.1 to 6.5 feet. These soils could cause up to 0.6 inches of heave if they get wetter.
- Unsuitable fill materials were encountered to depths of 0.6 to 1.2 feet.
- Onsite soils are moist and will required wetting prior to use as fill.

### FACTORS AFFECTING FOUNDATION AND BUILDING DESIGN

- Natural foundation soils were encountered at elevations of 1149.5 to 1144.4 feet (0.7 to 2.5 feet below existing grade). These soils could be used to support the proposed building, however, portions of the soils are moist, and these moist soils could swell/heave if they get wetter.
- Previously removed structures are in the vicinity of the proposed building area. It is unknown whether all of the below grade remnants of these buildings were removed during demolition of the structures.

## 2.0 SUBSURFACE EXPLORATION

A program of Dutch friction-cone soundings, test borings and soil sampling was performed at the project site on March 15, 2013. Five (5) Dutch friction-cone soundings were made at the site. The results of the soundings were used to determine the depths for obtaining undisturbed soil samples from an exploratory boring made immediately adjacent to each sounding. Five (5) exploratory borings were taken to depths of 10 to 15 feet below the existing grade to establish the general subsurface conditions of the area under consideration.

The Dutch friction-cone soundings were performed with a mechanical penetrometer in accordance with ASTM D 3441, Standard Method for Deep, Quasi-Static, Cone, and Friction Cone Penetration Tests of Soil. The plot of the data from this test identifies the relative positions and thicknesses of hard and soft layers of soil.

The borings were made in accordance with ASTM D 1452, Standard Practice for Soil Investigation and Sampling by Auger Borings. A machine-driven, continuous-flight auger having a diameter of 6 inches used to advance the holes for and thin-walled tube sampling. The bore holes were stable and casing was not required.

Undisturbed soil samples were recovered for visual observation and laboratory testing in accordance with ASTM D 1587, Standard Method for Thin-Walled Tube Sampling of Soil, utilizing an open-tube sampler having an outside diameter of 3.0 inches.

The vicinity map and the boring location plan are presented in Appendix A. The penetration diagrams (see Appendix B) present the results of the Dutch friction-cone soundings. The boring logs (see Appendix C) present the data obtained in the subsurface exploration. The logs include the surface elevations, the approximate depths and elevations of major changes in the character of the subsurface materials, visual descriptions of the materials in accordance with the criteria presented in Appendix D, groundwater data, and the locations of undisturbed samples of soil.

The locations of the soundings and borings were determined by tape measurements from the center of the intersection of North 44<sup>th</sup> and Superior Streets. Elevations (approximate) at the sounding and boring locations were determined by survey with reference to a brass cap located in the intersection of North 44<sup>th</sup> and Superior Streets. ADA indicated that the elevation of this benchmark is 1143.95 feet (NAVD88). Water level readings were made in the auger borings at times and under conditions stated on the boring logs.

### 3.0 LABORATORY ANALYSES

The undisturbed soil samples obtained during the subsurface exploration were examined in the laboratory by a member of Benesch's professional engineering staff to supplement the field identification. Standard tests were performed on selected samples to determine the engineering properties of the foundation materials.

The moisture contents and dry unit weights of selected undisturbed soil samples were determined in the laboratory. These test results are presented in the boring logs opposite the respective sample locations. The moisture contents were determined in accordance with either ASTM D 4643, Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method, or ASTM D 2216, Standard Test Method for Determination of Water (Moisture) Content of Soil and Rock by Mass. The dry unit weights were determined in accordance with the Displacement Method of the Corps of Engineers, EM1110-2-1906, Appendix II, Unit Weights, Void Ratio, Porosity, and Degree of Saturation. These data correlate with the strength and compressibility of the soil. High moisture content and low density usually indicate low strength and high compressibility.

The unconfined compressive strengths of several undisturbed samples were estimated in the laboratory with a calibrated hand penetrometer. These strengths are presented on the boring logs and are estimates only. Actual values are generally lower than the estimated values indicated on the boring logs.

## 4.0 GEOLOGY AND SITE CONDITIONS

The city of Lincoln lies in the Dissected Till Plains section of Nebraska, a part of the Central Lowland province of the Interior Plains physiographic division<sup>1</sup>. The project site is located in northeast Lincoln on loess-mantled terraces. The terraces are located adjacent to alluvial bottomlands of Salt Creek, and generally consist of Peoria loess deposits atop alluvial silts and sands. The site has been previously graded as evidenced by the fill encountered at the boring locations.

HWS Consulting Group (now Benesch) published a “Desktop Geotechnical Report” for the project site in 2009, which noted that there were former buildings that were located in the approximate vicinity of the proposed building based on 1956 aerial photographs and a 1964 quadrangle map (see the boring location plan in Appendix A).

The subsurface materials encountered at the boring locations begin at the ground surface with either fill or topsoil, then extend down the soil development profile to subsoil, lower subsoil, and Peoria loess overlying cohesive and granular Peoria alluvium. Detailed descriptions are provided in the boring logs, which are presented in Appendix C.

Groundwater was not encountered to the depths of any of the borings. The water table could be expected to fluctuate several feet depending on surface drainage, rainfall, temperature, and other factors.

---

<sup>1</sup> Physiographic Provinces of North America, Map by A. K. Lobeck, 1948; The Geographical Press; Columbia University, New York

## 5.0 DISCUSSION AND RECOMMENDATIONS

Four basic requirements for a satisfactory foundation of a structure are as follows:

- A. The base of the foundation must be located below the depth to which the soil is subject to frost action and seasonal volume change caused by alternate wetting and drying.
- B. The foundation (including the earth beneath it) must be stable or safe from failure.
- C. The foundation must not settle or deflect enough to disfigure or damage the structure.
- D. The foundation structure must be properly located with respect to any future influence that could adversely affect its performance.

The following recommendations for design and construction of the foundation for the proposed shooting range building are based upon site conditions, the engineering properties of the subsurface materials, and the requirements of the proposed structure.

### 1. SUITABLE FLOOR, PAVEMENT AND FOUNDATION SUBGRADE MATERIAL

The building area will be filled approximately 2 to 8.5 feet above existing grade. The existing fill material and upper 0.5 feet of topsoil should not be used to support the footings, floor slab, pavement structure, or new fill. Any remaining soils may be left in the building area and areas to be paved if these soils are "wet" and prove stable under a loaded dump truck or similar piece of equipment. By Benesch's definition, a "wet" cohesive soil contains sufficient moisture to be rolled into a 1/8-inch-diameter thread without crumbling. A "moist" cohesive soil would crumble when being rolled to form a 1/8-inch-diameter thread. Footings could then be seated in either controlled earth fill, or natural soils at normal plan depths.

At the time of the exploration, portions of the topsoil, subsoil, lower subsoil, and Peoria were moist. Table 1 presents the locations of the moist soils at each boring location. These soils have moderate to high volume-change potential and will swell as their moisture contents increase. The estimated heave is 0.6 inches as these moist soils become wetter. The magnitude of potential heave is difficult to estimate and should only be used as a rough approximation. To eliminate the potential swell, all moist soils should be (a) removed and replaced with controlled earth fill, (b) reworked to conform to the moisture content and compaction recommendations presented in Table 2, or (c) "cured" to raise the moisture content of the soils. Controlled earth fill is defined as earth fill that is designed, compacted, and tested in accordance with generally accepted good practice and placed with observation by the Geotechnical Engineer. The potential swell might be reduced by using a chemical soil stabilizer like EcSS 3000<sup>TM</sup>. The design and injection of a soil stabilizer are highly specialized work requiring skilled personnel. Experts in this work should be contacted to determine if this is a feasible solution for this project site.

**TABLE 1  
LOCATION OF MOIST SOILS**

Boring No.	Top/Bottom Elevation, ft	Top/Bottom Depth Below Existing Grade, ft
1	Not Encountered	--
2	1149.0/1144.0	1.5/6.5
3	1146.7/1142.8	2.1/6.0
4	1143.4/1140.6	1.7/4.5
5	1148.0/1144.7	0.8/4.1

\*Depth of boring. Moist soils might extend below this depth

Curing of a soil that is low in moisture content consists of uniformly wetting the soil until the moisture content has increased to a level at least equal to its plastic limit (approximately 22%). The time required to uniformly cure the moist soil is dependent on several factors including the thickness of the dry materials, the variability of the subsurface material types, and weather conditions. The curing process could take from several days to two or more weeks to occur. Serious consideration should be given to starting the curing operations prior to beginning the subsequent construction activities. A moisture content at least equal to the plastic limit of the soil should be maintained until the footings, floor slab, and pavement structure are constructed. The Geotechnical Engineer should inspect areas that have been "cured" to verify that the moisture content of the subgrade soils has been increased to sufficient depth prior to the commencement of the construction activities.

## **2. MINIMUM DEPTH OF FOOTINGS**

The bottoms of all exterior footings should be placed at a minimum depth of 40 inches below finished grade to provide reasonable protection against frost action and seasonal volume change.

## **3. ALLOWABLE BEARING PRESSURE**

The allowable net bearing pressure on the natural materials located at or below the depths in Recommendation 1 or on controlled earth fill is 3,000 lbf/ft<sup>2</sup>. The net bearing pressure is the contact pressure at the base of the foundation in excess of the pressure at the same level due to the surrounding surcharge. The surcharge pressure is equal to the total weight of a column of soil that extends from the lowest immediately adjacent ground surface to the bottom of the foundation divided by the soil column's area.

## **4. SETTLEMENT**

Settlement of the building is expected to be negligible (less than 1/4 inch), if the fill materials are properly placed (see Recommendation 10), and the recommendations in this report are carried out.

## 5. VERTICAL MODULUS OF SUBGRADE REACTION

The suggested value of the vertical modulus of subgrade reaction to be used in the design of footings and pavement structure is 75 and 100 lbf/in<sup>3</sup>, respectively.

## 6. PREPARATION OF THE BUILDING AREA AND AREAS TO BE PAVED

All vegetation, the existing fill materials, and the upper 0.5 foot of topsoil should be removed from the building area and areas to be paved. In addition, any existing footings, debris, rubble, etc. from the demolition of the former buildings should be removed. If the estimated heave presented in Recommendation 1 is considered excessive, all moist soils (see Table 1) should be (a) removed and replaced, (b) reworked, (c) cured or (d) possibly chemically stabilized. The removal, reworking, or curing of these materials should extend beyond the outside edges of the proposed footings a minimum horizontal distance of 3.0 feet or two-thirds the distance between the bottom-of-footing elevation and the surface of the suitable wet soils, whichever is greater. The sides of the excavation should be sloped to permit the controlled earth fill to be placed against the sides of the excavations to the recommended degree of compaction. Thereafter, the exposed ground located in areas that have been "cut" to the proposed subgrade elevations and areas to be filled should be proofrolled with a loaded dump truck or similar piece of equipment (in the presence of the Geotechnical Engineer) to locate unstable materials.

The Geotechnical Engineer should observe the building area and areas to be paved to verify conformance to the above recommendations. Upon approval of the site by the Geotechnical Engineer, any exposed ground surface that has not been previously reworked should be scarified to a minimum depth of 6 inches and reworked to conform to the moisture content and compaction recommendations presented in Table 2. Areas to be filled should then be raised to the desired elevation with controlled earth fill.

Immediately prior to placement of the pavement structure, the subgrade in cut and fill sections should be scarified to a minimum depth of 6 inches and reworked to a uniform condition conforming to the moisture content and compaction recommendations presented in Table 2.

The footing excavations should extend into either the controlled earth fill or suitable natural foundation materials located at normal plan depths. The Geotechnical Engineer should observe the foundation excavations to verify that the footings will be seated in suitable foundation material.

## 7. OSHA EXCAVATION REQUIREMENTS

Excavations that will be occupied by personnel should be made in accordance with the Occupational Safety and Health Administration (OSHA) Construction Standards-29 CFR Part 1926, Subpart P-Excavations as published in the Federal Register, Vol. 54, 209, Tuesday, October 31, 1989, Rules and Regulations. OSHA states that a soil should be reclassified if the properties, factors, or conditions affecting the soil's classification change in any way. Sheet piling and/or shoring will be necessary if the sides of the excavations cannot be sloped to meet OSHA regulations.



## 8. PROTECTIVE SLOPES AROUND THE BUILDING

The site should be graded in a manner that will divert water away from the building. The protective slopes around the building should meet the following requirements:

- A. Slope downward from the building to lower areas or drainage swales.
- B. Minimum horizontal length of 10 feet, minimum vertical fall of 6 inches (5 percent).
- C. Minimum gradient (beyond 10 feet from building):
  1. Impervious surface; 1/8 inch per foot (1 percent).
  2. Pervious surface; 1/4 inch per foot (2 percent).

## 9. TYPES OF SOILS TO BE USED AS FILL AND BACKFILL

Controlled earth fill placed within the building area and areas to be paved should be constructed of inorganic CL<sup>2</sup>, ML<sup>3</sup>, SM<sup>4</sup>, and/or SC<sup>5</sup> materials (all with a liquid limit less than 50 and a plasticity index less than 30). The lean clays encountered at the project site are considered suitable for use as fill within the building area and areas to be paved. It should be noted, however, that portions of these materials are low in moisture content and will require the addition of water to achieve a moisture content necessary for proper placement.

The materials used as fill and backfill outside the building area and areas to be paved may consist of CL, ML, SM, SC, and/or CH (fat clay, fat clay with sand, and/or sandy fat clay). Proposed fill and backfill materials should be subject to approval by the Geotechnical Engineer. Representative samples of the proposed fill and backfill materials should be submitted to the Geotechnical Engineer at least three days prior to placement so the necessary laboratory tests can be performed.

## 10. PLACEMENT OF FILL AND BACKFILL

The suggested basis for controlling the placement of fill and backfill on the site, excluding free-draining granular materials, are the "optimum moisture content" and "maximum dry density" as determined by ASTM D 698, Procedure A, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using **Standard Effort** (12,400 ft-lbf/ft<sup>3</sup>) (600 kN-m/m<sup>3</sup>). The recommended acceptable values of moisture content and degree of compaction are given in Table 2.

---

<sup>2</sup> Lean clay, lean clay with sand and sandy lean clay.

<sup>3</sup> Silt, silt with sand and sandy silt.

<sup>4</sup> Silty sand.

<sup>5</sup> Clayey sand.

**TABLE 2  
COMPACTION RECOMMENDATIONS FOR CONTROLLED EARTH FILL AND BACKFILL**

<b>Location</b>	<b>Soil Type</b>	<b>Minimum Moisture Content</b>	<b>Minimum Compaction*</b>
Below bottom-of-interior-footing elevation in the building area.	Glacial Till	Optimum	97%
	Silts and Lean Clays	2% Below Optimum	97%
	Silty and Clayey Sands	**	100%
From 0.0 to 1.0 foot below pavement subgrade elevation outside the building area.	Glacial Till	Optimum	100%
	Silts and Lean Clays	2% Below Optimum	100%
	Silty and Clayey Sands	**	100%
(a) Above bottom-of-interior-footing elevation in the building area and (b) greater than 1.0 foot below pavement subgrade elevation outside the building area.	Glacial Till	Optimum	95%
	Silts and Lean Clays	2% Below Optimum	95%
	Silty and Clayey Sands	**	95%
Backfill of footings and utility trenches outside the building area and outside of areas to be paved.	Silts and Clays	2% Below Optimum	92%

\*Percent of Maximum Dry Density (ASTM D 698, Procedure A)

\*\*Moisture as necessary to obtain density (near Optimum)

Clean free-draining sand used as backfill should be consolidated by means of a vibratory compactor to at least 55% "relative density", as determined in accordance with ASTM D 4253 (Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table) and D 4254 (Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density).

## 11. PAVEMENT THICKNESS

Assumptions used in the pavement thickness determinations included:

- Design life = 20 yrs.
- Annual "Traffic" Growth = 2%
- 28 day concrete compressive strength = 4000 lbf/in<sup>2</sup>
- Soil CBR = 5
- Soil resilient modulus = 7,500 lbf/in<sup>2</sup>
- Soil modulus of subgrade reaction = 100 lbf/in<sup>3</sup>

The recommended minimum pavement thicknesses are presented below.

- Light Duty Pavement (car and pickup traffic):
  - Asphalt = 6 inches
  - Concrete = 5 inches
- Medium Duty Pavement (buses and a garbage truck):
  - Asphalt = 7 inches
  - Concrete = 7 inches

## **12. GRADING OBSERVATION**

Observation and frequent testing by the Geotechnical Engineering Firm during compaction of fill and backfill are necessary to verify proper moisture content and degree of compaction. A professional opinion should be obtained from the Geotechnical Engineer that the site has been properly prepared, that all footings will be seated on suitable foundation materials, and that all fill, backfill, and subgrade materials conform to the moisture content and compaction recommendations presented above. If these testing and observation services are not performed, the allowable bearing pressure stated in Recommendation 3 might be invalid. As the Geotechnical Engineer for this project, Benesch has interpreted the results of the subsurface exploration and laboratory tests to arrive at the recommendations presented in this report. Consequently, Benesch is in the best position to relate actual observed conditions to those assumed for this report and to provide revised recommendations if differences are found during grading operations and construction of the foundation for the referenced project.

## **14. SUBGRADE OBSERVATION**

The floor subgrade, pavement subgrade and foundation materials should be observed by the Geotechnical Engineer immediately prior to placement of the concrete or paving components. Severe changes in the condition of these materials can occur after initial preparation as the result of rain, drying, freezing, and construction activities. Any subgrade or foundation material that becomes disturbed, desiccated, or does not conform to the moisture content and compaction recommendations previously presented should either be removed and replaced or reworked to meet these recommendations.

## **15. APPLICABILITY OF RECOMMENDATIONS**

The recommendations presented in this report are based in part upon Benesch's analyses of the data from the Dutch friction-cone soundings and soil borings. The penetration diagrams, boring logs, and related information depict subsurface conditions only at the specific sounding and boring locations and at the time of the subsurface exploration. Soil conditions might differ between the soundings and exploratory borings and might change with the passage of time. The nature and extent of any variations between the sounding and boring locations or of any changes in soil conditions (e.g., drying of soil) might not become evident until grading operations and construction of the foundation for the referenced project have begun. If variations and changes in the soil conditions then appear, it will be necessary to re-evaluate the recommendations stated in this report.

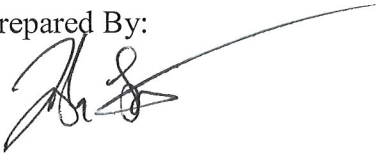
## 6.0 CONCLUSIONS

Benesch concludes, on the basis of the findings of the subsurface exploration at the project site and the evaluation of the engineering properties of samples of the foundation materials, that the proposed indoor shooting range can be supported by spread footings seated on either firm natural materials or controlled earth fill. The moist subsoil, lower subsoil, and Peoria have moderate to high volume-change potential and will swell as the moisture contents increase. Special attention should be paid to the recommendations provided above concerning the moist soils encountered on site.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices for exclusive use by the City of Lincoln, its designers, and contractors for specific application to the proposed Helen Boosalis Park indoor shooting range. The recommendations of this report are not valid for any other purpose.

Benesch should be contacted if any questions arise concerning this report or if changes in the nature, design or location of the structure are planned. If any such changes are made, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed by Benesch and the conclusions of this report are modified or verified in writing. This report shall not be reproduced, except in full, without the written approval of Alfred Benesch & Company.

Prepared By:

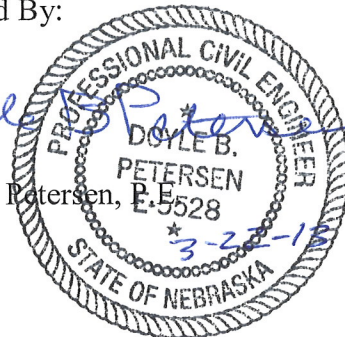


Joshua M. Letts  
Engineering Geologist

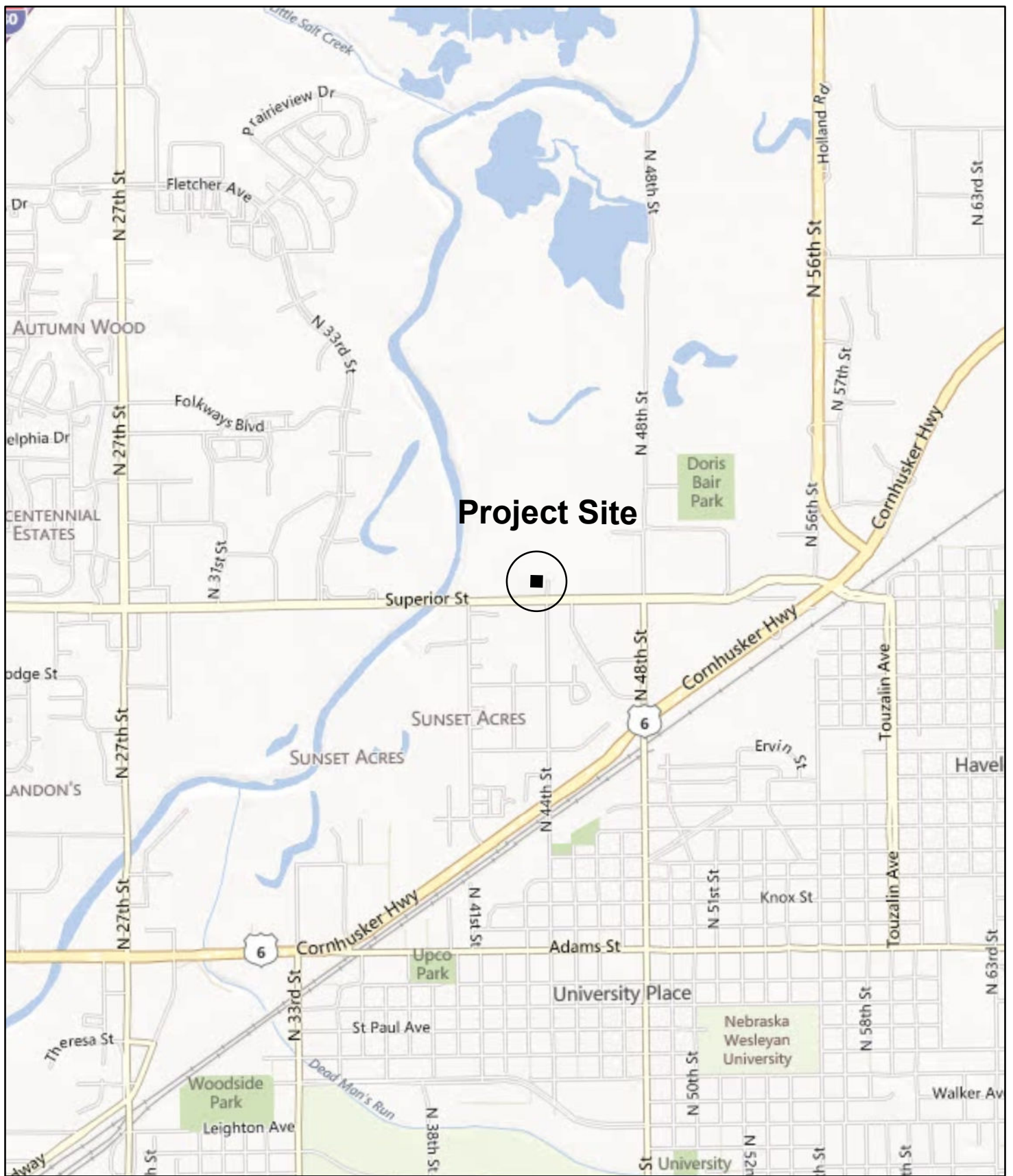
Reviewed By:



Doyle B. Petersen, P.E. 5528



**APPENDIX A. VICINITY MAP AND BORING LOCATION PLAN**



**Project Site**

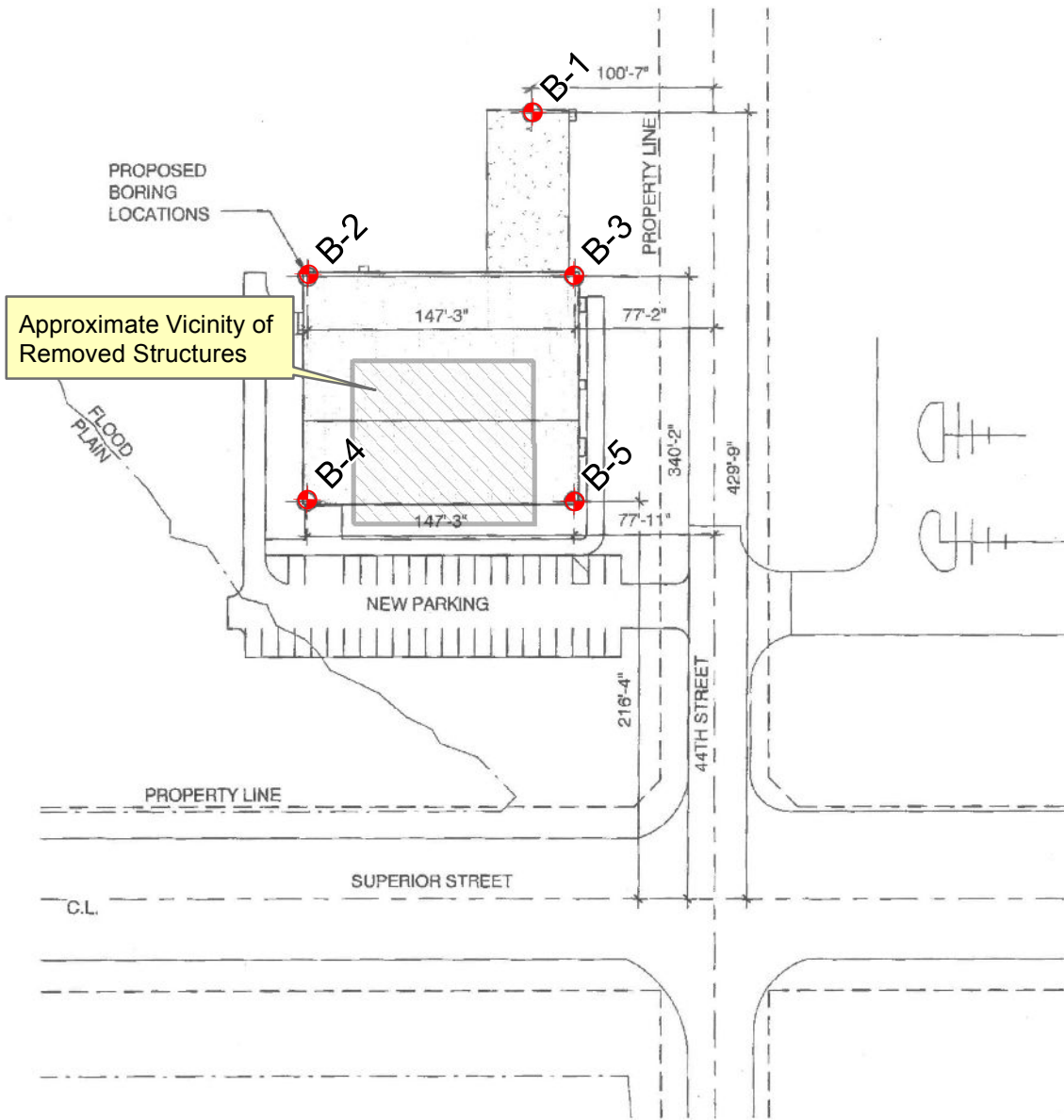
ADA Drawing



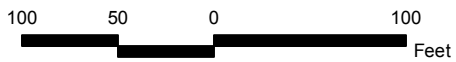
Helen Boosalis Park  
Indoor Shooting Range  
Lincoln, Nebraska



**Vicinity Map**  
**Figure A-1**



ADA Drawing



Helen Boosalis Park  
Indoor Shooting Range  
Lincoln, Nebraska

**Boring Location Plan**  
**Figure A-2**

**APPENDIX B. DUTCH FRICTION-CONE PENETRATION DIAGRAMS**





engineers · scientists · planners

**LINCOLN OFFICE**  
 825 "J" Street  
 PO Box 80358  
 Lincoln, NE 68508

**PENETRATION DIAGRAM OF  
 DUTCH FRICTION-CONE PENETROMETER**

**PROJECT:** Helen Boosalis Park Indoor Shooting Complex  
 Lincoln, Nebraska

**SOUNDING NO.:** S-1  
**LOCATION:** B-1  
**SURFACE ELEVATION:** 1149.1 feet

**DATE:** March 15, 2013  
**TESTED BY:** CL  
**RECORDED BY:** GW

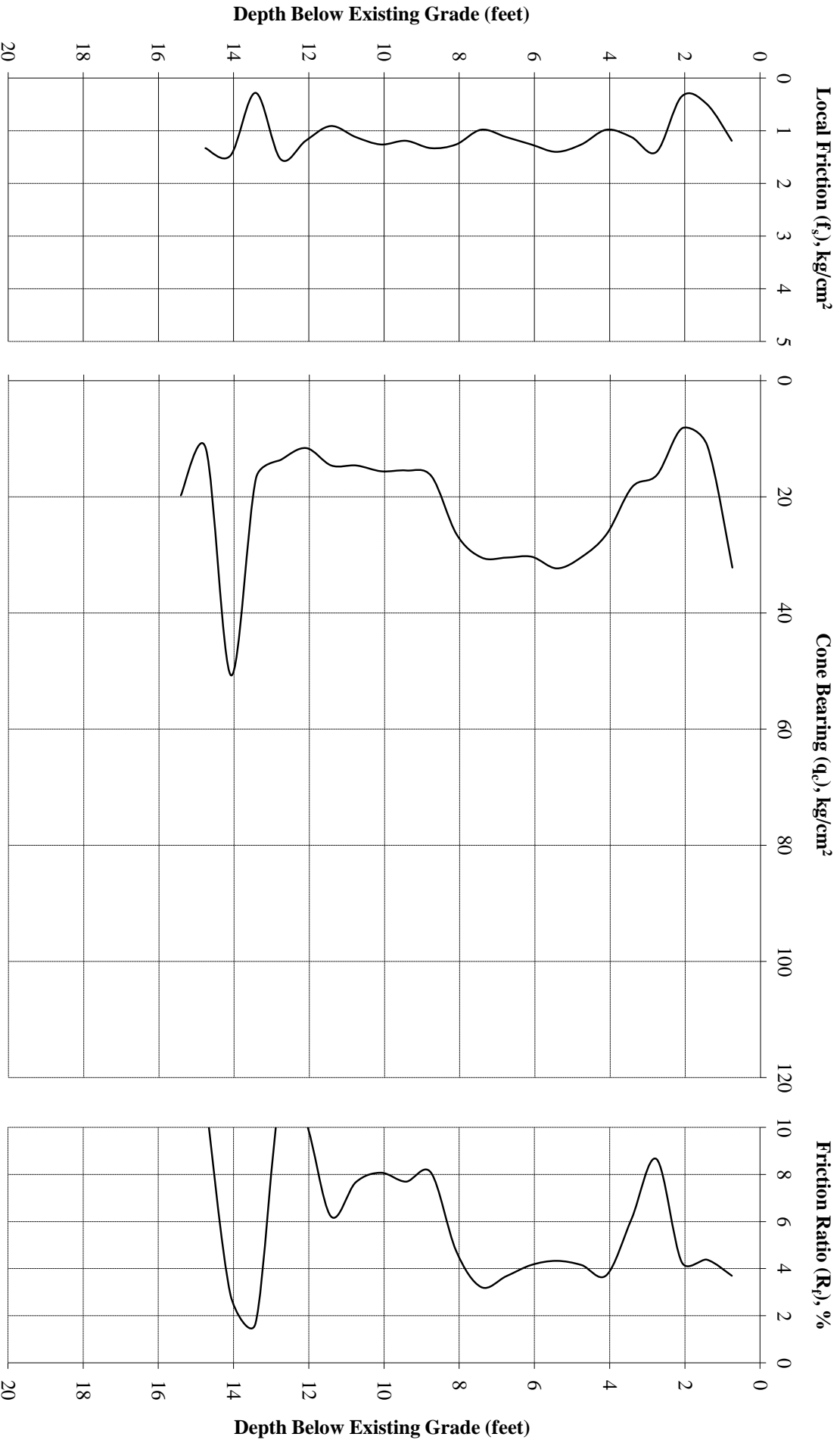


Figure C-1a



engineers · scientists · planners

**LINCOLN OFFICE**  
 825 "J" Street  
 PO Box 80368  
 Lincoln, NE 68508

**PENETRATION DIAGRAM OF  
 DUTCH FRICTION-CONE PENETROMETER**

**PROJECT:** Helen Boosalis Park Indoor Shooting Complex  
 Lincoln, Nebraska

**SOUNDING NO.:** S-2  
**LOCATION:** B-2  
**SURFACE ELEVATION:** 1150.5 feet

**DATE:** March 15, 2013  
**TESTED BY:** CL  
**RECORDED BY:** GW

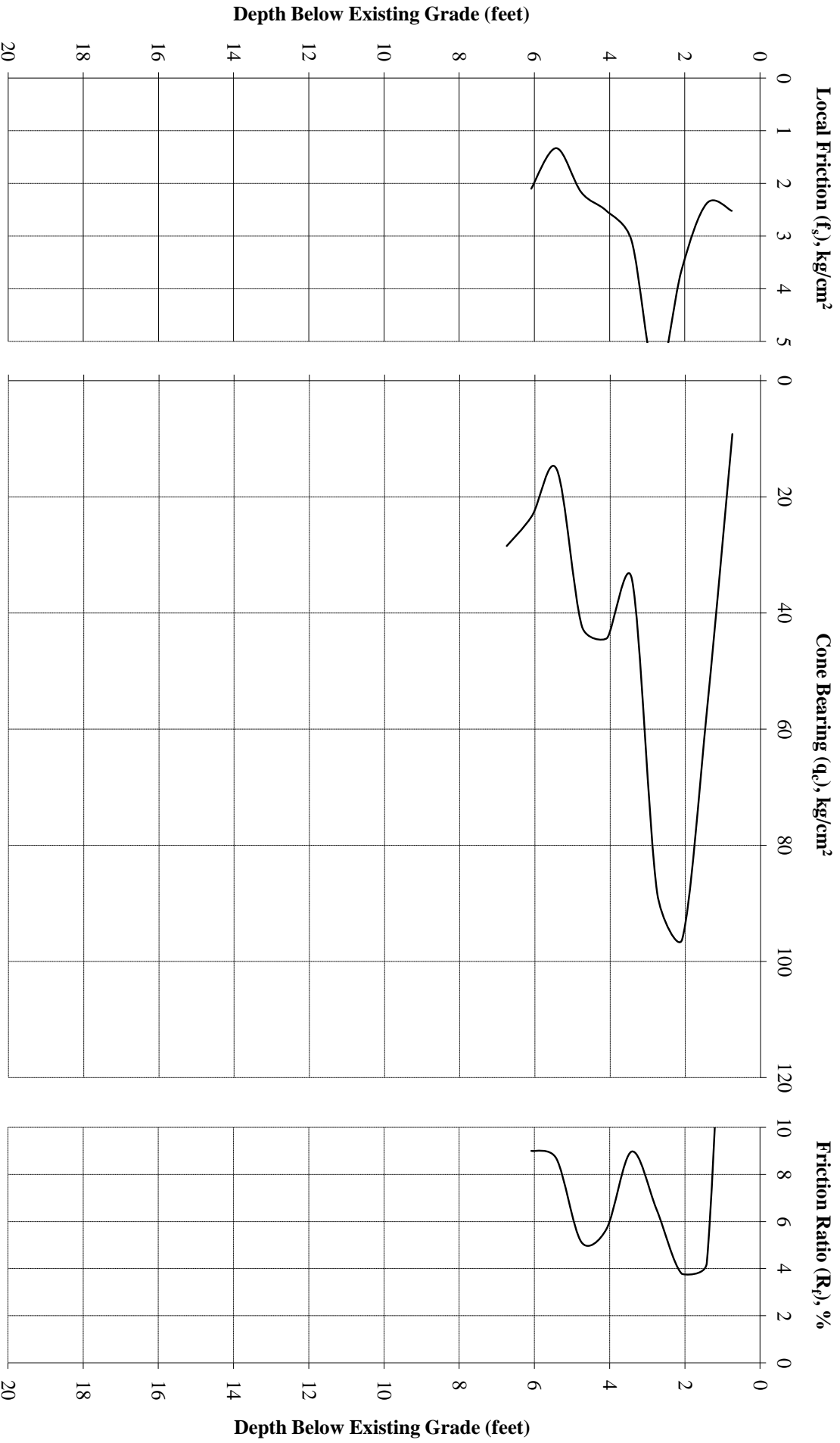


Figure C-2a



engineers · scientists · planners

**LINCOLN OFFICE**  
 825 "J" Street  
 PO Box 80368  
 Lincoln, NE 68508

**PENETRATION DIAGRAM OF  
 DUTCH FRICTION-CONE PENETROMETER**

**PROJECT:** Helen Boosalis Park Indoor Shooting Complex  
 Lincoln, Nebraska

**SOUNDING NO.:** S-3  
**LOCATION:** B-3  
**SURFACE ELEVATION:** 0.0 feet

**DATE:** March 15, 2013  
**TESTED BY:** CL  
**RECORDED BY:** GW

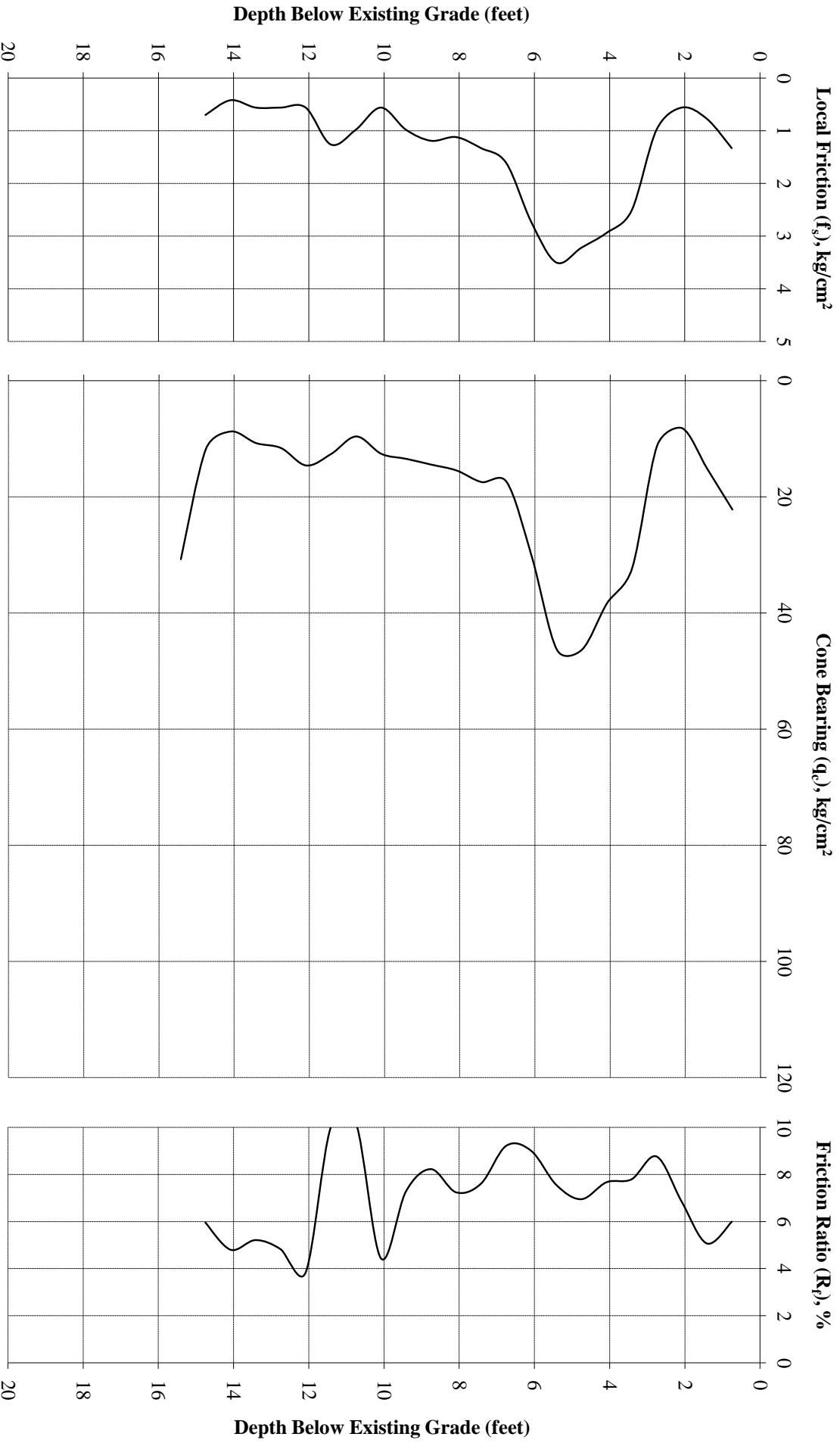


Figure C-3a



engineers · scientists · planners

**LINCOLN OFFICE**  
825 "J" Street  
PO Box 80358  
Lincoln, NE 68508

**PENETRATION DIAGRAM OF  
DUTCH FRICTION-CONE PENETROMETER**

**PROJECT:** Helen Boosalis Park Indoor Shooting Complex  
Lincoln, Nebraska

**SOUNDING NO.:** S-4  
**LOCATION:** B-4  
**SURFACE ELEVATION:** 1145.1 feet

**DATE:** March 15, 2013  
**TESTED BY:** CL  
**RECORDED BY:** GW

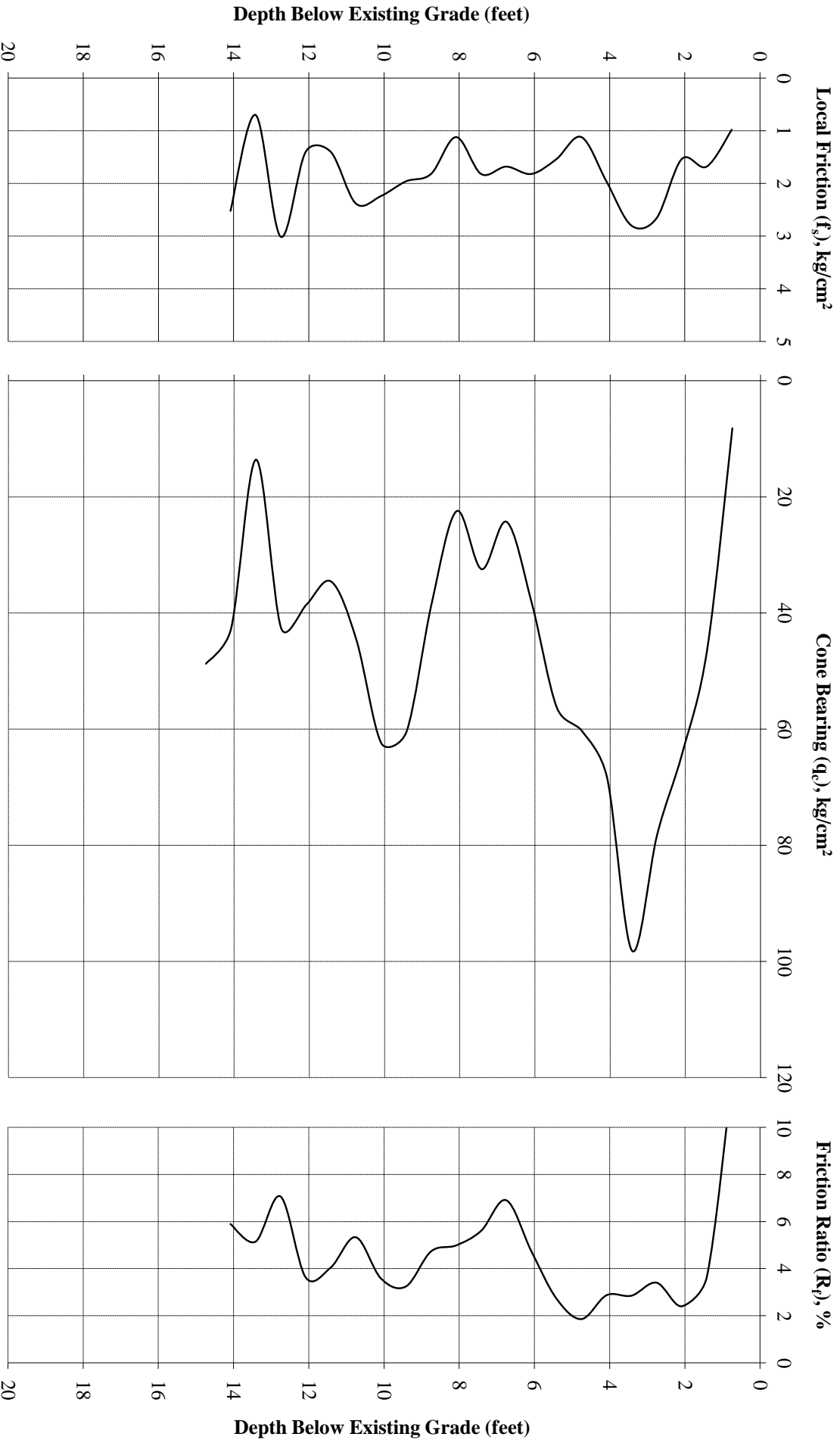


Figure C-4a



**LINCOLN OFFICE**  
 825 "J" Street  
 PO Box 80368  
 Lincoln, NE 68508

**PENETRATION DIAGRAM OF  
 DUTCH FRICTION-CONE PENETROMETER**

**PROJECT:** Helen Boosalis Park Indoor Shooting Complex  
 Lincoln, Nebraska

**SOUNDING NO.:** S-5  
**LOCATION:** B-5  
**SURFACE ELEVATION:** 1148.8 feet

**DATE:** March 15, 2013  
**TESTED BY:** CL  
**RECORDED BY:** GW

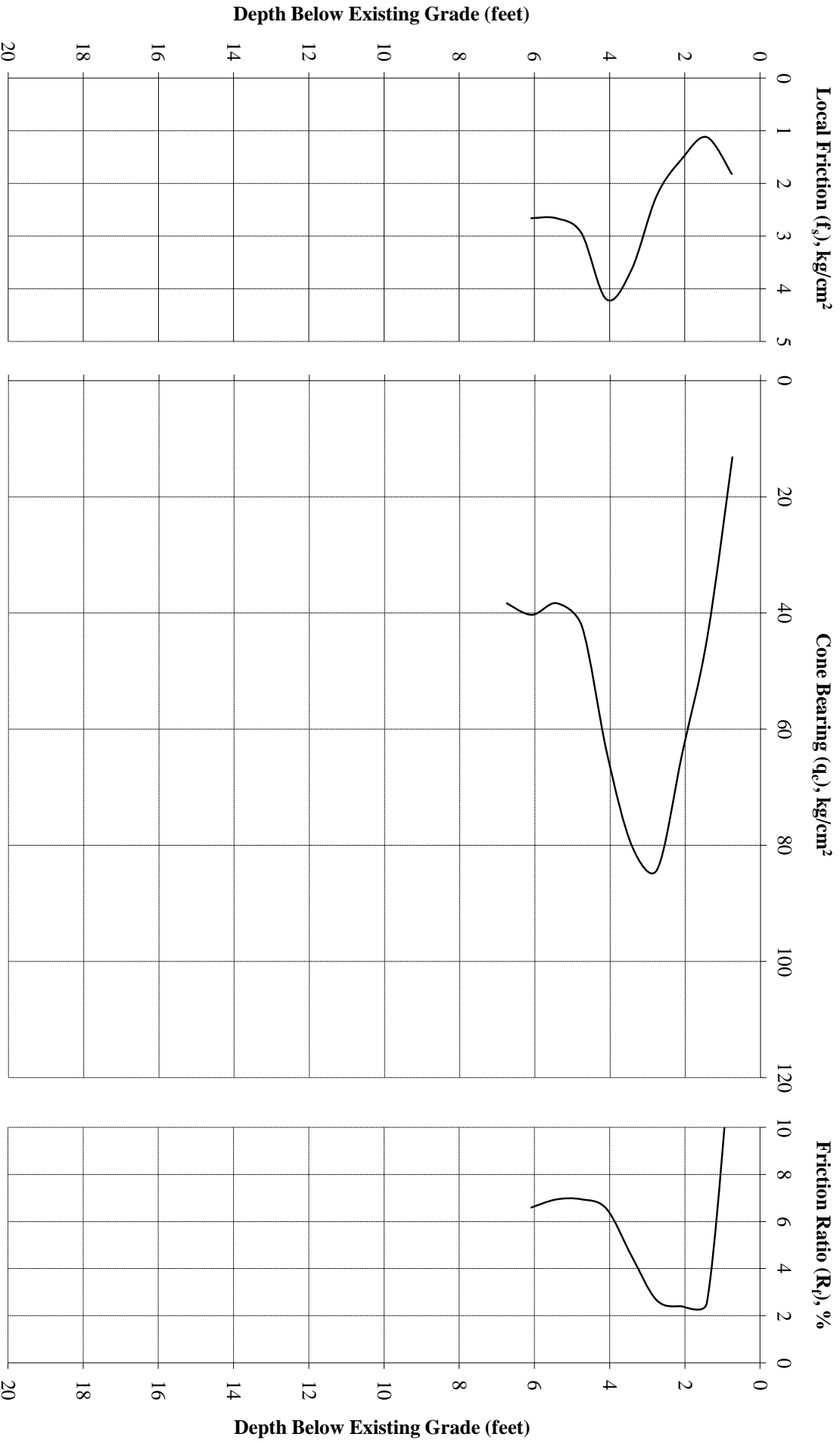


Figure C-5a

**APPENDIX C. BORING LOGS**



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

# BORING LOG

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-1

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	qu (tsf)	DEPTH (feet)
1149.1	0.0		SM - SILTY SAND; 75-85% fine to coarse sand; nonplastic; black; moist; loose; with 40-50% of the sand made of cinders. (Fill)			0.0
1148.6	0.5		CL - LEAN CLAY; 5-15% fine to coarse sand; medium plasticity; very dark brown; wet; medium stiff. (Fill)			
1147.9	1.2		CL/CH - LEAN TO FAT CLAY; medium to high plasticity; black with very dark grayish brown and dark grayish brown; wet; very stiff. (Lower Subsoil)			
1147.1	2.0		CL - LEAN CLAY; medium plasticity; olive brown heavily mottled with dark grayish brown; wet; very stiff. (Lower Subsoil)			2.5
1146.1	3.0		CL - LEAN CLAY; medium plasticity; olive brown slightly mottled with white; wet; very stiff; with calcareous nodules. (Peoria)			
1143.5	5.6		CL - LEAN CLAY; medium plasticity; olive brown; wet; very stiff. (Peoria)	1	3.5*	5.0
1142.3	6.8		CL - LEAN CLAY; medium plasticity; light olive brown slightly mottled with white; wet; stiff; with trace of calcareous nodules. (Peoria)		3.75*	7.5
1141.1	8.0		CL - LEAN CLAY; medium plasticity; light olive brown; wet; stiff. (Peoria)			
1139.1	10.0		Boring Terminated at: 10.0ft			10.0
						12.5
						15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

\* Unconfined compressive strength was estimated using a calibrated hand penetrometer.

Figure C - 1



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

**BORING LOG**

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-2

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1150.5	0.0		CL - LEAN CLAY; medium plasticity; black; wet; frozen. (Topsoil)				0.0
1150.0	0.5		CL - LEAN CLAY; medium plasticity; black; wet; soft to medium stiff. (Topsoil)				
1149.5	1.0		CH - FAT CLAY; high plasticity; brown; wet; very stiff. (Subsoil)				
1149.0	1.5		CH - FAT CLAY; high plasticity; olive brown with dark brown; moist; hard. (Subsoil)				
1148.0	2.5		CL - LEAN CLAY; medium plasticity; olive brown slightly mottled with brown; moist; hard. (Lower Subsoil)	2	89.8	15.3	2.5
1147.0	3.5		CL - LEAN CLAY; medium plasticity; light yellowish brown; moist; very stiff. (Peoria)				
1146.0	4.5		CL - LEAN CLAY; same as above except light olive brown. (Peoria)				5.0
1145.0	5.5		CL - LEAN CLAY; medium plasticity; light olive brown; moist to wet; very stiff. (Peoria)				
1144.0	6.5		CL - LEAN CLAY; medium plasticity; light olive brown; wet; very stiff. (Peoria)				7.5
1142.5	8.0		CL - LEAN CLAY; same as above except stiff to very stiff. (Peoria)				10.0
1140.0	10.5		CL - SANDY LEAN CLAY; 40-50% fine to medium sand; medium plasticity; olive brown; wet; very stiff. (Peoria Alluvium)				
1139.5	11.0		SP-SM - POORLY GRADED SAND with Silt; 85-95% fine to medium sand; nonplastic; light yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				
1139.0	11.5		SC - CLAYEY SAND; 55-65% fine sand; medium plasticity; olive brown; moist to wet; loose to medium dense. (Peoria Alluvium)				
1138.0	12.5		SM - SILTY SAND; 75-85% fine sand; low plasticity; light olive brown with olive brown; moist; loose to medium dense; with few thin clayey sand seams. (Peoria Alluvium)				12.5
1135.5	15.0		Boring Terminated at: 15.0ft				15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

Figure C - 2





825 J Street  
 Lincoln, NE 68508  
 402-479-2200 \* Fax: 402-479-2276  
 www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

LOCATION: NW Corner of N44th and Superior Street  
 Lincoln, NE

JOB NO.: 110705.00  
 RIG / METHOD: CME 550 / Straight Auger  
 CREW: CL & GW

**BORING LOG**

BORING No.: B-3

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	qu (tsf)	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1148.8	0.0		SC-SM - SILTY, CLAYEY SAND; 0-5% fine gravel; 75-85% fine to coarse sand; low to medium plasticity; black; moist to wet; loose to medium dense; with 20-30% cinders. (Fill)					0.0
1148.2	0.6		CL - LEAN CLAY; medium plasticity; very dark grayish brown; wet; medium stiff to stiff. (Topsoil)					
1146.7	2.1		CL - LEAN CLAY; medium plasticity; dark brown; moist; hard. (Topsoil)		1.75*			
1146.3	2.5		CL - LEAN CLAY; medium plasticity; dark brown with very dark brown; moist; hard. (Subsoil)	3	2.5*	102.7	13.4	2.5
1145.1	3.7		CL - LEAN CLAY; medium plasticity; light yellowish brown with dark grayish brown; moist; very stiff. (Lower Subsoil)					
1144.8	4.0		CL - LEAN CLAY; medium plasticity; light yellowish brown slightly mottled with dark grayish brown; moist to wet; very stiff. (Peoria)					
								5.0
1142.8	6.0		CL - LEAN CLAY; medium plasticity; light olive brown; wet; stiff. (Peoria)					
								7.5
1139.8	9.0		CL - LEAN CLAY; same as above except medium stiff to stiff. (Peoria)					
1138.8	10.0		Boring Terminated at: 10.0ft					10.0
								12.5
								15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

\* Unconfined compressive strength was estimated using a calibrated hand penetrometer.

Figure C - 3



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

**BORING LOG**

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-4

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1145.1	0.0		CL - LEAN CLAY; medium plasticity; black; wet; medium stiff, friable. (Topsoil)				0.0
1144.4	0.7		CL/CH - LEAN TO FAT CLAY; medium to high plasticity; brown mottled with very dark grayish brown; wet; stiff. (Subsoil)				
1143.9	1.2		CL - LEAN CLAY; medium plasticity; olive brown slightly mottled with black; wet; stiff. (Peoria)				
1143.4	1.7		CL - LEAN CLAY; medium plasticity; yellowish brown slightly mottled with white; moist; hard. (Peoria)				
				4	88.4	12.2	2.5
1141.8	3.3		SM - SILTY SAND; 70-80% fine sand; low plasticity; yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				
1141.5	3.6		CL - SANDY LEAN CLAY; 35-45% fine to medium sand; medium plasticity; light yellowish brown; moist; very stiff. (Peoria Alluvium)				
1140.6	4.5		SM - SILTY SAND; 75-85% fine to medium sand; nonplastic; yellowish brown with olive brown; moist; loose to medium dense. (Peoria Alluvium)				5.0
1139.1	6.0		SC-SM - SILTY, CLAYEY SAND; 70-80% fine sand; low to medium plasticity; olive brown; moist; loose to medium dense. (Peoria Alluvium)				
1138.1	7.0		SC - CLAYEY SAND; 70-80% fine sand; medium plasticity; olive brown; wet; loose to medium dense. (Peoria Alluvium)				7.5
1137.6	7.5		SM - SILTY SAND; 75-85% fine sand; low plasticity; light yellowish brown with light olive brown; moist; loose to medium dense. (Peoria Alluvium)				
1135.6	9.5		SP - POORLY GRADED SAND; 95-100% fine sand; nonplastic; light yellowish brown; moist; medium dense. (Peoria Alluvium)				10.0
1135.1	10.0		Boring Terminated at: 10.0ft				
							12.5
							15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

Figure C - 4



825 J Street  
Lincoln, NE 68508  
402-479-2200 \* Fax: 402-479-2276  
www.benesch.com

PROJECT: Helen Boosalis Park Indoor Shooting Complex

# BORING LOG

LOCATION: NW Corner of N44th and Superior Street  
Lincoln, NE

BORING No.: B-5

JOB NO.: 110705.00  
RIG / METHOD: CME 550 / Straight Auger  
CREW: CL & GW

SHEET 1 of 1

DATE: 3-15-2013

WATER LEVELS ∇ Groundwater was not encountered to the depth of this boring

ELEV (NAVD88)	DEPTH (feet)	LOG	LITHOLOGY DESCRIPTION	SAMPLE	DRY DENSITY (pcf)	MOISTURE (%)	DEPTH (feet)
1148.8	0.0		CL - LEAN CLAY; medium plasticity; very dark grayish brown; wet; medium stiff, friable. (Topsoil)				0.0
1148.0	0.8		CH - FAT CLAY; high plasticity; brown; moist; very stiff. (Subsoil)				
1147.3	1.5		CL - LEAN TO FAT CLAY; medium to high plasticity; light olive brown; moist; very stiff. (Lower Subsoil)				
1146.3	2.5		CL - LEAN CLAY; medium plasticity; brown slightly mottled with black; moist; hard. (Lower Subsoil)	5	98.1	15.7	2.5
1144.7	4.1		CL - LEAN CLAY; medium plasticity; yellowish brown mottled with yellowish red and black; wet; very stiff. (Peoria)				
1143.8	5.0		CL - LEAN CLAY; medium plasticity; light olive brown; wet; stiff to very stiff. (Peoria)				5.0
1141.3	7.5		CL - LEAN CLAY; same as above except stiff. (Peoria)				7.5
1137.3	11.5		CL - LEAN CLAY with Sand; 15-25% fine sand; medium plasticity; light olive brown; wet; stiff. (Peoria Alluvium)				11.5
1136.3	12.5		SM - SILTY SAND; 75-85% fine sand; low plasticity; light yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				12.5
1135.8	13.0		CL - SANDY LEAN CLAY; 30-40% fine sand; medium plasticity; light olive brown; moist; stiff. (Peoria Alluvium)				13.0
1134.3	14.5		SM - SILTY SAND; 75-85% fine sand; nonplastic; light yellowish brown; moist; loose to medium dense. (Peoria Alluvium)				14.5
1133.8	15.0		Boring Terminated at: 15.0ft				15.0

BORING LOG SHOOTING RANGE LOGS.GPJ HWS.GDT 3/20/13

Figure C - 5

**APPENDIX D. CRITERIA USED FOR SOIL CLASSIFICATION**

## USCS SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LESS THAN 5% FINES)		GW	WELL-GRADED GRAVEL
				GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES (MORE THAN 12% FINES)		GM	SILTY GRAVEL (LOW PLASTIC FINES)
				GC	CLAYEY GRAVEL (MEDIUM TO HIGH PLASTIC FINES)
	SAND AND SANDY SOILS	CLEAN SANDS (LESS THAN 5% FINES)		SW	WELL-GRADED SAND
				SP	POORLY-GRADED SAND
MORE THAN 50% OF MATERIALS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (MORE THAN 12% FINES)		SM	SILTY SAND (LOW PLASTIC FINES)
				SC	CLAYEY SAND (MEDIUM TO HIGH PLASTIC FINES)
		FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	
	CL				LEAN CLAY (0-15% SAND) LEAN CLAY WITH SAND (15-30% SAND) SANDY LEAN CLAY (30-50% SAND)
	OL				ORGANIC SILTS AND LEAN CLAYS
SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50			MH	ELASTIC SILT (0-15% SAND) ELASTIC SILT WITH SAND (15-30% SAND) SANDY ELASTIC SILT (30-50% SAND)
				CH	FAT CLAY (0-15% SAND) FAT CLAY WITH SAND (15-30% SAND) SANDY FAT CLAY (30-50% SAND)
				OH	ORGANIC ELASTIC SILTS AND FAT CLAYS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

## GENERAL NOTES

### CRITERIA FOR DESCRIBING CLAY SOILS

MOISTURE CONDITION		CONSISTENCY	
Description	Criteria	Description	Penetration Resistance, $N_{60}$ (blows/ft) <sup>1</sup>
Dry	Absence of moisture, dusty, dry to touch.	Very Soft	Less than 3
Moist	Damp, slightly wet, moisture content below plastic limit.	Soft	3 to 4
Wet	Moisture content above the plastic limit.	Medium Stiff	5 to 8
Saturated	Very wet. Usually soil is below the water table.	Stiff	9 to 16
		Very Stiff	16 to 32
		Hard	Greater than 32

### CRITERIA FOR DESCRIBING GRANULAR SOILS

MOISTURE CONDITION		DENSITY	
Description	Criteria	Description	Penetration Resistance, $N_{60}$ (blows/ft) <sup>1</sup>
Dry	Absence of moisture, dry to the touch.	Very Loose	Less than 5
Moist	Damp but no visible free water.	Loose	5 to 10
Wet	Visible free water.	Medium Dense	11 to 30
Saturated	Usually soil is below water table.	Dense	31 to 50
		Very Dense	Greater than 50

### CRITERIA FOR DESCRIBING ROCK

#### STRENGTH/HARDNESS

Description	Criteria
Very Soft	Permits denting by moderate pressure of the fingers.
Soft	Resists denting by the fingers, but can be abraded and pierced to a shallow depth by a pencil point.
Moderately Soft	Resists a pencil point, but can be scratched and cut with a knife blade.
Moderately Hard	Resistant to abrasion or cutting by a knife blade, but can be easily dented or broken by light blows of a hammer.
Hard	Can be deformed or broken by repeated moderate hammer blows.
Very Hard	Can be broken only by heavy, and in some rocks, repeated hammer blows.

<sup>1</sup>Blow counts shown on the boring logs are those recorded directly in the field and have not been corrected for hammer efficiency. The boring log blow counts must be corrected to an equivalent hammer efficiency of 60% in order to use the criteria in this table.

## ROCK QUALITY DESIGNATION (RQD)

This is a general method by which the quality of the rock at a site is obtained based on the relative amount of fracturing and alteration.

The Rock Quality Designation (RQD) is based on a modified core recovery procedure that, in turn, is based indirectly on the number of fractures (except those due directly to drilling operations) and the amount of softening or alteration in the rock mass as observed in the rock cores from a drill hole. Instead of counting the fractures, an indirect measure is obtained by summing the total length of core recovered by counting only those pieces of hard and sound core which are 4 inches or greater in length. The ratio of this modified core recovery length to the total core run length is known as the RQD.

An example is given below from a core run of 60 inches. For this particular case, the total core recovery is 50 inches yielding a core recovery of 83 percent. On the modified basis, only 38 inches are counted the RQD is 63 percent.

---

<b><u>CORE RECOVERY, in</u></b>	<b><u>MODIFIED CORE RECOVERY, in</u></b>
10	10
2	-
2	-
3	-
4	4
5	5
3	-
4	4
6	6
4	4
2	-
5	5
-----	-----
50	38

$$\% \text{ Core Recovery} = 50/60 = 83\%; \text{ RQD} = 38/60 = 63\%$$

A general description of the rock quality can be made for the RQD value as follows:

<b><u>RQD</u></b>	<b><u>DESCRIPTION OF ROCK QUALITY</u></b>
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

---