

Professional

Engineering

Services

Well No. 45 Reservoir Replacement and Site Modifications

Bid No.
1224-W-125

Project Manual

City of Rockford

Rockford, Illinois

Issued for Bid

July 24, 2025

Volume 2 of 2



PLAN HOLDER: _____

Set No.: _____

PROJECT MANUAL

CITY OF ROCKFORD
ROCKFORD, ILLINOIS
WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS
BID NO. 1224-W-125

VOLUME 2 OF 2



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7/24/2025
Exp. 11/30/2025

Strand Associates, Inc.®

All sections including Section 33 16 13,
unless otherwise noted.



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July 24, 2025



SECTION 00 01 10

TABLE OF CONTENTS

CITY OF ROCKFORD
ROCKFORD, ILLINOIS
WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS
BID NO. 1224-W-125

Pages
Through

VOLUME 1 OF 2

DIVISION 00-BIDDING AND CONTRACTING REQUIREMENTS

INVITATION TO BID.....	1
ADVERTISEMENT TO BID	01 11 13- 2
BIDDING AND CONTRACT GENERAL CONDITIONS.....	11
INSTRUCTION TO BIDDERS.....	2
ADDITIONAL INSTRUCTIONS TO BIDDERS	00 21 13-11
BID	00 41 00-13
BID BOND	00 43 00- 2
NON-COLLUSION AND CERTIFICATION STATEMENT	00 45 19- 1
CITY OF ROCKFORD EQUAL EMPLOYMENT OPPORTUNITY CERTIFICATION	2
CITY OF ROCKFORD SUBCONTRACTOR UTILIZATION FORM	2
CITY OF ROCKFORD VENDOR WORKFORCE DATA FORM	1
CITY OF ROCKFORD SUBCONTRACTOR WORKFORCE DATA FORM	1
JOB CATEGORY DESCRIPTIONS	1
CITY OF ROCKFORD ILLINOIS PREVAILING WAGE ACT NOTICE AND ACKNOWLEDGEMENT.....	1
CITY OF ROCKFORD LCPTRACKER VENDOR INFORMATION FORM	1
ACKNOWLEDGEMENT OF STORMWATER MANAGEMENT ORDINANCE AND IEPA GENERAL CONSTRUCTION PERMIT (ILR10) REQUIREMENTS.....	1
ACKNOWLEDGEMENT OF ADDENDA	1
CITY OF ROCKFORD BIDDER'S AFFIDAVIT	1
REQUEST FOR TAXPAYER IDENTIFICATION NUMBER AND CERTIFICATION (W-9 FORM)	6
NOTICE OF REQUIREMENTS FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246).....	00 45 21-10
USEPA CERTIFICATION OF NONSEGREGATED FACILITIES	00 45 22- 1
NOTICE TO LABOR UNIONS OR OTHER ORGANIZATIONS OF WORKERS NONDISCRIMINATION IN EMPLOYMENT	00 45 23- 1
CERTIFICATION REGARDING DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS.....	00 45 24- 2
CONSTRUCTION CONTRACTS OF LOAN RECIPIENT AND OTHER SECTIONS FROM "PROCEDURES FOR ISSUING LOANS FROM THE PUBLIC WATER POLLUTION CONTROL LOAN PROGRAM.....	00 45 25- 4
BIDDER CERTIFICATION IN COMPLIANCE WITH ARTICLE 33E-11 TO THE "CRIMINAL CODE OF 2012"	00 45 26- 1

SPECIFICATIONS FOR DISADVANTAGED BUSINESS ENTERPRISE (DBE) PARTICIPATION AND DOCUMENTATION OF COMPLIANCE, INCLUDING IEPA DBE PROGRAM FORMS #1, #3, AND #4	00 45 27- 8
BIDDER CERTIFICATION THAT ALL IRON, STEEL, MANUFACTURED PRODUCTS AND CONSTRUCTION MATERIALS USED IN THE PROJECT ARE PRODUCED IN THE UNITED STATES PER THE FEDERAL BUILD AMERICA, BUY AMERICA ACT	00 45 28- 4
ILLINOIS WORKS JOBS PROGRAM ACT APPRENTICESHIP INITIATIVE INFORMATION FOR CONTRACTORS	00 45 29- 4
DAVIS-BACON WAGE REQUIREMENTS	00 45 30- 7
EMPLOYMENT OF ILLINOIS WORKERS ON PUBLIC WORKS ACT	00 45 31- 1
CITY OF ROCKFORD APPRENTICESHIP FORM	00 45 32- 2
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY-PUBLIC WATER SUPPLY LOAN PROGRAM (PWSLP) LOAN APPLICANT'S CERTIFICATION OF PLANS/SPECIFICATIONS COMPLIANCE WITH PWSLP RULES	3
NOTICE OF INTENT TO AWARD	00 51 00- 1
NOTICE OF AWARD	00 51 00- 2
CHANGE ORDER	00 51 00- 3
AGREEMENT	00 52 00-10
NOTICE TO PROCEED	00 55 00- 1
EROSION CONTROL CERTIFICATION	00 55 10- 1
PERFORMANCE BOND	00 61 13.13- 4
PAYMENT BOND	00 61 13.16- 4
GENERAL CONDITIONS	00 72 00-70
SUPPLEMENTARY CONDITIONS	00 73 00-21
CERTIFICATE OF LIABILITY INSURANCE	1

SPECIFICATIONS

DIVISION 01-GENERAL REQUIREMENTS

SUMMARY OF WORK	01 11 00- 9
CONTRACT CONSIDERATIONS	01 29 00- 2
COORDINATION, FIELD ENGINEERING, AND MEETINGS	01 31 00- 4
SUBMITTALS	01 33 00-11
REGULATORY REQUIREMENTS	01 41 00- 4
REFERENCE STANDARDS AND DEFINITIONS	01 42 00- 6
QUALITY CONTROL	01 45 00- 2
TEMPORARY FACILITIES	01 50 00- 3
IEPA SRF PROJECT PUBLIC NOTIFICATION REQUIREMENTS	3
USEPA STATE REVOLVING FUND GUIDELINES CONSTRUCTION SIGN MEMO	7
FIELD OFFICES AND SHEDS	01 52 13- 4
TEMPORARY CONTROLS	01 57 00- 3
MATERIALS AND EQUIPMENT	01 60 00- 4
CUTTING, PATCHING, AND ALTERATIONS	01 73 29- 6
CONTRACT CLOSEOUT	01 77 00- 3
STARTING OF SYSTEMS	01 91 00- 8
PERMITS	1
WAGE RATES	7
FEDERAL WAGE RATES	104

DE MINIMIS WAIVER FOR AMERICAN IRON AND STEEL	3
DE MINIMIS WAIVER FOR BUILD AMERICA, BUY AMERICA.....	4

VOLUME 2 OF 2

DIVISION 02–EXISTING CONDITIONS

DEMOLITION	02 41 00- 4

DIVISION 03–CONCRETE

CONCRETE FORMWORK	03 11 00- 4
CONCRETE REINFORCEMENT	03 20 00- 5
CAST-IN-PLACE CONCRETE.....	03 30 00-16
PRECAST CONCRETE HOLLOW CORE PLANKS	03 41 13- 5

DIVISION 04–MASONRY

MASONRY RESTORATION AND CLEANING	04 01 20- 4
MORTAR AND MASONRY GROUT	04 05 13- 3
UNIT MASONRY SYSTEM.....	04 20 00- 7
CAST STONE.....	04 72 00- 6

DIVISION 05–METALS

METAL FABRICATIONS	05 50 00- 9
HANDRAILS AND RAILINGS	05 52 00- 2
GRATING, FLOOR PLATES, AND FLOOR PLANK	05 53 00- 2
ANCHOR BOLTS AND POST-INSTALLED ANCHORS	05 56 00- 4

DIVISION 06–WOOD, PLASTICS, AND COMPOSITES

WOOD FRAMING AND SHEATHING.....	06 11 00- 2
WOOD BLOCKING AND CURBING	06 11 10- 2
FINISH CARPENTRY	06 20 00- 4
ARCHITECTURAL WOODWORK	06 40 00- 7

DIVISION 07–THERMAL AND MOISTURE PROTECTION

FLUID-APPLIED WATERPROOFING	07 14 00- 3
BOARD INSULATION.....	07 21 12- 2
BATT INSULATION	07 21 13- 2
RETROFIT BUILDING INSULATION SYSTEM	07 21 13.1- 3
SPRAY FOAM INSULATION	07 21 29- 4
VAPOR AND AIR BARRIER.....	07 26 00- 2
SINGLE-PLY ROOFING–FULLY ADHERED	07 53 00- 4
PREPARATION FOR REROOFING	07 56 01- 2
FLASHING AND SHEET METAL.....	07 62 00- 4
MANUFACTURED ROOF SPECIALTIES.....	07 71 00- 2

ROOF HATCHES	07 72 33- 2
FIRESTOPPING	07 84 00- 3
CAULKING AND SEALANTS	07 90 00- 3
<u>DIVISION 08–OPENINGS</u>	
STANDARD STEEL DOORS AND FRAMES.....	08 11 00- 4
FLUSH WOOD DOORS	08 14 16- 4
ACCESS DOORS AND FRAMES.....	08 31 13- 2
SECTIONAL OVERHEAD DOORS.....	08 36 13- 3
ALUMINUM ENTRANCES.....	08 41 13- 5
ALUMINUM WINDOWS.....	08 51 13- 8
PLASTIC UNIT SKYLIGHTS.....	08 60 10- 3
DOOR HARDWARE	08 71 00- 3
GLAZING.....	08 81 00- 3
<u>DIVISION 09–FINISHES</u>	
METAL STUD FRAMING SYSTEM	09 22 16- 3
GYPSUM BOARD	09 29 00- 4
TILES	09 30 00- 3
SUSPENDED ACOUSTICAL CEILINGS	09 51 00- 3
RESILIENT FLOORING.....	09 65 00- 3
CARPET TILE	09 68 13- 8
PAINTING.....	09 91 00-11
<u>DIVISION 10–SPECIALTIES</u>	
IDENTIFYING DEVICES	10 13 00- 3
SOLID PLASTIC TOILET COMPARTMENTS.....	10 21 13.19- 4
TOILET AND BATH ACCESSORIES.....	10 28 00- 4
FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES.....	10 44 43- 2
LOCKERS AND BENCHES.....	10 51 00- 2
<u>DIVISION 11–EQUIPMENT</u>	
APPLIANCES	11 30 00- 1
ATHLETIC FIELD EQUIPMENT	11 68 33- 3
<u>DIVISION 12–FURNISHINGS</u>	
OFFICE FURNITURE.....	12 51 00- 1
<u>DIVISION 13–SPECIAL CONSTRUCTIONS</u>	
FABRICATED STRUCTURES.....	13 34 23- 5

DIVISION 20–COMMON FIRE SUPPRESSION, PLUMBING, AND HVAC REQUIREMENTS

IDENTIFICATION FOR FIRE SUPPRESSION, PLUMBING AND HVAC PIPING AND EQUIPMENT	20 05 53- 4

DIVISION 22–PLUMBING

GENERAL PLUMBING PIPING SPECIALTIES	22 05 19- 5
GENERAL-DUTY VALVES FOR PLUMBING PIPING	22 05 23- 4
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT	22 05 29- 5
EQUIPMENT INSULATION FOR PLUMBING	22 07 16- 4
PIPING INSULATION FOR PLUMBING	22 07 19- 6
FACILITY WATER DISTRIBUTION PIPING	22 11 00- 6
DOMESTIC WATER PUMPS	22 11 23- 4
SANITARY WASTE AND VENT PIPING	22 13 16- 5
SANITARY WASTE PIPING SPECIALTIES	22 13 19- 5
SANITARY WASTE INTERCEPTORS	22 13 23- 3
FACILITY STORM DRAINAGE PIPING.....	22 14 00- 4
GENERAL SERVICE COMPRESSED AIR PIPING	22 15 13- 4
COMPRESSED AIR EQUIPMENT	22 15 19- 6
PLUMBING EQUIPMENT	22 30 00- 3
COMMERCIAL PLUMBING FIXTURES.....	22 42 00- 4

DIVISION 23–HEATING, VENTILATING, AND AIR CONDITIONING

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	23 05 29- 5
TESTING, ADJUSTING, AND BALANCING	23 05 93- 5
DUCTWORK INSULATION FOR HEATING, VENTILATION, AND AIR CONDITIONING	23 07 13- 5
PIPING INSULATION FOR HVAC	23 07 19- 4
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC	23 09 23-28
FACILITY FUEL GAS PIPING	23 11 23- 9
REFRIGERANT PIPING	23 23 00- 5
DUCTWORK AND DUCTWORK SUPPORTS	23 31 00- 6
AIR DUCT ACCESSORIES	23 33 00- 4
CENTRIFUGAL HVAC FANS	23 34 16- 5
HIGH VOLUME-, LOW-SPEED PROPELLER FANS.....	23 34 39- 5
VARIABLE AIR VOLUME (VAV) UNITS	23 36 16- 3
LOUVERS AND VENTS	23 37 08- 3
DIFFUSERS, REGISTERS, AND GRILLES.....	23 37 13- 3
HVAC GRAVITY VENTILATORS	23 37 23- 3
BREECHINGS, CHIMNEYS, AND STACKS.....	23 51 00- 5
FUEL-FIRED UNIT HEATERS.....	23 55 33- 4
PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSER UNITS	23 62 13- 5
MODULAR INDOOR CENTRAL STATION AIR-HANDLING UNITS	23 73 13- 6
PACKAGED OUTDOOR HEATING ONLY MAKE-UP AIR UNITS.....	23 74 23- 6
SPLIT-SYSTEM AIR CONDITIONERS.....	23 81 26- 5
AIR COILS.....	23 82 16- 3
UNIT HEATERS	23 82 39- 3
RADIANT HEATING PANELS	23 82 40- 3

DIVISION 26–ELECTRICAL

GENERAL ELECTRICAL REQUIREMENTS	26 05 00-10
WIRE	26 05 19- 9
INSTRUMENT AND COMMUNICATION WIRE AND CABLE	26 05 23- 3
SECONDARY GROUNDING	26 05 26- 4
SUPPORTING DEVICES	26 05 29- 2
CONDUIT	26 05 33- 9
SURFACE RACEWAY	26 05 34- 2
BOXES	26 05 35- 6
HANDHOLES	26 05 44- 3
ELECTRICAL IDENTIFICATION	26 05 53- 6
CONTROLS AND INSTRUMENTATION	26 09 00-18
CONTROLS AND INSTRUMENTATION DRAWINGS	26 09 10- 4
SCADA SYSTEM I/O LISTING	26 09 90- 1
ELECTRICAL SERVICE SYSTEM	26 21 00- 2
PANELBOARDS	26 24 16- 3
MOTOR CONTROL	26 24 19-10
WIRING DEVICES	26 27 26- 8
OVERCURRENT PROTECTIVE DEVICES	26 28 00- 2
DISCONNECT SWITCHES	26 28 16- 2
SURGE PROTECTIVE DEVICES (SPD)	26 43 13- 4
LIGHTING	26 51 13- 8
EXTERIOR LIGHTING	26 56 29- 5

DIVISION 27–COMMUNICATION

STRUCTURED CABLING	27 10 00-13

DIVISION 28–ELECTRONIC SAFETY AND SECURITY

FIRE ALARM SYSTEM	28 46 00-22

DIVISION 31–EARTHWORK

CLEARING AND GRUBBING	31 10 00- 2
EXCAVATION, FILL, BACKFILL, AND GRADING	31 23 00-18
DEWATERING	31 23 19- 4
SLOPE PROTECTION AND EROSION CONTROL	31 25 00- 7
GEOTEXTILES	31 32 19- 2
RIPRAP	31 37 00- 2

DIVISION 32–EXTERIOR IMPROVEMENTS

AGGREGATE BASE COURSE	32 11 23- 3
HOT MIX ASPHALT PAVING	32 11 26- 4
CONCRETE CURB AND GUTTER, SIDEWALKS, AND DRIVEWAY APRONS	32 16 13- 5
PAVEMENT MARKINGS	32 17 23.13- 2
FENCE GATE OPERATOR	32 31 11- 6

CHAIN LINK FENCE	32 31 13- 7
RESTORATION.....	32 92 00- 3

DIVISION 33–UTILITIES

BURIED PIPING AND APPURTENANCES	33 00 10-17
WIRE-WOUND PRESTRESSED CONCRETE WATER STORAGE TANK.....	33 16 13-21
FUEL BAS DISTRIBUTION UTILITIES.....	33 52 16- 8

DIVISION 40–PROCESS INTERCONNECTIONS

PIPING AND APPURTENANCES.....	40 05 00- 8

DIVISION 46–PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

SUBMERSIBLE MIXING SYSTEM	46 41 23- 3

DRAWINGS

STANDARD DETAIL–STORM SEWER MANHOLES AND INLETS	01-975- 41A
STANDARD DETAIL–SANITARY SEWER APPURTENANCES.....	01-975- 43A

APPENDICES (NOT PART OF CONTRACT DOCUMENTS)

SAMPLE DRAWINGS.....	23
SUPPLEMENTAL GEOTECHNICAL ENGINEERING REPORT	21
GEOTECHNICAL ENGINEERING REPORT	47
ASBESTOS SAMPLING	24
COMPREHENSIVE LEAD-BASED PAINT INSPECTION REPORT	48
CCDD 663 REPORT	11
PRELIMINARY ASBESTOS INSPECTION.....	14

END OF SECTION

SPECIFICATIONS

SECTION 02 41 00

DEMOLITION

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: All demolition, removal, and salvage work as shown on the Drawings or specified herein to include, but not necessarily limited to the following:
 - 1. A 5-MG reservoir and connecting piping
 - 2. Stanley Street Booster Station and connecting piping. In addition to watermain piping to the booster station that needs to be demolished, there is also boiler piping within the basement that is not shown on Drawings that needs to be demolished.
 - 3. Asphalt surrounding the Stanley Street Booster Station, as shown on Drawings.
 - 4. Retaining walls as shown on Drawings.
 - 5. Portions of the Administration Building (Structure 90) to accommodate renovations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. CONTRACTOR shall submit permits and notices, if required, authorizing building demolition.
- B. The City of Rockford has a specific building demolition permit application that must be completed by the CONTRACTOR.

1.03 QUALITY ASSURANCE

- A. CONTRACTOR shall perform demolition, removal, and salvage in conformity with applicable federal, state, and local safety practices and code requirements.
- B. CONTRACTOR shall contact all public utilities and shall shut off, cut and cap all utility services in accordance with utility requirements, codes, rules, and regulations.
- C. Obtain and pay for all necessary permits, licenses, and certificates required.
- D. Removal of flammable and combustible liquid storage tanks shall be by a contractor licensed for tank removal in accordance with the Illinois Petroleum Equipment Contractor Licensing Act.
- E. Flammable and combustible liquid storage tank removal shall be in accordance with all applicable codes including State of Illinois Administrative Code Title 41, Chapter I, Parts 172, 175, and 176.

1.04 SEQUENCE

- A. No demolition, removal, or salvage work shall commence until approval to proceed has been granted by OWNER. Such work shall be completed in accordance with the construction

sequence included in Division 01 of these Specifications and in accordance with the construction phases of this project and work to be done by other contractors.

- B. OWNER has completed asbestos and hazardous inventory inspections at each existing facility where work is required to be completed by CONTRACTOR. A copy of the hazardous inventory inspection reports is available in the appendices. Asbestos and other hazardous material identified in the inspection reports shall be removed by CONTRACTOR during demolition. Precautions for proper handling and disposal during demolition will be required during demolition work as indicated in the hazardous inventory and asbestos inventory inspection reports.

PART 2-PRODUCTS

2.01 GENERAL

- A. Compacted fill shall meet the requirements of Section 31 23 00-Excavation, Fill, Backfill, and Grading.
- B. Pipe fittings and materials shall meet the requirements of Section 33 00 10-Buried Piping and Appurtenances and Section 40 05 00-Piping and Appurtenances.
- C. Existing wrought iron fence on the roof of the reservoir may be recycled or sold by CONTRACTOR.
- D. Wherever any light pole, concrete sidewalk or driveway, concrete steps, mailbox, fencing, end wall, storm sewer pump line, pavement, signs, or any other existing item has been damaged or removed by CONTRACTOR, whether as a normal part of construction activities, deliberately, through failure to carry out the requirements of the appropriate codes, the Contract Documents, or the specific request of OWNER relative to its protection, or through failure to employ usual or reasonable safeguards, such existing improvements shall be replaced or repaired to their original condition at CONTRACTOR's expense.
- E. CONTRACTOR shall be responsible for the proper replacement of all damaged or relocated street signs and highway signs and markers at all times during construction.

PART 3-EXECUTION

3.01 BREAKING DOWN AND REMOVING STRUCTURES

- A. General:
 - 1. All existing structures, with all attached parts and connections, shown on the Drawings or specified to be removed or that interfere with the new construction, shall be entirely removed within the limits shown or specified, unless otherwise provided.
 - 2. When a portion of any existing structure is to be retained, CONTRACTOR shall take care during construction operations so as not to impair the value of the retained portion.
 - a. Complete all operations necessary for the removal of any existing structure which might endanger the new construction prior to the construction of the new work.
 - b. Do not use any equipment or devices which might damage structures, facilities, or property which are to be preserved and retained.

3. When existing reinforcing is exposed at the surface of removal areas, CONTRACTOR shall burn back the reinforcing bars 2 inches and patch with nonshrink grout, unless noted otherwise.
- B. Pavement, Curb, Gutter, Sidewalk, Driveways, Crosswalk, and Similar Structures:
 1. Where portions of the existing structure are to be left in the surface of the finished work, CONTRACTOR shall remove the structure to an existing joint, or saw and chip the structure to a true line.
 2. Sufficient removal shall be made to provide for proper grades and connections in the new work.
- C. Walls, Piers, Surface Drains, Foundations, and Similar Masonry Structures:
 1. Remove entirely as noted on the Drawings.
 2. Remove existing construction as required to clear new construction.
- D. Underground Tanks and Clearwells:
 1. CONTRACTOR to remove the contents of underground tanks to allow the complete removal of such tanks.
 2. Backfill the resulting hole or pit in accordance with the backfill portion of this section.

3.02 ABANDONING AND REMOVING UTILITIES AND UNDERGROUND PROCESS PIPING

- A. CONTRACTOR shall be responsible for the turning off or unhooking of all utilities and process piping before starting the demolition work. Remove all utility lines, including electrical services and process piping that are shown or specified to be removed. Remove utility lines that are to be abandoned as needed to clear new construction.
- B. The ends of utility lines and process piping shown or specified to be abandoned that are exposed by excavation shall be plugged with concrete to prevent soil infiltration into the pipes.

3.03 EQUIPMENT

- A. CONTRACTOR shall remove all equipment specified herein or indicated.
- B. CONTRACTOR shall remove associated exposed conduit, power wiring, controls, switches, instrumentation, control wiring, control boxes, appurtenances, and their supports serving equipment to be removed. Electrical items shall be removed to their junction with panelboards, control panel, or their junction with conduit serving other equipment that is to remain.
- C. CONTRACTOR shall remove all piping and appurtenances and their supports serving equipment indicated to be removed. Piping shall be removed to its junction with the main service header serving other equipment that is to remain or new equipment as indicated. Remaining piping and tubing shall be fitted with an appropriate blind flange or plug and insulated as required.

3.04 INTERIOR PIPING, DUCTWORK, AND APPURTENANCES

- A. CONTRACTOR shall remove all piping, ductwork, and appurtenances as indicated. The location and elevations of existing piping are approximate.

3.05 SALVAGE

- A. OWNER has first right of refusal to all material, piping, and equipment removed.
- B. All equipment, material, and piping, except as specified hereinafter, within the buildings and structures to be demolished and additional items as noted shall be removed by CONTRACTOR. CONTRACTOR shall inspect each structure and determine the type and amount of equipment, materials, and piping to be removed.
- C. All equipment, material, and piping, except as specified hereinafter, within the limits of the demolition and additional items noted to be removed, will become the property of CONTRACTOR if OWNER does not claim under first right of refusal and shall be removed from the project site. Comply with State and local ordinances and regulations for disposing of materials.
- D. The following equipment and materials shall be removed and reused in the new facilities:
 - 1. Six 4-foot-wide by 16-foot-wide pallet storage racks shall be moved from the existing administration building garage to the new maintenance garage.
 - 2. Air compressor located in the existing maintenance garage shall be relocated to the new maintenance garage.
 - 3. All existing valves from abandoned lines removed.
- E. If CONTRACTOR chooses to dispose of materials in a Clean Construction or Demolition Debris (CCDD) fill operation, CONTRACTOR shall provide all required testing, certifications and fees associated with using the CCDD fill operation.

3.06 BACKFILL

- A. CONTRACTOR shall fill all removed structures and excavations resulting from removal of structures and utilities with compacted fill. See Section 31 23 00–Excavation, Fill, Backfill, and Grading for required degree of compaction.

END OF SECTION

SECTION 03 11 00
CONCRETE FORMWORK

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Forms for cast-in-place concrete.
 - 2. Form accessories.
 - 3. Openings for other work.
 - 4. Form stripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 117–Tolerances for Concrete Construction.
- B. ACI 301–Structural Concrete for Buildings.
- C. ACI 318–Building Code Requirements for Reinforced Concrete.
- D. ACI 347–Recommended Practice for Concrete Formwork.
- E. PS1–Construction and Industrial Plywood.
- F. NSF/ANSI 61–Drinking Water System Components.

1.03 DESIGN

- A. All formwork shall comply with ACI 347 and ACI 301.
- B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00–Submittals for form ties, form coatings, form liners (if any), and any other form accessories.
- B. Submit geometry of forms for circular structures.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with

each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 FORMS

- A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.
- B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

2.02 FORM TIES—NONREMOVABLE

- A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall have cones on the water side of water-containing structures. Ties shall also have cones on the exterior side of all structures which have PVC water-stopped construction joints. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.
- B. All wall ties used in the placement of structures which have PVC or hydrophilic water-stopped construction joints shall contain integral waterstops. All such ties shall be crimped or deformed in such a manner that the bond between concrete and tie cannot be broken in removal of the outer units. This portion of the tie shall not be removed prior to 24 hours after completion of the concrete placement.
- C. The use of wood spacers and wire ties will not be approved.

2.03 FORM TIES—REMOVABLE

- A. Taper ties which are designed to be removed entirely from the wall may be used with forms designed for this tie type and spacing.
- B. Tie holes shall be plugged with either a neoprene plug, Sure-Plug by Dayton Superior, Inc., or an EPDM rubber plug, X-Plug by Sika Greenstreak, or equal.
- C. Cementitious waterproofing material for patching taper tie holes shall be Hey Di K-11, Xypex Patch-N-Plug, or equal. Taper tie holes above the normal operating water surface shall be patched with mortar mix as specified in Section 03 30 00—Cast-In-Place Concrete for patching tie holes.

2.04 FORM COATINGS

- A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
- B. Form release agents for potable water containing structures shall be compliant with NSF/ANSI 61.

2.05 CHAMFER STRIPS

- A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

2.06 KEYWAYS

- A. Keyways shall be formed with wood inserts.

PART 3-EXECUTION

3.01 CONSTRUCTION

- A. Forms shall conform to the shape, line, grade, and dimensions as shown on the Drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork and finished concrete construction shall meet the tolerances specified in ACI 117.
- C. All exposed curved surfaces shall be formed to the continuous surface of the radius specified. Where segmented forms are proposed, a form system which deviates more than 3/8 inch from a circle through pan edges will not be allowed.
- D. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the Drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
- E. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- F. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.
- G. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.

- H. Provide top forms for inclined surfaces where the slope is too steep to place and vibrate concrete.
- I. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to allow for ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.
- J. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.
- K. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to review of ENGINEER.

3.02 FORM REMOVAL

- A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.
- B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete.
- C. Forms shall not be removed before the expiration of the minimum times as stated below or until the concrete has attained its minimum 28-day design strength as confirmed by concrete cylinder tests, unless specifically authorized by ENGINEER. Wall and Vertical Faces: 24 hours.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Applicable standards listed in this section include, but are not necessarily limited to the following:
 - 1. ACI 315—Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 2. ACI 318—Building Code Requirements for Reinforced Concrete.
 - 3. ASTM A1064—Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 4. ASTM A615—Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM A996—Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcing.
 - 6. ASTM C1116—Standard Specification for Fiber-Reinforced Concrete.
 - 7. CRSI—Manual of Standard Practice.

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section:
 - 1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
 - 2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
 - 3. Shop drawings shall be in accordance with ACI 315.

1.04 PRODUCT HANDLING

- A. Delivery:
 - 1. Deliver reinforcement to the job site bundled, tagged, and marked.
 - 2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Reinforcing bars shall comply with ASTM A615 or A996 Type R, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Reinforcement supports, including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
 - 1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
 - 2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
 - 3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
 - 4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.
- C. Fibrous Reinforcing:
 - 1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Propex Concrete Systems, or equal.
 - 2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
 - 3. Physical Characteristics:
 - a. Specific Gravity: 0.91.
 - b. Fiber Length: Multidesign gradation.

- D. Mechanical Splices and Threaded Couplers:
 - 1. Mechanical splices shall be Zap Screwlok by Bar Splice Products, Inc., or equal.
 - 2. Threaded couplers and dowel bar replacements shall be Dowel Bar Splicer System by Dayton/Richmond, or equal.
 - 3. Mechanical splices and couplers shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

2.02 FABRICATION

- A. General:
 - 1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
 - 2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
 - 3. Unless otherwise shown on the Drawings, all end hook dimensions shall conform with "ACI Standard Hooks."
- B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:
 - 1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
 - 2. Bend or kinks not indicated on Drawings or final shop drawings.
 - 3. Bar with reduced cross section because of excessive rusting or other cause.

PART 3-EXECUTION

3.01 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.
- B. Correct conditions detrimental to the proper and timely completion of the work.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Comply with the specified standards for details and methods of placing reinforcement and supports.
 - 2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials that reduce or destroy bond with concrete.
- B. Placing Reinforcement:
 - 1. All reinforcing shall be placed in accordance with Contract Drawings and with shop drawings stamped and approved by ENGINEER.
 - 2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
 - 3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
 - 4. Unless otherwise shown on the Drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
 - a. Three inches of cover where the concrete is placed directly against ground.

- b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
 - c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
 - d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
- 5. Reinforcement shall be positioned within $\pm 3/8$ inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be $\pm 1/2$ inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
 - 6. Bars shall be securely tied at all intersections, except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly if acceptable to ENGINEER. Tack welding of reinforcing will not be permitted.
 - 7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 - 8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the Drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
 - 9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at ± 4 feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3 foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4 foot 0-inch centers.
 - 10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the Drawings and Specifications.
- C. Reinforcement Supports:
- 1. Strength and number of supports shall be sufficient to carry reinforcement.
 - 2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
 - 3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.
- D. Splices:
- 1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
 - 2. Lap splices in reinforcing shall be provided as shown on the Drawings. Where lap splice lengths are not shown on the Drawings, provide Class B, Category 1 lap splices in accordance with ACI 318.
 - 3. Adjacent splices of tangential bars in circular slabs and horizontal bars in circular walls shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of lap splices.
 - 4. For circular walls, horizontal bar lap splices shall not coincide in vertical arrays more frequently than every third bar.

5. Mechanical splices and threaded dowel bar inserts may be used where acceptable to ENGINEER.
- E. Embedded Items:
1. Allow other trades to install embedded items as necessary.
 2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.
- F. Fibrous Reinforcing:
1. Fibrous concrete reinforcing shall be used in all building interior slab-on-grade concrete and all precast concrete topping, and where shown on the Drawings.
 2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
 3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All cast-in-place concrete, for all structures except Structure 45, as shown except as noted otherwise.
 - 2. Expansion joint fillers, bonding agents, patching mortars, curing compounds, nonshrink grout, floor sealer, concrete topping for precast plank, and other related items and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301—Specifications for Structural Concrete.
- C. ACI 304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R—Guide to Hot Weather Concreting.
- E. ACI 306R—Guide to Cold Weather Concreting.
- F. ACI 308—Specification for Curing Concrete.
- G. ACI 309—Guide for Consolidation of Concrete.
- H. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
- I. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33—Standard Specification for Concrete Aggregates.
- K. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40—Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C88—Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- N. ASTM C94—Standard Specification for Ready-Mixed Concrete.
- O. ASTM C143—Standard Test Method for Slump of Hydraulic-Cement Concrete.

- P. ASTM C150—Standard Specification for Portland Cement.
- Q. ASTM C156—Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
- R. ASTM C172—Standard Practice for Sampling Freshly Mixed Concrete.
- S. ASTM C231—Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- T. ASTM C260—Standard Specification for Air-Entraining Admixtures for Concrete.
- U. ASTM C309—Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- V. ASTM C494—Standard Specification for Chemical Admixtures for Concrete.
- W. ASTM C595—Standard Specification for Blended Hydraulic Cements.
- X. ASTM C618—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- Y. ASTM C652—Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
- Z. ASTM D994—Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00—Submittals.
- B. Submit the following information:
 - 1. Gradation of fine and coarse aggregate—ASTM C33.
 - 2. Specific gravity and dry rodded density of each aggregate.
 - 3. Test of deleterious substances in fine and coarse aggregate—ASTM C33.
 - 4. Design mix of each individual concrete mix to be used.
 - 5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
 - 6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
 - 7. Brand, type, principal ingredient, and amount of each admixture to be used.
- C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be

included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 CEMENT

- A. Cement shall be Portland cement Type I/II conforming to ASTM C150 or Portland limestone cement Type IL conforming to ASTM C595. All cement shall be the product of one reputable manufacturer and mill.
- B. Cement shall be stored in a dry, weathertight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

2.02 FLY ASH

- A. All fly ash used as an admixture in Portland cement or Portland limestone cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

2.03 AGGREGATE

- A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

Deleterious Substance	Aggregate	
	Fine	Coarse
Clay Lumps and Friable Particles	3.0	3.0
Coal and Lignite	0.5	0.5
Mineral finer than No. 200 sieve	3.0	
Soft Fragments	3.0	3.0
Chert*	---	5.0
Sum of Chert and Clay Lumps		5.0

* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

- B. The combined amount of all deleterious substances in an aggregate shall not exceed 5% of the weight of the aggregate.

- C. If requested by ENGINEER, sodium sulfate soundness tests (ASTM C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.
- D. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following requirements:

Percentage by Weight	
Passing 3/8-inch sieve	100
Passing No. 4 sieve	95-100
Passing No. 8 sieve	80-100
Passing No. 16 sieve	50-85
Passing No. 30 sieve	25-60
Passing No. 50 sieve	5-30
Passing No. 100 sieve	0-10

- E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.
- F. If requested by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.
- G. Coarse aggregate shall be well-graded from coarse to fine, and when tested by laboratory sieves having square openings, shall conform to the following requirements:

	Percentage by Weight Aggregate	
	3/4-Inch Stone	1 1/2-Inch Stone
Passing 2-inch sieve	---	100
Passing 1 1/2-inch sieve	---	90-100
Passing 1-inch sieve	100	20-55
Passing 3/4-inch sieve	90-100	0-15
Passing 3/8-inch sieve	20-55	0-5
Passing No. 4 sieve	0-10	---
Passing No. 8 sieve	0-5	---

- H. The 3/4-inch aggregate shall be used in concrete members no thinner than 4 inches and less than 10 inches thick. A blend of 3/4-inch and 1 1/2-inch aggregate shall be used in members 10 inches thick and thicker with the 3/4-inch aggregate comprising between 35% and 65% of the total coarse aggregate. When members thinner than 10 inches are placed monolithically with members thicker than 10 inches, the aggregate requirements for the thinner member shall apply.

- I. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained, and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

2.04 WATER

- A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

2.05 ADMIXTURES

- A. Water Reducing Admixture shall be Master Pozzolith® 200 by Master Builders Solutions, Daracem 19 by Grace, or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.
- B. Air-Entraining Admixture shall be equal to MasterAir® AE 90 by Master Builders Solutions, Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.
- C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

2.06 PROPORTIONING

- A. The proportions of aggregate to cement shall be such as to produce a workable mixture that can be thoroughly compacted and that will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.
- B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

Class	Maximum Water/ Cement or Water/ (Cement+Fly Ash)	Minimum 28 Day Strength-Pounds per Square Inch	Cement Content-Pounds per Cubic Yard	Fly Ash- Pounds per Cubic Yard	
				Type C	Type F
A	0.45	4,000	564	---	---
A-FA	0.45	4,000	480	110	125

- C. Unless noted otherwise on the Drawings or in the Specifications, all concrete shall be Class A or Class A-FA concrete.
- D. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a qualified concrete engineer or qualified laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.

- E. Concrete topping for precast plank topping shall contain pea gravel, crushed stone, or other suitable coarse aggregate graded from 1/8 inch to 3/8 inch in addition to well-graded sand. Use six bags of Portland cement and 100 pounds of Class C fly ash per cubic yard. Not more than 35 gallons of mixing water per cubic yard, including free water in aggregate, shall be used. Minimum 28-day design strength shall be 4,000 psi. Provide similar mix with fibrous reinforcing added for concrete topping over precast plank.
- F. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable, unless otherwise stated.
- G. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.
- H. An air-entraining admixture shall be used in all concrete except as noted. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between 4% to 7% by volume. An air-entraining admixture is not required for concrete patching and for concrete floors, equipment pads, and supports in interior heated buildings where the concrete will be protected from freezing during and after construction.
- I. CONTRACTOR shall submit to ENGINEER concrete cylinder compressive strength results from previous projects for the same concrete mixes proposed on the current project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.
- J. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device that can be adjusted to deliver the desired amount of water.

2.07 JOINT FILLER

- A. Expansion joints in exterior concrete walks and between concrete walks and other structures which shall be asphalt expansion joint filler, 1/2-inch-thick, Grace, W.R. Meadows, or equal, meeting ASTM D994.

2.08 BONDING AGENT

- A. Bonding agent for bonding new concrete to existing concrete at construction joints and for bonding concrete overlays to existing concrete shall be a liquid latex product meeting ASTM C1059, Type II. Acceptable products include Euroweld 2.0 by Euclid Chemical, Acrylic Bonding Agent J40 by Dayton Superior, or equal.

2.09 PATCHING ADDITIVE

- A. Acceptable manufacturers include MasterEmaco® A 660 by Master Builders Solutions, Sonocrete by Sonneborn Contech Co., or equal.

2.10 NONSHRINK GROUT

- A. Acceptable manufacturers include Dayton Superior, Master Builders Solutions, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

2.11 CURE-SEAL HARDENER

- A. Penetrating sealer for interior building floors shall be Ashford Formula by Curecrete Chemical Company, Inc., or equal. See finish schedule for locations to be used.

PART 3-EXECUTION

3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304R. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.
- B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.
- C. No water shall be added on the job unless required by CONTRACTOR and with the knowledge of ENGINEER; the amount of water, if added, shall be recorded on all copies of the delivery tickets. If water is added, CONTRACTOR shall verify that the required water-cement ratio is not exceeded.
- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the jobsite.
- E. With each load of concrete, CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:
 - 1. Date.
 - 2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
 - 3. Type of cement and admixtures, if any.
 - 4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
 - 5. Amount of concrete in load, in cubic yards.
 - 6. Water-cement ratio.
 - 7. Water added at job, if any.
 - 8. Truck number and time dispatched.
 - 9. Number of mixing drum revolutions.
- F. For job-mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive

timing device that will positively prevent discharging the mixture until the specified mixing time has elapsed.

3.02 JOINTS

- A. CONTRACTOR shall place all joints as shown on the Drawings or specified herein. If acceptable to ENGINEER, CONTRACTOR may, at its own expense, place construction joints in addition to and at places other than those shown on the Drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.
- B. Where construction joints are not shown on the Drawings or specified elsewhere, CONTRACTOR shall provide construction joints in walls as follows:
 - 1. Vertical construction joints at 60 feet on center maximum but not more than 15 feet from corners or intersections.
 - 2. Horizontal construction joints at 18 feet on center maximum for walls 12 inches or more in thickness.
 - 3. Horizontal construction joints of 8 feet on center maximum for walls 10 inches or less in thickness.
- C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.
- D. Concrete at all joints shall have been in place at least 48 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

3.03 BONDING TO EXISTING CONCRETE

- A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

3.04 PATCHING EXISTING CONCRETE

- A. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish shall match existing concrete. New concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

3.05 EMBEDDED ITEMS IN CONCRETE

- A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

- B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

3.06 PLACING CONCRETE

- A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.
- B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.
- C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.
- D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the segregation or loss of materials. Chuting for conveying purposes must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.
- E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.
- F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.
- G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation from rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. Once concreting is started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.
- H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas, vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.
- I. A sufficient number of spare vibrators shall be kept in ready reserve to provide adequate vibration in case of breakdown of those in use.
- J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.

- K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

3.07 MOIST CURING

- A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:
 - 1. Wood forms left in place and kept wet at all times. If wood forms are not going to be kept wet or if metal forms are used, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
 - 2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces that are to be painted, receive ceramic tile or resilient flooring, or be waterproofed. The curing compound for potable water structures shall be certified per NSF/ANSI-61. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
 - 3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.
 - 4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
 - 5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.
 - 6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
 - 7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."
- B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

3.08 HOT WEATHER CONCRETING

- A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.
- B. The temperature of the delivered concrete shall not exceed 85°F.

- C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the jobsite.
- D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.
- E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.
- F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

3.09 COLD WEATHER CONCRETING

- A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than three successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, except as modified by the requirements of these specifications.
- B. Detailed procedures for the production, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been reviewed for conformance with ACI 306.1.
- C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.
- D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.
- E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.

- F. If heating is used, the housing shall be constructed weathertight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within 2 hours after concrete placement.
- G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.
- H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to provide compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.
- I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.
- J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

3.10 FINISHING

- A. Flat Work:
 - 1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
 - 2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.
 - 3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
 - 4. Tolerance for concrete floors shall be 1/4 inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
 - 5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
 - 6. The above finishes shall be used in the following locations:
 - a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
 - b. Light Troweled Finish: Submerged tank slabs.
 - c. Hard Troweled Finish: Building floors.
 - d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.
- B. Formed Surfaces:
 - 1. Within 2 days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete

using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots that appear shall be repaired. No extra compensation will be allowed CONTRACTOR for such work.

2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
 3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner such that it completely fills the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
 4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
 5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
 - a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all unpainted surfaces (See Section 09 91 00—Painting for painted surfaces), interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel-faced forms are used to form walls, the portion of wall to receive the sack finish shall first be roughened by brush blasting or other acceptable method to achieve a texture similar to 40 to 60 grit sandpaper.
 - b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof- and moistureproof-coated surfaces.
 - c. Finish C shall be referred to as a finish that has surface imperfections less than 3/8 inch in any dimension. Surface imperfections greater than 3/8 inch shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
 - d. Finish D shall be the finish for surfaces that may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.
- C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

3.11 LOADING OF CONCRETE STRUCTURES

- A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.
- B. Extreme care shall be taken so that construction loads do not exceed design loading of the structure.

3.12 NONSHRINK GROUT

- A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

3.13 TESTING AND SAMPLING

- A. The following tests of fresh concrete shall be performed by the SPECIAL INSPECTOR. The SPECIAL INSPECTOR shall prepare, protect, transport, and have tested all cylinders at its expense.
 - 1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C172.
 - 2. Cylinders:
 - a. Three test cylinders shall be made for each pour less than 25 cubic yards, four test cylinders shall be made for each pour between 25 and 100 cubic yards, and eight test cylinders shall be made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least four cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.
 - b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration. In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the jobsite.
 - c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
 - d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test results shall be transmitted immediately and directly to ENGINEER and OWNER. Test data shall include date and location of pour and concrete mix used.
 - 3. Slump Test: The SPECIAL INSPECTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143.
 - 4. Air Test:
 - a. When air-entrained concrete is used, the air content shall be checked by SPECIAL INSPECTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by ENGINEER.
 - b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.

- B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

3.14 RECORDS

- A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The Resident Project Representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

3.15 CONCRETE TOPPING

- A. Before the grout topping is applied, the plank shall be thoroughly cleaned. The plank shall be wetted and kept saturated prior to placing the topping. A thin coat of cement grout shall be broomed into the plank for a short distance ahead of the topping. The topping shall be applied before the grout is hardened.

3.16 CONCRETE REMOVAL AND PATCHING

- A. All areas disturbed as a result of concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

3.17 CURING AND SEALING INTERIOR BUILDING FLOORS

- A. Install cure-seal hardener product in accordance with manufacturer's instructions. Apply only to those floors noted to be sealed in the finish schedule.
- B. Where product will be used for moist curing, sealing and hardening, apply to new concrete as soon as the concrete is firm enough to walk on after troweling. Where product will be used for sealing and hardening only, surface must be free of dust, dirt, laitance, curing compounds, and any material that would inhibit the penetration of the product. In some instances, the floor may need to be stripped and neutralized before application.
- C. Spray on at rate of 200 square feet per gallon.
- D. Keep surfaces wet with cure-seal hardener for minimum soak-in period of 30 minutes, without allowing drying out or becoming slippery. In hot weather, slipperiness may appear before the 30-minute time period has elapsed. If that occurs, apply more cure-seal hardener as required to keep entire surface in a nonslippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a nonslippery state.
- E. After this period, when treated surface becomes slippery, lightly mist with water until slipperiness disappears.
- F. Wait for surface to become slippery again and then flush entire surface with water removing all residue of cure-seal hardener.
- G. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.

- H. Wet vacuum or scrubbing machines may be used to remove residue, provided manufacturer's instructions are followed.
- I. Protect installed floors until chemical reaction process is complete; at least 3 months.
- J. Clean up spills immediately and spot-treat stains with good degreaser or oil emulsifier.
- K. Protection and cleaning of floors are the responsibility of CONTRACTOR until final completion. Replace concrete that becomes stained because of improper precautions or lack of cleaning.

END OF SECTION

SECTION 03 41 13

PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Precast concrete hollow core planks.
 - 2. Connection plates and hangers.
 - 3. Grouting plank joint keys.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 318-Building Code Requirements for Reinforced Concrete.
- B. ASTM C150-Portland Cement.
- C. AWS D1.1-Structural Welding Code.
- D. AWS D1.4-Structural Welding Code-Reinforcing Steel.
- E. PCI-Manual For The Design of Hollow Core Slabs.
- F. PCI MNL-116—Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- G. PCI MNL-120—Design Handbook—Precast and Prestressed Concrete.
- H. PCI MNL-123—Manual on Design of Connections for Precast Prestressed Concrete.
- I. PCI-Design Handbook-Precast and Prestressed Concrete.
- J. PCI-Tolerances for Precast and Prestressed Concrete.

1.03 DESIGN REQUIREMENTS

- A. Size components to withstand design loads in an unrestrained condition as follows:
 - 1. Roof Assembly: All dead loads plus live loads plus concentrated loads shown on the Drawings. Increased loading due to snow drifting at obstructions and changes in roof elevation shall be included in the design.
 - 2. Floor Assembly: All dead loads plus live loads plus concentrated loads shown on the Drawings.
- B. Plank shall be designed in accordance with the PCI-Manual For The Design of Hollow Core Slabs and PCI-Design Handbook.

- C. Plank shall be capable of resisting shear forces as a diaphragm. Diaphragm chords will be the masonry bond beams.

1.04 SUBMITTALS

- A. Professional Engineer: All plank designs shall bear the name and seal of a State of Illinois licensed structural engineer. CONTRACTOR shall be responsible for submitting the required additional copies of plank drawings with original stamp and signature for submittal to the State of Illinois. These materials must be submitted prior to installation.
- B. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
- C. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.

1.05 QUALIFICATIONS

- A. Fabricator: Company specializing in manufacturing the work of this section with 3 years experience. Maintain plant records and quality control program during production of precast planks. Make records available upon request.
- B. Erector: Company specializing in erecting the work of this Section approved by fabricator.
- C. Design precast concrete members in accordance with PCI Manual For The Design of Hollow Core Slabs under direct supervision of a structural engineer experienced in design of this work and licensed in the State of Illinois.
- D. Welder: Qualified within previous 12 months in accordance with AWS D1.1.

1.06 REGULATORY REQUIREMENTS

- A. Conform to ACI 318 and the 2015 International Building Code for design load and on-site construction requirements.
- B. CONTRACTOR shall submit additional copies of shop drawings for submittal to the building code official by ENGINEER.

1.07 PREINSTALLATION CONFERENCE

- A. Convene minimum one week prior to commencing work of this section under provisions of Section 01 31 00—Coordination, Field Engineering, and Meetings.
- B. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Lifting or handling devices shall be capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

- B. Mark each member with date of production and final position in structure.

1.09 COORDINATION

- A. Coordinate the work of framing components not post tensioned but directly associated with the work of this section.
- B. Coordinate field cut openings with affected section.
- C. Coordinate location of hanger tabs and devices for mechanical and electrical work.
- D. Coordinate location of anchors to be placed in masonry walls.

1.10 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 FABRICATORS

- A. The plank shall be prestressed hollow-core precast concrete plank as fabricated by Wells Concrete, Flexicore Company, or equal.

2.02 MATERIALS

- A. Materials shall comply with provisions of ACI 318.
- B. Cement grout for grouting joints shall be one part Portland Cement per ASTM C150, three parts sand and water.

2.03 ACCESSORIES

- A. Connecting and supporting devices shall be painted A36 steel unless noted otherwise.
- B. Bearing pads shall be high-density plastic, 1/8 inch thick.
- C. Caulk as approved by plank manufacturer.

2.04 FABRICATION

- A. Conform to AWS D1.4., PCI MNL-116, and PCI MNL-120, and PCI MNL-123.
- B. Embed anchors, inserts, plates, angles, and other items at locations indicated.
- C. Cut exposed ends flush.

2.05 FINISHES

- A. Plank to be painted shall be field abrasive blasted and painted as specified in Section 09 91 00–Painting.
- B. Connecting and supporting steel devices shall be prime painted per Section 09 91 00–Painting. Do not paint surfaces in contact with concrete or surfaces requiring field welding.

2.06 FABRICATION TOLERANCES

- A. Conform to PCI-Tolerances for Precast and Prestressed Concrete.

PART 3–EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions and supporting structure are ready to receive work and field measurements are as indicated on shop drawings.

3.02 PREPARATION

- A. Prepare support devices for the erection procedure and temporary bracing.

3.03 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and end joints as erection progresses.
- C. Maintain temporary bracing in place until final connection is made. Protect members from staining.
- D. Install bearing pads at bearing ends of planks as indicated.
- E. Adjust differential camber between precast members to tolerance before final attachment and grouting.
- F. Adjust differential elevation between precast members to tolerance before final attachment.

- G. Grout plank joints, trowel smooth. Any grout that may have seeped through to the ceiling below shall be removed before it hardens. Grout shall also be placed between masonry and underside of roof plank in spaces created by roof plank camber over all exterior walls and bearing walls. On nonbearing interior walls, a void over 1/2 inch shall be filled with 1/2-inch expansion material and grout the remainder. This grout shall be applied following roofing. It is the intent that a space of 1/4 inch to 1/2 inch be left for caulking as required in Section 07 90 00–Caulking and Sealants.
- H. Underside of joints between planks that remain exposed shall be caulked as required in Section 07 90 00–Caulking and Sealants.
- I. Where open cores at end of planks are to remain exposed to view. The cores shall be grouted full for a minimum 6-inch depth to provide finished end of plank.
- J. Secure units in place. Perform welding, where shown, in accordance with AWS D1.1.

3.04 ERECTION TOLERANCES

- A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-116.

3.05 CUTTING OPENINGS

- A. Cooperation shall be extended to all trades in permitting the insertion of anchors, hangers, vents, electrical outlets, etc. Holes needed for such devices shall be cut in the field by the various trades. Cuts shall be made with a masonry saw or core drill. The various trades shall be present during installation of the roof deck. All openings not dimensioned or shown on the Drawings shall be located by the trades requiring the openings. All openings larger than 8 inches in any dimension shall be made by the roof slab supplier, and where necessary, hangers shall be furnished by the supplier. All spalling shall be repaired by the roof plank supplier prior to caulking. It is essential that plank which will remain exposed from below have a neat finished surface. Particular care shall be given to appearance of holes and openings.

END OF SECTION

SECTION 04 01 20

MASONRY RESTORATION AND CLEANING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Repointing mortar joints.
 - 2. Replacement of damaged masonry.
 - 3. This section is only for work at Structure 90. The to be demolished Stanley Street Booster Station does not apply to this Section. See Bid Alternative No. 3 for brick salvaging requirements for the booster station demolition.
- B. Related sections and divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Allowance: At existing masonry buildings, CONTRACTOR shall include the assumed quantities for the various types of repair. Cash Allowance unit prices shall include all materials, labor, and incidental items associated with completing repairs. Payment to CONTRACTOR for repairs will be adjusted, add or deduct, based on the actual repairs performed (more or less than quantities below) and the Cash Allowance unit price for the type of repair in question. Before any work included in this allowance begins, CONTRACTOR and ENGINEER shall agree on the extent of the work. Masonry work such as infill of existing openings, repairs after installation of new lintels, etc., that are noted on the Drawings shall be included in the Lump Sum Bid and are not part of this allowance.
 - 1. Repointing: 250 linear feet.
 - 2. Replacement of damaged masonry: 50 square feet.

1.02 REFERENCES

- A. ACI 530/ASCE 5/TMS 402—Building Requirements for Masonry Structures; American Concrete Institute International; 2002.
- B. ACI 530.1/ASCE 6/TMS 602—Specification for Masonry Structures; American Concrete Institute International; 2002.
- C. IMIABC (CW)—Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- D. IMIABC (HW)—Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.

1.03 SUBMITTALS

- A. Product Data: Provide data on mortar mixes.

1.04 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the Contract Documents.
- B. Restorer: Company specializing in masonry restoration with minimum 5 years of documented experience on historic masonry buildings.
- C. CONTRACTOR shall provide approximately a 3-foot by 3-foot test patch area before work begins to establish quality of work for project.

1.05 PREINSTALLATION MEETING

- A. Require attendance of parties directly affecting work of this section.
- B. Review conditions of installation, installation procedures, and coordination with related work.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Requirements: Comply with recommendations of IMIAWC (CW).
- B. Hot Weather Requirements: Comply with IMIAWC Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

1.07 PROJECT CONDITIONS

- A. Perform repointing after cleaning masonry surfaces.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type 1; color as required to produce approved color sample.

- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Aggregate: ASTM C 144.
- D. Pigments for Colored Mortar: Iron or chromium oxides with demonstrated stability and colorfastness.
- E. Sand: ASTM C 144.
- F. Water: Clean and potable.
- G. Additives: None permitted.

PART 3—EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces to be cleaned and restored are ready for work of this section.

3.02 PREPARATION

- A. Protect surrounding elements from damage because of restoration procedures.
- B. Carefully remove and store removable items located in areas to be restored; reinstall upon completion.
- C. Separate areas to be protected from restoration areas using means adequate to prevent damage.
- D. Cover existing landscaping with tarpaulins or similar covers.
- E. Mask immediately adjacent surfaces with material that will withstand cleaning and restoration procedures.

3.03 REBUILDING

- A. Cut out damaged and deteriorated masonry with care in a manner to prevent damage to any adjacent remaining materials.
- B. Cut away loose or unsound adjoining masonry or mortar to provide firm and solid bearing for new work.
- C. Mortar Mix: ASTM C 270, using the Proportion Specification. Colored to match existing work.
- D. Exterior, loadbearing masonry: Type N.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.
- F. Anchors, ties, reinforcing, stone cramps and dowels, and flashings shall be correctly located and built in.

- G. Install built-in masonry work to match and align with existing, with joints and coursing true and level, faces plumb and in line. Build in all openings, accessories and fittings.

3.04 REPOINTING

- A. All exterior masonry on the Administration Building (Structure 90) structure that is to remain shall be inspected for cracks or "defective" mortar joints. Any mortar joint that is loose, porous, crumbled, cracked, badly weathered (deeper than 1/4 inch behind masonry surface), unbonded to adjacent masonry units, or a potential source of leakage shall be deemed "defective." "Hairline" cracks in the mortar are not considered "defective."
- B. All cracks and "defective" mortar joints shall be repointed.
- C. Cut out loose or disintegrated mortar in joints so that the depth equals or exceeds two times the mortar joint thickness or until sound mortar is reached.
- D. Use power tools only after test cuts determine no damage to masonry units will result.
- E. Do not damage masonry units.
- F. When cutting is complete; remove dust and loose material by brushing/with water jet/air jet.
- G. Premoisten joint and apply mortar. Pack tightly. Form a smooth, compact concave joint to match existing.
- H. Mortar mix (exterior, nonloadbearing masonry): ASTM C 270, Type N, using the Proportion Specification. Colored to match existing work.
- I. Prehydrate mortar.
- J. Mixing: Use mechanical batch mixer and comply with referenced standards.
- K. Moist-cure for 72 hours.

3.05 PROGRESS AND FINAL CLEANING

- A. Immediately remove stains, efflorescence, or other excess resulting from the work of this section.
- B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.
- C. Clean surrounding surfaces.

END OF SECTION

SECTION 04 05 13
MORTAR AND MASONRY GROUT

PART 1—GENERAL

1.01 SUMMARY

- A. The work includes mortar and grout for masonry.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. 2015 International Building Code.
- B. ASTM C91—Masonry Cement.
- C. ASTM C144—Aggregate for Masonry Mortar.
- D. ASTM C150—Portland Cement.
- E. ASTM C207—Hydrated Lime for Masonry Purposes.
- F. ASTM C404—Aggregates for Masonry Grout.
- G. ASTM C476—Grout for Masonry
- H. ASTM C979—Pigments for Integrally Colored Mortar/Concrete.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Submit information on Portland cement, integral waterproofing compound, and hydrated lime for mortar. Include design mix with proportions of materials being used. Submit gradation on aggregates.
- C. Submit design mix for grout including gradation of aggregates.
- D. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All cement shall be stored in a dry, weatherproof, properly ventilated structure which will protect it from dampness and freezing.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. See Section 04 20 00—Unit Masonry System, for cold weather requirements.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MORTAR

- A. Provide Portland cement-lime mortar or masonry cement mortar with proportion restrictions as stated in the 2015 International Building Code. Provide integral waterproofing compound in mortar for all exterior masonry. Provide Type N mortar for exterior non-load bearing brick and split face block veneer. Provide Type S mortar for all other masonry.
- B. Portland cement shall conform to ASTM C150, Type I or III.
- C. Hydrated lime shall conform to ASTM C207, Type S.
- D. Masonry cement shall conform to ASTM C91.
- E. Integral waterproofing compound shall be Dry-Block by W.R. Grace Company, or equal.
- F. Mortar aggregate for ordinary tile, brick, stone, and block shall consist of clean, sharp sand, conforming to ASTM C144. The sand shall be graded within the following limits:

Sieve Number	Percent by Weight Passing
4	100
8	95 to 100
16	70 to 100
30	40 to 75
50	10 to 35
100	2 to 15
200	---

- G. Sand from any one source shall not vary over the extreme limits shown above. For unusually thin joints, such as occur with a unit having cut or ground edges, the aggregate used shall conform to these specifications except that 95% shall pass a No. 16 sieve.
- H. Water used in mixing water shall be clean and free of injurious materials.
- I. Mortar shall be thoroughly mixed until of uniform color and consistency. Only sufficient mortar to meet the immediate requirements of the work shall be mixed at one time. No mortar shall be retempered after it has begun to set, and no partially set mortar shall be used. No antifreeze material shall be used in the mortar to lower the freezing point.
- J. Color of mortar shall match existing.

2.02 GROUT

- A. Grout shall conform to ASTM C476–Mortar and Grout for Reinforced Masonry.
- B. Aggregates shall conform to ASTM C404–Aggregates for Masonry Grout.
- C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:
 - 1. Fine Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate.
 - 2. Coarse Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate: 1 to 2 coarse aggregate.
- D. Fine grout shall be used in spaces with least horizontal dimension greater than 3/4 inch and less than 2 1/2 inches. Coarse grout shall be used in all spaces with least dimensions 2 1/2 inches or greater.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Brace masonry for wet grout pressure.
- B. Work grout into masonry cores and cavities.
- C. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.
- D. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the Drawings.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY SYSTEM

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Concrete block.
 - 2. Brick.
 - 3. Reinforcement, anchorage, control joints, and accessories.
 - 4. Cold weather requirements.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. 2015 International Building Code.
- B. ASTM C67—Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- C. ASTM C90—Standard Specification for Loadbearing Concrete Masonry Units.
- D. ASTM C216—Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
- E. ASTM C744—Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
- F. UL—Fire Resistance Directory.

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section.

1.04 QUALITY ASSURANCE

- A. Variation from the plumb in the lines and surfaces of columns and walls shall not exceed 1/4 inch in 10 feet, 3/8 inch in a story height or 20 feet maximum or 1/2 inch in 40 feet or more. Variation from plumb for external corners, expansion joints, and other conspicuous lines shall not exceed 1/4 inch in any story or 20 feet maximum or 1/2 inch in 40 feet or more.
- B. Variation from the level of the grades indicated on the drawing for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines shall not exceed 1/4 inch in any bay or 20 feet or 1/2 inch in 40 feet or more.

- C. Variation of the linear building line from an established position in plan and related portion of columns, walls, and partitions shall not exceed 1/2 inch in any bar or 20 feet maximum or 3/4 inch in 40 feet or more.
- D. Variation in cross-sectional dimensions of columns and thickness of walls shall not exceed minus 1/4 inch or plus 1/2 inch from the dimensions indicated on the drawings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground, shall be kept clean and covered.

1.06 MOCKUP

- A. Provide a 4-foot by 4-foot mockup panel of masonry, including anchor accessories and flashings, before any masonry work begins. Location will be indicated by OWNER. Mockup panel shall be approved by OWNER and used as a sample of the quality of work to be expected on the job. Mockup panel may not remain as part of the work.

1.07 COLD WEATHER REQUIREMENTS

- A. All masonry units delivered to use in freezing weather shall be fully protected by a weathertight covering to prevent accumulation of ice on the units. Loose board covering will not be permitted.
- B. Cold Weather Protection:
 - 1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
 - 2. Remove all masonry determined to be frozen or damaged by freezing conditions.
 - 3. Perform the following construction procedure while the work is progressing. When air temperature is from 40°F (4°C) to 32°F (0°C), heat sand or mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C):
 - a. When air temperature is from 32°F (0°C) to 25°F (-4°C), heat sand or water to produce mortar temperature between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
 - b. When air temperature is from 25°F (-4°C) to 20°F (-7°C), heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
 - c. When air temperature is from 20°F (-7°C) and below, heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); provide enclosures and auxiliary heat to maintain air temperature above 32°F (0°C); do not lay units which have a surface temperature of 20°F (-7°C).
 - 4. Perform the following protections for completed masonry and masonry not being worked on:
 - a. When the mean daily air temperature is from 40°F (4°C) to 32°F (0°C), protect masonry from rain or snow for at least 24 hours by covering with weather-restrictive membrane.
 - b. When the mean daily air temperature is from 32°F (0°C) to 25°F (-4°C), completely cover masonry with weather-restrictive membrane for at least 24 hours.

- c. When the mean daily air temperature is from 25°F (-4°C) to 20°F (-7°C), completely cover masonry with insulating blankets or similar protection for at least 24 hours.
- d. When mean daily temperature is 20°F (-7°C) and below, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures, blankets, and supplementary heat.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 CONCRETE BLOCK

- A. Concrete block shall be load bearing and shall conform to the requirements of ASTM C90 and the 2015 International Building Code. Bond shall be running bond. Concrete block shall be the two-cell type and shall be made with normal weight aggregate.
- B. Concrete block shall have a minimum net area compressive strength f'_{cmu} of 3,250 psi.
- C. Unless otherwise indicated, interior concrete block at window sills and lintels, pilasters, and the top course of walls at roof lines shall be constructed of solid concrete block, lintel block filled with grout, or the cores of the block filled with grout. Interior block at window sills shall be solid concrete block unless otherwise noted. Bullnose block shall be used at all door, window, and wall corners that remain exposed.
- D. All interior concrete block walls shall extend to the underside of roof deck or floor above unless noted otherwise.
- E. Provide sash units with integral dovetail slots at masonry control joints.

2.02 BRICK

- A. Face brick shall be ASTM C216, latest edition, Grade SW, Type FBS, made from clay, shale, fine clay, or mixture thereof. All brick shall be free from cracks, laminations, and other defects that may interfere with proper laying of brick or impair the strength or permanence of the structure. Where possible, existing brick veneers that are being removed shall be salvaged and reused for new brick construction.

- B. A certificate of conformance as to grade and type shall be supplied by the manufacturer.
- C. Brick shall match existing. CONTRACTOR shall submit brick samples to OWNER or selection. The bricks to be used shall be of economy size (7 5/8 by 3 5/8 by 3 5/8) and running bond.
- D. Provide all brick masonry to complete work.

2.03 REINFORCEMENT AND ANCHORAGE

- A. For concrete block walls, masonry wall reinforcement shall be 220 Ladder-Mesh manufactured by Hohmann & Barnard, Inc., Ladder Wire, manufactured by Wire-Bond, or equal.
- B. For cavity walls, masonry wall reinforcement shall be 270-2X Ladder Eye-Wire manufactured by Hohmann & Barnard, Inc., Ladder Adjustable Tab by Wire-Bond, or equal.
- C. Wall reinforcement and ties shall be hot-dipped galvanized having a minimum 1.50 ounce/square foot zinc coating in accordance with ASTM A153 Class B2.
- D. Side rods shall be 9 gauge wire, and cross rods and tabs shall be 9 gauge wire. Maximum spacing of tabs shall be 24 inches.
- E. Prefabricated corner and tee sections shall be used to form continuous reinforcement around corners and for anchoring abutting walls and partitions.
- F. Reinforcing Bar Positioners: Where vertical reinforcing bars are required, provide bar positioners by Hohmann and Barnard, or equal.

2.04 ACCESSORIES

- A. Cellular or honeycomb cell vents, 2 1/2 inches high, shall be provided at weep holes. Cell vents shall be UV-resistant polypropylene, QV-Quadro-Vent, or equal.
- B. Vertical expansion control joints shall be located as shown on the drawings. Control joints shall be constructed with a factory-extruded section of rubber equal to RS Series—Rubber Control Joint by Hohmann & Barnard, Inc., Rubber Control Joint by Wire-Bond, or equal, and shall extend for the entire height of the wall. Care shall be taken so that the gap is free of mortar or debris. Control joint shall be caulked on exposed faces with caulk of a color to match mortar.
- C. See Section 05 50 00—Metal Fabrications for masonry veneer support system at lintels.
- D. See Section 07 26 00—Vapor and Air Barrier for air barrier on masonry walls.
- E. See Section 07 62 00—Flashing and Sheet Metal for masonry flashing specifications.

PART 3-EXECUTION

3.01 MASONRY WORKMANSHIP

- A. All masonry shall be laid plumb and true to lines. Brick shall be laid with complete full mortar joints. Mortar beds shall be spread smooth or only slightly furrowed. The ends of brick shall be buttered with sufficient mortar to fill the end joint.
- B. All masonry shall be laid in running bond, unless specified otherwise.
- C. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after being set in position. Where an adjustment must be made after the mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.
- D. In building cavity walls, the cavity shall be kept clean by slightly beveling the mortar bed to incline toward the cavity or by placing wood strips with attached wire pulls on the metal ties. The strips shall be withdrawn and cleaned before placing the next row of metal ties. Any mortar fins that protrude into the cavity space as the wall is built shall be troweled flat onto the inner face of the wythe.
- E. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor-driven masonry saw or by other methods that provide cuts that are straight and true.
- F. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections that might puncture the flashing material. Through-wall flashing shall be placed on a bed of mortar, and mortar shall be placed above the flashing.
- G. Weep holes spaced 32 inches on center 2 1/2 inches high shall be provided in the first course immediately above all flashing and at the uppermost course immediately below soffits or coping. Weep holes shall be kept free of mortar droppings.
- H. Outside joints around the perimeter of exterior door and window frames or other wall openings shall be not less than 1/4 inch nor more than 3/8 inch wide and shall be cleaned out to a uniform depth of at least 3/4 inch ready for placement of caulk.
- I. All walls shall be adequately braced until they are completed and anchored to the roof construction.
- J. All brick having initial rates of absorption in excess of 0.25 ounce per square inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. Wetting of units shall be such so that each unit is nearly saturated, surface dry when laid. During freezing weather, units that require wetting shall be sprinkled with warm water just before laying.

3.02 MORTAR JOINTS

- A. All joints shall be laid plumb to lines. Unless specified otherwise, mortar beds shall be full 3/8 inch thick and shall be spread smooth or only slightly furrowed. Vertical joints shall be shoved not over 3/8 inch thick, unless otherwise shown. All joints shall be completely filled.

- B. Interior and exterior joints shall be tooled concave. All joints shall be tooled to uniform depth and shall be straight and true. Mortar joints shall be cut flush with masonry where rigid thermal insulation will be applied to interior masonry surfaces.

3.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcement shall be installed in the first and second bed joint 8 inches apart immediately above lintels and below sills at openings. Elsewhere, spacing shall be at 16-inch vertical intervals or as shown on the drawings. Extend reinforcement in the second joint above and below openings 2 feet beyond the jambs. All other reinforcing shall be continuous.
- B. Side rods shall be lapped 6 inches minimum at splices. Reinforcement units shall be of widths required for wall thicknesses as shown. Reinforcement shall be placed to allow for a 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.
- C. Vertical reinforcing bars shall be installed using prefabricated bar positioners. Provide one positioner at the top of the first course of block and one additional positioner at a maximum spacing of 200 bar diameters.

3.04 BUILT-IN WORK

- A. As work progresses, install all built-in work (such as window and door frames, anchor bolts, plates, and lintels) to be provided by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door frames in adjacent mortar joints. Grout all steel door frames full with mortar except those called for to be "removable."
- D. Do not use built-in organic materials subject to deterioration.
- E. Pointing: See Section 04 01 20—Masonry Restoration and Cleaning.

3.05 JOINING OF WORK

- A. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned and lightly wetted so as to obtain the best possible bond with the new work. All loose brick and mortar shall be removed. If it becomes necessary to "stop-off" a horizontal run of masonry, this shall be done only by racking back brick in each course, and if grout is used, stopping grout 4 inches back of the rack. Toothing will not be permitted.

3.06 PROTECTION OF WORK

- A. During erection, all walls shall be kept dry by covering at the end of each day or shutdown period with a canvas or waterproof covering. Partially completed walls not being worked on shall be similarly protected at all times. All covering shall overhang at least 2 feet on each side of the wall and shall be securely anchored.

3.07 MASONRY CONTROL JOINTS

- A. Provide vertical masonry control joints as detailed on the drawings.

- B. Where possible, joints shall be located at one or both edges of door, window, and louver openings and at changes in wall height.

3.08 CLEANING NEW WORK

- A. Masonry faces to remain exposed shall be wiped with a damp cloth as the work progresses and thoroughly cleaned and pointed upon completion. If stiff brushes and water will not suffice, the surface shall be thoroughly wetted with plain water and then scrubbed with a 5% or 10% solution of hydrochloric acid. Alternatively, a commercial cleaner such as Sure Klean, or equal, may be used. Immediately after, the surface shall be washed to remove all traces of acid. All surfaces not being cleaned shall be protected from the acid. All mortar shall be removed from surfaces other than masonry.

3.09 EXISTING MASONRY

- A. Openings in existing walls which are to be filled shall be filled with masonry units to match existing including bull nose jamb, headers, or row lock units necessary to match existing coursing.
- B. Where possible, new openings in existing masonry shall be sawcut.
- C. Provide all necessary removals and repairs required for installation of new louvers, fans, openings, etc.
- D. At lintel bearings of all new openings, grout masonry full for 16 inches full height on both sides of opening.
- E. Repair all masonry damaged during construction.
- F. All existing joints, interior and exterior, shall be pointed. Pointing mortar shall be prehydrated Type N. All adjacent surfaces shall be dampened. Joints shall be finished to match existing.
- G. All existing masonry which will remain exposed shall be cleaned as specified for new masonry.
- H. New units shall be toothed into existing units including jambs, sills, and headers.
- I. Where toothing is not practical or desirable, joint reinforcing may be drilled and anchored into existing mortar joints and carried into new units.
- J. Masonry reinforcing shall be carried through new units.

END OF SECTION

SECTION 04 72 00

CAST STONE

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes cast stone bands.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A184—Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
- B. ASTM A615—Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C. ASTM A1064—Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- D. ASTM C33—Concrete Aggregates.
- E. ASTM C150—Portland Cement.
- F. ASTM C260—Air-Entraining Admixtures for Concrete.
- G. ASTM C494—Chemical Admixtures for Concrete.
- H. ASTM C979—Pigments for Integrally Colored Concrete.

1.03 DESCRIPTION

- A. Cast stone is a building material manufactured from carefully controlled portions of Portland Cement and coarse and fine aggregates molded into shapes by the manufacturer.

1.04 DESIGN REQUIREMENTS

- A. Units shall be designed to withstand dead and live loads, applicable snow load, erection forces, and other loads in accordance with the 2015 International Building Code.

1.05 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawings shall indicate layout, configuration, dimensions, joint locations, identification marks, reinforcement, connection details, openings, lifting devices, and relationship to adjacent materials.
- C. Submit sample of each type of unit illustrating surface finish, color, and texture.

1.06 QUALITY ASSURANCE

- A. Manufacturer shall have minimum 5 years of continuous successful experience in fabricating cast stone materials in compliance with Cast Stone Institute standards.
- B. Installer shall have minimum 5 years successful experience in handling and installing cast stone units on projects of comparable size and scope.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Provide protective coverings and temporary lateral support to prevent damage during shipping. Blocking and supports shall be clean, nonstaining, and shall not cause harm to exposed surfaces.
- B. Store stone units under cover, off the ground, away from areas subject to high humidity conditions.
- C. Where extended on-site storage is necessary, provide nonstaining wood cribbing between stacked units to promote air circulation and prevent condensation.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cast stone members shall be as manufactured by Edwards Cast Stone Company, Dubuque, Iowa, or equal.

2.02 MATERIALS

- A. Cement: ASTM C150, Portland, Type 1 or III, grey.
- B. Fine Aggregate: ASTM C33, graded and washed natural sand; gradation required to attain indicated texture and finish.

- C. Coarse Aggregate: ASTM C33, graded and washed natural gravel; gradation required to attain indicated texture and finish.
- D. Color Pigments: ASTM C979, inorganic iron oxide pigments, limeproof. Cement grade carbon black pigment is not acceptable.
- E. Reinforcing: ASTM A615, Grade 60, galvanized where embedment is less than 2 inches for No. 5 bars or greater; 1 1/2 inches for No. 4 bars or smaller.
- F. Steel Wire Reinforcement: ASTM A1064.
- G. Welded Wire Fabric: Comply with ASTM A1064, where applicable.
- H. Steel Bar or Rod Mat Reinforcement: Comply with ASTM A184, where applicable.
- I. Admixtures: Comply with ASTM C494.
- J. Water: Potable, free of impurities.
- K. Air Entrainment: Comply with ASTM C260. Wet-cast mixtures shall contain between 5 to 7% air entrainment where surfaces are exposed to freeze-thaw conditions.
- L. Mortar shall be as specified in Section 04 05 13–Mortar and Masonry Grout.

2.03 SUPPORT DEVICES

- A. Connecting and supporting devices shall be Type 304 or 316 stainless steel.
- B. Bolts, nuts, and washers shall be Type 304 stainless steel.
- C. Provide cramp anchors for anchoring stones together at corners.
- D. Setting buttons, shims, and sheet shall be lead or resilient plastic, nonstaining, thickness to suit joint thickness. For pointed joints, sized to avoid interference with pointing operation.

2.04 ACCESSORIES

- A. Sealant shall be type specified in Section 07 90 00–Caulking and Sealants.

2.05 FABRICATION

- A. Factory fabrication shall comply with Cast Stone Institute recommended fabricating practices.
- B. Comply with Cast Stone Institute recommended tolerances and the following:
 - 1. Height and Width: Plus 1/16 inch; minus 1/8 inch.
 - 2. Lengths:
 - a. Up to 2 feet 0 inch: Plus 1/16 inch; minus 1/8 inch.
 - b. From 2 feet 0 inch to 5 feet 0 inch: Plus or minus 1/8 inch.
 - c. From 5 feet 0 inch to 10 feet 0 inch: Plus 1/8 inch; minus 3/16 inch.

- C. Color and texture shall match approved samples, when viewed in direct daylight at a 20-foot distance.
- D. Cast stone manufacturer is responsible for preparing design mix to attain compressive strength of 6,500 psi at 28 days.
- E. Water absorption shall be maximum 6% by dry weight.
- F. Reinforcing shall be placed according to Cast Stone Institute recommendations for safe handling, settling, and structural requirements and as indicated on approved shop drawings.
- G. After manufacturing, cure all dry-tamped cast stone minimum of 8 hours in a totally enclosed curing room at 85°F and 100% relative humidity; then steam cure for minimum 10 hours.
- H. For new design mixes, take daily test cylinders and test in-house using a certified technician, at 20 hours and 28 days after manufacture to provide compliance with minimum compressive strength requirements. Cast stone manufacturer will not be required to retest previous tested and used standard design mixes.
- I. Maintain consistent quality during manufacture.
- J. Exposed-to-view finish surfaces shall be uniform in color and appearance.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive cast stone work and verify that building structure, anchors, devices, and openings are ready to receive work of this section. Do not proceed with installation until surfaces and conditions meet requirements for acceptable installation.

3.02 PREPARATION

- A. Verify that installation of items required for stonework to be installed by others are proper type, size, finish, and are located at proper spacings with proper anchorage.

3.03 ERECTION

- A. Install/set all units and accessories accurately, using skilled experienced personnel, according to approved shop and setting drawings.
- B. Clean stone surfaces before setting using only water or mild cleaning compounds containing no caustic or abrasives.
- C. Drench all stone units thoroughly with water just before setting.
- D. Provide chases, reveals, openings, and other spaces required to accommodate other work. Close up after other work is complete with cast stone which matches stone already set.
- E. Where an open cavity is indicated between cast stone and backup material, keep cavity free of mortar and grout.

- F. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stonework in place. Attach anchors securely to stone and to supporting surfaces. Place anchors and dowels firmly, and fill holes with mortar or nonshrink grout.
- G. Set cast stone accurately, in patterns and locations indicated, with uniform joints of dimensions indicated and with edges and faces aligned according to established relationships and indicated tolerances.
- H. Set stones supported on solid structural members on setting buttons, shims, or sheets, or a combination of setting buttons and mortar.
- I. After setting each stone, sponge off mortar smears and splashes.
- J. Embed only ends of lugged sills and similar stones; leave remainder of joint open and tuckpoint on faces only.
- K. Set all partially or fully horizontal stones with unfilled vertical joints. After setting, install backer rod, prime ends, and caulk.
- L. Setting Tolerances: Set cast stone units to the following tolerances unless detailed otherwise:
 - 1. Variation from plumb of lines and surfaces of columns, walls, and arises: Maximum 1/4 inch in 10 feet.
 - 2. Variation from level of grades indicated for floors, exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines: Maximum 1/2 inch in any 20-foot bay; maximum 3/4 inch in any dimension over 40 feet.
 - 3. Variation of linear building lines from position in plan: Maximum 1/2 inch in any 20-foot bay.
 - 4. Variation in cross-sectional dimensions of column and wall thicknesses: maximum $\pm 1/4$ inch.
 - 5. Variation between faces of adjacent pieces and panels is not permitted.

3.04 FIELD QUALITY CONTROL

- A. Remove and replace work that is broken, chipped, stained, or otherwise damaged; work that does not match approved samples or approved mockup; and work containing defective joints. Replace unacceptable materials in accordance with the cast stone manufacturer, leaving no visible evidence of replacement.

3.05 CLEANING

- A. Perform final cleaning as soon as possible after mortar has set and been tooled. Use no wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods which could damage or cause discoloration or etching of surfaces or joints, without written approval from cast stone manufacturer.

3.06 PROTECTION

- A. Protect work from staining or damage to finished surfaces by ongoing construction until acceptance by OWNER.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Shop-fabricated carbon steel, stainless steel, and aluminum items, including lintels, metal stairs, and ladders.
 - 2. Stair treads and nosings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36—Carbon Structural Steel.
- B. ASTM A53—Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123—Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A143—Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- E. ASTM A153—Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A240—Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- G. ASTM A276—Stainless Steel Bars and Shapes.
- H. ASTM A307—Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- I. ASTM A384—Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- J. ASTM A385—Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- K. ASTM A500—Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- L. ASTM A780—Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- M. ASTM A992—Structural Steel Shapes.
- N. ASTM A1008—Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

- O. ASTM A1011—Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- P. ASTM B209—Aluminum and Aluminum-Alloy Sheet and Plate.
- Q. ASTM B211—Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
- R. ASTM B221—Aluminum and-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- S. AWS A2.0—Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- T. AWS A5.4—Stainless Steel Electrodes for Shielded Metal Arc Welding.
- U. AWS D1.1—Structural Welding Code—Steel.
- V. AWS D1.2—Structural Welding Code—Aluminum.
- W. AWS D1.6—Structural Welding Code—Stainless Steel.
- X. ASTM F593—Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- Y. ASTM F594—Standard Specification for Stainless Steel Nuts.

1.03 DESIGN REQUIREMENTS

- A. All fabrications shall meet applicable code requirements including OSHA.

1.04 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.
- C. Mill Test Reports: Submit indicating structural strength and composition.
- D. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.05 QUALITY ASSURANCE

- A. Fabricate steel members in accordance with AISC Code of Standard Practice.
- B. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

1.06 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS *Standard Qualifications Procedures*.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to allow uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MATERIALS—CARBON STEEL

- A. Steel Sections:
 - 1. ASTM A36 (channels, angles, plates).
 - 2. ASTM A992 (wide flange sections).
 - 3. Pipe: ASTM A53, Grade B.
 - 4. Tubes: ASTM A500, Grade B.
 - 5. Silicon content of steel members to be hot-dipped galvanized shall be in the range of 0 to 0.04%. Submit mill test reports confirming compliance.
- B. Sheet Steel: ASTM A1011.
- C. Plain Washers: Round carbon steel complying with FS FF-W-92.
- D. Bolts, Threaded Rods, and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.
- E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.

- F. Welding Electrodes: Comply with AWS D1.1. E70XX electrodes for carbon steel. For ASTM A992 steel and any other steel with 50 ksi or greater yield strength, use only E7018 or other E70XX electrodes specifically permitted by AWS D1.1.
- G. Select fasteners for the type, grade, and class required.

2.02 MATERIALS—STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel bars and shapes shall meet the requirements of ASTM A276 and shall be Type 316L.
- B. Unless otherwise noted, all stainless steel bolts shall meet the requirements of ASTM F593 and shall be Type 316L.
- C. Unless otherwise noted, all stainless steel nuts shall meet the requirements of ASTM F594 and shall be Type 316L.
- D. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.
- E. Welding Electrodes:
 - 1. Comply with AWS D1.6.
 - 2. Use ER316L electrodes for 316L stainless steel.
 - 3. Use ER308L electrodes for 304L stainless steel.

2.03 MATERIALS—ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.
- B. Sheet Aluminum: ASTM B209, Alloy 3005.
- C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.
- D. Bolts, Nuts, and Washers: Stainless steel.
- E. Welding Materials: AWS D1.2; type required for materials being welded.

2.04 ACCESSORIES

- A. Stair Treads: Stair treads for galvanized steel grated stairs shall be constructed of nonslip grating and shall have an integral nosing. Treads shall be hot-dipped galvanized welded steel stair treads with 1 1/4-inch abrasive nosing by Ohio Gratings, or equal.
- B. Masonry Veneer Support System:
 - 1. For exterior masonry cavity wall construction, provide prefabricated, hot-dip galvanized steel masonry veneer support system to support brick or split face block veneer from concrete masonry backup wall.
 - 2. System shall be Hohmann and Barnard TBS Thermal Brick Support System, Fero Fast Thermal Bracket system, Halfen Brickwork Support System, or equal.
 - 3. When shelf angle size is not indicated on the drawings, shelf angle design shall be provided by manufacturer. Manufacturer's design shall bear the seal of a professional engineer licensed in the state the project is located in.

4. Fasten veneer support system to masonry backup wall using manufacturer standard adjustable brackets and 304 stainless steel masonry anchors. Fastener type and sizing shall be provided by the manufacturer. Manufacturer's fastener design shall bear the seal of a professional engineer licensed in the state the project is located in.
5. Submit product details, shop drawings including overall layout, shelf angle sizes, bracket locations, and connections details, and design calculations bearing the seal of a professional or structural engineer, as appropriate, and licensed in the state the project is located in.

2.05 FABRICATION

A. Fabrication and Assembly:

1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.
5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

B. Connections:

1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
3. Assemble and weld built-up sections to produce true alignment of axes without warp.
4. Welding shall be done by the shielded arc process.
5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.

C. Workmanship:

1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.
2. Work to dimensions shown or accepted on the shop drawings using proven details of fabrication and support.
3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
5. Cap all open ends of pipe and structural tubing.
6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

2.06 MISCELLANEOUS METAL FABRICATION

- A. Metal Stairs:
 - 1. Fit and shop-assemble components in largest practical sections for delivery to site.
 - 2. Fabricate components with joints tightly fitted and secured.
 - 3. Supply components for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
 - 4. Welded steel grating stair treads shall be bolted to stringers with galvanized steel bolts.
- B. Galvanized Steel Ladder: Provide fixed ladder with serrated surface on rungs.

2.07 FINISHES

- A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09 91 00–Painting.
- B. Do not prime surfaces where galvanizing or field welding is required.
- C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer's instructions and Section 09 91 00–Painting.
- D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.
- E. Surfaces that will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.
- F. Galvanizing:
 - 1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
 - 2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in *Recommended Details for Galvanized Structures* as published by the American Hot Dip Galvanizer's Association, Inc.
 - 3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
 - 4. Silicon content for steel to be hot-dipped galvanized shall be in the range of 0 to 0.04%.
 - 5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
 - 6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, *Welding Zinc Coated Steel*. All uncoated weld areas shall be touched up.
- G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Correct conditions detrimental to the proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.
- B. Coordinate delivery of such items to project.
- C. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

- A. Setting Precast Anchorages:
 - 1. Clean bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
 - 2. After the bearing members have been positioned and plumbed, tighten and anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 - 3. Pack grout solidly between bearing surfaces and plates so that no voids remain.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- C. Cutting, Fitting, and Placement:
 - 1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
 - 2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
 - 3. Fit exposed connections accurately together to form tight hairline joints.
 - 4. Weld connections that are not to be left as exposed joints, grind joints smooth, and touchup shop paint coat or galvanizing repair.

3.04 FIELD WELDING

- A. Comply with AWS Code for procedures of manual shielded metal arc welding (steel, stainless steel) and gas metal arc welding (aluminum), appearance and quality of weld made, and methods in correcting welding work.

3.05 TOUCH-UP PAINTING

- A. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting in accordance with Section 09 91 00-Painting.

3.06 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting, or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16 inch in width.
 - 1. Cold Galvanizing Compound:
 - a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be power disc-sanded to bright metal. So that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
 - c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
 - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
 - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
 - 2. Zinc-Based Solder:
 - a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
 - b. Areas to be repaired shall be wire-brushed.
 - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
 - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

3.07 SCHEDULE

- A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Guard Posts: Steel pipe, concrete-filled, crowned cap, as detailed-galvanized and field finish paint in accordance with Division 09.
- C. Lintels: Shop prime paint finish for interior wall lintels; galvanized and field finish paint in accordance with Division 09 for exterior wall lintels. Lintels approved by ENGINEER shall be placed over all masonry openings, even though not shown on the Drawings. See lintel schedule on the Drawings.
- D. Door Frames for Overhead Door Openings: Jamb angle sections-galvanized and field finish paint in accordance with Division 09. Sill angle sections-galvanized finish.
- E. Aluminum ladder.
- F. Galvanized steel stairs with serrated welded steel treads and landings.
- G. Galvanized steel ladders.

END OF SECTION

SECTION 05 52 00
HANDRAILS AND RAILINGS

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes steel handrails, railings, and fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A53–Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

1.03 DESIGN REQUIREMENTS

- A. Railings and handrails shall be designed in accordance with and meet the applicable requirements of the Occupational Safety and Health Act and the 2015 International Building Code.
- B. Submit engineering calculations for all rails, posts, and connections demonstrating compliance with the design requirements. Calculations shall be stamped by a Illinois Structural Engineer.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 STEEL PIPE RAILING SYSTEM

- A. Rails and posts shall be ASTM A53 pipe, Grade B, 1 1/2-inch standard pipe.

- B. Furnish and install 4-inch by 1/4-inch toeboards as shown on the Drawings.
- C. Furnish and install self-closing steel gates with stainless steel torsion springs at openings in railings providing points of access as shown on the Drawings.
- D. Provide expansion joints in railing and toeboards at expansion joints in structures and as necessary to prevent buckling or buildup of stresses. Expansion joints shall be located within 1 foot of posts.
- E. Finished joints shall be smooth.
- F. All rails, posts, and toeboards shall be shop-primed with an epoxy primer per Section 09 91 00–Painting.
- G. Posts shall be anchored to the top of walls and decks with a flange base plate. Base plate shall reinforce the bottom end of the post as required to meet OSHA design criteria. Provide side-mounted posts where shown on the Drawings.
- H. Steel adhesive or expansion bolt anchoring system, in accordance with manufacturer's recommendations, shall be used.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.
- B. Install components plumb and level, accurately fitted, and free from distortion or defects.
- C. Clean all components as recommended by railing manufacturer.

END OF SECTION

SECTION 05 53 00

GRATING, FLOOR PLATES, AND FLOOR PLANK

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes tread grating.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A123—Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. NAAMM Metal Bar Grating Manual ANSI NAAMM MBG531 and MBG532.
- C. ASTM B221—Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.03 PERFORMANCE REQUIREMENTS

- A. Grating shall be designed for a maximum deflection of 1/4 inch when supporting a 100 psf uniform load.

1.04 FIELD MEASUREMENTS

- A. Take all field measurements prior to preparation of shop drawings. Verify that field measurements are as indicated on shop drawings.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 STEEL GRATING

- A. Grating shall be galvanized welded steel grating with minimum 3-inch by 5/16-inch bearing bars. Cross bars shall be minimum 1-inch by 1/4-inch.
- B. Acceptable manufacturers include the following or equal: Harsco Industrial Borden Heavy Duty Steel Grating, Type C.
- C. All edges of the grating and all openings in the grating for pipe and miscellaneous equipment shall be banded by welding on minimum 3/16-inch-thick bars. The band shall have less depth than the bearing bars to permit drainage.
- D. Provide grating in 12-inch maximum width sections.
- E. Grating support angles shall be galvanized steel, hot-dipped in accordance with ASTM A123.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Verify that dimensional tolerances are acceptable.
- B. Prior to installation, CONTRACTOR shall inspect supports for correct size, layout, and alignment. Any inconsistencies between Contract Drawings and supporting structure deemed detrimental to placement shall be reported in writing to ENGINEER prior to placement.

3.02 INSTALLATION

- A. All grating and plank shall be secured to supporting members with steel saddle clips supplied by the grating manufacturers. Stud bolts and other hardware shall be supplied by CONTRACTOR.
- B. Install in accordance with shop drawings and standard installation clearances as recommended by the NAAMM Metal Bar Grating Manual.
- C. Cutting, Filling, and Placement:
 - 1. Perform all cutting and fitting required for installation.
 - 2. Cutouts for circular obstructions are to be at least 2 inches larger in diameter than the obstruction. Cutouts for all piping 4 inches or less shall be made in the field.
 - 3. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance not to exceed bearing bar spacing.
 - 4. Utilize standard panel widths wherever possible.

END OF SECTION

SECTION 05 56 00

ANCHOR BOLTS AND POST-INSTALLED ANCHORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, adhesive anchors, and screw anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
- B. ASTM F1554—Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.
- C. ICC-ES International Code Council—Evaluation Service.
- D. AC 193—Acceptance Criteria for Mechanical Anchors in Concrete Elements.
- E. AC 308—Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete.
- F. ACI 355.2—Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
- G. ACI 355.4—Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 GENERAL

- A. Unless indicated otherwise on the Drawings or specified, use the following bolt material for the various installation situations:
 - 1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
 - 2. Steel: In other locations in contact with items to be painted or encased in concrete.

2.02 ANCHOR BOLTS

- A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.
- B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

2.03 EXPANSION BOLTS

- A. Expansion bolts shall be KWIK Bolt TZ by Hilti, Inc., Power-Stud+ SD2, SD4, or SD6 by DeWalt, Strong-Bolt or Strong-Bolt 2 by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All expansion bolts shall comply with the 2015 International Building Code, AC 193, and ACI 355.2. They shall be ICC-ES approved for use in cracked and uncracked concrete.
- C. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.

2.04 ADHESIVE ANCHORS

- A. Adhesive anchors shall be HIT HY 200 by Hilti, Inc., Red Head C6+ or Red Head A7+ by ITW, Pure 110+ or AC200+ by DeWalt, Set-XP by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All adhesive anchors shall comply with the 2015 International Building Code, AC 308, and ACI 355.4. They shall be ICC-ES approved for use in cracked and uncracked concrete.

2.05 SCREW ANCHORS

- A. Screw anchors shall be KWIK HUS-EZ by Hilti, Inc., Screw-Bolt by DeWalt, Titen-HD by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All screw anchors shall comply with the 2015 International Building Code. They shall be ICC-ES approved for use in cracked and uncracked concrete.

PART 3-EXECUTION

3.01 ANCHOR BOLTS

- A. Anchor bolts for structural members shall be located as shown and specified.
- B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.
- C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

3.02 EXPANSION BOLTS

- A. Unless otherwise noted on the Drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's printed installation instructions.
- B. Bolt embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of bolts is adjustable, reinforcing steel shall be located prior to drilling holes and bolts shall be located to clear reinforcing steel.

3.03 ADHESIVE ANCHORS

- A. At locations shown on the Drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.
- B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Adhesive anchors shall be installed in concrete having a minimum age of 21 days at the time of installation.
- E. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.
- F. CONTRACTOR shall arrange an anchor manufacturer's representative to provide on-site installation training for installation of their adhesive anchor system products. Submit documentation that all CONTRACTOR's personnel or subcontractors who install adhesive anchors have been trained prior to the announcement of anchor installation.
- G. Adhesive anchors in horizontal and upwardly inclined orientations to resist sustained tension loads are subject to the following requirements:
 - 1. They shall be installed by personnel certified by an applicable certification program. Certification shall include written and performance tests in accordance with the

ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent, as approved by ENGINEER.

2. They require continuous special inspection during installation. CONTRACTOR shall notify ENGINEER and SPECIAL INSPECTOR of the schedule for these anchor installations to permit coordination of inspections.

3.04 SCREW ANCHORS

- A. Unless otherwise noted on the Drawings, screw anchor edge distance and spacing shall be in accordance with manufacturer's recommendations.
- B. Anchor embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.

END OF SECTION

SECTION 06 11 00

WOOD FRAMING AND SHEATHING

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Miscellaneous framing and sheathing.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. APA–American Plywood Association.
- C. AWWA–American Wood Preservers Association.
- D. NFPA–National Forest Products Association.
- E. NLGA–National Lumber Grades Authority.
- F. SPIB–Southern Pine Inspection Bureau.
- G. WCLIB–West Coast Lumber Inspection Bureau.
- H. WWPA–Western Wood Products Association.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber and other building materials and keep under cover both in transit and at the job site. Protect from dampness. Stack framing lumber and plywood to provide proper air circulation. Locate stacks on well-drained areas. Support 6 inches above grade and protect with waterproof cover.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material,

with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MATERIALS

- A. Lumber shall be kiln-dried with moisture content not to exceed 19% at time of installation and grade marked according to the National Lumber Manufacturer's Association.
- B. All lumber shall be 2 inches by 4 inches nominal or 2 inches by 6 inches nominal as shown on the Drawings and shall be No. 2 Douglas Fir, No. 2 Southern Pine, or better.
- C. Plywood sheathing shall be grade C-D (CDX), Exposure 1, or better, graded in accordance with the American Plywood Association.
- D. Wood sills, plates, blocking, etc., to be same grade as studs.

PART 3-EXECUTION

3.01 FRAMING

- A. General: All rough framing lumber and all other wood framing, studs blocking, and furring shall be accurately set to required lines and levels, closely fitted, shimmed, and rigidly secured in place.

3.02 PLYWOOD SHEATHING

- A. Plywood sheathing shall be nailed at 6 inches on center at edges and 12 inches on center at intermediate supports with 10d common nails.
- B. Secure roof sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing. Use sheathing clips between sheets between roof framing members, or provide solid edge blocking between sheets.

3.03 CONNECTIONS

- A. All framing connections and nailing shall be in accordance with the details shown and/or the 2015 International Building Code minimum requirements, whichever is more restrictive.
- B. Framing connectors shall be Simpson Strong Tie, Mitek, or equal. Connector numbers shown on details are Simpson. Submit engineering data on any substitutes.
- C. Connectors shall be installed in accordance with manufacturer's requirements.

END OF SECTION

SECTION 06 11 10

WOOD BLOCKING AND CURBING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Roof Curbs and Cants.
 - 2. Wood Blocking.
 - 3. Wood Furring and Grounds.
 - 4. Preservative Treatment of Wood.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. AWWA–American Wood Preservers Association.
- C. NFPA–National Forest Products Association.
- D. NLGA–National Lumber Grades Authority.
- E. SPIB–Southern Pine Inspection Bureau.
- F. WCLIB–West Coast Lumber Inspection Bureau.
- G. WWPA–Western Wood Products Association.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00–Submittals.
- B. Certification of type of wood and wood treatment to be used.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be thoroughly sealed and protected from weather during transport and at the jobsite. Protect from dampness.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be

included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Lumber for roof curbs, cants, blocking, furring, and grounds shall be “standard” grade Douglas Fir, No. 2 Southern Pine, or better, graded in accordance with the WWP, WCLIB, NLGA, or SPIB grading rules as applicable. Lumber shall bear the grading agency’s stamp.
- B. Wood shall be kiln-dried with moisture content not to exceed 19% at time of installation.
- C. All lumber to be installed on the exterior side of air and vapor barrier membrane shall be pressure-treated with a chromated copper arsenate (CCA) waterborne preservative to a minimum retention of 0.40 pounds per cubic foot. Acceptable products include Hoover Treated Wood Products CCA, Wood Preserving Co. Osmose CCA, or equal. Cuts shall be treated in the field with a brush-on waterborne preservative compatible with the pressure treatment. Lumber to be installed on the interior side of air and vapor barrier membrane shall not be pressure-treated.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Provide and install wood curbs, cants, blocking, furring, and grounds of proper size and shape where shown on the Drawings and where required to secure other work or equipment in place.
- B. Members shall be installed true to lines, level, plumb, and secure.
- C. Connections and nailing shall be in accordance with the details shown and/or the 2015 International Building Code minimum requirements, whichever is more restrictive.
- D. Apply brush-on wood preservative treatment to cuts in accordance with manufacturer’s recommendations.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Installation of items furnished by others including, but not limited to:
 - 1. Wood and metal doors.
 - 2. Finish hardware.
 - 3. Architectural woodwork items.
 - 4. Miscellaneous specialties.
 - 5. Signage.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. PS 1–Construction and Industrial Plywood.
- B. PS 20–American Softwood Lumber Standard.
- C. PS 51–Hardwood and Decorative Plywood.
- D. PS 56–Glued-up Lumber Standard.
- E. PS 60–Basic Hardboard.
- F. AWI–“Architectural Woodwork Quality Standards, Guide Specification and Quality Certification Program.”
- G. NHLA–“Rules for Measurement and Inspection of Hardwood and Cypress Lumber.”
- H. Wood Products Publications–“The Wood Book” (Current Issue).

1.03 SUBMITTALS

- A. Submit samples and shop drawings in accordance with Section 01 33 00–Submittals.
- B. Samples: Submit upon request samples of standing and running trim and plastic laminates.
- C. Shop Drawings: Submit shop drawings for on-site fabrications. Indicate materials, component profiles, fastening, jointing details, and accessories.

1.04 QUALITY ASSURANCE

- A. Perform finish carpentry work in accordance with recommendations of the Millwork Standards of the Architectural Woodwork Institute (AWI).

- B. Factory-mark each piece of lumber and plywood with type, grade, mill, and grading agency identification; except omit marking from surfaces to receive transparent finish, and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver finish carpentry materials until painting, wet work, grinding, and similar operations which could damage, soil, or deteriorate woodwork have been completed in installation areas. If finish carpentry materials must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.06 JOB CONDITIONS

- A. Do not install finish carpentry until a minimum temperature of 60°F (16°C) and relative humidity of 25 to 55% have been stabilized and will be maintained in installation areas.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Nominal sizes are indicated, except as shown by detailed dimensions. Provide dressed or worked and dressed lumber, as applicable, manufactured to the actual sizes as required by PS 20 or to actual sizes and patterns as shown, unless otherwise indicated.
- B. Optimum Moisture Content: Kiln-dry finish carpentry woodwork to an average moisture content of 8% for interior use and 12% for exterior use or as otherwise recommended by applicable AWI Quality Standards for the regional climatic conditions involved.
- C. Laminates: Provide as specified in Section 06 40 00—Architectural Woodwork.
- D. Fasteners and Anchorages:
 - 1. Provide all nails, spikes, screws, lag screws, hangers, bolts, nuts, washers, and other anchoring devices of the type, size, material, and finish required for application indicated

to provide secure attachment, concealed where possible, and complying with applicable Federal Specifications.

2. Where finish carpentry is exposed on exterior or in areas of high relative humidity, provide fasteners and anchorages with a hot-dipped zinc coating (ASTM A153).

2.02 HARDWARE

- A. Closet Rod: Tubing KV770-5CHR x 760.
- B. Flanges: KV764 CHR and 766 CHR.
- C. Standards: KV87 ANO.
- D. Brackets: KV186 x 211.
- E. Knap & Vogt is specified to indicate quality and type. Other approved products may be used.

2.03 FABRICATION

- A. Fabricate on-site woodwork and cabinetwork in accordance with Section 06 40 00—Architectural Woodwork.

PART 3—EXECUTION

3.01 PREPARATION

- A. Field Measurements: Before proceeding with woodwork required to be fitted to other construction, obtain measurements and verify dimensions to provide accurate fit.
- B. Preparation of Surfaces: Deliver materials and fabrications for back priming and/or prefinishing prior to installation.
- C. Condition wood materials to average prevailing humidity conditions in installation areas prior to installing.

3.02 INSTALLATION

- A. Apply all nails, spikes, screws, lag screws, hangers, bolts, nuts, washers, anchors, and other items of hardware required for the assembling and securing of this work. Use suitable type of nails and anchors for various types of carpentry. Use annular nails and other special nails where required. Correct any defective work caused by inadequate nailing, holding power or nails used, and the use of nails which result in the staining of other materials. All finish work shall have nails set for puttying. Recess all screws and bolt heads and provide flush hardwood plugs where exposed.
- B. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned, or too small to fabricate work with minimum of joints or optimum jointing arrangements, or which are of defective manufacturer with respect to surfaces, sizes, or patterns.

- C. Install the work plumb, level, true, and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8 feet 0 inch for plumb and level countertops; and with 1/16 inch maximum offset in flush adjoining surfaces and 1/8 inch maximum offsets in revealed adjoining surfaces.
- D. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
- E. Architectural Woodwork: Install and secure plumb and level. Cut, fit, and scribe in place. See Section 06 40 00—Architectural Woodwork for installation procedures.
- F. Doors: Install in accordance with requirements specified in Section 08 11 00—Standard Steel Doors and Frames and Section 08 14 16—Flush Wood Doors. Fabricate trim and inserts as detailed and install.
- G. Countertops: Cut, fit, scribe, and secure in place.
- H. Laminates: Apply as specified in Section 06 40 00—Architectural Woodwork.
- I. Hollow Metal Doors: Hang doors; drill and tap for all surface-applied hardware.
- J. Use hardware list as working instructions when applying hardware. Fit hardware before painter finishes work; remove for painting and put on after painter has completed last coat.
- K. Install all finish hardware in accordance with manufacturer's written instructions and adjust so that latches, bolts, and other moving parts operate easily, quietly, and properly. Neatly fit butts, face plates, strikes, and other parts which are let into work.
- L. Secure thresholds in place with countersunk expansion bolts or to straps with machine screws. Drill holes for shields carefully to avoid cracking or otherwise damaging concrete. Drill and tap straps. Cut to fit profile of jamb and full bed in sealant as specified in Section 07 90 00—Caulking and Sealants.
- M. Prior to completion of building and after finish work is completed, examine doors and other movable parts, adjust and lubricate as required for correct operation, and leave hardware in working order, free of defects.

3.03 CLEANING, ADJUSTMENT, AND PROTECTION

- A. Repair damaged and defective finish carpentry work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace woodwork at no cost to OWNER. Adjust joinery for uniform appearance.
- B. Adjustment: Adjust all hardware for proper operation.

END OF SECTION

SECTION 06 40 00

ARCHITECTURAL WOODWORK

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Plastic laminate cabinets.
 - 2. Solid-surfacing-material countertops.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. AWI–Quality Standards.
- B. ANSI A156.9–American National Standard for Cabinet Hardware.
- C. BHMA Cabinet Hardware Standard 201.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

- A. Except as otherwise shown or specified, the work shall comply with specified provisions of the Architectural Woodwork Institute (AWI) “Quality Standards.”
- B. For following types of architectural woodwork; comply with indicated standards as applicable:
 - 1. Casework and Countertops: AWI Section 400.
 - 2. Shelving: AWI Section 600.
 - 3. Miscellaneous Work: AWI Section 700.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product’s value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA.

CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standards for each type of woodwork and quality grade specified, unless otherwise noted.
- B. Wood Moisture Content: Provide kiln-dried lumber with an average content range of 9% to 13% for exterior work and 6% to 11% for interior work. Maintain temperature and relative humidity during fabrication, storage, and finishing operations so that moisture content values for woodwork at time of installation do not exceed 5% to 10%.
- C. Interior wood for transparent finish shall be plain sliced maple.
- D. Wood Panel Products: Comply with the following:
 - 1. Particle board: ANSI A208.1, Grade M-2.
 - 2. Sky Blend particle board (SCS Certified 100% pre-consumer recycled wood fiber particle board with below .04 ppm formaldehyde emissions) as supplied by Roseburg Forest Products, 1-800-245-1115, or equal.
- E. Thermoset Decorative Overlay: Medium-Density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
- F. High Pressure Decorative Laminate:
 - 1. NEMA LD3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 2. Manufacturer to provide high-pressure decorative laminates to be Formica Corporation, Wilsonart International, or equal.
- G. Adhesive for bonding plastic laminate: water-based contact cement.
- H. Solid-Surfacing Material:
 - 1. Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI 2124.3 for Type 5 or Type 6, without a precoated finish.
 - 2. Manufacturer to be Corian, Dupont Polymers, Vendura, Vendura Industries, Wilsonart, or equal.

2.02 HARDWARE

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for units which are specified as "door hardware" in other sections of these specifications.

- B. Hardware Standards: Except as otherwise indicated, comply with ANSI A156.9:
 - 1. Quality Level: Type 2 (institutional), unless otherwise indicated.
 - 2. Quality Certification: Where available, provide cabinet hardware bearing the BHMA certification label affixed either to hardware or its packaging showing compliance with BHMA Cabinet Hardware Standard 201.
- C. Cabinet Door Hardware: Provide hinges, catches and pulls of types indicated to properly accommodate each door size and style.
- D. Drawer Hardware: Provide slides and pulls of types indicated to properly accommodate each drawer size and style.
- E. Locks: Where indicated, provide standard pin-type or disc type (5 pins or disks) tumbler locks keyed individually, except as otherwise noted.
- F. Hinges: No. 1590 Stanley, or equal.
- G. Shelf Supports: Where shelving is indicated as "adjustable," provide slotted type standards and brackets to support uniform 40 pound-per-square-foot Knappe and Vogt Manufacturing Company 255/256, or equal.
- H. Drawer Slides: Side mounted full extension ball bearing nylon roller, rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf.
 - 2. Pencil Drawer Slides: 45 lbf.
 - 3. Keyboard Slides: 75 lbf.
- I. Pulls: Stanley Hardware No. 4477, or equal.
- J. Sliding Door Pulls: Stanley Hardware No. 2689, or equal.
- K. Magnetic Catches: Stanley Hardware No. 46, or equal.
- L. Grommets: 2 1/2-inch-diameter black plastic with notched cover cap, Hughes plastic H404, H786, or equal.
- M. Exposed Hardware Finish: Except where noted or not available, provide with BHMA Code 626 satin chromium plate finish (US26D) where not available provide either aluminum or satin stainless steel finish.
- N. Concealed Hardware Finish: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.03 SHELVING

- A. Wood storage shelving with transparent finish shall be custom grade and shall be Economy Grade (HPMA Sound Grade) hardwood plywood with matching hardwood edge bands on exposed edges. Provide matching end and closure panels (if any). Species shall be Plain Sliced Maple.

- B. Finish for shelving shall meet the following requirements:
 - 1. General: The primary and prefinishing (if any) of architectural woodwork required to be performed at the shop or factory is specified as work of this section. Refer to Division 09 sections for final finishing of installed architectural woodwork.
 - 2. Preparations for Finishing: Comply with AWI Quality Standards, Section 1500, for sanding, filling countersunk fasteners, back priming, and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
 - 3. Transparent Finish:
 - a. General Finish Standard: AWI Finish System No. 3, Premium Grade, open grain finish.
 - b. Shop Application: Stain and sealer (match approved sample for color).
 - c. Final Finish: Sanding, followed by two coats of clear alkyd-urea conversion varnish, rubbed to medium sheen.

2.04 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide premium grade interior woodwork complying with the referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Complete fabrication, including assembly and hardware application to maximum extent possible before shipment to project site.
 - 1. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming and fitting.
 - 2. Trial fit assemblies at 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 shop drawings before disassembling for shipment.
- D. Shop cut openings to maximum extent possible to receive hardware, 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. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.

2.05 PLASTIC-LAMINATE CABINETS

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay.
- D. Core Materials: Sky Blend particle board.
- E. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other than Tops: GP.

2. Vertical Surfaces: VST.
 3. Door and Drawer Edges: VST.
- F. Materials for Semiexposed Surfaces: Provide surface materials indicated below:
1. Surfaces Other Than Drawer Bodies: Thermoset decorative overlay.
 2. Drawer Sides and Backs: Thermoset decorative panels.
 3. Drawer Bottoms: Thermoset decorative panels.
- G. Wood Grain Plastic Laminate Pattern: Orient wood grain vertically and provide continuous sequenced vertical match as follows:
1. Between base cabinet doors and drawers.
 2. Between wall cabinet doors and soffit.
- H. Colors, patterns and finishes to be selected by OWNER from manufacturer's standard products.

2.06 SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
- B. Grade: Premium.
- C. Products: Provide the following, or equal:
1. Corian.
 2. Vendura.
 3. Wilsonart, Gibraltar.
- D. Solid-Surfacing-Material Thickness: 1/2 inch.
- E. Colors, Patterns and Finishes to be selected by OWNER for manufacturer's standard products.
- F. Fabricate tops in one piece with shop-applied backsplashes and edges unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication and finishing.
- G. Drill holes in countertops for plumbing fittings and soap dispensers in shop, as required.

2.07 SHOP FINISHING

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
- B. General: Finish paneling at fabrication shop as specified in this section. Defer only final touchup, cleaning and polishing until after installation.
- C. Preparations for Finishing:
1. Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling as applicable to each unit of work.
 2. Backpriming: Apply two coats of sealer compatible with finish coats to concealed surfaces of paneling.

- D. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining and sheen, with sheen measured on 60° gloss meter per ASTM D523.
 - 1. Grade: Premium.
 - 2. AWI Finish System: Conversion Varnish Transparent.
 - 3. Sheen: Satin, 30-50 gloss units.
- E. Transparent Finish for Woodstalk Machinable Fiberboard: Polyureseal BP, Interior Clear Gloss Satin, Safecoat, or equal.
- F. Finish color to be selected by OWNER.

PART 3-EXECUTION

3.01 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.
- B. Prior to installation of architectural woodwork, examine shop-fabricated work for completion, and complete work as required including back priming and removal of packing.

3.02 INSTALLATION

- A. Install the work plumb, level, true, and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8 feet 0 inch for plumb and level (including countertops); and with 1/16-inch maximum offset in flush adjoining surfaces, 1/8-inch maximum offsets in revealed adjoining surfaces.
- B. Scribe and cut work to fit adjoining work, and refinish cut surfaces, or repair damaged finish at cuts.
- C. Anchor woodwork to anchors of blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk concealed fasteners and blind nailing as required for a complete installation.
- D. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk, and filled flush with woodwork and matching final finish where transparent finish is indicated.
- E. Casework: Install without distortion so that doors and drawers will fit openings properly and be accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of casework with transparent finish.
- F. Countertops: Anchor securely to base units and other support systems.
- G. Wood Storage Shelving: Complete the assembly of units and install in the areas indicated, including hardware and accessories as indicated.

3.03 PROTECTION

- A. Installer of architectural woodwork shall advise CONTRACTOR of final protection and maintained conditions necessary so that work will be without damage or deterioration.
- B. Cover completed work with 4 mil polyethylene film protective enclosure applied in a manner which will allow easy removal and without damage to woodwork or adjoining work. Remove cover immediately before time of final acceptance.

END OF SECTION

SECTION 07 14 00

FLUID-APPLIED WATERPROOFING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Fluid-applied elastomeric waterproofing membrane for belowgrade walls. Fluid-applied waterproofing membrane is required on the earth side of concrete walls that are below grade, have earth on one side, and are common with rooms, tunnels, or galleries to be occupied by equipment, piping, or personnel.
- B. Fluid-applied elastomeric waterproofing membrane for belowgrade structures.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NRCA (National Roofing Contractors Association)—Waterproofing Manual.

1.03 SUBMITTALS

- A. Submit two samples of coating system applied to 1/4-inch plywood or similar rigid base.
- B. Submit list of at least five projects of similar nature by waterproofing applicator that have been installed within the last 5 years, identified with project name, location, and date.
- C. Submit letter from membrane manufacturer stating that applicator is an approved or certified applicator of its product.
- D. Submit copies of warranty.

1.04 QUALIFICATIONS OF APPLICATOR

- A. Membrane applicator shall be approved by the manufacturer and shall have a minimum of 5 years experience in application of fluid-applied waterproofing coatings.

1.05 ENVIRONMENTAL CONDITIONS

- A. No waterproofing work shall be performed at ambient temperatures below 40°F.
- B. No waterproofing work shall be performed during inclement weather or when such weather is imminent.

1.06 WARRANTY

- A. Provide installer's 2-year total system warranty of watertightness covering cost (labor and materials) to repair any leaks in the waterproofing membrane, including cost to remove backfill material or other materials concealing the membrane, if required.

- B. Provide manufacturer's standard 5-year product warranty.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MEMBRANE

- A. Membrane shall be a one-part, moisture curing, high solids, VOC-compliant, modified polyurethane waterproofing membrane that can be applied to damp and green concrete.
- B. Acceptable products include the following, or equal: Tremproof 250 GC, manufactured by Tremco.

2.02 ACCESSORIES

- A. Cleaners and conditioners, primers, sealants, backer rod, flashing and flashing reinforcements, and other accessories related to the membrane application shall be provided as required by the membrane manufacturer.
- B. Provide 1/8-inch-thick protection board, Tremco Protection Mat by Tremco, or equal.

PART 3—EXECUTION

3.01 SURFACE PREPARATION

- A. Surface preparation shall be in accordance with the membrane manufacturer's recommendations.
- B. Verify that curing methods used for concrete are compatible with the membrane system.
- C. Concrete surfaces shall be free of laitance, loosely adhering materials, oil, curing compounds, and all other contaminants prior to membrane application. Prepare all concrete surfaces by sandblasting followed by vacuum cleaning or by acid etching.

3.02 PRODUCT APPLICATION

- A. Preparatory work (priming and flashing) must be fully cured in accordance with manufacturer's recommendations prior to coating application.
- B. Apply coating in accordance with manufacturer's recommendations using approved squeegee, trowel, or spray equipment to produce a 60 mil wet film thickness. This is in addition to the primer and flashing coats. Extend coating over all previously flashed and primed areas.
- C. The membrane shall be cured as recommended by the manufacturer prior to water testing, backfilling, or allowing foot traffic on surfaces.
- D. Horizontal surfaces shall be flooded to a depth of 2 inches maintained over a 12-hour period. Any leaks evident after this period shall be repaired and the leaky areas retested until leaks are stopped.
- E. Apply protection board to all surfaces prior to backfilling.

END OF SECTION

SECTION 07 21 12

BOARD INSULATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes board insulation for cavity wall construction, for perimeter foundation walls, and under floor-slabs on-grade.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 CAVITY WALL INSULATION

- A. Cavity wall insulation shall be 3-inch-thick polyisocyanurate foam board with foil facing on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 19.0.
- B. Acceptable products include the following, or equal: Thermax Sheathing by DuPont.
- C. Adhesive for adhering insulation to backup wall shall be as recommended by the insulation manufacturer.

2.02 FOUNDATION AND UNDER-SLAB INSULATION

- A. Foundation and under-slab insulation shall be 2-inch-thick extruded polystyrene closed cell rigid foam board with continuous skins on both sides. Aged thermal resistance (R-value) at 75°F shall be a minimum of 10.0.

- B. Acceptable products include the following, or equal:
 - 1. Styrofoam Square Edge by DuPont.
 - 2. Foamular NGX 250 by Owens Corning.

PART 3-EXECUTION

3.01 INSTALLATION-CAVITY WALLS

- A. Insulation shall be installed horizontally within the cavity space between masonry wythes.
- B. Take care during installation so that all insulation boards are butted and installed between ties and fit flush against inner wythe or backup wall.
- C. Cut insulation neatly to fit around obstructions across the cavity such as vents, louvers, pipes, and conduits.
- D. Secure insulation in place against backup wall with mastic adhesive and observe label directions.

3.02 INSTALLATION-FOUNDATION WALLS AND UNDER FLOORS

- A. Rigid insulation shall be laid dry against the foundation walls as backfill is placed. Insulation shall be located at all perimeter frost walls and below-grade walls of buildings and structures containing areas that may be occupied by personnel.
- B. At perimeter frost wall foundations, insulation shall be installed as shown on the Drawings.
- C. Insulation under edges of slab-on-grade floors shall be 24 inches wide.

END OF SECTION

SECTION 07 21 13

BATT INSULATION

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes sound batt insulation in interior stud walls as called for on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C665—Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 SOUND BATT INSULATION

- A. Sound batt insulation in interior stud walls shall be an unfaced fiberglass acoustical insulation complying with ASTM C665, Type 1. The wall system shall have an STC of 46 with 3 1/2 inches of insulation.
- B. Acceptable manufacturers include the following, or equal:
 - 1. Owens Corning.
 - 2. Manville.
 - 3. Certainteed.

PART 3-EXECUTION

3.01 INSTALLATION-WALL INSULATION

- A. Install per manufacturer's recommendations.
- B. Carefully cut insulation around wall penetrations.
- C. Friction fit insulation between studs.

END OF SECTION

SECTION 07 21 13.1

RETROFIT BUILDING INSULATION SYSTEM

PART 1-GENERAL

1.01 WORK INCLUDED

- A. Interior liner system fabric of the color specified, support strapping of the appropriate color, fasteners of the appropriate type and color, sealants, thermal break materials and thermal insulation of the appropriate type to insulate the roof and wall areas to the full designed R-value of the building as specified.

1.02 RELATED SECTIONS AND DIVISIONS

- A. Applicable provisions of Division 01 shall govern work in this section.

1.03 QUALITY ASSURANCE

- A. Provide the materials in original manufacturer's packages together with detailed instructions and project drawings of the installation. Materials shall be inspected for damage, proper sizes and quantities upon delivery and stored in a dry, secure manner. Post the detailed training instructions, project specific safety drawings, and plans for OSHA compliance using the product. Installation shall proceed with care to provide proper sealing of the liner system fabric. Insulation shall be placed on (roof) or behind (walls) the liner system fabric in the full-specified thickness without voids. Notify Thermal Design (800.255.0776) immediately of any damages, improper sizes or shortages. Substitutions of systems that do not have a continuous vapor retarder on the inside plane of the purlins or girts will not be allowed. Purlins, girts and insulation must be completely isolated from the inside conditioned air with an effective vapor retarder. Taping or stapling of vapor retarder lap joints is not acceptable. Sealing field joints with a permanent vapor retarder lap sealant is required. Field seams, if any, shall be made on a structural member and mechanically attached with a steel strap and fasteners along its full length.
- B. All exposed parts of the liner system shall be Class A material and have flame spread of 25 or less based on ASTM E84 standards. Vapor retarder fabric shall be white or colored woven coated fabric and triple extrusion-welded seams fabricated in one piece, to fit not less than the full bay length by the width of the building. Buildings more than 100 feet wide may have field seams on the bottom of a purlin but no less than 50 feet apart. Any field seams must be sealed with vapor retarder lap sealant. Wall bay minimum fabric size shall be not less than one entire wall bay or end wall column space from the ceiling to the floor. Perimeter edges of the vapor retarder fabric shall be trimmed and sealed to the adjoining steel or fabric with vapor retarder lap sealant. All edges of liner system fabric, including field seams, shall be mechanically fastened with steel retaining straps the full perimeter. In the event that the crew is not experienced in the installation procedures, videotaped or on-site installation training shall be requested by the installing contractor from Thermal Design to provide proper installation procedures.

1.04 SUBMITTALS

- A. Include manufacturer's product brochures; component specifications, specific detailed drawings from Thermal Design for the project showing purlin spacings, support strap

locations and spacings, fastening points, liner system fabric sizes and locations; insulation widths and thicknesses, sizes and locations and detailed installation instructions for quality assurance and OSHA compliance.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ROOF LINER SYSTEM

- A. Acceptable systems shall be the Simple Saver insulation system (with OSHA compliant through fall protection) manufactured by Thermal Design with an installed total roof insulation R-value of 30.0 and an average installed thickness of 9 inches. Roof system shall be a single-layer system.

2.02 UVMAX® STEEL STRAP

- A. 100 KSI minimum yield high tensile strength steel, galvanized, primed and then painted the specified color on the exposed side with a clear coat primer on the unexposed side. Minimum size shall be 0.02-inch by 1-inch by continuous length. The strap color shall be UVMAX 8 White.

2.03 FASTENERS

- A. #12 by 3/4-inch, plated self-drilling screws with sealing washers painted to match the specified color for fastening to light gauge steel (up to 12 GA purlins). Special fasteners for wood, concrete and other structure types are available from Thermal Design and should be used when appropriate.

2.04 SYSEAL® FABRIC

- A. Shall be woven reinforced high-density polyethylene yarns coated on both sides with a continuous white or colored polyethylene film. The fabric grade for the roof shall be Syseal FP (White). The fabric shall comply with UL/ULC 723 or ASTM E84 and be Class A compliant with a low flame spread index of 25 or less based on ASTM E84 test standards. This material shall be manufactured in large custom pieces by extrusion welding from roll goods. Pieces shall be fabricated to substantially fit the large defined building areas with

minimum practical sealing to be done on job site. Fabric shall be folded to allow for rapid pull-out on the strap support system. Custom colors available by special order. Call (800) 255-0776 for details.

- B. Syseal liner system fabric perm rating shall be < 0.02 grains per hour per square foot based on ASTM E96.

2.05 SEALANTS

- A. Sealants shall be Simple Saver System G524 High Tack Sealant™ for sealing vapor retarder laps.

2.06 INSULATION

- A. Insulation shall be fiberglass blanket or batt insulation meeting ASTM C991 Type 1, ASTM E136 and ASTM E84.

PART 3-EXECUTION

3.01 SIMPLE SAVER ROOF SYSTEM

- A. Existing buildings often have light fixtures, electrical conduits, fire sprinkler system hangers, HVAC duct supports, etc. which may be attached to the roof structure. Planning momentary disconnection and reattachment of such items shall be included in the scope of the project. Items that are not possible to temporarily disconnect may be left in place and a field splice made on the closest purlin, sealed and fastened for permanent attachment. Items to be permanently removed are noted on the project drawings or in the specifications. The responsibility for removal and disposal shall also be noted if other than the ceiling insulation contractor; electrical, plumbing, or HVAC contractors may be required to be employed to perform such items of work.
- B. Receive, inventory and store materials in a secure weatherproof environment. Store materials off the floor or ground if there is any risk of water damage from rain, flood, etc. Cut to length and install the painted steel straps or other support strapping if specified under "Products" or above in the pattern and spacing as shown on the project shop drawings. The straps are installed in tension, perpendicular to and at the bottom plane of the roof purlins. Position the pre-folded liner fabric on the strap platform, pull the liner system fabric out of its fold and fasten the fabric to the overlying purlins with the appropriate fastener. Liner system fabric shall be installed neatly and as wrinkle free as possible. Install the insulation materials on the fabric and strap platform at the specified thickness required to yield the resultant R-value of the insulation specified. Seal, fasten and trim the edges of the fabric liner to complete the installation.

END OF SECTION

SECTION 07 21 29

SPRAY FOAM INSULATION

PART 1—GENERAL

1.01 SECTION INCLUDES

- A. Spray-in-place, medium-density, semi-rigid, closed-cell polyurethane foam insulation in assemblies indicated on the Drawings.

1.02 RELATED SECTIONS

- A. Section 08 11 00—Standard Steel Doors and Frames.

1.03 REFERENCES

- A. ASTM International (ASTM):
 1. ASTM C 423—Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 2. ASTM C 518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 3. ASTM D 1621—Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 4. ASTM D 1622—Standard Test Method for Apparent Density of Rigid Cellular Plastics.
 5. ASTM D 1623—Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
 6. ASTM D 2126—Standard Test Method for Response of Rigid Cellular Plastic to Thermal and Humid Aging.
 7. ASTM D 2842—Standard Test Method for Water Absorption of Rigid Plastics.
 8. ASTM D 6226—Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
 9. ASTM E 84—Standard Test Method for Surface Burning Characteristics of Building Materials.
 10. ASTM E 96—Standard Test Methods for Water Vapor Transmission of Materials.
 11. ASTM E 283—Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 12. ASTM E 413—Classification for Rating Sound Insulation.
- B. International Code Council—International Building Code.
- C. NFPA 286—Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Before commencing work, submit in accordance with local code:
 1. Technical data sheet from the manufacturer showing the test results from the ASTM E84 (Surface Burning Characteristics).

2. Other technical data sheets and samples as required by local code officials.
- C. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: CONTRACTOR performing work under this section shall be trained in the art of application of spray polyurethane foam insulation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered in manufacturer's original containers clearly labeled with manufacturer's name, product identification, safety information, net weight of contents and expiration date.
- B. Material shall be stored in a safe manner and where the temperatures are in the limits specified by the material manufacturer.
- C. Empty containers shall be removed from site on a daily basis.

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 recommended limits.
- B. Ventilate insulation application area in accordance with the Spray Foam Coalition's Guidance on best practices for the installation of Spray Polyurethane Foam.
- C. Protect workers as recommended by the standards of the Spray Foam Coalition's Guidance on best practices for the installation of Spray Polyurethane Foam.
- D. Protect adjacent surfaces, windows, equipment and site areas from damage of overspray.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: ThermoSeal, LLC, or equal.

2.02 SPRAY FOAM INSULATION

- A. Spray Applied Semi Rigid Polyurethane Closed Cell Foam Insulation System: Two component, high density insulation.
 - 1. Product: Thermoseal 2000 manufactured by ThermoSeal, LLC, or equal.
 - 2. Contains zero ozone depleting agents, catalysts, polyols, and fire retarding materials.
 - 3. Fills cracks, crevices, and voids to form air seal and thermal insulation.
 - 4. Evaluation Report: ICC-ESR Pending Publication.
 - 5. Physical Properties:
 - a. Density (ASTM D 1622): 2.0 lb/cf.
 - b. Thermal Resistance (ASTM C 518): R-6.9 (sf.h degree F/BTU) at 1 inch at 90 days at 76°F (24.4°C).
 - c. Closed Cell Content (ASTM D 6226): Minimum 92 percent.
 - d. Water Vapor Transmission - Permeance (ASTM E 96): 0.8 Perms at 1 inch, 0.23 at 3 1/2 inches.
 - e. Air Leakage (ASTM E 283): Zero at 75 Pa.
 - f. Compressive Strength (ASTM D 1621): 20 psi.
 - g. Tensile Strength (ASTM D 1623): 60 lbf/sq. inch (414 kPa).
 - h. Dimensional Stability (ASTM D 2126): Less than 5 percent.
 - i. Fungi Resistance (ASTM G 21): Zero rating.
 - j. Surface Burning Characteristics (ASTM E 84): Class 1 Pass, Flame Spread Index less than 25, Smoke Developed Index less than 450.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Commencement of work outlined in this section shall be deemed as acceptance of existing work and conditions.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved submittals. Apply as recommended by manufacturer to thickness as indicated on the Drawings.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before covering.

END OF SECTION

SECTION 07 26 00

VAPOR AND AIR BARRIER

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes:
 - 1. Vapor barrier under concrete floors on grade, in exterior construction, and on top of precast roof plank.
 - 2. Air barrier in masonry double wythe walls on concrete block backup wall.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Vapor barrier for below slabs: Vapor barrier shall consist of 10 mil ASTM E1745 Class B polyethylene sheeting with less than 0.3 perm water vapor permeance in accordance with ASTM E96.
- B. Permeable air barrier for masonry cavity wall construction shall be fluid applied membrane, ExoAir 230 by Tremco, or equal. Apply to outside face of inner wythe of concrete block prior to installation of rigid insulation. Apply in strict accordance with manufacturer's instructions. Air barrier shall be included in all new cavity wall construction on the project.

PART 3-EXECUTION

3.01 INSTALLATION-UNDER CONCRETE FLOORS ON GRADE

- A. Provide continuous vapor barrier under concrete floors on grade that are 8 inches or less in thickness, lap all joints a minimum of 12 inches.
- B. Specific location of vapor barrier (whether directly under slab or under granular cushion) shall be as shown on the Drawings.

3.02 INSTALLATION OF AIR BARRIER

- A. Install air barrier on outside face of inner wythe of concrete block in cavity wall construction.
- B. Install air barrier per manufacturer's recommendations and approved details.

END OF SECTION

SECTION 07 53 00

SINGLE-PLY ROOFING—FULLY ADHERED

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Vapor retarder.
 - 2. Rigid roof insulation.
 - 3. Protection board.
 - 4. Membrane roofing and related accessories.
 - 5. See drawings for locations of adhered roofing.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NRCA (National Roofing Contractors' Association)—Roofing and Waterproofing Manual.
- B. UL 790—Fire Hazard Classifications.
- C. UL 1256—Standard for Fire Test of Roof Deck Constructions.

1.03 SUBMITTALS

- A. See Section 01 33 00—Submittals for general submittal requirements.
- B. Submit the following:
 - 1. Tapered insulation layout plan.
 - 2. Roofing layout plan.
 - 3. Flashing, joint, and termination details.
 - 4. Product data for all products specified in this section.
 - 5. Manufacturer's installation instructions.
 - 6. Copy of system warranty.

1.04 QUALITY ASSURANCE

- A. The roofing system must achieve a UL Class B.
- B. The membrane must be manufactured by the material supplier. Manufacturer's supplying membrane made by others are not acceptable.
- C. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.
- D. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide

evidence of having at least 5 years successful experience installing single-ply roofing systems and having installed at least one roofing application or several similar systems of equal or greater size within one year.

- E. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and an experienced superintendent on the job at all times roofing work is in progress.
- F. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a nonsales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner 72 hours prior to the manufacturer's final inspection.

1.05 QUALIFICATIONS OF INSTALLER

- A. Roofing system shall be installed by a manufacturer-authorized roofing applicator who is thoroughly familiar with the system, and has extensive experience in performing the work of this section.

1.06 REGULATORY REQUIREMENTS

- A. The roofing system shall meet UL Class B fire hazard classification.

1.07 WARRANTY

- A. Furnish to OWNER the roofing manufacturer's 15-year total system warranty covering the costs of all labor and materials required to repair any leaks and any defects in the roofing system. All products and applications required by the roof manufacturer to obtain the warranty shall be included in the Bid. OWNER will not pay for the roofing system unless the warranty is issued by the manufacturer.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 VAPOR RETARDER

- A. Vapor retarder shall be a three-ply laminate combining two layers of fire retardant linear low density polyethylene and a high-strength cord grid. Vapor retarder shall conform to UL construction No. 1 fire-resistance requirements.
- B. Vapor retarder shall be approved by roofing manufacturer for use in the roofing system. Unless prohibited by the roofing manufacturer, acceptable products include the following, or equal: Griffolyn Tx-1200 FR by Reef Industries.

2.02 ROOF INSULATION

- A. Roof insulation shall be Type 2, Class 1, Grade 2 closed cell polyisocyanurate insulation board. Minimum thickness shall be 1 inch at roof drains. Aged thermal resistance (R-value) at 75°F shall be a minimum of 5.7 per inch of thickness.
- B. Slope of tapered insulation shall be as shown on the Drawings, but shall not be less than the minimum slope required by the roofing manufacturer.
- C. Roof insulation shall be approved by roofing manufacturer for use in the roofing system.

2.03 PROTECTION BOARD

- A. Provide a protection board that is a minimum 1/2-inch-thick material as approved by the roofing manufacturer for use in this system.

2.04 MEMBRANE, FLASHING, AND ACCESSORIES

- A. Roofing membrane shall be nonreinforced EPDM, 0.060-inch-thick.
- B. Acceptable systems include the following, or equal:
 - 1. Sure-Seal, Design A Adhered System by Carlise SynTec Systems, Division of Carlise Corporation.
 - 2. RubberGard Adhered System by Holcim Elevate.
- C. Flashing shall be minimum 0.060-inch-thick neoprene or EPDM sheet flashing provided by the roofing manufacturer. All adhesives, sealants, splicing tape, fastening strips, fasteners, pipe flashing boots, walkway pads, and all accessories necessary to complete the system shall be provided by the roofing manufacturer.

PART 3-EXECUTION

3.01 SURFACE PREPARATION

- A. Surfaces on which the roofing system is to be applied shall be clean, smooth, dry, and free of fins, sharp edges, loose and foreign materials, oil, grease, and all contaminants that would be detrimental to the bonding of the roof system. The condition of the roof deck shall be approved by the roofing manufacturer before the membrane is applied.

3.02 INSTALLATION

- A. Wood nailers shall be provided around all roof projections and penetrations except drains, as required by the roof manufacturer. Wood nailers shall be in accordance with Section 06 11 10–Wood Blocking and Curbing. Height of nailers shall be matched to the thickness of the insulation being used. Nailers shall be firmly anchored to the deck to resist a force of 200 pounds per linear foot. A minimum of three anchors shall be used to anchor each length of nailer, with 1/2-inch vent left between length of nailers. Provide approved nailing strip at perimeter of roof.
- B. The thermal insulation and fiberboard shall be adhered to deck with adhesive approved by the roofing manufacturer. The insulation shall be neatly cut to fit around all roof penetrations and projections. Any other requirements of the roofing manufacturer shall be complied with. Slope of roof insulation shall be as shown on the Drawings, but in no case shall be less than the minimum slope required by the roofing manufacturer.
- C. The roofing membrane and accessories shall be furnished and installed in accordance with manufacturers' recommendations. Lap adjacent sheets a minimum of 3 inches. Seams shall be sealed with splicing cement. A bead of lap sealant shall be applied to completely cover the splice edge providing a second independent seam seal. All seams shall be taped with an approved seam tape and installed in accordance with manufacturer's recommendations.
- D. Flashing shall be provided at all vertical surfaces, roof interruptions, and penetrations in accordance with membrane manufacturer's recommendations and Contract Documents. All flashings and terminations shall be securely fastened in the plane of the roof deck with fasteners recommended by the system manufacturer. Membrane edges or flashing shall be mechanically fastened to the nailer at maximum of 8-inch centers.
- E. No unit having defects shall be installed. In no event shall more insulation be placed on the surface to be roofed than can be covered with roofing membrane prior to the onset of inclement weather or termination of the day's work. Water must not be allowed beneath any completed section of roof. Temporary water cutoffs may be made by extending the membrane beyond the insulation and setting the end of the membrane in a sealant. All water cutoffs shall be removed prior to proceeding with the next day's work.

END OF SECTION

SECTION 07 56 01

PREPARATION FOR REROOFING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes removal of existing roofing system on buildings as noted on the drawings in preparation for installation of a new membrane roofing system.
- B. CONTRACTOR shall include in the Lump Sum Base Bid, removing and replacing 200 square feet of the existing damaged board on roof decking system for the Administration Building as part of reroofing process.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REGULATORY REQUIREMENTS

- A. CONTRACTOR shall properly dispose of roofing in accordance with all local, state, and federal regulations.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.
- B. Maintain continuous temporary protection prior to and during installation of the new roofing system.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 TEMPORARY PROTECTION MATERIALS

- A. Provide polyethylene sheeting or other materials required to provide temporary protection in accordance with Paragraph 1.03.B.

PART 3-EXECUTION

3.01 PREPARATION

- A. All roof-mounted equipment and appurtenances shall be removed and reinstalled as part of this work.
- B. All roofing, insulation, and nailers as shown on Drawings shall be removed and disposed of by CONTRACTOR.

END OF SECTION

SECTION 07 62 00

FLASHING AND SHEET METAL

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes masonry wall flashing, custom-fabricated sheet metal flashing and counter flashing at: parapet walls; scuppers; roof hatches; roof-mounted equipment; vent stacks; and other locations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653—Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- B. ASTM A924—General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
- C. ASTM B32—Solder Metal.
- D. ASTM B209—Aluminum and Alloy Sheet and Plate.
- E. ASTM D4586—Asphalt Roof Cement, Asbestos-Free.
- F. SMACNA—Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. See Section 01 33 00—Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details and requirements.

1.05 QUALIFICATIONS

- A. Fabricator and installer shall be a company specializing in sheet metal fabrication work with a minimum of 5 years of verifiable experience in that field.

1.06 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MATERIALS

- A. Masonry wall flashing and flashing around windows, doors, and other openings shall be 32 mil of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane. Flashing shall be PERM-A-BARRIER wall flashing as manufactured by Grace Construction Products, or equal. Provide primer or surface conditioner as recommended by manufacturer.
- B. Galvanized Steel Sheet: 26 gauge meeting ASTM A525, Grade A with G90 zinc coating.
- C. Aluminum Sheet: 0.032-inch-thick meeting ASTM B209.
- D. Fasteners: Same material and finish as flashing sheet. Stainless steel fasteners may be used with any flashing material. Provide soft neoprene washers with fasteners.
- E. Primer: Zinc chromate type.
- F. Protective Backing Paint: Bituminous type.
- G. Sealant: See Section 07 90 00—Caulking and Sealants.
- H. Bedding Compound: Rubber asphalt or butyl type.
- I. Plastic Cement: ASTM D4586, Type I or II.
- J. Reglets: Galvanized steel or PVC, surface-mounted or recessed, or as shown on the Drawings.
- K. Solder: ASTM B32. Soldering is not permitted on aluminum or stainless steel sheet.

2.02 FABRICATION

- A. All flashing and fascia shall be formed to the configurations shown on the Drawings and/or the applicable manufacturer's details, or in accordance with SMACNA standard details where not shown on the Drawings, or in manufacturers details. Form sections true to shape, accurate in size, square, and free from buckles, kinks, or other defects.
- B. All exposed edges shall be folded or returned on themselves at least 1/2 inch. Corners shall be mitered and seamed.
- C. Form pieces in the longest possible lengths. Form material with flat lock seams.
- D. All sections shall be provided with slip joints at 8 feet on center.
- E. Cleats shall be fabricated of the same materials as the flashing sheets and shall be interlockable with the sheets.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form a drip.
- G. Fabricate corners from one piece with minimum 18-inch-long legs. Seam or solder for rigidity and seal with sealant.

2.03 FINISH

- A. Back paint all sheet metal with asphaltum paint where sheet metal surfaces come in contact with masonry or steel.
- B. Flashing and fascia shall be painted where exposed to view from the ground. Galvanized steel shall be painted in accordance with Section 09 91 00–Painting. Aluminum shall be coated with a Kynar 500 coating system.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Through-wall flashing shall be installed 1/2 inch back of the outside face of the wall, carried through the outside wythe, turned up in the collar, and adhered to back-up wall as shown on the Drawings. At no time should any portion of the flashing be allowed to hang or drape beyond the width of the wall. All laps shall be sealed and shall not be less than 3 inches in width. Flashing around openings shall extend at least 3 inches beyond each side of opening.
- B. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and line accurate to profiles. Seal metal joints watertight.
- C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by ENGINEER.
- D. Insert flashings into reglets where shown on the Drawings. Seal flashings into reglets with sealant.

- E. Counter flashing shall be provided at all vertical masonry and/or concrete walls which extend above the roof line. The counter flashing shall be installed in a reglet unless otherwise shown. Surface-mounted reglets shall be used where noted.
- F. CONTRACTOR shall provide copper sleeves for hot pipes penetrating the roof as approved by the roofing manufacturer. The annular space between the sleeve and the pipe shall be packed with insulation capable of withstanding the maximum temperature of the pipe. CONTRACTOR to provide a galvanized steel rain collar welded to the hot pipe.

END OF SECTION

SECTION 07 71 00

MANUFACTURED ROOF SPECIALTIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Metal coping and scuppers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. SMACNA–Architectural Sheet Metal Manual.

1.03 SUBMITTALS

- A. Submittals shall comply with requirements of Section 01 33 00–Submittals.
- B. Submit sample panels for selection of anodized or Kynar 500 finish colors.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details.

1.05 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 COPING

- A. Coping cap on masonry wall construction shall be constructed of 24 gauge Kynar-coated steel. Provide hold-down cleats or continuous clip and fully concealed joint covers. Provide mitered corners.
- B. Acceptable products include the following, or equal:
 - 1. PAC-LOC or TITE-LOC by Peterson Aluminum Corporation.
 - 2. Permasnap by the W.P. Hickman Company.

2.02 SCUPPER

- A. Scupper shall be constructed of 24 gauge Kynar-coated steel of sizes as shown on the Drawings. Provide prefabricated mitered corners, splice sections, and all accessories for a complete weathertight installation.
- B. Acceptable products include the following, or equal: Thru-Wall Scupper by Peterson Aluminum Corporation.

2.03 FINISHES

- A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER. All exposed fasteners shall be provided with the same finish as the sheet metal products.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install components in accordance with the Drawings and the manufacturer's instructions.
- B. Installation details shall be such as to allow for thermal expansion and contraction of the components and to provide for a complete weatherproof installation.

END OF SECTION

SECTION 07 22 33

ROOF HATCHES

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes prefabricated roof hatches with integral support curb and operable hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ROOF HATCHES

- A. Roof hatches shall consist of the following: a 12-inch-high, 11 gauge insulated aluminum curb with integral cap flashing of same material and thickness; an insulated cover with 11 gauge aluminum exterior liner, and 18 gauge aluminum interior liner; zinc-plated hinges, compression-spring operators, latches, and other associated hardware.
- B. Acceptable manufacturers include the following, or equal: Bilco Company.

2.02 ACCESSORIES

- A. Provide Bilco Ladder-up, or equal, at all roof hatches which have a ladder access. Materials and finish shall be aluminum, mill finished.
- B. Where noted, provide handrail on underside of hatch leaf so that when open, the rail is an extension of the stair rail below.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install roof hatches in accordance with manufacturer's recommendations and Contract Drawings. Coordinate installation with roofing work of this division.

3.02 SCHEDULE

- A. The roof hatches are scheduled in the Door Schedule on the Drawings.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Silicone firestopping foam for sealing annular spaces around ductwork penetrations through fire-rated assemblies.
 - 2. Silicone firestopping sealant for sealing annular spaces around piping and conduit penetrations through fire-rated assemblies and to seal gaps at intersections of walls and floors/ceilings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. UL 1479–Fire Tests of Through-Penetration Fire Stops.
- B. UL–Fire Hazard Classifications.

1.03 REGULATORY REQUIREMENTS

- A. Firestopping materials and installation shall conform to the 2015 International Building Code requirements, including fire-resistance ratings and surface-burning characteristics.
- B. Provide certificate of compliance from local building inspector indicating approval of firestopping materials and installation.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. A small amount of hydrogen gas is released as the firestopping foam cures. Use forced-air ventilation when installing if areas of installation have less than 2 cubic feet of free air for each pound of liquid mixture being formed.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material,

with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 FIRESTOPPING FOAM

- A. Firestopping foam for duct penetrations through fire-rated assemblies shall be a foamed-in-place silicone elastomer produced from two liquid components.
- B. Acceptable products include the following, or equal: Fire Barrier Rated Foam, FIP 1 Step by 3M Corporation.

2.02 FIRESTOPPING SEALANT

- A. Firestopping sealant for piping and conduit penetrations through fire-rated assemblies shall be a single-component silicone elastomer.
- B. Acceptable products include the following, or equal: Fire Barrier Silicone Sealant 2000 by 3M Corporation.

2.03 DAMMING MATERIAL

- A. Damming material shall be fire-resistant mineral fiber (if left in place) or other combustible material (if removed), as directed by the appropriate fire-tested designs.

2.04 PRIMER AND WRAP STRIP

- A. Primer for firestopping sealant shall be 3M Corporation, or equal.
- B. Wrap strip for firestopping sealant shall be 3M Fire Barrier FS-195 Wrap/Strip, or equal.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Firestopping foam and sealant shall be applied according to manufacturer's written instructions and shall achieve a fire rating equal to rating of construction which is penetrated. Substrate shall be free of all combustible materials (except damming material for later removal), loose impediment, oil, and other free liquids.
- B. Install damming material to establish the thickness and hold the firestopping foam/sealant in place. Follow the manufacturer's installation instructions. All gaps or cracks left after damming materials are in place must be sealed.
- C. Firestopping Foam: Immediately after mixing, dispense liquid foam into the penetration opening in accordance with manufacturer's installation instructions. Do not overfill penetration openings with liquid foam. Foam expands approximately three times its original volume during cure. Follow manufacturer's guidelines. If the opening is not filled when the

cured foam has completed its expansion, repeat the installation and cure procedure until the opening is filled to the desired level. Allow 15 minutes between application of each shot.

- D. Firestopping Sealant: Apply primer and wrap strip in accordance with manufacturer's instructions prior to installing sealant. Apply sealant to a minimum depth of 1 1/2 inches and with uniform density and texture.
- E. Remove combustible damming material after foam/sealant has cured. Noncombustible damming material may be left in place.

3.02 QUALITY CONTROL

- A. Firestopping Foam:
 - 1. Perform manufacturer's four-step in-line quality control check at least once daily and upon changing to a new lot of material in order to review performance of both dispensing equipment and foam product prior to installing penetration seals. The four-step quality check includes evaluation for: snap time (cure rate); foam color and uniformity; foam cell structure; and foam density (weight).
 - 2. Check cured penetration seal after 24-hour cure by removing damming materials to examine seal.
 - 3. Cured foam should completely fill penetration. Fill all remaining gaps with freshly mixed foam or firestopping sealant.
 - 4. Recheck after added material has cured 24 hours.
 - 5. Damming materials required to achieve a fire rating must be returned to the penetration.
 - 6. Clean up spills of liquid components with high-flash mineral spirit solvent, following manufacturer's instructions.
 - 7. If necessary, trim excess cured foam with a sharp knife or blade.
- B. Firestopping Sealant:
 - 1. Check completed work for complete adhesion and seal 48 hours after sealant application.
 - 2. Clean adjacent surfaces of excess sealant using a compatible solvent in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 07 90 00

CAULKING AND SEALANTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Caulking and sealants on the project, including primers and backer rod material.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C920—Elastomeric Joint Sealants.

1.03 SUBMITTALS

- A. Submittals shall comply with provisions of Section 01 33 00—Submittals.
- B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.
- C. Submit copies of warranty.

1.04 WARRANTY

- A. Caulked joints shall be weathertight and guaranteed watertight by installer for two years from the earlier of either the date established for partial utilization in accordance with GC 15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project. Deliver original guarantee to OWNER with copies to ENGINEER.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 CAULK-GENERAL

- A. Caulk for general applications in all locations except floor joints shall be a one-part or two-part polyurethane sealant.
- B. Acceptable products include the following, or equal:
 - 1. Masterseal NP1 by Master Builders Solutions.
 - 2. Vulkem 116 by Tremco, Inc. (exterior applications only).
 - 3. Dymonic 100 by Tremco, Inc.
 - 4. Sikaflex-2c NS EZ Mix by Sika Products.

2.02 CAULK-FLOOR JOINTS

- A. Caulk for floor joint applications shall be a one-part, self-leveling, polyurethane sealant.
- B. Acceptable products include the following, or equal:
 - 1. MasterSeal SL1 by Master Builders Solutions.
 - 2. Vulkem 45 SSL by Tremco, Inc.
 - 3. Sikaflex-2c SL by Sika Products.

2.03 CAULK-VERTICAL EXPANSION JOINTS

- A. Caulk at vertical expansion joints in nonsubmerged and submerged non-potable water contact applications shall be a one-part or two-part polyurethane sealant.
- B. Caulk shall be capable of $\pm 50\%$ joint movement.
- C. Acceptable products include the following, or equal:
 - 1. Dymonic 100 by Tremco, Inc.
 - 2. Sikaflex-2c NS EZ Mix by Sika Products.

2.04 CAULK-EXPANSION JOINTS-FLOORS

- A. Caulk at floor expansion joints in nonsubmerged and submerged non-potable water contact applications shall be a one-part or two-part polyurethane sealant.
- B. Caulk shall be capable of $\pm 50\%$ joint movement.
- C. Acceptable products include the following, or equal: Sikaflex-2c SL by Sika Products.

2.05 ACCESSORIES

- A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.
- B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.

- C. Cleaning fluid shall be methyl ethyl ketone (MEK), methyl isopropyl ketone (MIK), or similar solvent material which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer, of type expressly recommended for use with the caulking or sealant compound used.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the Drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weathertight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the Drawings. Caulking not specified in other sections shall be performed under this heading.
- B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.
- C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross section 1/2-inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.
- D. Backer rod shall be used in all openings 3/4 inch or more in depth and shall be tightly packed to completely fill the space to 1/2 inch back of face. The 1/2 inch shall then be filled with caulking compound.
- E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.
- F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a clean, weathertight condition.

3.02 CAULKING EXISTING JOINTS

- A. All caulked joints in walls, ceilings, and floors requiring painting in the Room Finish Schedule (see Drawings) shall be recaulked. Existing caulk and backer shall be completely removed. Caulk joints as specified for new construction.
- B. Caulking of existing joints shall be coordinated with Section 09 91 00-Painting.

END OF SECTION

SECTION 08 11 00

STANDARD STEEL DOORS AND FRAMES

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Thermally-insulated and fire-rated steel doors and frames.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/SD1-100–Standard Steel Doors and Frames.
- B. UL 10B–Fire Tests of Door Assemblies.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. In addition to shop drawings and product data, indicate type of primer paint to be used and verify compatibility with field paint system specified.

1.04 REGULATORY REQUIREMENTS

- A. Fire-Rated Door and Frame Construction: Conform to UL 10B.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 THERMALLY-INSULATED DOORS

- A. Thermally-insulated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with QMAX Thermally Enhanced core full thickness.
- B. Acceptable products include the following, or equal:
 - 1. Ceco Imperial.
 - 2. Curries 707 Series.

2.02 FIRE-RATED DOORS

- A. Fire-rated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with honeycomb or steel stiffened rib core for full thickness of door. Fire doors shall carry Underwriters label on the door.
- B. Acceptable products include the following, or equal:
 - 1. Ceco Regent.
 - 2. Curries 747 Series.

2.03 FABRICATION-DOORS

- A. Doors shall be fully-sealed, continuously-welded construction with all surface welds, joints, and seams filled and ground smooth.
- B. Tops and bottoms of doors shall be completely closed with 16 gauge channels. Outside edges of doors shall be flush without depressions. No inverted channels will be allowed.
- C. Mortise, reinforce, drill, and tap doors to receive hardware. Reinforcement shall be welded within the stiles and rails. Reinforce top rails to accommodate closers on either side and reinforce bottom for kickplate.
- D. All Underwriters fire doors shall be constructed to meet Underwriters Laboratories specific approval according to current procedure for the indicated class.
- E. Glass in exterior doors shall be 1 inch thick.

2.04 FRAMES

- A. Steel door frames shall be made of 14 gauge, cold-rolled, prime-quality steel in accordance with ANSI/SD1-100.
- B. Fire-rated frames shall carry Underwriters label on the frame.
- C. Frames shall be removable where shown on the Drawings.

2.05 FABRICATION-FRAMES

- A. Fabricate frames as welded unit. Weld joints continuously through full throat width of frames, including rabbets, soffits, and stops; grind, fill, dress, and make smooth, flush, and invisible.

- B. Welded frames shall be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and shall not be used to size the frame opening.
- C. Frames shall be 2 inches by 5 3/4 inches. Frames shall have 4-inch head member at 7 feet 0 inches doors in masonry walls.
- D. Fabricate frames with hardware reinforcement plates welded in place.
- E. All Underwriters fire-rated frames shall be constructed to meet Underwriters Laboratories specific approval according to current procedure for the indicated class.
- F. Provide anchors appropriate to wall type.
- G. Provide frames for all steel doors.

2.06 FINISH

- A. Doors and frames shall receive one coat of rust-inhibitive, shop-applied primer paint. Primer paint must be compatible with field-paint system specified.
- B. Frames shall be finish-painted as specified in Section 09 91 00—Painting prior to installation. This includes back sides of door frames.

PART 3—EXECUTION

3.01 INSTALLATION—FRAMES

- A. Install frames in accordance with ANSI/SD1-100.
- B. Coordinate installation of frames with wall construction for anchor placement.
- C. Coordinate installation of frames with installation of doors, hardware, joint sealers, and field painting.
- D. Set all frames as supplied by manufacturer.
- E. Frames in interior masonry walls shall be grouted full.
- F. Frames in exterior masonry walls shall be filled with spray foam insulation.

3.02 INSTALLATION—DOORS

- A. Install doors in accordance with ANSI/SD1-100.
- B. Coordinate installation of doors with installation of frames, hardware, glass and glazing, and field painting.
- C. Set all doors as supplied by manufacturer. Hang all doors allowing for expansion and contraction at time of setting.

- D. Set all hardware in accordance with templates as supplied by hardware supplier.
- E. Cover all exposed hardware until completion of painting and finishing.
- F. Examine hardware at completion; test, oil, grease, and adjust as needed for smooth operation.

3.03 SCHEDULE

- A. See Door Schedule on the Drawings.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Solid core flush wood doors with veneer faces.
 - 2. Fire-rated doors where indicated or required.
 - 3. Factory prefitting to frames and factory premachining for hardware.
 - 4. Factory finish.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit in accordance with Section 01 33 00—Submittals.
- B. Product Data: Submit door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory finishing specifications.
- C. Shop Drawings: Submit 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, trim for glass and louvers, and requirements for factory finishing and other pertinent data.

1.03 QUALITY ASSURANCE

- A. Comply with the following standards:
 - 1. WDMA Quality Standard: I.S.1 "Industry Standard for Wood Flush Doors," of Window and Door Manufacturer's Association (WDMA).
 - 2. AWI Quality Standard: "Architectural Woodwork Quality Standards," including Section 1300 "Architectural Flush Doors," of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish, and other requirements exceeding those of NWWDA quality standard.
 - 3. Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies per NFPA 80 and 252 and which are labeled and listed for ratings indicated by Underwriters Laboratories (UL) or Warnock Hersey testing and inspection agency acceptable to authorities having jurisdiction.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors," as well as with manufacturer's instructions.

- B. Identify each door with individual opening numbers which correlate with designation system used on schedule and shop drawings for door, frames, and hardware using temporary removable or concealed markings.

1.05 PROJECT CONDITIONS

- A. Conditioning:
 - 1. Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location.
 - 2. Referenced AWI quality standard including Section 100-S-3 "Moisture Content."

1.06 WARRANTY

- A. Submit two copies of written warranty on door manufacturer's standard form, signed by the manufacturer, installer, and CONTRACTOR agreeing to repair or replace defective doors which have warped (bow, cup, or twist), or which show telegraphing of core construction in face veneers, or do not conform to tolerance limitations as defined in WDMA Standard Door Warranty, except the WDMA provision for refunding the price received by the door manufacturer for any defective door shall not apply. The warranty shall also include refinishing and reinstallation that may be required because of repair or replacement of defective doors. Warranty shall be in effect during the life of installation.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S AND PRODUCTS

- A. Doors shall be:
 - 1. Algoma Hardwoods, Inc.—Novodor.
 - 2. Eggers Industries—Architectural Wood Door-Particle.
 - 3. Weyerhaeuser Company—Timblend Particleboard Core (DPC-1), or equal.

- B. Core shall be 1 3/4 inches thick.
- C. Face veneer shall be AWI "premium" Grade A face veneers, plain-sliced, book matched select white hard maple for transparent finish. Provide exposed solid wood components of the same specie as face veneer for wood stops.
- D. Provide manufacturer's standard fire-rated solid core doors with standard core construction as required to provide fire-resistance ratings indicated. Faces and AWI grade shall match nonrated doors, unless otherwise indicated.
- E. Provide manufacturer's standard core reinforcement material at top rail and lock blocks at both vertical stiles to allow surface-mounted hardware to be attached with screws.
- F. Provide wood beads for light opening in doors. Provide manufacturer's standard metal vision frame for light openings in fire-rated doors approved for use in doors of fire ratings indicated.

2.02 FABRICATION

- A. Factory prefit and premachine doors to fit frame opening sizes indicated complying with tolerance requirements of AWI for prefitting. Comply with final hardware schedules and door frame shop drawings and with hardware templates.
- B. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory premachining.
- C. Cut and trim openings through doors and panels as shown. Comply with applicable requirements of referenced standards for kind and quality of door shown and specified. Trim openings for nonrated doors with solid wood moldings of profile shown, or if not otherwise shown, with rectangular section, flush with faces of door.

2.03 FRAMES

- A. Frames for wood doors shall be w hollow metal as noted in the Door Schedule. See Section 08 11 00—Standard Steel Doors and Frames for hollow metal frames.

2.04 FACTORY FINISH

- A. All doors (including beading and moldings) to be finished at the factory, with UV-cured system with performance properties equivalent to TR-6 Catalyzed Polyurethane. Factory prefinished doors to be individually protected at the factory. Final color, build, and sheen to be approved by OWNER based on actual review samples.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Condition doors to average prevailing humidity in installation area prior to hanging.
- B. Prepare doors to receive hardware; refer to Section 08 71 00—Door Hardware for hardware.

- C. Install wood doors to comply with manufacturer's instructions and of referenced AWI standard and as indicated.
- D. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA Standard No. 80.
- E. Provide clearances complying with NFPA Standard No. 80. Bevel fire-rated doors 1/8 inch in 2-inch lock edge; trim stiles and rails only to extent permitted by labeling agency.
- F. Provide openings in doors as indicated or scheduled. Install glass and/or metal louvers in prepared openings in accordance with manufacturer's recommendations.
- G. Doors shall be finished prior to installation.

3.02 ADJUSTING AND PROTECTION

- A. Rehang or replace doors which do not swing or operate freely.
- B. Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer so that wood doors will be without damage or deterioration at time of Substantial Completion.

3.03 SCHEDULE

- A. See Door Schedule on the Drawings.

END OF SECTION

SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Steel access doors, and frame units.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 ACCESS DOORS AND FRAMES

- A. Access doors shall be 14-gauge steel with 16-gauge frame.
- B. Acceptable products include the following, or equal: J.L. Industries, Model RHG (galvanized).

2.02 FINISH

- A. Steel access doors shall have shop-applied prime coat compatible with field paint system specified.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Installation shall be in accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.

3.02 ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer that will not damage finish.
- B. Test units for proper function and adjust until proper operation is achieved.
- C. Repair finishes damaged during installation.
- D. Restore finishes so no evidence remains of corrective work.

END OF SECTION

SECTION 08 36 13

SECTIONAL OVERHEAD DOORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Electrically operated insulated overhead sectional door.
 - 2. Operating hardware, controls, track, and supports.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM E283—Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
- C. ANSI/NFPA70—National Electrical Code.

1.03 SYSTEM REQUIREMENTS

- A. Total air leakage through the doorway opening at a wind velocity of 15 mph shall be 0.08 cfm per square foot or less in accordance with ASTM E283.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.
- B. Submit air leakage test data done by lab in accordance with ASTM E283.

1.05 REGULATORY REQUIREMENTS

- A. Conform to the 2015 International Building Code for motor and motor control requirements.
- B. Products requiring electrical connection shall be listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be

included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 INSULATED DOORS

- A. Thermally insulated sectional overhead doors shall be nominal 2 inches thick, ribbed, embossed panels with 0.015-inch-thick minimum G30 galvanized exterior steel face and minimum G40 galvanized interior steel face in accordance with ASTM A653 and polyurethane core.
- B. Acceptable products include the following, or equal:
 - 1. Wayne Dalton Thermospan 200.
 - 2. Overhead Door Corporation Thermacore 592.

2.02 ELECTRICAL COMPONENTS

- A. Electric operator shall be drawbar center-type, 1/2 horsepower, 208 volts, three-phase. Operator shall be equipped with quick-release equipment for manual operation in case of emergency or power failure.
- B. Provide one interior NEMA 12 3-button control station for each door, open/close/stop, 24-volt circuit.
- C. Each door with electric operator shall have electric sensing edge to stop and reverse the door upon contacting an object while closing. Sensing edge shall be powered from the electric operator and monitored in accordance with UL 325:2010. Sensing edge shall be as manufactured by Miller Edge Model MGO20Y, with 25 feet of factory-provided cable, or equal.
- D. Each door with electric operator shall have infrared optoelectronic sensors mounted maximum 6 inches above the floor to stop and reverse the door upon sensing an object while closing. Provide manufacturer’s mounting adapters. Sensors shall be powered from the electric operator and monitored in accordance with UL 325:2010. Sensors shall have visible LEDs to indicated power and proper alignment and shall utilize self-adjusting light intensity. Sensors shall be constructed of polypropylene and rated NEMA 4X. Sensors shall be as manufactured by Vitector Model OSE with 50 feet of factory-provided cable, or equal. Sensors shall be tested with the electric operator to comply with UL 325:2010.
- E. Interior operator and controls for doors as noted on schedule shall be NEMA 12.

2.03 ACCESSORIES

- A. Provide one full-panel-width row of double-glazed acrylic lights.
- B. Provide springs rated at 25,000 cycles.

2.04 FABRICATION

- A. Insulated doors shall have a thermal break between exterior and interior faces.
- B. Insulated doors shall have joint seals between sections, jamb seals, top seal, and a U-type threshold gasket.
- C. Track shall be 2 inches, minimum 14 gauge galvanized steel. Provide high-lift track where noted.
- D. Doors with electric operators shall be provided without interior slide lock. Provide lock on manually operated doors only.

2.05 FINISH

- A. Exterior face shall be primed with a baked-on polyester primer and finished with a baked-on polyester finish coat. Color shall be selected by OWNER.
- B. Interior face shall be primed and finish-coated with baked-on polyester. Color shall be white.
- C. All other ferrous surfaces, except galvanized surface and working parts of machinery, shall receive one shop-coat of rust-inhibitive metal primer. Primer shall be compatible with field-paint system. Those areas that will become inaccessible after installation shall be finish painted as specified in Section 09 91 00—Painting prior to installation.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Erection shall be performed in accordance with the manufacturer's standards and instructions by their authorized representatives.
- B. All required casing materials shall be provided by CONTRACTOR.
- C. Upon completion of installation, operating devices and controls shall be adjusted and lubricated to operate properly.

3.02 SCHEDULE

- A. See Door Schedule on the Drawings.

END OF SECTION

SECTION 08 41 13

ALUMINUM ENTRANCES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Aluminum entrance doors and frames.
 - 2. Vestibule doors and frames.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A123—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM B209—Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B221—Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- D. ASTM E283—Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- E. ASTM E330—Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- F. ASTM E331—Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

1.03 SYSTEM PERFORMANCE

- A. Provide aluminum entrance and storefront assemblies that comply with specified performance characteristics. Each system shall be tested by a recognized testing laboratory or agency in accordance with specified test methods. Provide certified test results.
- B. Provide systems capable of withstanding thermal movements resulting from an ambient temperature range of 120°F (67°C) that could cause a metal surface temperature range of 180°F (100°C) within the framing system.
- C. Provide assemblies capable of withstanding a uniform test pressure of 25 psf inward and 20 psf outward when tested in accordance with ASTM E330.
- D. Maximum deflection of 1/175 of the span and allowable stress with a safety factor of 1.65. The system shall perform to these criteria under wind loading indicated above.

- E. Air infiltration shall not be more than 0.06 CFM per sq. ft. of fixed area (excluding operable door edges) when tested in accordance with ASTM E283 at an inward test pressure differential of 6.24 psf.
- F. No penetration of water shall occur (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E331 at an inward test pressure differential of 6.24 psf.
- G. Air infiltration shall not be more than 0.50 CFM for single doors when tested in accordance with ASTM E283 at an inward test pressure differential of 1.567 psf.
- H. Certification: Provide certified test results showing that entrance and storefront systems have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 FRAMING SYSTEMS

- A. System shall be Kawneer 451 for interior applications and Kawneer 601T for exterior applications, or equal.
- B. Provide aluminum members with alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B221 for extrusions and ASTM B209 for sheet or plate.
- C. Provide fasteners of aluminum, nonmagnetic stainless steel, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors, and other components.
- D. Except where unavoidable for application of hardware, do not use exposed fasteners. For the application of hardware, use fasteners that match the finish of member or hardware being fastened. Provide Phillips flat-head machine screws for exposed fasteners.

- E. Where fasteners screw-anchor into aluminum less than 0.125 inch thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard noncorrosive pressed-in grommet nuts.
- F. Perimeter anchors shall be aluminum or steel, providing the steel is properly isolated from the aluminum.
- G. Mullion configurations shall allow for pockets at the inside and outside glazing face to receive extruded elastomeric gaskets.
- H. Exposed flashing, sills, trim, and closures shall be plain, unpatterned, architectural quality 5005 alloy aluminum of alloy aluminum sheet 0.063 inch-thick finish to match adjacent framing members.
- I. Concealed flashing shall be 26 gauge minimum dead-soft stainless steel, or 0.026 inch minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.
- J. Brackets and reinforcements where feasible shall be high-strength aluminum brackets and reinforcements; otherwise provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A123.
- K. Bituminous coatings shall be cold-applied asphalt mastic complying with SSPC-PS 12, compounded for 30 mil thickness per coat.

2.02 DOORS

- A. Doors shall be Kawneer Series 500T with 10-inch bottom rail for exterior doors. Doors shall have finish as specified for framing system. See Door Schedule on the Drawings.

2.03 FABRICATION

- A. Sizes of door and frame units are indicated on the Drawings and Door Schedule.
- B. Before shipment to the project site, complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible. Disassemble components only as necessary for shipment and installation. Do not drill and tap for surface-mounted hardware items until time of installation at project site. Perform fabrication operations, including cutting, fitting, forming, drilling, and grinding of metal work to prevent damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.
- C. Welding shall comply with AWS recommendations; grind exposed welds smooth and restore mechanical finish.
- D. Install reinforcing as required for hardware and necessary for performance requirements, sag-resistance, and rigidity.
- E. Maintain accurate relation of planes and angles with hairline fit of contacting members.
- F. Fabricate to profiles indicated for a flush glazing appearance with no projecting stops. Provide internal anchorages and construction sealants. Provide glazing gaskets. Door jamb

shall have integral stop. Fabricate frames directly supporting the doors using screw-spline or shear block joinery at frame connections.

- G. Provide fully-resilient glass settings in rails and mullions.
- H. Doors (and associated door frame) indicated to be equipped with electric strikes on the door schedule shall be equipped to accommodate electric strike and associated wiring.

2.04 ACCESSORIES

- A. Provide all necessary accessories for a complete weather-tight installation.
- B. Provide 0.040 inch aluminum sills, jamb, and head flashings where noted.

2.05 FINISH

- A. Finish on all exposed surfaces of framing and accessories shall have Architectural class 1 anodic finish, conforming to AAMA 611. Color selected by OWNER.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation.
- B. Set units plumb, level, and true to line without warp or rack of framing members, doors, or panels. Anchor securely in place, separating aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- C. Drill and tap frames and doors and apply surface-mounted hardware items complying with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
- D. Set sill members and other members in bed of sealant as indicated to provide weather-tight construction. Comply with requirements of Section 07 90 00-Caulking and Sealants for sealants.
- E. Seal all interior perimeter joints between frames and adjacent dissimilar materials in the manner specified in Section 07 90 00-Caulking and Sealants.
- F. Refer to Section 08 81 00-Glazing for installation of glass indicated to be glazed into doors and framing.
- G. Adjust operating hardware to function properly, for smooth operation without binding and for weather-tight closure.
- H. Clean the completed system, inside and out, promptly after installation exercising care to avoid damage to coatings.

- I. Clean glass surfaces after installation. Remove excess glazing and sealant compounds, dirt, and other substances from aluminum surfaces.

END OF SECTION

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1—GENERAL

1.01 SUMMARY

- A. Section includes Architectural Aluminum Windows including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of window units. Types of aluminum windows include:
 - 1. Kawneer Series AA™6500 Windows.
 - 2. Project-Out and Fixed Windows.
 - 3. 3-3/8-inch Project-Out vent depth.
 - 4. AW-PG70-AP.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 DEFINITIONS

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA)—AAMA Glossary (AAMA AG).

1.03 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed window system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Window Performance Requirements:
 - 1. Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS). Performance Class and Grade: AW-PG70-AP.
 - 2. Wind loads: Provide window system; include anchorage, capable of withstanding wind load design pressures as required by the 2015 International Building Code.
 - 3. Air Infiltration: The test specimen shall be tested in accordance with ASTM E283 at a minimum size of 60-inch by 36-inch. Air infiltration rate shall not exceed 0.10 cfm/ft² at a static air pressure differential of 6.24 psf (300 Pa). The test specimen shall meet the A3 rating of less than 0.55 (m³/h)/m at 1.57 psf (75 Pa) when tested in accordance with CAN/CSA-A440-00 Windows.
 - 4. Water Resistance: The test specimen shall be tested in accordance with ASTM E547 and ASTM E331 at a minimum size of 60-inch by 36-inch. There shall be no leakage as defined in the test method at a static air pressure differential of 15 psf (720 Pa). The test specimen shall meet the B7 rating with no water leakage at 15 psf (720 Pa) when tested in accordance with CAN/CSA-A440-00 Windows.
 - 5. Uniform Load Deflection: A minimum static air pressure difference of 70 psf (3352 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member. The test specimen shall meet the C5 rating when tested in accordance with CAN/CSA-A440-00 Windows.

6. Uniform Load Structural: A minimum static air pressure difference of 105 psf (5028 Pa) shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load with permanent set not to exceed 0.2% of span length.
7. Component Testing: Window components shall be tested in accordance with procedures described in AAMA/WDMA/CSA 101/I.S.2/A440 and AAMA 910.
8. Energy Efficiency: Thermal Transmittance (U-Factor): When tested to AAMA Specification 1503, AAMA Specification 507 or NFRC 100 the thermal transmittance (U-Factor) shall not be more than 0.43 BTU/hr/ft²/°F per AAMA 1503 with exterior 1/4-inch low-e glass, 1/2-inch Technoform TGI spacer, and interior 1/4-inch clear glass.
9. Condensation Resistance Test (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, the condensation resistance factor (CFR) shall not be less than:
 - a. Fixed: CRF not less than 77 (frame) and 72 (glass).
 - b. Project-Out: CRF not less than 71 (frame) and 69 (glass).
10. Temperature Index (I): Provide aluminum windows tested for thermal performance according to CSA-A440 with a Temperature Index (I) not less than Project-Out: (I) not less than 62 (frame) and 64 (glass).
11. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested in accordance with AAMA Specification 1801, the STC and OITC shall not be less than:
 - a. Fixed: STC not less than 48; OITC not less than 38
 - b. Project-Out: STC not less than 35; OITC not less than 28.
12. Forced Entry Resistance: All windows shall conform to ASTM F588, Grade 10.
13. Thermal Barrier Test: Thermal break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

1.04 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
- B. Environmental Product Declaration (EPD): Include a Type III Product-Specific EPD created from a Product Category Rule.
- C. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances and installation details.
- D. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- E. Samples for Verification: For aluminum windows and components required.
- F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experiences with installation of the same or similar units required for this project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum windows and are based on the specific system indicated. Do not modify size and dimensional requirements. Do not modify intended aesthetic effects, as judged solely by ENGINEER. If modifications are proposed, submit comprehensive explanatory data to ENGINEER for review.
- E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 requirements.

1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.07 WARRANTY

- A. Manufacturer's Warranty: Submit, for OWNER's acceptance, manufacturer's standard warranty. Warranty Period: Two years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product:
 - 1. Kawneer Company Inc.
 - 2. Kawneer Series AA™6500 Windows.
 - 3. Project-Out and Fixed.
 - 4. 5-inch AA™6500 frame depth.
 - 5. 3 3/8-inch Project-In vent depth.
 - 6. AW-PG70-AP.

2.02 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070 inch wall thickness at any location for the main frame and sash members. Recycled Content: Shall have a minimum of 50% mixed pre- and post-consumer recycled content.
 - 1. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - 2. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - 3. Indicate location recovery of recycled content.
 - 4. Indicate location of manufacturing facility.
- B. Thermal Barrier: The thermal barrier shall be Kawneer consisting of two parallel glass fiber-reinforced nylon strips installed continuously and mechanically bonded to the aluminum.
- C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
- D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- E. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- F. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

2.03 WINDOW SYSTEM

- A. Series AA™6500 Windows–Project-Out and Fixed.

2.04 GLAZING

- A. Glass and Glazing Materials: Refer to Section 08 81 00—Glazing for glass units and glazing requirements applicable to glazed aluminum window units.
- B. Glazing System: Glazing method shall be a wet/dry type in accordance with manufacturer's standards. Exterior glazing shall be TPE gasket. Interior glazing shall be snap-in type glazing beads with an interior gasket in accordance with AAMA 702 or ASTM C864.

2.05 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.
- B. Typical Hardware:
 - 1. Locking: Duel Handle Multi-Point Locks (Standard) Project-Out.
 - 2. Hinging:
 - a. 4-Bar Hinges (Standard).
 - b. Limit Stop.
 - 3. Other:
 - a. Pole Ring.
 - b. Pole.
 - c. Roto Operator.

2.06 ACCESSORIES

- A. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- B. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.
- C. Sealants and joint fillers for joints at perimeter of window system.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- E. Interior Trims: Extruded aluminum, 6063-T6 alloy and temper, extruded to profiles and details indicated. The interior face trim minimum wall thickness shall be 0.062 inch. The face trim shall snap-fit onto concealed mounting clip. Exposed fasteners shall not be accepted. The mounting clip shall be extruded aluminum of 6063-T6 alloy and temper. The minimum wall thickness shall be 0.062 inch. The trim clips shall be provided in 4-inch lengths and spaced a maximum of 18 inches center to center.
- F. Coupling Mullions: Shall be extruded aluminum of 6063-T6 alloy and temper of profile and dimensions indicated on drawings. Mullions shall provide structural properties to resist wind pressure required by performance criteria and standards.

- G. Insect Screens: Extruded aluminum frames, 6063-T6 alloy and temper, joined at corners: 18 by 16 mesh fiberglass screen cloth; frames finished to match aluminum windows; splines shall be extruded vinyl, removable to permit rescreening.

2.07 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fit joints; make joints flush, hairline and weatherproof.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Window Vent and/or Vent Frame Joinery: Mitered and Mechanically clipped and/or staked. Factory sealed vent and /or vent frame and corner joints.
- C. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- D. Fabricate aluminum windows that are re-glazable without dismantling sash or framing
- E. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact. Thermal barriers shall be designed in accordance with AAMA TIR A8. Thermal Barrier: The thermal barrier shall be Kawneer consisting of two parallel glass fiber-reinforced nylon strips installed continuously and mechanically bonded to the aluminum.
- F. Glazing Stops: Provide snap-on glazing stops coordinated with glazing system indicated. Provide glazing stops to match frame.

2.08 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing: Kawneer Permanodic™ AA-M10C21A41 / AA-M45C22A41, AAMA 611, Architectural Class I Anodic Coating. Color selected by OWNER.

PART 3—EXECUTION

3.01 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions

affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to provide a coordinated, weather tight window installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Nail heads shall be driven flush with surfaces in opening and within 3 inches of opening.
3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install aluminum framed window system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.
- D. Install aluminum framed window system and components to drain condensation, water penetrating joints, and moisture migrating within system to the exterior.
- E. Separate aluminum from dissimilar materials to prevent corrosion or electrolytic action at points of contact.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
 1. Testing Methodology: Testing Standard shall be per AAMA 502 including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 for Water Penetration Test.
 - a. Air Infiltration Test: Conduct test in accordance with ASTM E 783 at a minimum uniform static test pressure of 1.57 psf (75 Pa) for CW or 6.24 psf (300 Pa) for AW. The maximum allowable rates of air leakage for field testing shall not exceed 1.5 times the project specifications.
 - b. Water Infiltration Test: Water penetration resistance tests shall be conducted in accordance with ASTM E 1105 at a static test pressure equal to 2/3 the specified water test pressure.
 2. Testing Extent: ENGINEER shall select window units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present.
 3. Test Reports: Shall be prepared according to AAMA 502.

3.04 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weather tight closure. Lubricate hardware and moving parts.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION

SECTION 08 60 10

PLASTIC UNIT SKYLIGHTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Factory-fabricated skylights with double acrylic domes and aluminum frames mounted on built-up wood curb (shingled roofs), or insulated aluminum curbs (flat single-ply membrane roofs).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. FS TT-C-494–Coating Compound, Bituminous, Solvent Type, Acid Resistant.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 SKYLIGHTS AND FRAMES

- A. Skylights on flat single-ply membrane roofs shall be WASCO EcoSky Series Model E3CA by WASCO Products, Inc., of Sanford, Maine, or equal.
- B. Units shall be mounted on insulated aluminum curbs with aluminum inner and outer skin and 1-inch fiberglass insulation.
- C. Curb frames and retainer frames shall be fabricated from 6063-T5 or 6063-T6 aluminum extrusion 0.060 inch thick. Corners to be filled and welded. Curb frames shall have built-in condensation gutter.

- D. Skylights shall be insulated double domes constructed of 100% cast acrylic. Outer dome shall be impact modified, infrared blocking, light diffusing, and 100% haze white. Inner dome shall be a clear Lumira® aerogel-filled multi-wall polycarbonate panel.
- E. Thermal performance values shall equal or exceed the following:
 - 1. Solar heat gain coefficient 0.34.
 - 2. Visible light transmission 43%.
- F. See schedule for unit sizes.

2.02 ACCESSORIES

- A. Anchorage Devices: Type recommended by manufacturer.
- B. Counter Flashing: Same metal type and finish as skylight frame.
- C. Protective Back Coating: Bituminous.
- D. Sealant: See Section 07 90 00—Caulking and Sealants.

2.03 FABRICATION

- A. Fabricate units free of visual distortion and defects.
- B. Fabricate units for a weather-tight assembly.
- C. Apply bituminous paint on aluminum surfaces of units in contact with cementitious materials or dissimilar metals.

2.04 FINISHES

- A. Aluminum: Clear anodized.

PART 3—EXECUTION

3.01 EXAMINATION

- A. Verify that openings and materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install aluminum curb frame on aluminum curb.
- C. Place unit and secure to curb frame with retainer frame. Flash and counter flash into roof system.
- D. Apply sealant and seal watertight and weathertight.

3.03 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed surfaces; wipe surfaces clean.
- C. Remove excess sealant.

3.04 SCHEDULE

Building	Model	Size	No. Required
Maintenance Garage	E3CA	30 1/4" x 30 1/4"	4

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Hardware to fully equip all doors.
 - 2. Thresholds and weatherstripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NFPA 80–Fire Doors and Windows.

1.03 REGULATORY REQUIREMENTS

- A. Hardware shall conform to the 2015 International Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.
- B. Hardware for Maintenance and Administration Buildings shall comply with barrier-free requirements.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 LOCKSETS AND LATCHSETS

- A. Locksets and latchsets without stainless steel (ss) finish shall be Sargent cylindrical type Series 10X, Schlage D Line, Best Access Systems 9K Series, or equal.

- B. Locksets and latchsets shall have 2 3/4-inch backset. Strikes shall be curved lip.
- C. Lockset and latchset numbers listed in Hardware Groups on the Drawings are Sargent.
- D. Provide removable core brass 6- or 7-pin cylinders for all locksets and latchsets.

2.02 HINGES

- A. Butt hinges shall be Stanley FBB 191, Hager BB 1191, or equal, full mortise, ball bearing, nonferrous, nonrising, loose pin, and flat bottom tip, unless otherwise specified. Provide three 4 1/2-inch by 4 1/2-inch hinges per door for doors 7 feet or less in height with one additional hinge for each additional 30 inches or fraction thereof, unless otherwise specified. Provide additional hinges or heavyweight hinges for all doors that are over 36 inches wide, unless specified otherwise. Finish on aluminum entrance doors shall match framing.

2.03 DOOR CLOSERS

- A. Door closers shall be LCN Series 1460 for exterior doors and 1461 for interior doors, or equal. Provide aluminum finish on closers. Provide full covers. Door closers specified in Hardware Groups on the Drawings are LCN.

2.04 OVERHEAD DOOR HOLDERS

- A. Overhead door holders shall be Glynn Johnson GJ 81H Series, or equal, unless otherwise specified. Numbers specified in Hardware Groups on the Drawings are Glynn Johnson.

2.05 SURFACE BOLTS

- A. Surface bolts shall be 8-inch Ives 1630 series, or equal.

2.06 KICKPLATES

- A. Kickplates shall be Rockwood, or equal, 6 inches high. Kickplate width shall be 2 inches less than door width.

2.07 DOOR STOPS

- A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, or equal.

2.08 THRESHOLD AND WEATHERSTRIPPING

- A. All exterior doors shall be weatherstripped with Reese DS75, National Guard Products, Inc., or equal, weatherstripping. Provide Reese 323C, Pemko 315AN, or equal, sweeps; and Reese S475A, Pemko 171A (provide Reese S439A, Pemko 273A, for areas with thicker flooring on one side), or equal, thresholds. Exterior doors without mullion shall have Reese No. 87, Pemko 352A, or equal, positive sealing astragal.

2.09 KEYING

- A. Door keys shall be keyed to match existing facility. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion.

2.10 ROLLER LATCH

- A. Roller latch shall be Glynn Johnson GJ32, or equal.

2.11 LATCH PROTECTION PLATE

- A. Latch protection plate shall be 3 inches by 11 inches for use with cylindrical locksets with a 2 3/4-inch backset. Protection plate shall be steel with finish to match door hardware, Hager 341D, DonJo MLP211, or equal.

2.12 ELECTRIC STRIKE

- A. Electric strike shall be Von Duprin Model 6211 for standard cylindrical locks, and Model 6112 for exit devices, or equal. Provide with dual-voltage (12/24VDC) continuous operation.

2.13 FINISH

- A. Finish for all hardware, except as noted below, shall be US 26D or US 32D.
- B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Provide finish hardware to fully equip all doors.
- B. Install hardware in accordance with manufacturer's instructions.

3.02 SCHEDULE

- A. Provide hardware groups in the amounts indicated in Hardware Groups on the Drawings or required for a complete and proper installation.

END OF SECTION

SECTION 08 81 00

GLAZING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes glass and glazing for windows and door lights.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. GANA—Glass Association of North America.
- B. NFPA 257—Standard on Fire Test for Window and Glass Block Accessories.
- C. NFPA 80—Standard for Fire Doors and Other Opening Protectives.
- D. UL 9—Standard for Safety Fire Tests of Window Assemblies.

1.03 WARRANTY

- A. Exterior insulating glass shall be provided with a 10-year warranty against failure of the seal.
- B. Coated glass shall be provided with a 10-year warranty against peeling, cracking, or deterioration of the coating.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 EXTERIOR GLASS

- A. Glass in exterior metal windows and exterior door lights shall be 1-inch-thick insulating glass consisting of two pieces of 1/4-inch float glass separated by a 1/2-inch air space.
- B. Acceptable manufacturers include the following, or equal: Oldcastle Glass Company, PPG Solarban 70XL.
- C. Glass shall be Low-E with grey tint outboard light and clear tint inboard light with the following maximum values, or equal.

	Shading Coefficient	U-Value		SHGC
		Winter	Summer	
Clear	.32	.28	.26	.27
Grey tint	.23	.28	.26	.20

- D. Exterior windows adjacent to doors and exterior door lights shall have tempered glass in compliance with the governing building code.

2.02 INTERIOR GLASS

- A. Glass in interior windows and interior door lights, except as noted, shall be 1/4-inch-thick float glass, fully tempered.
- B. Acceptable manufacturers include the following, or equal: Oldcastle Glass Company, PPG.

2.03 FIRE RATED GLASS

- A. Fire rated wire glass, 1/4-inch thick, shall be Wirelite NT manufactured by TGP Fire Rated, or equal.
- B. Fire rated clear glass, 5/16-inch thick, shall be Firelite Plus manufactured by TGP Fire Rated, or equal.
- C. Fire rated glass shall comply with NFPA 257 or UL 9 and NFPA 80.
- D. Glazing accessories, manufacturer's standard compression gaskets, standoff spacers, setting blocks, and other accessories necessary to complete installation.

2.04 SPANDREL GLASS

- A. Spandrel glass shall be fully tempered, 1/4-inch thick, Vari-Tran shadow box spandrel by Interpane Glass Company, or equal. Color to be chosen from manufacturer's standard colors (minimum 8).

2.05 GLAZING COMPOUNDS AND ACCESSORIES

- A. Glazing system shall consist of a polyisobutylene-butyl tape, liquid polymer sealant, and vinyl roll-in strip.

- B. Acceptable products include the following, or equal:
 - 1. Tremco Vision Strip System.
 - 2. General Electric Silglaze.

2.06 FABRICATION

- A. Glazing of windows shall be from the interior.
- B. Accessories such as setting blocks, clips, etc., shall be provided to properly set glass.
- C. Obtain sizes from work at the site or from the manufacturer of work into which the materials will be set. Responsibility for the correctness of measurements shall be assumed by CONTRACTOR.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Comply with "Glazing Manual" by Glass Association of North America (GANA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials.
- B. Completed installation shall be water- and airtight.

END OF SECTION

SECTION 09 22 16

METAL STUD FRAMING SYSTEM

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes metal studs, furring channels, and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C754–Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products.
- B. ASTM C840–Standard Specification for Application and Finishing of Gypsum Board.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal:
 - 1. Dietrich Industries, Inc.
 - 2. Clark Western.
 - 3. UNIMAST Incorporated.
 - 4. Marino/WARE.

2.02 MATERIALS

- A. Metal studs shall be 25 gauge, galvanized, except as otherwise shown or specified; channel shaped and punched for utility access. Depth as shown on the Drawings; 3 1/2 inches minimum if size not shown.
- B. Top and bottom runners shall be of same material and thickness as studs with 1 1/4-inch leg.
- C. Provide fasteners, 20-gauge sheet metal backing, and other accessories for a complete installation.
- D. Furring channels shall be 25 gauge, galvanized, except as otherwise shown or specified. Depth and configuration shall be as shown on the Drawings.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install metal framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.
- B. Provide supplementary framing, blocking, and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer, or if none available, with *Gypsum Construction Handbook* published by United States Gypsum Company.
- C. Framing shall be with studs and runners of depth shown or required.
- D. Provide continuous floor and ceiling runner tracks sized to match stud depth. Align runner tracks accurately to the partition layout at both sill and head. Secure runner tracks as recommended by the stud manufacturer for the sill and head construction involved, except do not exceed 24 inches on center spacing for nail- or power-driven fasteners or 16 inches on center for other types of attachment. Provide fasteners at all corners and ends of runner tracks.
- E. Erect studs from floor up to structural deck above and space 16 inches on center maximum, unless shown otherwise.
- F. Align stud web openings horizontally.
- G. Friction fit studs to runner tracks by positioning and rotating into place. Provide positive attachment to runner tracks for studs located at partition corners and intersections and adjacent to openings using 3/8-inch self-tapping screws or stud-clinching tool on both flanges of studs. Do not weld.
- H. Provide additional studs to support inside corners at partition intersections and corners and to support outside corners, terminations of partitions, both sides of expansion and control joints, and adjacent to all openings. Brace stud framing system rigid.

- I. Install full-length studs between runner tracks wherever possible. If necessary, splice studs by nesting with a minimum lap of 8 inches and fasten lap with two screws through each flange.
- J. Frame door openings less than 4 feet 0 inch wide with 20-gauge studs at head and side jambs. Frame door openings over 4 feet 0 inch wide with two 20-gauge studs back-to-back at head and side jambs. Install one additional 25-gauge stud within 6 inches of each side jamb.
- K. Refer to Drawings for indication of partitions extending to finished ceiling only and for partitions extending through the ceiling to the structure above. Where partitions abut ceiling or deck construction or vertical structural elements, provide slip- or cushion-type joint between partition and structure to prevent transfer of loading imposed by structural movement to partitions.
- L. Frame drops, ceilings, and soffits for gypsum wallboard with studs, channels, or suspension system to support 20 psf superimposed load. Do not exceed 24-inch spacing for components to which gypsum wallboard is attached. Install miscellaneous braces and supports to maintain rigidity with structure. Minimum stud gauge is 20. Frame chases in similar manner as partitions.
- M. Frame and/or furr out to receive miscellaneous gypsum wallboard surfaces. Use applicable framing members and accessories for use intended.
- N. Install flat plate to underside of metal deck to provide support for runner tracks parallel to deck flutes.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes gypsum wallboard, accessories, and texture finish.
- B. Related Sections: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C475—Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- B. ASTM C840—Standard Specification for Application and Finishing of Gypsum Board.
- C. ASTM C1396—Standard Specification for Gypsum Board.
- D. ASTM E119—Standard Test Methods for Fire Tests of Building Construction and Materials.

1.03 REGULATORY REQUIREMENTS

- A. Conform to the 2015 International Building Code for fire-rated assemblies.

1.04 ENVIRONMENTAL CONDITIONS

- A. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C840 and with gypsum board manufacturer's recommendations.
- B. For nonadhesive attachment of gypsum board to framing, maintain not less than 40°F. For adhesive attachment and finishing of gypsum board, maintain temperature uniformly within the range of 55°F to 70°F for 48 hours prior to application and continuously thereafter until drying is complete.
- C. Ventilate building spaces to remove moisture not required for drying joint treatment materials. Avoid drafts during dry hot weather to prevent materials from drying too rapidly.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal:
1. United States Gypsum Company (USG).
 2. Gold Bond Building Products Division, National Gypsum Company.

2.02 MATERIALS

- A. Gypsum Wallboard-Interior Sheathing:
1. Provide gypsum board conforming to ASTM C1396, in maximum lengths available to minimize end-to-end joints.
 2. Gypsum shall be 5/8-inch-thick by 48-inch-wide USG Sheetrock SW Gypsum Panels, Gold Bond Sta-Smooth Gypsum Wallboard, or equal.
 3. Provide moisture-resistant gypsum wallboard on the walls in the restrooms, USG Fiberock Aqua-Tough Interior Panel, 5/8 inch thick.
 4. Gypsum board for fire-rated walls shall be 5/8-inch USG Sheetrock Firecode C core gypsum panels, or equal.
- B. Accessories:
1. Provide materials complying with ASTM C475, ASTM C840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.
 2. Reinforcement at exterior corners shall be USG Galvanized Dura-Bead No. 101, Gold Bond Standard Cover Bead, or equal.
 3. Reinforcement at internal corners shall be USG No. 100 Perf-a-Tape, Gold Bond Joint Tape, or equal.
 4. Provide trim accessories as required.
 5. Provide No. 200 case beads and other accessories as detailed or required.
 6. Joint compound shall be USG Durabond 90, Gold Bond Sta-Smooth, or equal, at cased edge joints.

PART 3-EXECUTION

3.01 EXAMINATION

- A. Examine substrate to receive gypsum wallboard systems for alignment, support, bracing, etc., prior to installation. Shim, block as required to comply with tolerances.
- B. Verify that the installation of all blocking, mechanical, and electrical work is completed.

3.02 INSTALLATION

- A. Install and finish gypsum board to comply with ASTM C840.
- B. Direct Attachment:
 - 1. All ends and edges of sheetrock shall occur over nailing members except when joints are at right angles to framing members.
 - 2. All wallboards shall be applied horizontally. All ends and edges shall fit neatly. End joints shall be staggered. Joints on opposite sides of a partition shall be arranged to occur on different studs.
 - 3. Sheetrock shall be applied to studs by power-driven 1 1/4-inch Type W screws, spacing not to exceed 12 inches on center.
 - 4. Fasteners shall be at least 3/8 inch from edges.
- C. Direct Furring Channel Attachment:
 - 1. Apply gypsum panels horizontally (right angles to framing). Use maximum practical lengths to minimize end joints. Fit ends and edges closely, but not forced together. Stagger end-joints in successive courses. When necessary, cut ends, edges, and cutouts within the field of the panel in a workmanlike manner.
 - 2. Drive fasteners in field of panel first working toward ends and edges. Hold panel in firm contact with framing while driving fasteners. Space perimeter fasteners at least 3/8 inches from ends and edges.
 - 3. Attach gypsum panels to framing supports by power-driven USG brand screws, Gold Bond 1 1/4-inch Type A drywall screws, or equal, spaced 12 inches on center maximum.
- D. Cut openings required for ducts, piping, etc., above ceiling or fit panels after installation.
- E. Provide edge trim at all exposed edges of board and where board abuts dissimilar material. No raw drywall shall abut another material without a bead.
- F. Treat cut edges and holes in moisture-resistant gypsum board with sealant.
- G. Provide control joints at locations indicated or, if not indicated, at spacings and locations required by referenced gypsum board application and finish standard to prevent cracking of finished drywall.
- H. Patch all existing areas that are modified or damaged.

3.03 JOINT TREATMENT

- A. Finish all exposed-to-view surfaces.
- B. Reinforce and trim all joints, vertical and horizontal corners, and exposed edges.
- C. Fill with finishing compound all joints, fastener heads, trim accessory flanges, and other depressions in the surface of the wallboard to obtain a smooth flush surface.
- D. Prefill all V-grooved SW board. Butter all joints. Embed tape and apply skim coat of joint compound.
- E. Do not use topping compound for embedding tape.

- F. Do not intermix joint compounds.
- G. Spot fastener heads and fill beads and trim.
- H. Apply second and third coats.
- I. Allow drying time between application of joint compound in accordance with manufacturer's recommendations for the relative humidity and temperature levels at the time of application. In no case, allow less than 24 hours drying time between applications of joint compound.
- J. Lightly sand joint compound smooth between coat applications.
- K. Apply not less than three separate coats of joint compound over joints, fastener heads, and metal flanges on surfaces exposed to view.
- L. Where not exposed to view within building, embed tape at joints and skim coat with joint compound.
- M. Finishing work will not be considered acceptable if corners of edges do not form true, level, straight, or plumb lines, or if joints, fasteners, head, flanges of trim accessories, or defects are visible after application of field-applied decoration.

END OF SECTION

SECTION 09 30 00

TILES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Quarry tile floor and base.
 - 2. Ceramic tiles (floors and walls).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI A108.1–Installation of Ceramic Tile.
- B. ANSI A137.1–Standard Specifications for Ceramic Tile.
- C. TCA (Tile Council of America)–Handbook for Ceramic Tile Installation.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Samples shall be submitted for approval and color selection.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall maintain temperature of 50°F minimum during tile work and for 7 days after completion.

1.05 EXTRA MATERIALS

- A. Supply extra 2% of total quantity of each tile used and place in marked carton for OWNER's future use.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA.

CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 CERAMIC TILE

- A. All ceramic tile shall be Standard Grade materials conforming to ANSI A137.1.
- B. Provide 1-inch by 1-inch unglazed tile for ceramic floors. Provide 4-inch by 4-inch glazed tile for ceramic tile walls. Ceramic tile shall be by American Olean, or equal.
- C. Provide 12-inch by 12-inch unglazed tile for ceramic tile floor and walls. Ceramic tile shall be Color Story by American Olean, or equal.
- D. Provide bullnose cap, square incorners, bullnose outcorner, and bullnose jambs.
- E. Furnish all ceramic tile and accessories from same manufacturer.
- F. Grout for floors shall be commercial, gray, sanded Portland cement-type, Polyblend Sanded Grout by Custom Building Products, or equal, meeting requirements of ANSI A108.1. Color by OWNER.
- G. Sealants, where required, shall be American Olean Redi-Set Grout, Dow Corning 784, or equal, white fungicidal one-part silicone rubber.
- H. Color of wall and floor tile shall be selected by OWNER.

2.02 UNCOUPLING MEMBRANE

- A. Manufacturer to be Schluter-DITRA, or equal.
- B. Description: 1/8-inch-thick (3 mm), orange, high-density polyethylene membrane with a grid structure of 1/2-inch by 1/2-inch (12 mm by 12 mm) square cavities, each cut back in a dovetail configuration, and a polypropylene anchoring fleece laminated to its underside. Conforms to definition for uncoupling membranes in the Tile Council of North America Handbook for Ceramic Tile Installation; and meets or exceeds the requirements of the *American National Standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A108.1,* and is listed by cUPC®, and is evaluated by ICC-ES (see Report No. ESR-2467).

2.03 WATERPROOFING MEMBRANE

- A. Manufacturer to be Schluter-KERDI, or equal.
- B. Description: 0.008-inch-thick (0.2 mm), orange polyethylene membrane, with polypropylene fleece laminated on both sides, which meets or exceeds the requirements of the *American National Standard specifications for load bearing, bonded, waterproof membranes for*

thin-set ceramic tile and dimension stone installation A108.1," and is listed by cUPC®, and is evaluated by ICC-ES (see Report No. ESR-2467).

PART 3—EXECUTION

3.01 PREPARATION

- A. Floor and wall surfaces shall be level with maximum surface variations not exceeding 1/8 inch in 8 feet.
- B. Floors and walls to be tiled shall be cleaned and prepared in accordance with manufacturer's recommendations.
- C. Surfaces to be tiled shall be free from coatings, curing membranes, oil, grease, wax, and dust.
- D. Clean, etch, and otherwise prepare concrete floors so that there is an adequate bond of setting bed.

3.02 INSTALLATION

- A. Comply with ANSI A108.1 and TCA handbook for installation standards that apply.
- B. All surfaces shall be cleaned with cloth as work progresses.
- C. Wall tile does not need to be installed behind lockers.
- D. CONTRACTOR shall prohibit all traffic on newly tiled floors for at least 3 days. Where use is unavoidable, CONTRACTOR shall protect newly tiled floor with large flat boards for 7 days.

3.03 CLEANING

- A. At completion of tile installation, grout haze shall be removed according to tile manufacturer's recommendations.
- B. Protect completed floors from construction dirt and damage with plywood in traffic areas and with heavy-duty construction paper masked-in-place in other areas.
- C. Clean all floors and walls at project completion.

3.04 SCHEDULE

- A. Ceramic tile floors and walls shall be provided in rooms as indicated on the Finish Schedule on the Drawings.

END OF SECTION

SECTION 09 51 00

SUSPENDED ACOUSTICAL CEILINGS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes normal acoustical ceilings, moisture-resistant ceilings, and suspended grid system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C423—Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.
- B. Submit samples for ENGINEER's review before installation.

1.04 EXTRA MATERIAL

- A. Provide an extra package of each type of ceiling tile used.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 SUSPENSION SYSTEM

- A. Suspension system for normal acoustical and metal-clad ceilings shall be rolled-steel exposed grid system with white aluminum bottom trim, PRELUDE ML 15/16 inch by Armstrong, or equal. Suspension system for moisture-resistant, and laboratory acoustical ceiling shall be rolled-aluminum exposed grid system with white finish, AL PRELUDE XL 15/16 inch by Armstrong, or equal. Anchor suspension systems to roof with galvanized steel hanger wire.
- B. The suspension system shall support the ceiling assembly with a maximum deflection of 1/360 of the span.

2.02 NORMAL ACOUSTICAL CEILINGS

- A. Unless otherwise specified, acoustical ceiling material in rooms with suspended ceilings shall be Cortega Tegular as manufactured by Armstrong, or equal. Finish shall be 24 inches by 24 inches by 5/8 inch thick. Edge shall be Angled Tegular.

2.03 MOISTURE-RESISTANT CEILINGS

- A. Ceiling in toilet and shower rooms shall be Grindstone Gypsum Ceiling Panels by Armstrong, or equal. Finish size shall be 24 inches by 24 inches and 1/2 inch thick.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Coordinate grid layouts with building electrical plan sheets.
- B. The systems shall be installed to permit border units of the greatest possible size.
- C. All members shall be aligned for true, level surface, and straight lines.
- D. Metal moldings shall be provided at the perimeter of the ceiling, at the face of beams, and at all openings.
- E. Where conduits, pipes, or ductwork penetrate ceiling, they shall be banded by properly supported ceiling grid.
- F. Cut recess into edge of field cut panels to match full-size panels where recessed edges are provided.
- G. Remove and reinstall all piping, conduit, lights, etc., to allow installation of ceiling in existing building.

3.02 CLEANING AND ADJUSTING

- A. Remove and replace units which are damaged or improperly installed.
- B. Following installation, clean soiled or discolored surfaces of units.

3.03 SCHEDULE

- A. Acoustical ceiling board and grid system suspended from ceilings shall be provided in rooms indicated on the Finish Schedule on the Drawings.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Vinyl flooring.
 - 2. Vinyl wall base.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall provide a constant temperature of 70°F 48 hours prior to the installation, during installation, and 48 hours after installation. A minimum temperature of 55°F shall be maintained thereafter.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 VINYL FLOORING

- A. Vinyl tile flooring shall be 0.125-inch-thick square vinyl composition, conforming to ASTM F1066, Composition 1, Class 2. Vinyl composition tile shall be Armstrong Standard Excelon Imperial Texture Tile Flooring, or equal, as manufactured by AHF Products, Mountville, Pennsylvania.
- B. Color shall be selected by OWNER.

- C. Adhesives, subfloor fillers, and other application materials shall be those as recommended by the vinyl flooring manufacturer.
- D. Provide 1-inch by 1/8-inch edging at doors where no threshold is provided.

2.02 WALL BASE

- A. Vinyl wall base shall be top set-type, ribbed back, rounded top, 1/8-inch-thick, 4-inch-high wall base.
- B. Color shall be selected by OWNER.

2.03 RUBBER TILE

- A. Rubber tile shall be Triumph Rubber Multi-functional and Sports Floor Tiles as manufactured by Tarkett North America, or equal.
- B. Color shall be selected by OWNER from manufacturer's standard colors.
- C. Adhesives shall be supplied by manufacturer of rubber tile.

PART 3-EXECUTION

3.01 PREPARATION

- A. Floor surfaces shall be smooth and flat with maximum variation of 1/8 inch in 10 feet.
- B. All surfaces to receive resilient flooring shall be dry, clean, and smooth.
- C. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- D. Where curing compounds have been used, they shall be removed by CONTRACTOR by sanding, sandblasting, or grinding.

3.02 INSTALLATION

- A. Install materials in strict accordance with manufacturer's printed instructions.
- B. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- C. Install edge strips at unprotected or exposed edges and where flooring terminates.
- D. Scribe flooring to walls, columns, cabinets, and other appurtenances to produce tight joints.
- E. Carry wall base around door jambs to meet frames. Do not install wall base at locations of baseboard heaters.

3.03 CLEANING

- A. Immediately after installation of the floor, CONTRACTOR shall damp-mop and clean all adhesive from exposed surfaces. Vinyl flooring shall receive a light coat of floor polish.
- B. The floor shall be protected from construction dirt and traffic as necessary.
- C. Clean the floors in accordance with the manufacturer's recommendations immediately prior to final completion.

3.04 SCHEDULE

- A. Resilient flooring and accessories shall be installed where indicated in the Finish Schedule on the Drawings.

END OF SECTION

SECTION 09 68 13

CARPET TILE

PART 1—GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Carpet tile.
 - 2. Installation.
- B. Related Documents: Drawings and general provisions of the Contract, including Applicable Provisions of Division 01 shall govern work on this section.

1.02 REFERENCES

- A. ASTM E648—Flooring Radiant Panel.
- B. ASTM E662—Smoke Density.
- C. AATCC 134—Electrostatic Propensity.
- D. CRI TM-102—Fluorine Analysis.
- E. ASTM D3936—Delamination.
- F. Other from methods specified in Part 2—Products.

1.03 SUBMITTALS

- A. Shop drawing showing columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required, as well as direction of carpet pile and pattern, location of edge moldings and edge bindings shall be submitted to ENGINEER for approval prior to installation.
- B. Carpet schedule using same room designations indicated on Drawings.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics, sizes, patterns, colors available, and method of installation.
- D. Selection Samples: Submit manufacturer's complete set of color samples for OWNER's color selection.
- E. Verification Samples: Submit two 18-inch by 18-inch samples illustrating color and pattern for each carpet material specified.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

- G. Maintenance Data: Include maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.
- H. Manufacturer's Carpet Warranty.
- I. Certification of Recycled Content and verification of reclamation and recycling program.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Company specializing in manufacturing specified carpet with minimum 6 years documented experience.
 - 2. Upon request, manufacturer to provide representative to assist in project start-up and to inspect installation while in process and upon completion. Representative will notify designated contact if any installation instructions are not followed.
 - 3. Single Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.
- B. Installer Qualifications:
 - 1. Flooring subcontractor must be certified by the carpet manufacturer prior to bid.
 - 2. Flooring subcontractor to be a specialty contractor normally engaged in this type of work and shall have prior experience in the installation of these types of materials.
 - 3. Flooring subcontractor will be responsible for proper product installation, including floor testing and preparation as specified by the carpet manufacturer and job conditions herein.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site in manufacturer's original packaging listing manufacturer's name, product name, identification number, and related information.
- B. Store in a dry location, between 60°F and 80°F and a relative humidity below 65%. Protect from damage and soiling. Store in pallet form as supplied by manufacturer. Do not stack pallets.
- C. Make stored materials available for observation by OWNER's representative.
- D. Store materials in area of installation for minimum period of 48 hours prior to installation.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Subfloor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document and manufacturer's installation instructions.
- B. The maximum amount of moisture evacuation from the floor is 3.0 pounds per 1,000 square feet in 24 hours. The acceptable pH level of the substrate is between 7.0 and 9.0. Flooring contractor is responsible for floor testing.
- C. All material used in subfloor preparation and repair shall be recommended by the carpet manufacturer and shall be chemically and physically compatible with the carpet system being bid.

- D. Maintain minimum 65°F ambient temperature and 65% relative humidity for 72 hours prior to, during, and 48 hours after installation.
- E. 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 ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.07 EXTRA MATERIALS

- A. Provide additional 5% of each type, color, and pattern furnished; product to be boxed and, when necessary, palletized. Coordinate storage location with OWNER.
- B. Deliver all unused carpet and large scraps to OWNER for “attic stock.”

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product’s value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Carpet tile flooring shall be modular tile Kinetex Strata Plank as manufactured by J&J Flooring, or equal.

2.02 RECYCLED CONTENT

- A. Product must contain a minimum of 31% recycled content by weight. This percentage is calculated by dividing the weight of recycled content in 1 square yard of finished carpet by the total weight of 1 square yard of finished carpet, and multiplying by 100. (Recycle Content Weight) / (Total Product Weight) by 100] per FTC Marketing Guides 16 C.F.R. 260.7 (e).
- B. Recycled content must be certified by a neutral, independent, third-party organization such as Scientific Certification Systems. Product must carry product label certifying overall recycled content (including post-industrial and post-consumer content). Report percentage of post-industrial and post-consumer recycled content as a percentage of total product weight and the source(s) of recycled content.

- C. Product must have a minimum 8% post-consumer recycled content by weight from recycled post-consumer carpet. This is so that carpet is diverted from landfills for the production of the product and that virgin resource use in the product is reduced.
- D. Product must be available inclusive of 100% recycled content secondary backing with no up-charge. The secondary backing must contain at least 75% recycled carpet of which a minimum of 25% shall be post-consumer carpet.
 - 1. Recycled content and post-consumer content must not be subject to availability. Post-industrial and post-consumer recycled content of product installed must be the same as those claimed by the manufacturer and required by project requirements.
 - 2. Recycled content must be expressed as an exact percentage or a range. Statements such as “up to 60%” recycled content are not acceptable.
 - 3. Recycled content products provided must have equal or better performance and cost no more than comparable virgin products.
 - 4. Product’s recycled content must comply with FTC Guides 16 CFR Part 260.7 (e) in that normal by-products in product manufacturing which are normally reused within the original manufacturing process, or waste by-products that would not normally enter the waste stream, do not constitute as either post-consumer or post-industrial recycled content.

2.03 PRODUCT RECYCLABILITY

- A. Product must meet FTC guides for recyclability and must be 100% closed-loop recyclable back into carpet. Products containing both recyclable and nonrecyclable components, manufacturer must adequately report which portions of the product are recyclable per FTC guides 16 CFR section 260.7(d). Note: A manufacturer cannot claim that a product or any portion of a product that is incinerated is recyclable, even if incineration is used to produce heat and power (i.e., waste-to-energy) per FTC guides 16 CFR section 260.7 (d) example 3.
- B. Recyclability of product installed must be the same as that claimed by the manufacturer and required by Contract requirements.

2.04 RECYCLING PROGRAM

- A. Manufacturer must have a collection and recovery system for product and a fully established, currently operational recycling program at time of bid per FTC guides Section 260.7 (d).
- B. Manufacturer must be able to reclaim and recycle 100% of existing carpet of similar composition back into carpet at time of bid.
- C. Manufacturer must have product, a take-back program, and be able to reclaim and recycle 100% of installed product back into carpet at the end of its service life at time of bid. Claiming a product is recyclable based on future expectation of technology, equipment, process, or availability of that product as feed stock is not acceptable. Recycling process must be available for viewing.
- D. Collection and recycling program must be verified by an independent, neutral third-party organization such as Scientific Certification Systems.

- E. Manufacturer must have written guarantee that 100% of the recovered product will be recycled and that no portion of the product will be landfilled or incinerated (including waste-to-energy).

2.05 ENVIRONMENTALLY PREFERABLE PRODUCT

- A. Carpet must be certified as an Environmentally Preferable Product (EPP) by a neutral, independent, third party organization such as Scientific Certification Systems. Carpets must carry an EPP carpet label certifying its Environmental Preferability. Products carrying EPP carpet labels will be given higher preference than those carrying only an EPP fiber label.

2.06 INDOOR AIR QUALITY

- A. Product must have low VOC, factory-applied, “dry” adhesive.
- B. Product, inclusive of floor covering adhesive, must meet CRI’s IAQ requirements for carpet only. Environmental chamber testing per ASTM D5116. Emission rates determined at 24 hours.
 - 1. Product, inclusive of preapplied adhesive, must off gas less than:
 - a. 0.5 mg/sq. meter per hour of Total Volatile Organic Compound (TVOC);
 - b. 0.05 mg/sq. meter per hour of formaldehyde;
 - c. 0.4 mg/sq. meter per hour of styrene; and
 - d. 0.05 mg/sq. meter per hour of 4-Phenyl Cyclohexene (4-PC)
 - 2. Submit Indoor Air Quality report showing CRI Green label Certification Number for carpet (inclusive of adhesive). [If results for carpet testing are not inclusive of adhesive, submit separate IAQ test reports for carpet and adhesive.]
 - 3. Indoor air quality results of the product installed must be same as those specified by the Contract requirements.

2.07 CARPET WARRANTY

- A. Warranty to be sole source responsibility of the manufacturer.
- B. If the product fails to perform as warranted when properly installed and maintained, the affected area will be repaired or replaced at the discretion of the manufacturer.
- C. Warranty shall be for a specifically defined nonprorated period of 15 years. “Lifetime” warranties are not acceptable. The nonprorated 15-year warranty shall specifically warrant against:
 - 1. Excessive surface wear: More than 15% loss of pile fiber weight.
 - 2. Excessive static electricity: More than 3.0 kV per AATCC 134.
 - 3. Resiliency loss of the backing: More than 10% loss of backing resiliency.
 - 4. Delamination.
 - 5. Edge ravel.
 - 6. Zippering.
- D. Tuft Bind warranty in lieu of edge ravel; zippering is not acceptable.
- E. Manufacturer to provide a written warranty that 100% of carpeting returned to manufacturer for recycling will be recycled and that no portion of the carpet will be landfilled or incinerated.

2.08 FIBER

- A. Nylon Fiber:
 - 1. Invista.
 - 2. Antron.
 - 3. Solution dyed.
 - 4. Multicolored / Solid / Patterned.
 - 5. Bulked Continuous Filament (BCF) Nylon.
- B. Bulked Continuous Filament (BCF) Nylon in a loop-pile construction. Cut pile is not acceptable.
- C. Report Fiber Type (i.e., EPP Certified Invista Antron, SAVANT, etc.).
- D. Report postconsumer and postindustrial recycled content of the pile face yarn in product based on weight i.e., total weight of pile face yarn by 100.
- E. Fiber to contain carbon-core filament for permanent static control. Topical treatments are not acceptable.
- F. Durable stain inhibitor should be applied to the fiber during product manufacturing to resist fiber staining and soiling:
 - 1. Initial: Minimum 500 ppm Fluorine per CRI TM-102.
 - 2. After two hot water extractions per AATCC 171: Minimum 400 ppm Fluorine per CRI TM-102.

2.09 BACKING CHARACTERISTICS

- A. Primary Backing: Synthetic nonwoven.
- B. Secondary Backing:
 - 1. ER3–100% recycled content.
 - 2. Density (ASTM D-1667): Min. 65 lbs/cu ft $\pm$ 5%.
 - 3. Standard Size: 18-inch by 18-inch; 24-inch by 24-inch; or 36-inch by 36-inch.
 - 4. Fiberglass reinforced.
 - 5. Fully-fused secondary backing system that will not delaminate.
- C. Adhesive System: RS:
 - 1. Low VOC, factory-applied “dry” adhesive applied to backing and cured during manufacturing.
 - 2. Product as installed to be securely attached to the floor in compliance with Americans with Disabilities Act (ADA), Section 4.5.3.

2.10 PERFORMANCE CHARACTERISTICS

- A. Test reports for the following performance assurance testing to be submitted upon request. Submitted results shall represent average results for production goods of the referenced style. Requirements listed below must be met by all products:
 - 1. Flooring radiant panel: ASTM E648: Class 1 (CRF: 0.45 watts/sq cm, or greater).
 - 2. Federal flammability: CPSC FF 1-70: Passes.
 - 3. Smoke density: ASTM E662: < 450 Flaming Mode.
 - 4. Electrostatic propensity: AATCC 134 (Step and Scuff): 3.0 kV or less.

5. Static coefficient of friction: Passes ADA Requirements for accessible routes (minimum 0.60).
6. Delamination of secondary backing of pile floor coverings: ASTM D3936: No delamination.
7. Lightfastness: AATCC 16E: > 4 @ 100 hours.
8. Vetterman drum: ASTM D5417: Minimum three @ 22,000 cycles.
9. Dimensional Stability: ISO 2551: Maximum Change $\pm 0.149\%$.

2.11 ACCESSORIES

- A. Materials recommended by manufacturer for patching, leveling, priming, etc.
- B. Adhesives: Products to be supplied with a low VOC, factory-applied, "dry" adhesive for "peel-and-stick" installation.
- C. Base, Carpet Edge, and Transition Strips: As specified in applicable sections.

PART 3—EXECUTION

3.01 EXAMINATION/PREPARATION

- A. Prepare subfloor to comply with criteria established in manufacturer's installation instructions. Use only preparation materials that are acceptable to the manufacturer.
 1. Remove all deleterious substances from substrate(s) that would interfere with or be harmful to the installation (i.e., floor wax).
 2. Remove subfloor ridges and bumps. Fill cracks, joints, holes, and other defects.
- B. Verify that subfloor is smooth and flat within specified tolerances and ready to receive carpet.
- C. Verify that substrate surface is dust-free and free of substances that would impair bonding of product to the floor.
- D. Verify that concrete surfaces are ready for installation by conducting moisture and pH testing. Results must be within limits recommended by manufacturer.
- E. There will be no exceptions to the provisions stated in the manufacturer's installation instructions.

3.02 INSTALLATION-GENERAL

- A. Install product in accordance with manufacturer's installation instructions.
- B. Where demountable partitions or other items are indicated for installation on top of finished carpet tile floor, install carpet tile before installation of these items.
- C. 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.
- D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- E. Install borders parallel to walls.
- F. Roll with appropriate roller for complete contact of carpet with mill-applied adhesive to subfloor. Carpet to be securely adhered in accordance with ADA requirements (Section 4.5.3).
- G. Trim carpet neatly at walls and around interruptions.
- H. Completed carpet is to be smooth and free of bubbles, puckers, and other defects.

3.03 PROTECTION AND CLEANING

- A. Remove excess adhesive and/or other from floor and wall surfaces without damage.
- B. All rubbish, wrappings, debris, trimmings, etc., to be removed from site and disposed of properly.
- C. Clean and vacuum carpet surfaces using a beater brush/bar commercial vacuum.
- D. After each area of carpet is installed, protect from soiling and damage by other trades.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Surface preparation and application of paints and coatings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment Procedures:
 - 1. CONTRACTOR shall include in Bid an allowance of \$10,000 for the cost of abrasive-blast waste disposal that contains lead or chromium in excess of regulated amounts.
 - a. Costs include dumpster procurement, on-site storage, waste characterization, and disposal.
 - b. Final payment will be adjusted based on the actual invoiced payment amount.
 - c. OWNER will assist CONTRACTOR with waste disposal sampling, shipper manifesting, and recordkeeping.
 - 2. All other abrasive blast disposal and associated work shall be included in the Lump Sum Bid.

1.02 REFERENCES

- A. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
- B. ASTM D2247—Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- C. ASTM D3363—Standard Test Method for Film Hardness by Pencil Test.
- D. ASTM D4060—Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- E. ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- F. ASTM D4585—Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- G. Federal Register—Code of Federal Regulations (CFR).
- H. Federal Register—Resource Conservation and Recovery Act (RCRA).
- I. Federal Register—Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- J. ICRI—International Concrete Repair Institute.

- K. NACE–National Association of Corrosion Engineers.
- L. SSPC–The Society for Protective Coatings–Steel Structures Painting Manual.
- M. AMPP–Association for Materials Protection and Performance.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.
- C. Submit manufacturer's Safety Data Sheets (SDS) for each type of paint with each shop drawing submittal. SDS sheets shall be posted at the construction site at all times painting is in progress.
- D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in Paragraph 2.01.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
- B. Prepainting Meeting:
 - 1. A prepainting meeting shall be held prior to any material and equipment that requires painting is delivered to the site and before any painting work begins.
 - 2. CONTRACTOR, the paint subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
 - 3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

1.05 FIELD QUALITY CONTROL

- A. Furnish testing apparatus as applicable for observing surface preparation, testing atmospheric conditions and testing coatings, prior to beginning surface preparation. Provide the following apparatus:
 - 1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
 - 2. One wet-film thickness gauge.
 - 3. One dry-film thickness gauge, Mikrotest III, 0-40 mils with calibration standard approved by the Bureau of Standards.
 - 4. One Bacharach Sling Psychrometer, Model 12-7011.
 - 5. Tinker and Razor Model M-1 Holiday Detector and recommended wetting agent.
 - 6. One set of SSPC-VIS 1-89 Visual Standards for Abrasive Blast Cleaned Steel.
- B. Provide access via scaffolding or staging for inspection.
- C. Entire surface of coated submerged concrete shall be tested with holiday detector. Mark and repair all pinholes, then retest until no pinholes are found.

- D. CONTRACTOR shall provide documentation to ENGINEER of conditions before and during painting operations for each area and each day's work. Documented conditions shall include the following at a minimum: date, area of work, system used, preparation methods, environmental conditions, quantity and thickness of coating placed, noted conditions, and nonconforming items. ENGINEER can provide sample report form if CONTRACTOR does not have their own.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.
- B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.
- C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.
- B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open-flame heaters shall not be used.
- C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

1.08 COLOR SELECTIONS

- A. Provide color charts for all coatings being used on the project. After initial selection of colors by OWNER, provide draw down samples of selected colors for OWNER's final approval. For stained wood, provide specified wood species sample with selected color for final approval.
- B. CONTRACTOR shall provide a summary sheet at the completion of the project listing the finish paint products used and the manufacturer's color identification for each item painted. This summary sheet should be submitted to ENGINEER and OWNER for review.

1.09 EXISTING COATINGS

- A. The existing coatings within the existing Administration Building (Structure 90) was tested and found to have significant lead and chromium content. Other areas may be discovered during the course of the project. Copies of the test results are included as an appendix to the specifications. They are not part of the Contract Documents. Coatings shall be removed in accordance with applicable regulations.

1.10 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel,

manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin-Williams Company, Carboline, PPG Protective and Marine Coatings, or equal, unless noted otherwise in the schedule.
- B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.
- C. Paint and paint products of Tnemec Company and Sherwin-Williams, listed in the following specifications, are set up as standard of quality. Carboline and PPG Protective and Marine Coatings have preapproved equivalent products that shall be used. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM Specifications shall be the latest revision:
 - 1. Abrasion–ASTM D4060, CS-17 Wheel, 1,000 grams load.
 - 2. Adhesion–ASTM D4541.
 - 3. Hardness–ASTM D3363.
 - 4. Humidity–ASTM D2247 and D4585.
 - 5. Salt (Fog) Spray–ASTM B117.

PART 3–EXECUTION

3.01 SURFACE PREPARATION

- A. General:
 - 1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
 - 2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive-blast-cleaned and repainted.

3. Prior to field-blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
4. For on-site abrasive-blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.
5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.
6. All concrete surfaces shall be tested for moisture in accordance with ASTM D4263 and, if necessary, F1869. Surfaces shall also be verified that the pH of the cleaned concrete surface to be coated is within the range of 8 to 11.

B. Ferrous Metal:

1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
2. All ferrous metals not primed in the shop shall be abrasive-blasted in the field prior to application of the primer, pretreatment, or paint.
3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive-blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAF 500-03-04 Abrasive Blast Cleaning.
6. Existing motors, pumps, and piping which are to remain shall be power tool cleaned to remove all existing coatings as specified in SSPC-SP15 Commercial Grade Power Tool Cleaning or NAF 500-03-03 Power Tool Cleaning.
7. Other existing ferrous metal items in nonimmersion conditions to be painted shall be abrasive blasted to remove all existing coatings in accordance with SSPC-SP-6 Commercial Blast Cleaning or NAF 500-03-04 Abrasive Blast Cleaning.
8. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot-primed.

C. Concrete:

1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
2. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive-blast cleaned in accordance with SSPC-SP13/NACE No. 6 in order to prepare the surfaces for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a surface profile in accordance with ICRI No. 03732 at CSP-3 to CSP-5.
3. Bug holes, pits, voids, and cracks shall be filled as specified in Section 03 30 00—Cast-In-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.

5. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.
- D. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with nonhydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC-SP1 and shall be abrasive-blasted in accordance with SSPC-SP16 Brush-Off Blast Cleaning.
- E. Copper: Where copper piping is not submerged or buried, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- F. PVC and CPVC: All PVC and CPVC to be painted shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- G. Aluminum: Where listed in the Schedule to be painted, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- H. Wood:
 1. Wood surfaces shall be thoroughly cleaned and free of all foreign matter. Cracks and nail holes and other defects shall be properly filled and smoothed.
 2. Wood trim shall be sandpapered to a fine finish and wiped clean of dust.
- I. Abrasive-Blast Residue Disposal:
 1. All abrasive-blast residue for areas where paint contains significant amounts of lead or chromium shall be collected and stored in a bulk refuse container(s).
 - a. Bulk refuse container(s) shall be lined with a waterproof impervious plastic liner to prevent spilling.
 - b. Bulk refuse container(s) shall be protected by a waterproof cover to prevent rain water from entering the container.
 - c. The abrasive-blast residue shall be kept separate from all other waste for the project.
 - d. Construction waste shall be kept separate from abrasive-blast residue.
 2. The above blast-residue shall be disposed of by CONTRACTOR.
 - a. Cost of the container procurement and placement at the site shall be by allowance in Bid.
 - b. Cost of testing of the containers for heavy metals, known as the Toxicity Characteristic Leaching Procedure (TCLP) shall be by allowance in Bid.
 - c. Cost of removal and disposal of the residue shall be by allowance in Bid.
 - d. OWNER will assist CONTRACTOR to manifest and ship the waste container(s).
 3. Construction debris other than the abrasive-blast residue shall be collected separately from the residue and removed from the site by CONTRACTOR. Cost of construction waste disposal shall be by CONTRACTOR. Collection of abrasive-blast residue in accordance with this section and associated allowance is only required for material used to blast existing piping and equipment identified as being painted with materials with significant amounts of lead or chromium. All other blast media shall be disposed of by CONTRACTOR in accordance with applicable regulations.

3.02 APPLICATION

- A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.

- B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.
- D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.
- E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.
- F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.
- G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.
- H. Walls and ceiling surfaces shall receive a minimum of one coat of paint before surface-mounted items such as conduits, boxes, piping, etc., are installed on these surfaces.
- I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to, between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.
- J. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07 90 00—Caulking and Sealants requirements, except at moving joints which shall be finish-painted before caulking or caulking shall be protected during painting.
- K. For PVC and CPVC piping, unions and valves shall not be painted.

3.03 FIELD QUALITY CONTROL

- A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

3.04 CLEANING

- A. All stains and marks shall be removed from other surfaces upon completion of the work.

3.05 SCHEDULE

- A. General:
 - 1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched-up.
 - 2. See Finish Schedule on the Drawings for an additional reference for areas to be painted.
 - 3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze, machined surfaces, moving parts where

painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask ENGINEER.

4. Products listed first are Tnemec and second are Sherwin-Williams.

B. New Work:

1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all non-galvanized ferrous metal items scheduled for painting be shop-primed. If items are not shop-coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.
2. Interior concrete floors, including equipment bases:
 - a. For areas requiring a non-skid finish (see Room Finish Schedule), one prime coat of 201 Epoxoprime, ArmorSeal 1000 HS Epoxy (reduced), hand broadcast antiskid sand into the wet paint between finish coats in locations as requested by OWNER, and two finish coats of 280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy.
 - b. See Section 03 30 00—Cast-In-Place Concrete for sealed concrete floors for other concrete floor locations (see Room Finish Schedule).
3. Interior concrete block walls: One filler coat of Epoxoblock WB 1254, Kem Cati-Coat HS, and two coats Series N69 Hi-Build Epoxoline II, Macropoxy 646.

Note: Paint shall be roller- or brush-applied to concrete sound-absorptive block.

4. Interior concrete walls:
 - a. One filler coat (1/16 inch minimum thickness) Mortarclad 218, Duraplate 2300.
 - b. Two coats of Series N69 Hi-Build Epoxoline II, Macropoxy 646.

Note: Interior face of concrete tank walls and floors channels and pipe trenches are not to be painted.

5. All exposed concrete ceilings: Two coats of Series N69 Hi-Build Epoxoline, Macropoxy 646.
6. Cast or ductile iron; not submerged or buried:
 - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer;
 - b. Touch-up prime coat prior to finish coating; and apply either:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
7. Cast or ductile iron, tar coated; buried: Not painted.
8. Steel, machinery, and equipment; not submerged:
 - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Beige as primer.
 - b. Touch-up primer prior to finish coat, and either:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces; or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646; and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.

FIRST FIELD COAT SHALL BE APPLIED PRIOR TO INSTALLATION TO SURFACES INACCESSIBLE AFTER INSTALLATION INCLUDING BACK SIDES OF DOOR FRAMES. SEE DIVISION 08 FOR FACTORY-APPLIED DOOR PRIMERS.

9. Motors, gear drives, and doors delivered with nonepoxy primers:
 - a. Degrease per SSPC-SP1.
 - b. Lightly hand-sand per SSPC-SP2.
 - c. Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Beige.
 - d. Apply two finish coats as follows:
 - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 for interior surfaces, or
 - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
 10. Galvanized copper, brass, CPVC, and PVC; not submerged or buried:
 - a. One coat of N69-1255 Hi-Build Epoxoline II, Macropoxy 646, and either:
 - b. Two coats of N69 Hi-Build Epoxoline, Macropoxy 646 for interior surfaces, or
 - c. One coat of N69 Hi-Build Epoxoline, Macropoxy 646, and one coat of 1074 Endura-Shield, Acrolon 218HS for exterior surfaces.
 11. Insulation of equipment, pipes, and ductwork:
 - a. Two coats of Series 1029 Endurotone, DTM Acrylic B66100.
 - b. Colored PVC jacketing shall not be painted.
 12. Galvanized, copper, CPVC, and PVC; submerged or buried: Not painted.
 13. Aluminum items:
 - a. Exposed areas of structural items such as railings and grating shall not be painted.
 - b. For structural items in contact with concrete, see Division 05.
 14. High temperature coatings (250°F to 500°F for steel and ductile iron piping and accessories:
 - a. One prime coat of Sherwin Williams Heat-Flex® Hi-Temp 500 (2.0 to 3.0 DFT).
 - b. One finish coat of Sherwin Williams Heat-Flex® Hi-Temp 500 (2.0 to 3.0 DFT).
 15. Drywall:
 - a. Sherwin-Williams products.
 - b. One coat of ProMar 200 Interior Latex Wall Primer, B28W8200.
 - c. Two coats of ProMar 200 Latex Eg-Shel Enamel.
 16. Painted wood-outside:
 - a. Sherwin-Williams products.
 - b. One coat of A-100 Alkyd Exterior Wood Primer.
 - c. Two coats of A-100 Satin Latex House and Trim.
 17. Stained wood-inside:
 - a. Sherwin-Williams products.
 - b. One coat of A48 Series S-W Wood Classics Stain.
 - c. One coat of A66 Series S-W Wood Classics Gloss Varnish.
 - d. One coat of A66 Series S-W Wood Classics Satin Varnish.
 18. Stainless steel: Not painted.
- C. Existing Areas: Existing areas damaged by removal of existing work and/or installation of new work shall be repainted to match existing and in accordance with the schedule for new work. Existing equipment and structures shall be painted in accordance with the following schedule and as listed in the Finish Schedule, or as noted on the Drawings.
1. PVC and plastic piping:
 - a. Hand sand.
 - b. Solvent clean.
 - c. Coat in accordance with item 12 of new work.
 2. Ductile iron piping:
 - a. Remove existing coating and prepare as specified.
 - b. Coat in accordance with items 6 or 8 of new work with shop primer replaced by field primer.

3. Steel handrails, stairs-interior, monorails, lintels, etc.:
 - a. Remove all existing coatings and prepare as specified.
 - b. Prime and coat per new item 9.
4. Precast and Cast-in-Place Concrete Walls and Ceilings—Interior which remain exposed and are currently painted.
 - a. Prepare as specified.
 - b. Coat in accordance with Items 4 or 5 of new work.
5. Precast and cast-in-place concrete and concrete block walls, ceilings, and floors which are currently unfinished.
 - a. Prepare as specified.
 - b. Coat per new Items 2, 3, 4, or 5.
6. Concrete floors which are currently finished:
 - a. Remove existing coating as specified.
 - b. Coat in accordance with Item 2a of new work.
7. Interior concrete block walls which are currently painted and remain exposed:
 - a. Prepare and overcoat as specified.
 - b. Provide spot masonry filler coat as needed and two finish coats per Item 3 of new work.
8. Drywall: Prepare and finish coat per new Item 14 except for primer.
9. Insulation of Equipment and Pipes: Prepare and coat per new Item 13.

D. Coverage:

1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the painter, one additional coat, minimum, will be required to achieve total DFT as specified and recommended by the manufacturer.

	Min. Sq. Ft.** Coverage	Min. Dry Mil** Thickness Per Coat
Products		
1029 Endurotone, DTM Acrylic	200	
N69 Hi-Build Epoxoline II, Macropoxy 646		
Steel or Impervious Substrate Primer Coat	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0
Steel or Impervious Substrate Finish coat	---	5.0
135-1255 Chembuild, Macropoxy 646	335	4.0
Steel Doors	---	3.0
20HS Pota-Pox, Macropoxy 646		
Steel or Impervious Substrate Primer	---	4.0
Steel or Impervious Substrate Intermediate Coat(s)	---	5.0

	Min. Sq. Ft.** Coverage	Min. Dry Mil** Thickness Per Coat
Steel or Impervious Substrate Finish Coat	---	5.0
1074 Endura-Shield II, Acrolon 218HS	---	2.5
201 Epoxoprime, ArmorSeal 1000 HS Epoxy	250	
280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy	250	
Epoxoblock WB 1254, Kem Cati-Coat HS	80	
N69 Hi-Build Epoxoline, Macropoxy 646 (Masonry and Concrete)	250	
Series 1 Omnithane, DuraPlate 235 (Primer)		3.0, 5.0
N69 Hi-Build Epoxoline II (Submerged)		6.0
Sher-Glass FF (Submerged)		12.0
Macropoxy 5500 LT (potable water system)		
Stripe Coat	---	5.0
Tnemec Series 94-H20, Sherwin Williams Corothane I Galvapac 1k		
Potable Water System Primer	---	3.0
Insulating Coating System Primer	---	3.0
Sherwin-Williams Products		
ProMar 200 Primer (sprayed)	200	
ProMar200 Primer (rolled/brushed)	260	
ProMar 200 Enamel (sprayed)	280	
ProMar 200 Enamel (rolled/brushed)	360	
A 100 Alkyd Wood Primer (sprayed)	200	
A 100 Alkyd Wood Primer (rolled/ brushed)	260	
A 100 Satin Latex Trim (sprayed)	280	
A 100 Satin Latex Trim (rolled/ brushed)	360	
S-W Wood Classics Stain (sprayed)	390	
S-W Wood Classics Stain (rolled/brushed)	480	
S.W. Wood Classics Varnish (sprayed)	320	
S.W. Wood Classics Varnish (rolled/brushed)	360	

** Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final minimum total DFT shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to promote coverage.

- E. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch-up any damaged areas with factory-provided touch-up coating.
1. Sectional overhead doors and overhead coiling doors.
 2. Aluminum windows, doors and entrances.
 3. Fiberglass doors, equipment, structures, stairs, and railing.
 4. Factory-finished HVAC equipment. Rooftop units are to be field-painted.

END OF SECTION

Section 09 91 00-11

1110.037/1224-W-125

SECTION 10 13 00

IDENTIFYING DEVICES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Interior room and area signs.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Submit shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
 - 2. Furnish full-size spacing templates for individually-mounted dimensional letters and numbers.
 - 3. 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.
- D. Samples: Submit samples for verification of color, pattern, and surface texture:
 - 1. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 2. Aluminum: Samples of each finish type and color on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 3. Dimensional Letters: Provide full-size representative samples of each dimensional letter type required showing letter style, color and material finish, and method of attachment.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Package and label all signage as to type and location. Include complete installation instructions.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel,

manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 INTERIOR ROOM AND AREA SIGNS

- A. Interior room and area signs shall be Graphic Braille signs and Custom Braille Signs, or equal, by Seton Identification Productions, Branford, CT, (800) 243-6624. Signs shall be of acrylic construction and shall meet ADA requirements for permanent rooms and spaces.
- B. Signs shall have 5/8-inch-high letters raised 1/32 inch, accompanied by Grade 2 Braille. Pictograms to be provided with some signs.
- C. Background and lettering colors shall be selected by OWNER.
- D. See Interior Signage schedule at end of this section for sizes, wording, and locations of signs.

PART 3—EXECUTION

3.01 INSTALLATION

- A. General: Locate sign units and accessories where indicated on the Drawings and/or where requested by OWNER using mounting methods of the type described and in compliance with the manufacturer's instructions. Mounting locations shall comply with the Americans with Disabilities Act.
- B. Install signs level, plumb, and at the height indicated with sign surfaces free from distortion or other defects in appearance.

3.02 CLEANING AND PROTECTION

- A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by OWNER.

3.03 EXTERIOR SITE SIGNS

- A. Exterior site signs shall be constructed of 18 gauge steel with reflective-grade vinyl sheeting. Signs shall be mounted on 12 gauge galvanized steel U-channel posts. Signs and posts shall be as manufactured by Seton Identification Products, Branford, CT, or equal. Wording for custom signs shall be white on blue background.

B. Schedule of signs is as follows:

Style No.	Type	Size	Quantity
29570	Stop	30-IN by 30-IN	1
M2032	Exit only	18-IN by 18-IN	1
M2033	Enter only	18-IN by 18-IN	1
M4582	Accessible parking	12-IN by 18-IN	2
M2145	Van accessible	12-IN by 6-IN	1

3.04 INTERIOR SIGNAGE SCHEDULE

A. Style numbers are Seton Identification Productions numbers unless otherwise noted. Public room signs are Seton Custom, or equal. Wording shall be approved by OWNER.

Room/ Area No.	Door No.	Style No.	Wording	Size
Structure 90-Administration Building				
120	90136A	CUSTOM OPTIMA	GARAGE	8-IN by 3-IN
124	90124B	CUSTOM OPTIMA	VESTIBULE	8-IN by 3-IN
125	90125A	L10114	RESTROOM	8-IN by 3-IN
126	90126A	CUSTOM OPTIMA	OFFICE	8-IN by 3-IN
127	90127A	CUSTOM OPTIMA	OFFICE	8-IN by 3-IN
129	90129A	CUSTOM OPTIMA	CONFERENCE ROOM	8-IN by 3-IN
130	90130A	CUSTOM OPTIMA	MEN'S LOCKER ROOM	8-IN by 3-IN
131	90131A	CUSTOM OPTIMA	WOMEN'S LOCKER ROOM	8-IN by 3-IN
132	90132A	CUSTOM OPTIMA	SHOWER	8-IN by 3-IN
133	90133A	CUSTOM OPTIMA	JANITOR CLOSET	8-IN by 3-IN
135	90135A	CUSTOM OPTIMA	BREAK ROOM	8-IN by 3-IN
138	EXISTING	CUSTOM OPTIMA	SERVER	8-IN by 3-IN
139	EXISTING	CUSTOM OPTIMA	CLEAN ROOM	8-IN by 3-IN
140	EXISTING	CUSTOM OPTIMA	LABORATORY	8-IN by 3-IN
141	90141A/ EXISTING	CUSTOM OPTIMA*	OFFICE	8-IN by 3-IN
142	EXISTING	CUSTOM OPTIMA	U.P.S.	8-IN by 3-IN
143	90143A	CUSTOM OPTIMA	SCADA	8-IN by 3-IN
144	90144A	CUSTOM OPTIMA	STORAGE	8-IN by 3-IN
145	901445A	CUSTOM OPTIMA	EXERCISE	8-IN by 3-IN
147	90147A	CUSTOM OPTIMA	STORAGE	8-IN by 3-IN
201	90201A	CUSTOM OPTIMA	MEZZANINE	8-IN by 3-IN

* Provide two of each sign.

END OF SECTION

SECTION 10 21 13.19

SOLID PLASTIC TOILET COMPARTMENTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. HDPE toilet and shower compartments and vision screens, floor-mounted and overhead-braced.
 - 2. HDPE urinal screens, wall-mounted with floor brace.
 - 3. Hardware and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI A117.1–Safety Standards for the Handicapped.
- B. FS RR-P-1352–Partitions, Toilet, Complete.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, and door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.

1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI A117.1 Code for Accessible and Usable Buildings and Facilities.

1.05 WARRANTY

- A. Manufacturer to supply a written warranty covering all HDPE components against breakage, corrosion, and delamination for a period of 15 years.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Scranton Products, Inc. (Hiny Hiders), Scranton, Pennsylvania, Partition Systems Inc. of South Carolina, or equal.

2.02 MATERIALS

- A. Toilet compartments shall be floor-mounted, overhead-braced, with noncorrosive doors, panels, and pilasters, equal to High-Density Polyethylene (HDPE) compartments as manufactured by Scranton Products, Inc., or equal. Urinal screens, vision screens, and shower doors shall be constructed of the same materials as the toilet compartments.
- B. Panels, doors, and pilasters shall be fabricated from High-Density Polyethylene (HDPE) containing a minimum of 10% recycled material manufactured under high pressure forming a single-component section which is waterproof, nonabsorbent, and has a self-lubricating surface that resists marking with pens, pencils, or other writing utensils. All panels, doors, and pilasters to arrive at job site with special protective plastic covering.
- C. Doors, panels, and pilasters shall be a minimum of 1 inch thick and all edges machined to a radius of .250; all exposed surfaces to be free of saw marks.
- D. Panel edges at doors shall have shiplap edges.

2.03 ACCESSORIES

- A. Door hardware shall be as follows:
 - 1. Hinges shall be continuous surface-mounted stainless steel (Type 304, 20-gauge) hinges affixed with vandal-resistant stainless steel screws (with head set flush with face of hinge). Door closures to be factory set to accommodate all conditions and allow for a positive opening and closing action free of impediment.
 - 2. Each barrier-free door to include one door pull and one wall stop.
 - 3. Door strike and keeper shall be fabricated from heavy aluminum extrusion (6364-T5 Alloy) with clear anodized finish with wraparound flange surface-mounted and through-bolted to pilaster with one-way sex bolts. Size of strike shall be 6 inches in length.
 - 4. Door latch housing shall be fabricated from heavy aluminum extrusion (6364-T5 Alloy) with clear anodized finish, surface-mounted and through-bolted to door with one-way sex bolts. Slide bolt and button shall be heavy aluminum with “Tough-Coat Black” finish.
- B. Solid color plastic pilaster shoes shall be anchored to finished floor with plastic anchors and No. 14 by 1 1/2-inch stainless steel Phillips head screws.

- C. Provide full-length continuous plastic wall brackets (shall be solid color). Brackets shall be used for all panels-to-pilaster, pilaster-to-wall, and panel-to-wall connections. Wall brackets shall be through-bolted to panels and pilasters with one-way sex bolts. Attachment of brackets to adjacent wall construction shall be accomplished by No. 14 by 1 1/2-inch stainless steel Phillips head screws anchored directly behind the vertical edge of panels and pilasters at 12-inch intervals along the full length of bracket and at each 12-inch interval, alternately spaced between anchor connections.
- D. Headrail shall be heavy aluminum extrusion (6364-T5 Alloy) with mill finish in anti-grip configuration weighing not less than 1.188 pounds per linear foot as manufactured by Scranton Products, Inc. Headrail shall be fastened to tops of pilasters and headrail brackets by through-bolting with one-way stainless steel sex bolts (no cadmium-plated sex bolts allowed).
- E. Headrail brackets shall be 18 gauge stainless steel.

2.04 FABRICATION

- A. Toilet compartment dimensions shall be as shown on the Drawings, except shall be minimum 36 inches wide by 60 inches deep for a typical stall and 60 inches wide by 60 inches deep for an accessible stall.
- B. Door widths shall be minimum 24 inches for a typical stall and 34 inches for an accessible stall.
- C. Dividing panels shall be 55 inches high and mounted at 14 inches above finished floor.
- D. Doors shall be 55 inches high and mounted at 14 inches above finished floor.
- E. Pilasters shall be 82 inches high, mounted within a one-piece plastic shoe with one-way theft-proof, stainless steel sex bolts.
- F. Aluminum edging strips to be fastened to the bottom edge of all doors and panels using vandal-proof stainless steel fasteners.

2.05 FINISH

- A. Finish of doors, panels, and pilasters shall be similar and equal to Scranton Products, Inc. Color and texture of doors, panels, and pilasters to be selected by OWNER from the Classic, Mosaic, and Designer Collections.

PART 3—EXECUTION

3.01 EXAMINATION

- A. Verify correct spacing of and between plumbing fixtures.
- B. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 2-inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices specified.
- D. Attach panels and pilasters to brackets with hardware specified.
- E. All surfaces shall be cleaned after installation is completed and ready for use.

3.03 ERECTION TOLERANCES

- A. Maximum Variation from True Position: 1/4 inch.
- B. Maximum Variation from Plumb: 1/8 inch.
- C. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 1/4 inch.

END OF SECTION

SECTION 10 28 00

TOILET AND BATH ACCESSORIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Toilet, bath, shower, and washroom accessories.
 - 2. Grab bars.
 - 3. Attachment hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI A117.1—Safety Standards for the Handicapped.
- B. ASTM A123—Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A269—Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- D. ASTM A1008—Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- E. ASTM B456—Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.03 REGULATORY REQUIREMENTS

- A. Conform to ANSI A117.1 and Federal ADA-AG code and the 2015 International Building Code for access for the handicapped.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 TOILET TISSUE DISPENSERS

- A. Multiroll dispensers shall be surface-mounted. Bobrick B-288, Bradley 5402, or equal. Provide total of five.
- B. Unit shall be Type 304 stainless steel with satin finish.

2.02 HOOKS

- A. Heavy-duty hooks shall be Bobrick B-2116, Bradley Model 911, or equal. Provide total of two.
- B. Hook and flange shall be brass castings with satin nickel-plated finish.

2.03 SOAP DISPENSER

- A. Surface-mounted liquid soap dispensers shall be Bobrick B-86, Bradley 657, or equal. Provide total of six.
- B. Unit shall be chrome-plated brass with plastic container.
- C. Install where shown on Drawings.

2.04 TOWEL DISPENSERS

- A. Surface-mounted, 400 single-fold towel dispensers shall be Bobrick B-263, Bradley 251-15, or equal. Provide total of one.
- B. Unit shall be Type 304 stainless steel with satin finish.
- C. Locate near where shown on Drawings.

2.05 WASTE RECEPTACLE

- A. Waste receptacles shall be swing-type, free-standing Bobrick B-2250, Bradley 377, or equal.
- B. Units shall be stainless steel with satin finish.
- C. Provide one unit for each toilet room or locker room.

2.06 TOWEL DISPENSER

- A. Towel dispenser and waste receptacle shall be surface-mounted Bobrick B-3949, Bradley Model 234 surface-mounted, or equal. Provide total of four.
- B. Units shall be stainless steel with satin finish.

- C. Locate where shown on Drawings.

2.07 MIRRORS

- A. Mirrors shall be shelfless mirrors with frames, 24 inches by 36 inches high. Bobrick B-290-2436, Bradley Model 780, or equal. Provide total of six.
- B. Mirrors shall have heavy gauge 304 stainless steel frame with satin finish and No. 1 quality, 1/4-inch float plate-glass mirror.

2.08 SHOWER CURTAIN, ROD, AND BENCH

- A. Shower curtain rod shall be 1 1/4 inches diameter, 18 BW gauge, 304 satin-finish stainless steel shower curtain rod, Bradley Model 9531, or equal.
- B. Flanges shall be 3-inch-diameter satin-finish stainless steel. Provide twelve chrome-plated brass curtain hooks for each curtain, Bradley 9536, or equal.
- C. Provide one antibacterial shower curtains, Bradley 9537, or equal.
- D. ADA bench in showers shall be a durable, water-resistant, 1/2-inch plastic laminate seat with Type 304 stainless steel foldup-frame and mounting brackets, Bobrick B-5192, or equal.

2.09 GRAB BARS

- A. Provide stainless steel, peen grip with satin finish, 1 1/4-inch-diameter grab bars. Bars shall be concealed mounted-type, Bobrick B-550.99X18, B-550.99X36, B-550.99X42 and B-55.99X48; Bradley 832-00118, 832-00136 and 832-00142, or equal.
- B. See Drawings for configuration of grab bars.

2.10 SOAP DISH

- A. Soap dish in showers shall be extra heavy-duty chrome-plated cast-bronze dish with rounded edges, Bradley B-973, or equal.

2.11 UNDERSINK PROTECTIVE PIPE COVERS

- A. ADA-conforming, wheelchair-accessible lavatory P-trap and angle valve assemblies shall be covered with molded, antimicrobial undersink protective pipe covers, TRUE BRO, INC. LAV GUARD 2 No. 103 E-Z and No. 402 with 105 E-Z accessory, 1-800-340-5969, or equal.
- B. Cover shall be secured with reusable fasteners and access covers.
- C. Coordinate protective pipe covers for tailpiece and extensions to fit lavatories.
- D. Standard color to be selected by OWNER.

2.12 KEYING

- A. Supply two keys for each accessory to OWNER.

- B. Key all accessories alike.

PART 3—EXECUTION

3.01 INSTALLATIONS

- A. Install accessories in accordance with manufacturers' instructions, ANSI A117.1, Federal ADA-AG, and the 2015 International Building Code.
- B. Install plumb and level securely and rigidly anchored to substrate.

END OF SECTION

SECTION 10 44 43

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Fire extinguishers.
 - 2. Cabinets.
 - 3. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/NFPA 10–Portable Fire Extinguishers.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Product Data: Provide extinguisher operational features, color and finish, anchorage details, and cabinet dimensions.

1.04 QUALITY ASSURANCE

- A. Provide units conforming to NFPA 10 requirements for portable fire extinguishers.
- B. Provide fire extinguisher, cabinets, and accessories by single manufacturer.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MANUFACTURERS

- A. Larsen's Manufacturing Company, Product MP Series.
- B. Substitutions: Under provisions of Section 01 60 00–Materials and Equipment.

2.02 EXTINGUISHERS

- A. Provide three dry-chemical-type, Larsen's MP Series, 10-pound-capacity fire extinguishers. Fire extinguishers shall be UL-approved for Class A, Class B, and Class C fires.

2.03 CABINETS

- A. Provide one cabinet in the Administration Building where shown on the Drawings, Larsen's Architectural Series recessed mounted Model No. 2409 6R, with full glass door. Door and trim shall be fabricated from cold-rolled steel. Cabinet shall have white baked-enamel finish with flat trim. Provide brackets to mount extinguishers within cabinets.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place extinguishers in brackets or in cabinets where shown on the Drawings.
- C. Mount fire extinguisher so the handle is at 48 inches above the finished floor.
- D. The fire extinguishers will be located in the following buildings:
 - 1. Maintenance Building–Two.
 - 2. Administration Building–One.

END OF SECTION

SECTION 10 51 00

LOCKERS AND BENCHES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Steel lockers and portable bench.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 LOCKERS

- A. Provide twelve 15-inch by 15-inch by 72-inch single-tier lockers on 6-inch legs with louvers top and bottom; as manufactured by Penco, Oaks, Pennsylvania, (610) 666-0500, “Vanguard” line, or Republic Storage Systems, Canton, Ohio, (800) 477-1255, “Standard” line, or equal.
- B. Lockers shall be provided with continuous sloping tops with a height of 5 inches.
- C. Lockers shall have minimum 24-gauge steel body with minimum 16 gauge steel door and frame.
- D. Provide hat shelf, coat hooks, wall and base anchors, built-in master keyed combination locks, latches, end panels, corner panel if required, end and side base, and baked enamel finish; color to be selected by OWNER. All locker appurtenances, including bolts, shall be rustproof.

- E. Lockers shall be mounted on 4-inch-high concrete curbs and shall be anchored to walls and/or curbs per manufacturer's recommendations.

2.02 LOCKER ROOM BENCHES

- A. Provide one portable clear hardwood bench 9 1/2 inches wide, 1 1/4 inches thick, 4 feet long.
- B. Hardwood top shall be finished with three coats of plastic sealer and supported on steel standards with same finish as lockers.
- C. Overall bench height shall be approximately 18 inches.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Lockers and benches shall be installed in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 11 30 00

APPLIANCES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Administration Building appliance allowance.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 APPLIANCE ALLOWANCE

- A. CONTRACTOR shall include in the Bid an allowance of \$5,000 for appliances to be provided in the Administration Building. OWNER shall make a selection of the needed appliances and provide a list to CONTRACTOR. CONTRACTOR shall then furnish and install appliances as selected by OWNER. Contract amount will be adjusted (ADD or DEDUCT) by change order based on the actual cost of appliances selected by OWNER and a detailed breakdown of the installation costs from CONTRACTOR. **The allowance shall be used for the labor and materials to provide and install the appliances.**

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 11 68 33

ATHLETIC FIELD EQUIPMENT

PART 1–GENERAL

1.01 WORK INCLUDED

- A. Provide all equipment and materials. Do all work necessary to furnish and install the athletic equipment, as indicated on the drawings, and as specified herein.

1.02 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
 - 1. Division 03–Concrete.
 - 2. Division 31–Earthwork.
 - 3. Division 32–Exterior Improvements.

1.03 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern. Manufacturers Data and Recommended Installation Requirements.

1.04 SUBMITTALS

- A. Shop Drawings and Regulatory Requirements: Provide drawings of manufacturers recommended installation and foundation requirements prior to actual field installation work for ENGINEER or OWNER's Representative review and approval.

1.05 QUALITY ASSURANCE

- A. CONTRACTOR shall only accept bids from those vendors or manufacturers that have been pre-approved or identified as approved equal.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Materials delivered to the site shall be examined for concealed damage or defects in shipping. Any defects shall be noted and reported to OWNER's Representative.
- B. Replacements, if necessary, shall be immediately re-ordered, so as to minimize any conflict with the construction schedule.
- C. Sound materials shall be stored above the ground under protective cover or indoors so as to provide proper protection.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 BASIS OF DESIGN MANUFACTURERS

- A. Manufacturers and product selections named are provided to establish the minimum standard.

Douglas Industries
3441 South 11th Avenue
Eldridge IA, 52748
Phone: (800) 533.8907
Website: www.douglassports.com

2.02 PRODUCTS

- A. Basketball Court Standards: Basis of Design: Model D Pro Max 645.

PART 3—EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions where equipment and systems are to be installed and notify CONTRACTOR of conditions detrimental to the proper and timely installation and completion of the work.
- B. Do not proceed with the work until unsatisfactory conditions have been corrected by CONTRACTOR in a manner acceptable and to the satisfaction of ENGINEER or OWNER's Representative.

3.02 INSTALLATION

- A. All athletic equipment shall be installed as recommended by manufacturer and as indicated on the Drawings.

END OF SECTION

SECTION 12 51 00

OFFICE FURNITURE

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Administration Building and Maintenance Garage.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 OFFICE FURNITURE ALLOWANCE

- A. CONTRACTOR shall include in the bid an allowance of \$75,000 for office furniture to be provided in the Administration Building and Maintenance Garage. OWNER shall make a selection of the needed office furniture and provide a list to CONTRACTOR. CONTRACTOR shall furnish and install furniture as selected by OWNER. Contract amount will be adjusted (ADD or DEDUCT) by change order based on the actual cost of office furniture selected by OWNER and a detailed breakdown of the installation costs from CONTRACTOR. **The allowance shall be used for the labor and materials to provide and install the office furniture..**

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 13 34 23
FABRICATED STRUCTURES

PART 1—GENERAL

1.01 SECTION INCLUDES

- A. Prefabricated steel shelters, gazebo and pavilions.

1.02 RELATED SECTIONS

- A. Section 03 30 00—Cast-In-Place Concrete: Footings and installation of anchor bolts/base plates that are to be provided by shelter manufacturer.

1.03 REFERENCES

- A. ASTM A 36/A 36M—Standard Specification for Carbon Structural Steel; 2003a.
- B. ASTM A 325—Standard Specification for Structural Steel Bolts, Heat Treated, 120,000 PSI Minimum Tensile Strength; 2004.
- C. ASTM A 307—Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength; 2003a.
- D. ASTM A 563—Standard Specification for Carbon and Alloy Steel Nuts; 2004.
- E. ASTM A 500—Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
- F. ASTM A 653/A 653M—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process; 2003.
- G. American Institute of Steel Construction (AISC).
- H. American Iron and Steel Institute (AISI) Specifications for Cold Formed Members.
- I. American Society of Testing Material (ASTM).
- J. American Welding Society (AWS).
- K. OSHA Steel Erection Standard 29 CFR 1926.750 Part R.
- L. SSPC-SP 2 –Hand Tool Cleaning; Society for Protective Coatings; 2000.
- M. SSPC-SP 10 -Near-White Blast Cleaning; Society for Protective Coatings; 2000.
- N. ICC Evaluation Service, ESR-1006, Structural Insulated Panels.

1.04 SYSTEM DESCRIPTION

- A. Standard Design Loads: International Building Code (IBC 2000), 30 pounds per square foot roof snow load, 120 mile per hour wind speed, Exposure "C", Seismic Design Category D.
- B. Column to footing connection to be in compliance with OSHA Steel Erection Standard CFR 1926.750 Part R, which requires a minimum of four anchor bolts per column.
- C. Design Method shall be per applicable local building code requirements. Manufacturer's design shall utilize a three-dimensional structural analysis to determine all member loads and forces.
- D. The pre-engineered package shall be shipped as a pre-cut and pre-fabricated package that shall include the structural framing members, roof material, fasteners, and trim as well as the installation instructions. The structure shall be shipped un-assembled for minimum shipping charges. Field labor shall be only for the assembly of the pre-fabricated parts. No onsite welding shall be required or permitted. Connection bolts shall be concealed within the tubing where possible except at the base.

1.05 SUBMITTALS

- A. Submit a minimum of 4 sets of shop drawings and 2 sets of structural calculations signed and sealed by a Professional Engineer in the state of Illinois.
- B. Structural calculations shall show the conformance to the local building code information: IBC 2000, 30 psf Roof Snow Load, 120 mph Wind Speed, Exposure "C", and Seismic Design Category D.

1.06 QUALITY ASSURANCE

- A. Supplier Qualifications:
 - 1. The supplier shall have at least 5 years of experience in the design and fabrication of pre-engineered steel shelters.
 - 2. Membership in American Institute of Steel Construction.
 - 3. Membership in American Welding Society.
 - 4. Full time on-staff licensed Professional Engineer.
 - 5. Full time on-staff quality control manager.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery requirements with OWNER and other installers.
- B. Store products in manner to prevent damage prior to installation. Where products need to be stored outdoors, store off the ground and place so that water will drain
- C. Inspect parts within 48 hours of delivery, compare with manufacturer's bill of materials and report any missing or non-conforming parts to the manufacturer within this time frame.

1.08 WARRANTY

- A. Provide standard manufacturer's ten year warranty.

1.09 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. ICON Shelter Systems, Inc., 1455 Lincoln Avenue, Holland, MI 49423, Telephone (800) 748-0985 or email info@iconshelters.com. Contact the regional representative for pricing: Parkcreation Inc., 27 East Palatine Road, Prospect Heights, IL 60070, illinoisoffice@parkcreation.com, (847) 419-7744

2.02 APPLICATIONS

- A. Shelters: Pre-engineered, prefabricated all-steel framed shelters; column, rafter, and purlin structure, with steel roof panels or T&G roof deck or Sandwich Panel roof deck, all flashing, trim, accessories, and fasteners required for a complete installation.
- B. Structural framing (Columns, rafters, tie-beams, purlins, etc.) shall be Hollow Structural Sections (HSS) meeting ASTM A500 grade B. "I" beams, tapered columns, open channels, cold-formed box sections or wood products shall not be accepted.
- C. Compression rings shall be made of structural channel sections or welded plate sections that meet ASTM A36 grade steel.
- D. Structural connections shall be made with A325 high-strength bolts and A563 structural nuts, ASTM A307 grade anchor bolts, self-drilling screws and pop-rivets.
- E. Metal Roof Panel: 24-gauge galvalume roof panel with a Kynar 500 paint finish. The ribs shall be 1 3/16 inches high and 12-inch on center. Roof panel coverage shall be 36 inches wide; all angles shall be factory cut. The ribs shall run with the slope of the building for proper drainage. Color shall be selected from the manufacturer's standard color chart.

- F. Metal Roof Trim: Roof trim shall match the color of the roof and shall be formed from 26-gauge painted galvalume steel as follows:
 - 1. Metal ridge caps shall be preformed with a single central bend to match the roof slope. The trim shall be hemmed on both sides.
 - 2. Roof peak cap shall be supplied on all buildings that do not include a cupola.
 - 3. Edge of the roof deck shall have a preformed "J" channel eave trim, the channel shall be applied along all the eaves to trim and straighten the eave. The "J" shall have weep holes at 6 inches on center for roof drainage.
- G. T & G Roof Deck: 2x6 tongue and groove wood roof deck, Western Lodgepole Pine, kiln dried, #2 or better, one edge V'd, one edge grooved.

2.03 ACCESSORIES:

- A. Electrical Access knockouts- See Detail Sheets

2.04 FABRICATION

- A. All columns, rafters, tie-beams, purlins, compression rings shall be factory welded assemblies with provisions for bolted connections in the field. There will be no field welding required for any connections. All base plates, stiffener plates, rafter clips and end plates shall be factory welded in place.
- B. Factory welded connections shall be made by certified welders in accordance with the latest edition of AWS D1.1 and D1.3 Specifications.
- C. Factory Frame Finish: Powder coated per the following procedure; the steel shall be shot-blasted to the specification of SSPC-SP10 (shot-blasted to near white condition), this will remove all oil residue, mil scale, weld spatter and slag. The second step the steel is washed and zinc phosphated in an eight stage electro deposition (E-coat) pretreatment process. Then it is immersed in a liquid epoxy and coated to a uniform 0.7 to 0.9 mils, this E-coat totally encapsulates the part preventing rusting. Then a double coat of TGIC polyester powder is applied, one coat of color and one clear coating for a final finish that is 8 to 12 mils thick. All materials shall be inspected to meet 100% coating, proper cure, film thickness and impact resistance. Color to be selected from the manufacturer's standard color chart.

PART 3-EXECUTION

3.01 GENERAL

- A. When unloading, pad the forks and use other precautions to protect the powder-coated finish. Do not use chains to move materials. Handle all materials carefully in the field to avoid scratching the powder-coat finish. Before installing the roof, clean the steel and touch up any scratches and chips in the powder-coat finish using touch up paint from the manufacturer.
- B. The shelter shall be set on prepared footings or concrete slab (provided by others). Footing details shall be designed by an engineer (retained by other than the manufacturer), based on load information as provided on the manufacturer's supplied drawings. Foundation shall be constructed to all local building code requirements and per good construction practices for the specific site conditions.

- C. In accordance with OSHA Steel Erection Standard 29 CFR 1926.750 Part R, anchor bolts shall be installed for proper column stability and shall have a minimum of four anchor bolts per column.
- D. Install all parts and pieces per the manufacturer's supplied installation instructions and these specifications. The underside of the tongue and groove decking or sandwich panel roof deck shall be sealed before installation as specified and approved by the landscape architect or OWNER.

END OF SECTION

SECTION 20 05 53

IDENTIFICATION FOR FIRE SUPPRESSION, PLUMBING, AND HVAC PIPING AND EQUIPMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Perform all work required to furnish and install equipment, pipe, and wire identification with supplementary items necessary for proper installation as specified herein, or shown on the Drawings. CONTRACTOR shall identify all equipment, valves, piping, pumps, and wires.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

1.03 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASME A13.1—Scheme for the Identification of Piping Systems.
 - 2. Illinois Plumbing Code.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging with labels clearly identifying product name and manufacturer until ready for installation.
- B. Storage: Store materials in clean, dry area indoors until ready for installation.
- C. Handling: Protect materials and finish from damage during handling and installation.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA.

CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Equipment tags, valve tags, and pipe markers shall be manufactured by Marking Services, Incorporated, Seton Name Plate Company, WH Brady Company, or Graphic Products, Inc.

2.02 EQUIPMENT TAGS

- A. Plastic Labels For Equipment (Indoor Application):
 - 1. Use: All equipment purchased by CONTRACTOR or OWNER and CONTRACTOR installed included in Divisions 22 or 23.
 - 2. Materials and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick.
 - 3. Character Color: Black.
 - 4. Background Color: White.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 1 inch by 3 inches.
 - 6. Minimum Letter Size: 1/4 inch.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment (Outdoor Application):
 - 1. Use: All equipment purchased by CONTRACTOR or OWNER and CONTRACTOR installed included in Divisions 22 or 23.
 - 2. Material: MS-215 Max-Tek with printed graphics protected by a chemical and UV resistant MS-3000 top laminate.
 - 3. Letter Color: Black.
 - 4. Background Color: White.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 1 inch by 3 inches.
 - 6. Minimum Letter Size: 1/4 inch.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.03 LABELING TAGS

- A. Labeling Tags:

Use: Field-mounted devices (Natural gas pressure regulators, etc.).

Size: 1-inch by 3-inch.

Material: 1/32-inch-thick stainless steel.

Character Size: 1/4 inch.

Engraving: As requested by ENGINEER.

2.04 WIRE MARKERS

- A. Wire markers shall be permanently attached wraparound adhesive, sleeve- or heat-shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable.

- B. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

2.05 PIPE MARKERS

- A. Manufacturers: Marking Systems, Inc., Seton Name Plate Company, W.H. Brady Company, or equal.
- B. Pipe markers shall conform to ANSI A13.1. Arrow markers must have same ANSI background colors as their companion pipe markers or be incorporated into the pipe identification marker.
- C. Plastic Pipe Markers: Factory-fabricated, flexible, semirigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Pipe markers and arrow markers also shall be provided for all piping systems.
- E. Use Seton Setmark type SNA or Brady Snap-on type identification for all piping systems, up through 6 inches. For piping systems larger than 6 inches, use Seton or Brady strap-on markers, or similar, by Marking Services, Inc. Self-adhesive labels that stick directly to the pipe or insulation jacketing are not acceptable. Provide lettering in accordance with the following table.

PIPE MARK SIZE CHART

Outside Pipe Diameter (Including Covering)	Minimum Length of Label Field Color (Inch)	Minimum Height of Letters (Inch)
3/4 inch to 1 1/4 inch	8	1/2
1 1/2 inch to 2 inch	8	3/4
2 1/2 inch to 6 inch	12	1 1/4
8 inch to 10 inch	24	2 1/2
Over 10 inch	32	3 1/2

PART 3—EXECUTION

3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements and referenced standards and conform to code and ordinances of authorities having jurisdiction.
- B. Degrease and clean surfaces to receive nameplates.
- C. Install nameplates parallel to equipment lines.
- D. Affix nameplates with stainless steel screws or sticky-back adhesive.
- E. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8 inch hole to accommodate wire tie.

- F. Prepare and install neatly typed directions in all panels, including existing panels, where work is done under this Contract.
- G. Four-inch-round, 4-inch-square, and 4 11/16-inch junction boxes concealed above ceilings may be identified with neat lettering on the cover with a permanent-type black marking pen.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, control panels, thermostats, junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Wire markers shall be permanently attached wraparound adhesive or heat-shrink-type markers. Wire numbering preprinted on the conductor, individual wraparound numbers, and flag-type labels are not acceptable.
- B. Conductors in pull boxes, motor control centers, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

3.03 PIPE MARKERS

- A. Install pipe markers in accordance with manufacturer's instructions.
- B. Install in clear view and align with axis of piping.
- C. All pipes shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Locate identification at maximum 20-foot centers on straight runs, including risers and drops adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Labels shall be abbreviated as noted under fluid abbreviations on drawings.
- D. Labels shall identify fluid being conveyed and include flow direction arrow. Provide a double-ended arrow marker when flow can be in either or both directions.
- E. Indicate delivered water temperature on domestic hot water supply and return lines.
- F. CONTRACTOR shall include a schedule in its submittal identifying the various pipe designations, abbreviations, and labeling scheme. Colors, text, and piping abbreviations are to be selected by OWNER, with the following piping marker scheme used where applicable.

Pipe Contents	Label Colors (Background/Text)
Water Lines	
Non-potable water (Non-potable water, do not drink and no beba el agua)	Green/White
Potable water	Green/White
Other Lines	
Compressed air	Blue/White
Natural gas	Brown/White
Plumbing drains, vents, and stormwater	Green/White

END OF SECTION

SECTION 22 05 19

GENERAL PLUMBING PIPING SPECIALTIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Piping specialties for all plumbing piping systems unless noted otherwise.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. New start-up shall confirm all proper electrical connections, discharge, and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and ENGINEER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 THERMOMETERS

- A. Manufacturers: Ashcroft, H.O. Trerice, Ametek/U. S. Gauge.
- B. Stem Type: Cast aluminum case, 9-inch scale, clear acrylic window. Adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

Service	Hot Water
Scale Range, °F	30-180
Increment, °F	2

2.02 THERMOMETER SOCKETS

- A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

2.03 PRESSURE GAUGES

- A. Manufacturers: Ashcroft, H.O. Trerice, Ametek/U. S. Gauge.
- B. Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as follows:

Service	Hot Water	Cold Water	Compressed Air
Scale Range, psig	0-100	0-100	0-200
Increment, psig	1	1	2

- C. Pressure Snubbers: Bronze construction, 300 psig working pressure, 1/4-inch size.
- D. Gauge Valves: Provide ball valves as specified in Section 22 05 23–General Duty Valves for Plumbing Piping.

2.04 WATER HAMMER ARRESTORS

- A. Manufacturer: Sioux Chief, Wade, or Watts.
- B. ANSI A112.26.1, ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with O-ring seals, FDA-approved silicone lubricant, suitable for operation in temperature range 35 to 150°F, maximum 250 psig working pressure, 1500 psig surge pressure. Watts Series LF15M2 or LF15M2S, or equal.

2.05 BACKFLOW PREVENTERS

- A. Backflow Preventers: Reduced Pressure Zone (RPZ) Type:
 - 1. Manufacturers: Watts, or equal.
 - 2. The assembly shall meet the requirements of ASSE 1013, AWWA C511.
 - 3. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Back siphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.
 - 4. Test cocks.
 - 5. Seats: Bronze, removable and replaceable, without removing valve from the line.
 - 6. Checks: Independently operating.
 - 7. Relief Valve: Independently operating, located between the two check valves.
 - 8. Rated 175 psi maximum working pressure with continuous temperature range of 33°F to 140°F.
 - 9. Unit to be complete with vent-port funnel to maintain the air gap and to provide a drain connection point.
 - 10. Sizes 1/2 inch through 2 inches: Bronze body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections. Watts Regulator Company Series LFU009.
 - 11. Sizes 2 1/2 inches through 10 inches: FDA epoxy-coated cast iron body, FDA epoxy-coated strainer, upstream and downstream OSY-UL/FM outside stem and yoke resilient seated gate valves, flange connections: Watts Regulator Series LF-909.

2.06 WALL HYDRANTS (WH)

- A. Manufacturer: Watts, Woodford, or Zurn.
- B. WH-1: Freezeproof automatic draining wall hydrant with exposed chrome plated bronze wall plate, 3/4-inch inlet, 3/4-inch hose thread ASSE 1019-93 backflow preventer outlet, copper or bronze casing, loose key operator. Woodford model 65, or equal.

2.07 HOSE BIBBS (HB)

- A. Manufacturer: Woodford, Watts, or Wade.
- B. HB-1: Hose bibbs shall be Woodford Model 24, Watts, HB-1, or Wade HB-1. Provide 3/4-inch garden hose thread, 3/4-inch inlet, and ASSE 1011 approved backflow preventer outlet. Interior hose valves shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal. Provide metal handle and chrome plate finish. Hose bibbs providing non-potable water shall be provided with a removable key handle.

2.08 REFRIGERATOR WALL BOXES (WB)

- A. Oatey or equal.
- B. WB-1: Oatey 38688 Steel constructed outlet box with white paint finish. With 1/4-inch Turn Brass Ball Hammer Valve and copper sweat.

2.09 NON-POTABLE WATER SIGNS

- A. Non-potable Water Caution Signs: Place non-potable water signs permanently mounted at every hose bib or faucet on the non-potable water system. Sign shall include as a minimum the wording "CAUTION, NON-POTABLE WATER, DO NOT DRINK" and "NO BEBA EL AGUA" or similar standard language. Signs shall be Brady Safety sign, or equal, minimum size 7 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install thermometer in piping systems as indicated on the Drawings and/or details using a separable socket in each location.
- B. Install thermometer sockets at each point where a thermometer or temperature control sensing element is located in a pipeline.
- C. Install water hammer arrestors where indicated and at quick closing valve installations.
- D. Install backflow preventers in accordance with local authority having jurisdiction requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.
- E. Where backflow preventers requiring local authority having jurisdiction registration are installed, provide initial registration, testing and report filing required by local authority having jurisdiction. List the name and address of the building that the backflow preventer installations occur in.
- F. Mount wall hydrants recessed in exterior wall construction with valve plug extended beyond interior side of building insulation. Slope to drain to exterior. Install so discharge is 18 inches minimum above finished grade. Set wall box in grout or caulk and fill exterior wall penetration with insulation.
- G. Mount hose bibbs securely fastened to wall where indicated. Provide water hammer arrestor in line to hose bibb. Hose bibbs providing non-potable water shall be provided with non-potable water warning signage as outlined in this section.
- H. Install refrigerator box in wall construction, secured to structure, directly behind proposed refrigerator location. Provide ball valve in supply piping as close to main branch as possible. Mount box a maximum of 18 inches above floor.
- I. Install pressure gauges in locations where indicated on the Drawings and/or details, with scale range appropriate to the system operating pressures. Install pressure snubbers in gauge piping for all gauges used on water services. Install gauge valves at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.

END OF SECTION

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Valves of all descriptions except where indicated elsewhere.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00—Quality Control.

1.04 SYSTEM DESCRIPTIONS

- A. Performance Requirements:
 - 1. Lead-Free Requirements: All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per the Federal Safe Drinking Water Act as amended January 4th, 2011 Section 1417. All products used in potable water systems shall be UL classified in accordance with ANSI/NSF 61 for potable water service and shall meet the low lead requirements of NSF-372.
 - 2. Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e., domestic water, gas, etc.), each valve type shall be of the same manufacturer unless prior written approval is obtained from OWNER.
 - 3. Valves shall be line size unless specifically noted otherwise.

1.05 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves shall be used on the project. Temperature ratings specified are for continuous operation.

1.06 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under Section 01 33 00—Submittals.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 WATER SYSTEM VALVES (DCW, DHW, NPW, DHWR)

- A. All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless noted otherwise.
- B. Provide valve extensions for valves installed in all piping with insulation.
- C. All valves on potable water supplies shall be suitable for potable water applications.
- D. Shutoff valves in copper piping 3 inches in diameter and smaller shall be two-piece bronze body, solder joint or threaded ends, chrome plated bronze ball, glass filled Teflon seat, Teflon packing and threaded packing nut, blowout-proof stem, 600 psi. Apollo 70LF-200, Milwaukee UPBA150, Nibco S580-80-LF.
- E. Check valves in copper piping 3 inches in diameter and smaller shall be bronze body, wye pattern, swing check, with bronze disc, rated for 300 psig CWP, and NSF certified lead free Apollo valves 161S-LF, or equal.
- F. Potable Water Circuit Setters/Balance Valves:
 - 1. Manufacturers: Bell and Gossett, or equal.
 - 2. Valve shall be designed to allow installing contractor to pre-set balance points for proportional system balance prior to system start-up.
 - 3. All valves shall be of Lead-Free Brass body and stainless steel ball construction with glass and carbon filled TFE seat rings.
 - 4. Valves shall have differential pressure read-out ports across valve seat area. Read-out ports shall be fitted with internal EOT inserts/check valves. Valve bodies shall have 1/4-inch NPT tapped drain/purge ports.
 - 5. Valves shall have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves shall have calibrated nameplates to provide specific valve settings. Valves shall be designed for positive shut-off.

6. Valves shall be suitable for 400 psi service up to 250°F.

2.02 COMPRESSED AIR SYSTEMS (CA)

- A. Shut-Off Valves 3 Inches and Smaller: Two-piece bronze body; threaded ends, chrome plated bronze ball; glass filled Teflon seat; Teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Apollo 70-100, Milwaukee BA100, Nibco T585-70 or T-590-Y, Watts B-6000.

2.03 SPECIALTY VALVES AND VALVE ACCESSORIES

- A. Gauge Valves: Use 1/4-inch ball valves. Needle valves and gauge cocks will not be accepted.

PART 3-EXECUTION

3.01 GENERAL

- A. Properly align piping before installation of valves. Install and test valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- B. Mount valves in locations which allow access for operation, servicing, and replacement.
- C. Provide valve handle extensions for all valves installed in insulated piping.
- D. Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the stem in the horizontal position. Valves installed with the stems down will not be accepted.
- E. Prior to flushing of piping systems, place all valves in the full-open position.

3.02 SHUT-OFF VALVES

- A. Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair and elsewhere as indicated.

3.03 BALANCING VALVES

- A. Install where indicated on the Drawings and details for balancing of flow in pumped hot water recirculation piping systems.
- B. Upon project completion, adjust each valve and set position stop. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature throughout building.

3.04 COMPRESSED AIR VALVES

- A. Install shut-off valves at each piece of equipment, base of drip legs and elsewhere as indicated. Install safety exhaust shut-off valves at terminal equipment designed for frequent

removal. Install pressure reducing valves at filter stations and elsewhere as indicated. Mount in readily accessible location for gauge and maintenance access.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Hangers and supports for Plumbing Piping and Equipment.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00–Quality Control.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.05 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under Section 01 33 00–Submittals.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Anvil, B-Line, Pate, G-Strut, Piping Technology, Roof Products & Systems or approved equal.

2.02 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the Drawings.

2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2-Inch through 2 Inches:
 - 1. Carbon steel, adjustable swivel ring. B-Line B3170, Anvil 69 or 70.
 - 2. Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- B. Hangers for Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support:
 - 1. Carbon steel welded bracket with hanger. B-Line B3068 Series, Anvil 194 Series.
 - 2. Perforated, epoxy painted finish, 16-12 gauge, minimum, steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS 200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series.
- E. Vertical Support: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
- F. Floor Support: Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.
- G. Copper Pipe Supports: All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide isolation collar between supports/clamps/fasteners and copper piping.

2.04 PIPE HANGER RODS

- A. Steel Hanger Rods:
 - 1. Hanger rod shall be continuously threaded, complete with adjusting and lock nuts.
 - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
 - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, shall not exceed the limits indicated.

Maximum Load (pounds)	Rod Diameter (inches)
(650°F Maximum Temperature)	
610	3/8
1,130	1/2
1,810	5/8
2,710	3/4
3,770	7/8
4,960	1
8,000	1 1/4

2.05 BEAM CLAMPS

- A. MSS SP-58 Types 19 and 23 malleable black iron clamp for attachment to beam flange to 0.62 inch thick with a retaining ring and threaded rod of 3/8-, 1/2-, and 5/8-inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Anvil 86/92.
- B. MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1 1/2-inch diameter. B-Line B3054, Anvil 228.

2.06 CONCRETE INSERTS

- A. Poured in Place:
 - 1. MSS SP-58 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8-inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.
 - 2. MSS SP-58 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Anvil 282.
- B. Drilled Fasteners: Carbon steel drop-in type expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.07 CONTINUOUS CONCRETE INSERT CHANNELS

- A. Steel inserts with an industry standard pre-galvanized finish, nominally 1 5/8-inch wide by 1 3/8-inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2,000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with the channel inserts may be used. Select insert length to accommodate all pipe in the area.

2.08 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.

2.09 EQUIPMENT STANDS

- A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.
- B. Install supports to allow free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- C. Coordinate hanger and support installation to properly group piping of all trades.
- D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.
- E. Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on piping.
- F. Perform welding in accordance with standards of the American Welding Society.

3.02 HANGER AND SUPPORT SPACING

- A. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- B. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- C. Use hangers with 1 1/2-inch minimum vertical adjustment.
- D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- E. Support riser piping independently of connected horizontal piping.
- F. Adjust hangers to obtain the slope specified in the piping section of these specifications.
- G. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Horizontal Spacing	Maximum Vertical Spacing
Cast Iron ¹	2" and larger	5'-0"	15'-0"
Copper	1/2" through 3/4"	5'-0"	10'-0"
Copper	1" through 1 1/4"	6'-0"	10'-0"
Copper	1 1/2" through 2 1/2"	8'-0"	10'-0"
Copper	3"	10'-0"	10'-0"
Copper	4" and larger	10'-0"	10'-0"

Pipe Material	Pipe Size	Maximum Horizontal Spacing	Maximum Vertical Spacing
Ductile Iron ^{"1"}	All	5'-0"	15'-0"
Steel	1/2" through 1 1/4"	7'-0"	15'-0"
Steel	1 1/2" through 6"	10'-0"	15'-0"
Steel	8" through 12"	12'-0"	15'-0"
Steel	14" and over	12'-0"	15'-0"
PVC	All	4'-0"	10'-0"
CPVC	All	4'-0"	10'-0"

^{"1"} The maximum horizontal spacing for supports may be increased to 10 feet when 10-foot lengths of pipe are employed.

- H. Any piping materials not explicitly listed above shall have pipe support provided at maximum spacing intervals as noted in the applicable code or manufacturer recommendations, whichever is more restrictive.

3.03 RISER CLAMPS

- A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

3.04 CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS

- A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6 feet 0-inch maximum centers and 2 feet 0 inch from corners. Furnish inserts to Division 03 for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

3.05 ANCHORS

- A. Install where indicated on the Drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

SECTION 22 07 16

EQUIPMENT INSULATION FOR PLUMBING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes insulation for all equipment provided under Division 22—Plumbing:
 - 1. Flexible closed cell insulation.
 - 2. Adhesives, mastic, sealants, and reinforcing materials.
 - 3. Jacketing.
 - 4. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM C168—Standard Terminology Relating to Thermal Insulation.
 - 3. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 4. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 5. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 - 6. ASTM D1000—Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
 - 7. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 8. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
 - 9. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - 10. EPA Method 8260B—Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (Gc/Ms).
 - 11. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00–Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced without additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all equipment covering, jackets, insulation, vapor barriers, adhesive, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 FLEXIBLE CLOSED CELL INSULATION

- A. Acceptable manufacturers are K-flex Insul-tube, Nomaco ArcticFlex, or equal.
- B. Insulation shall be flexible closed cell type conforming to ASTM C1427, Type 1, Grade 1.
- C. Minimum nominal density shall be between 3 to 6 lbs/ft³.
- D. K-factor shall not exceed 0.25 (btu-in)/(hr-ft²-°F) at 75°F mean.
- E. Insulation shall be rated for service range of -20°F to 220°F on piping or 180°F where adhered to equipment.

2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Vapor Retarding Mastic:
 - 1. Acceptable Manufacturers: Foster 30-65 Vapor Fas, Childers CP-34, and Vimasco 749.
 - 2. For equipment insulation operating below 50°F, mastic water vapor permeance shall be less than 0.03 perms at 45 mils dry film thickness conforming to ASTM E96.
 - 3. Use insulation joint sealant at all joints. Acceptable manufacturers are Foster 95-50 Flextra, Childers CP-76 Chil-Byl, or Pittsburgh Corning CW Sealant.
- C. Weather Barrier Breather Mastic:
 - 1. Acceptable Manufacturers: Foster 46-50 Weatherite, Childers Vi-Cryl CP-10/CP-11, or Vimasco WC-5.
 - 2. For equipment insulation operating at 50°F or above, mastic water vapor permeance shall be greater than 1.0 perms at 1/16-inch dry film thickness conforming to ASTM E96.

2.03 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Staples shall be clinch style.
- E. Tack fasteners shall be stainless steel ring grooved shank tacks.

- F. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

PART 3-EXECUTION

3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All insulation shall be installed with joints butted firmly together.
- C. All valves shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation or with "Zeston"-type, premolded PVC fittings installed in accordance with the manufacturer's instructions.
- D. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

3.02 FLEXIBLE CLOSED CELL INSULATION INSTALLATION

- A. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces. Cover flexible closed cell insulation on systems operating below 40°F with vapor retarding mastic.

3.03 EQUIPMENT INSULATION

- A. Insulation shall not cover equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. Provide insulation on equipment as outlined in the schedule below:

Equipment	Insulation	Jacket	Thickness
Water Meters	Flexible Closed Cell	N/A	0.5"
Reduced Pressure Backflow Preventers	Flexible Closed Cell	N/A	0.5"

END OF SECTION

SECTION 22 07 19

PIPING INSULATION FOR PLUMBING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes insulation for all piping provided under Division 22—Plumbing.
 - 1. Rigid formed fiberglass insulation.
 - 2. Adhesives, mastic, sealants, and reinforcing materials.
 - 3. Jacketing.
 - 4. Insulation inserts and pipe shields.
 - 5. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASTM C168—Standard Terminology Relating to Thermal Insulation.
 - 2. ASTM C272—Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
 - 3. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 4. ASTM C533—Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 5. ASTM C547—Standard Specification for Mineral Fiber Pipe Insulation.
 - 6. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 7. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 8. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 - 9. ASTM D1000—Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
 - 10. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 11. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
 - 12. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - 13. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.

- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00—Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced as requested by OWNER without additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all pipe covering, jackets, insulation, vapor barriers, adhesives, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.
- B. All insulation and associated materials shall be free of asbestos.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be

included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 RIGID FORMED FIBERGLASS INSULATION

- A. Acceptable manufacturers are Johns Manville Micro-Lok, or equal.
- B. Insulation shall be mineral fiber type conforming to ASTM C547, Type IV.
- C. Minimum nominal density shall be of 3.0 lbs/ft³.
- D. K-factor shall not exceed 0.23 (btu-in)/(hr-ft²-°F) at 75°F mean.
- E. Insulation shall be rated for service to 850°F.

2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Fiberglass Insulation Adhesive: Acceptable Manufacturers: Foster 85-60, Childers CP-127, and Duro Dyne SSG.

2.03 JACKETING

- A. All Service Jackets (ASJ): Heavy duty, fire retardant material with white kraft reinforced foil vapor retarding jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permance of .02 perms and minimum beach puncture resistance of 50 units.
- B. ADA Accessible Lavatory Insulation: Provide Truebro, Inc. Lav-Guard, or equal, undersink piping cover. Piping cover shall meet applicable ADA requirements. The P-trap, angle valve assemblies, supply piping, and tailpiece shall be covered with the molded vinyl, antimicrobial pipe cover. Cover shall be secured with flush reusable fasteners; angle stop shall have locking access cover.

2.04 INSULATION INSERTS AND PIPE SHIELDS

- A. Acceptable manufacturers are B-Line, Pipe Shields, or Value Engineered Products.
- B. Construct inserts with calcium silicate or polyisocyanurate with minimum 140 psi compressive strength. Piping 12 inches and larger shall be supplemented with high density

600 psi structural calcium silicate insert. Provide 16-gauge, 12 inches long. Insert and shield shall include minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution stainless steel plate.

- C. Where CONTRACTOR proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.
- D. Wood blocks will not be accepted.
- E. All pipe shields shall be banded to the jacketing using stainless steel bands. One band is required on each side of the support.

2.05 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Load distributing metal shields shall be constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- E. Staples shall be clinch style.
- F. Tack fasteners shall be stainless steel ring grooved shank tacks.
- G. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

PART 3-EXECUTION

3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- C. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.

- D. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- E. All pipe insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required.
- F. All un-insulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

3.02 SUPPORT INSTALLATION

- A. For each pipe hanger, provide a hanger block on the bottom half of the pipe in place of the insulation.
- B. Pipe hangers and supports shall be sized large enough to be installed over the outer surface of the insulation.
- C. Load distributing metal shields shall be installed around the lower one-third circumference of the insulation and jacket.
- D. Blocks and shields shall be provided at all supports regardless of orientation, except inserts may be omitted on 3/4 inch and smaller copper piping provided 12-inch long 22 gauge pipe shields are used.

3.03 RIGID FORMED FIBERGLASS INSULATION INSTALLATION

- A. Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9-inch to 12-inch on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of flexible closed cell joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc., for a minimum distance of 6 inches from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.

3.04 PROTECTIVE JACKET INSTALLATION

- A. All Service Jackets (ASJ): Install according to manufacturer's recommendations using factory supplied lap seals and butt strip seals.
- B. Vapor Barriers:
 - 1. On systems operating at 50°F and above, pipe insulation jackets may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge. Mastics used shall be "breather" type allowing passage of water vapor.

2. On systems operating below 50°F and on roof drain lines, insulation laps shall be vapor-sealed using self-sealing lap, lap-seal tape gun, or adhesive. Jackets shall be applied with a continuous unbroken vapor seal. Mastics and adhesives used shall be vapor retarding type limiting passage of water vapor.

3.05 PIPING INSULATION

- A. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1 1/2"	1 1/2" to < 4"	4" to < 8"	8" and Larger
Cooling Coil Condensate Drain	Rigid Formed Fiberglass	ASJ	1"	1"	1"	1"	1"
Cold Water (Potable/Nonpotable)	Rigid Formed Fiberglass	ASJ	1"	1"	1"	1"	1"
Hot Water (Potable/Recirculation)	Rigid Formed Fiberglass	ASJ	1"	1"	1.5"	1.5"	1.5"
Above Grade Stormwater/Roof Drains	Rigid Formed Fiberglass	ASJ	1"	1"	1"	1"	1"

END OF SECTION

SECTION 22 11 00

FACILITY WATER DISTRIBUTION PIPING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: All pipe, fittings, and appurtenances for domestic (hot and cold) potable and non-potable water within and to 5 feet beyond building perimeter.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall provide schedule indicating the ASTM, AWWA, or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- C. CONTRACTOR shall provide statement from manufacturer on their letterhead that pipe furnished meets the ASTM, AWWA, or CISPI specification contained in this section.

1.05 DELIVERY AND STORAGE

- A. CONTRACTOR shall promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. CONTRACTOR shall cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Materials shall not be stored directly on grade. Pipe, tube, and fitting ends shall be protected so they are not damaged. Where end caps are provided or specified, CONTRACTOR shall take precautions so the caps remain in

place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.
- D. Deliver, store, and protect in accordance with Section 01 60 00—Materials and Equipment.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 DOMESTIC WATER (INCLUDES COLD, HOT, HOT RECIRCULATED, AND NON-POTABLE)

- A. Copper Piping and Fittings: Piping smaller than 3 inches in diameter shall be Type K copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for branch takeoffs up to one-half the diameter of the main.

2.02 DIELECTRIC UNIONS AND FLANGES

- A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2 inches and smaller; dielectric flanges 2 inches and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180°F.

2.03 UNIONS AND FLANGES

- A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180°F. Gasket material for flanges and flanged fittings shall be Teflon type. Treated paper gaskets are not acceptable.
- B. Two and One Half-Inch and Smaller Copper: ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.

PART 3-EXECUTION

3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers' recommendations, and recognized industry practices.

3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves, and piping specialties.
- E. Provide anchors, expansion joints, swing joints, and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

3.04 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking shall be allowed.

3.05 DOMESTIC WATER

- A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.
- B. Provide thrust restraints for 3-inch and larger exterior water piping joints, hydrants, caps, plugs, fittings, and bends of 22 1/2 degrees or more. Field apply continuous anti-corrosion coating to rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover. Cover with 8 mil sheet or tube polyethylene material sleeve.

- C. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.

3.06 DIELECTRIC UNIONS AND FLANGES

- A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

3.07 UNIONS AND FLANGES

- A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.08 TESTING AND CLEANING

- A. General:
 - 1. All new piping shall be tested. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
 - 2. All piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests, flushing, sterilization. CONTRACTOR shall also provide all temporary sectionalizing devices and vents as required.
 - 3. All new and parts of existing altered, extended, or repaired plumbing system piping shall be tested for leaks and defects. Piping being tested shall not leak nor show any loss in test pressure for duration specified.
 - 4. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, CONTRACTOR shall perform alternate testing procedures if acceptable to ENGINEER. Alternate testing procedures for minor installation and repairs may include visual evaluation of installed components by ENGINEER during a simulation of use.
 - 5. The water used for tests shall be obtained from a potable source of supply.
 - 6. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After testing has been accepted for portions thereof, certify in writing the time, date, name, and title of the persons reviewing the test. This shall also include the description of what portion of the system has been accepted. A complete record shall be maintained of all testing that has been accepted and shall be made available at the jobsite. Upon completion of the work, all records and certifications regarding testing shall be submitted to ENGINEER before final payment is made.
 - 7. Verify systems are complete, flushed, and clean prior to testing. Isolate or remove components subject to damage or not rated for test pressure. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. Leave piping uninsulated, uncovered, and unconcealed until it has been tested. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. CONTRACTOR shall expose all untested covered or concealed piping.

8. Gauges used for testing shall have increments as follows:
 - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
9. Separately test above- and belowground piping.
10. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.
11. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with OWNER to determine areas and/or equipment considered as being sensitive.
12. Defective work or material shall be reworked and replaced and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
13. CONTRACTOR shall be responsible for cleaning up any leakage during flushing, testing, repairing, and disinfecting to the original condition any building parts subjected to spills or leakage.
14. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground pressure mains prior to testing with the exception of thrust restrained valves that may be exposed to isolate potential leaks.
15. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
16. For air or nitrogen tests, gradually increase the pressure to not more than one-half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be accepted until it can be demonstrated that there is no measurable loss of test pressure during the test period.

B. Domestic Water System:

1. Subject piping system to a hydrostatic pressure of at least 100 pounds per-square-inch gauge, but not less than the operating pressure under which it is to be used. During test period, all pipe, fittings and accessories in the particular piping system that is being tested shall be carefully observed. If leaks are detected, such leaks shall be stopped and the hydrostatic test shall again be applied. This procedure shall be repeated until no leaks are detected. EXCEPTION: Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with oil-free air in lieu of water.
2. After completion of the testing, all new and/or altered water piping systems shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. Do not exceed 150 parts per million at any time. Introduce chlorine into the supply stream at a rate sufficient to provide a uniform concentration throughout the system. All outlets shall be opened and closed several times. When the specified level of chlorine is detected at every outlet in the system, close all valves to prevent release of water from the system for 24 hours. At the completion of the 24-hour disinfection period, test every outlet for a minimum chlorine residual of 50 parts per million. This minimum residual must be present to proceed with flushing. Flush the system with clean water at a sufficient velocity until the residual chlorine detected at every outlet is within 0.2 parts per million or the normal water supply's level.

3. Sufficient samples must be taken no sooner than 24 hours after sterilization and flushing to represent the extent and complexity of the affected water system, along with a control sample to indicate municipal water quality at the time of testing. Send water samples to an accredited and/or certified laboratory to perform qualitative and quantitative bacteriological analysis in accordance with AWWA C651 or in accordance with Plumbing Code. CONTRACTOR shall obtain written certification from the independent testing agency stating that the water samples meet federal and state guidelines for safe drinking water. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to OWNER.
4. Isolate or bypass equipment that would be detrimentally affected by disinfecting solution. Isolate all other sections of the domestic water system not being disinfected to prevent migration of chlorine.
5. Prior to injection of chlorine into the piping system, strategically place signs stating "Heavily Chlorinated Water-Do Not Drink," and protect all outlets to prevent use during disinfection and flushing procedures.
6. A bacteria test may not be necessary for small scale work. However, disinfection is required. Examples of small scale work are less than 20 feet of pipe, replacement and/or installation of a sink, drinking fountain, eyewash, backflow preventer, isolation valve, etc. Disinfect individual parts, fixtures, isolation valves, pipes, etc. by swabbing with full strength bleach (5.25%) or soaking for at least 30 minutes in a 500-ppm chlorine solution. Materials should then be thoroughly rinsed before putting into service.

System	Test Medium	Pressure	Final Test Duration
Belowground Domestic or Nonpotable Water	Water	200 psig	2 hours
Aboveground Domestic or Nonpotable Water	Water	100 psig	8 hours

END OF SECTION

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Domestic water pumps.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Field inspection and testing to be performed under provisions of Section 01 45 00–Quality Control.
- B. Inspect completed installation for physical damage.
- C. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as noted on the drawings.
- D. Electrical components shall be UL listed for the service specified.
- E. Electrical components and work shall be in accordance with the National Electrical Code.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations and sections.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submittal shall include pump-specific performance curves showing flow, head and motor horsepower.

- E. Submit manufacturer's installation instructions and recommendations.
- F. Submittals must be specific to this project. Generic submittals will not be accepted.
- G. Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.
- H. Provide detailed control wiring diagrams as well as all external connections.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.
- F. Motors, shafts and bearings shall be protected from weather and dust.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material,

with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 IN-LINE WET ROTOR CIRCULATOR PUMPS

- A. Acceptable manufactures are Bell and Gossett, Grundfos, or Taco.
- B. Type: Horizontal or vertical, variable speed, wet rotor, inline pumps, 175 psig maximum working pressure at operating temperature of 230°F continuous. The manufacturer shall certify all pump ratings. All pumps shall operate without excessive noise or vibration.
- C. The pump internals shall be capable of being serviced without removing piping connections.
- D. Pump volute shall be constructed of cast iron. Pump body shall be constructed of cast iron.
- E. Motor shall be synchronous, permanent-magnet motor. Conventional induction motors will not be accepted.
- F. Motor shall be driven by an integral variable frequency drive provided by the manufacturer. Pump, motor, and VFD shall be factory tested as one complete unit by the pump manufacturer prior to shipment.
- G. Motor shall be UL listed to protect the pump against over/under voltage, motor and electronics over-temperature, over-current, locked rotor, and no-load condition (dry run).
- H. Pumps shall be UL 778 listed and bear the UL listing mark.
- I. Provide temperature and pressure gauges as shown on the Drawings.
- J. Controls:
 - 1. Pump shall have standard analog (0-10V and 4-20mA) input connections built into the VFD.
 - 2. Pump shall have the following standard modes of operation: constant speed, constant pressure, proportional pressure, and night mode.
 - 3. Pump shall have the following temperature dependent operating modes: Setpoint temperature and differential temperature.
 - 4. Pump HWP-90-01 shall be placed in temperature mode by the plumbing contractor during installation.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.

- B. Connect equipment to water piping using unions or flanges and isolation valves. Pump shall be supported separately from piping.
- C. Startup and test equipment adjusting operating and safety controls for proper operation.
- D. Lubricate pumps before startup. Adjust pumps for rated flow. Clean and blowdown strainers after 8 hours of operation.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: All plumbing pipe and pipe fittings for this project within and up to 5 feet from the building foundation wall.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

1.02 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00—Quality Control.
- B. Order all copper, cast iron, steel, PVC, and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification shall be replaced with material that meets these specifications without additional cost to OWNER.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall provide schedule indicating the ASTM or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- C. CONTRACTOR shall provide statement from manufacturer on manufacturer's letterhead that pipe furnished meets the ASTM or CISPI specification contained in this section.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, aboveground packaging.
- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.

- D. Storage and protection methods must allow observation to verify products.

1.05 DESIGN CRITERIA

- A. Use only new material, free of defects, rust, and scale, and meeting the latest revision of ASTM or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 SANITARY WASTE AND VENT

- A. Aboveground PVC shall not be used where smoke generation, noise transmission, or physical abuse/durability are an issue.
- B. Interior Above Ground, Gravity: PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- C. Interior Below Ground, Gravity: PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

PART 3-EXECUTION

3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves and piping specialties.
- E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.04 THREADED PIPE JOINTS

- A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.05 SOLVENT WELDED PIPE JOINTS

- A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints with PVC Pipe and Fittings." Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other

superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.

- B. Maintain pipe, fittings, primer, and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3-inch and smaller piping only) or clean natural bristle brushes about half the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4 to 5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4 inches and larger. Hold joint for 30 seconds or until set. Reference manufacturer recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by ENGINEER.

3.06 PUSH-ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Pipe shall be supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.07 SANITARY WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4-inch per foot where possible and in no case less than 1/8-inch per foot for piping 3 inches and larger.
- B. Install exterior piping below predicted frost level or not less than 36 inches or maximum frost penetration of the local area bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with the Illinois Plumbing Code.
- C. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

3.08 PIPING SYSTEM LEAK TESTS

- A. Drainage and Vent System:
 - 1. Subject gravity drainage and vent piping and joints to a test pressure and duration as outlined in the schedule at the end of this section. If, at end of indicated test duration, the level of the water has been lowered by leakage, the leaks must be found and stopped and the water level shall again be raised to the level described and the test repeated until, after another test duration period, there shall be no perceptible lowering of the water level in the system being tested.

2. Piping located above sensitive areas and/or equipment that may be damaged or become contaminated because of test water leakage shall be tested with air. Air test may also be performed when allowed by ENGINEER. Isolate the test section from all other sections and slowly fill pipe with oil-free air until there is a uniform gauge pressure of 5 pounds per square inch. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.
 3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to ENGINEER.
 4. Test plugs must extend outside the end of pipe to provide a visible indication for removal after the test has been completed.
 5. Each floor drain P-trap that has successfully passed pressure testing shall be proven clean and free of debris as follows:
 - a. A request shall be submitted to OWNER, identifying the quantity and location of drain(s) to be observed.
 - b. Vacuum out each floor drain P-trap. An observation of the trap shall be performed to verify that the trap is debris free.
 - c. Perform a free-flowing test by pouring two 5-gallon buckets of water down the floor drain.
 - d. After confirming that the floor drain trap is clean and free of debris, review that the trap is filled with water.
 - e. At the discretion of ENGINEER, an observation of the trap using a sewer scope may be required in addition to, or in lieu of, a vacuum procedure.
 6. OWNER may require that any portion of the drainage, waste, and vent systems installed be proven undamaged, clean and free of debris. Verification of the interior condition of piping shall be accomplished using a sewer scope or other method as acceptable to ENGINEER.
- B. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- C. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- D. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- F. Entire test shall be witnessed by OWNER or ENGINEER.

System	Test Medium	Final Test	
		Pressure	Duration
Sanitary Waste and Vent	Water	10 feet water	2 hours

END OF SECTION

Section 22 13 16-5

1110.037/1224-W-125

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes specifications for floor drains, roof drains, cleanouts, hub drains, trench drains and other miscellaneous plumbing specialties.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. New start-up shall confirm all proper electrical connections and discharge and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and to ENGINEER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 FLOOR DRAINS (FD)

- A. All floor drains shall be furnished and installed with all options and accessories required for a leak-free installation within the particular construction in which they are to be mounted.
- B. FD-1: Floor drains in finished areas or tiled areas, where shown on the Drawings, shall be Zurn ZN-415, Type H, or Wade Model 1300-1-11, or Josam 32100-HP-7-2, with 6-inch round adjustable strainer top with integral clamping frame and secured heelproof grate. Provide polished nickel bronze top. Provide square grate for tiled floors.
- C. FD-2: Floor drains in unfinished areas for piping 4 inches and under shall be Zurn ZN-550, Wade 1100-AX, or Josam 30900-9AD, and for piping larger than 4 inches Zurn ZN-505, Wade W-1240-1, or Josam 32200-1. Provide nickel bronze grate.
- D. Each drain shall be provided with a trap. A minimum of one cleanout shall be provided for each single or common leader.
- E. Elevated floor drains above lower floor levels shall be installed with membrane flashing clamp to prevent water leakage to lower level. Install per manufacturer's recommendations.

2.02 TRAP GUARDS

- A. Manufacturer: ProSet Systems Trap Guard, Jay R. Smith Quad Close, Sure Seal or approved equal.
- B. Flexible elastomeric PVC construction diaphragm trap guard for installation in new and existing floor drains, hub drains, and trench drains. Trap guard to prevent trap evaporation and waste backflow. Size as applicable to the drain outlet size, up to 4-inch size.

2.03 HUB DRAINS (HD)

- A. HD-1: Provide Kusel Equipment, AWI Manufacturing, or Jay R. Smith 304 stainless steel hub drain. Drain shall consist of fully welded components. Portions of drain visible in final installation shall be blasted clean to remove discoloration and provide a uniform finished appearance. All pipe shall be sourced from the United States. Pipe thickness shall be Schedule 40.

2.04 TRENCH DRAINS (TD)

- A. TD-1:
 - 1. Trench drains shall be ACO Drain KS100 by ACO Polymer Products, Poly Drain System by ABT, Inc., or equal.
 - 2. Trench drain channels shall be made of precast polymer concrete. Channels shall have minimum top width of 5 inches, radiused bottom, minimum width of 4 inches, and nominal lengths of 1/2 meter or 1 meter. All channels shall interlock with tongue-and-groove connections with adjoining channels. Each channel shall have full-length horizontal anchoring ribs. Channels shall have minimum built-in bottom slope of 0.5%. Channels shall be one piece construction.

3. Channel rails shall be made of stainless steel and grates shall be ductile iron with a slotted configuration. Grates shall be securely locked down to channel without the use of bolts.
4. Accessories: Channels shall be provided with the following to facilitate installation:
 - a. End plates.
 - b. Outlet plates.
 - c. Locking devices.
 - d. Sealant.
 - e. Tools required for installation.
5. Trench drain system shall be rated for Class E.

2.05 CLEANOUTS

- A. Manufacturers shall be Zurn, Wade, Jay R. Smith, Josam, or Kusel.
- B. Each cleanout shall be gas- and watertight.
- C. Cleanouts that are elevated shall include a membrane flashing flange to prevent leakage to the lower floor.
- D. Interior concrete floor areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
- E. Interior vinyl tile floor areas: Enameled cast iron body with round adjustable scoriated nickel bronze cover, tapered threaded ABS closure plug; Zurn ZN-1400.
- F. Interior finished wall areas: Line-type cleanout tee with cast iron body and tapered threaded ABS cleanout plug, round polished stainless steel access cover secured with machine screw; Zurn Z-1446. (Note: Screw shall not pass completely through the ABS plug; trim screw as necessary.)
- G. Interior exposed vertical stacks: Line-type cleanout tee with cast iron body and tapered threaded ABS closure plug; Zurn Z-1445.
- H. Interior horizontal lines: Cast iron hub with tapped ferrule and tapered, threaded ABS or PVC closure plug, or no-hub coupling and blind plug.
- I. Exterior paved areas: Cast iron hub or plug with tapered, threaded ABS or PVC closure plug, cast iron frost sleeve, and cover set in 24-inch-square by minimum 4-inch-thick reinforced concrete pad top or surrounding pavement, crowned for drainage. Neenah R-1976 with nonferrous securing screw.

2.06 SAFINGS

- A. Manufacturers: Noble, Oatey, or equal.
- B. Chlorinated polyethylene sheeting, 40 mils thick, ASTM D4068, joined with CPE solvent; or 3 lb./sq. ft. sheet lead.

2.07 VENT FLASHINGS

- A. Manufacturers: Semco, Oatey.

- B. Formed 3 lb./sq. ft. lead flashing with minimum base size of 15 inches by 17 inches.
- C. Single Ply Membrane Roofs: Flashing boot of material compatible with roofing membrane with base flange for adhering to membrane and stainless steel drawband for securing to vent pipe.

2.08 VENT SCREENS

- A. Manufacturers: Raven Products, or equal.
- B. PVC termination vent with stainless steel screen. Pipe material shall be Schedule 40 PVC with Type 304 stainless steel screen. Model number shall be based on vent through roof pipe size.

2.09 ROOF DRAINS

- A. Roof drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are mounted.
- B. Roof drains shall be Zurn ZC-100, Wade W-3000, or Josam 21500. Drain shall include underdeck flashing clamp ring, adjustable extension, and gravel stop. All components, including dome, shall be made of cast iron.
- C. Provide roof drain leader and downspout of same size as roof drain or larger if required by code. Downspout shall extend through the exterior wall 4 inches at a point 16 inches above grade unless noted otherwise. Roof drain leaders and downspouts shall be Schedule 40 PVC.
- D. All roof drain domes shall be cast iron.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with manufacturers recommendations.
- B. Set floor drains, roof drains, trench drains, and cleanouts level and plumb adjusted to finished floor elevation, roof elevation or finished wall location. Locate where serviceable. Allow a minimum 18-inch clearance around cleanouts for rodding. Lubricate threaded cleanout plugs with graphite and oil, teflon tape, or waterproof grease. Install trap primer connections where indicated. Provide deep seal traps on floor drains and hub drains installed in mechanical rooms, penthouses, rooms with excessive positive or negative pressure, and as indicated on the Drawings.
- C. Trap guards shall be provided as indicated on the Drawings.
- D. Flash vent penetrations through roof. Turn down top of lead flashing into vent pipe. Tighten drawband of membrane boot to vent pipe. Adhere base flashing to deck or membrane. Provide waterproof patch around penetration on existing roofs.

END OF SECTION

Section 22 13 19-5

1110.037/1224-W-125

SECTION 22 13 23

SANITARY WASTE INTERCEPTORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes specifications for catch basins, oil interceptors, and other equipment used for plumbing applications located in and within 5 feet 0 inch of the building foundation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. All proper electrical connections, discharge and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and to ENGINEER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 CATCH BASIN GRATING

- A. Catch basin grates shall be Neenah R-1550 with machined frame and Type D open grate, or equal. Interior mud basin castings shall be Neenah R-6118, or equal, with grey iron Class 35 frame and grating for heavy-duty use.

2.02 OIL INTERCEPTOR

- A. One 50 gpm oil interceptor with 3-inch inlet/outlet connections, acid resistant coated interior/exterior steel fabrication, bronze cleanout plug, and visible double wall trap seal. Heavy duty traffic cover rated at 10,000 pounds maximum shall be provided. Provide extension as necessary. Oil interceptor shall be manufactured by Zurn, Model Z1186-800, or equal. Unit shall be approved and installed in accordance with Illinois Plumbing Code.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Set sumps, and below grade interceptors on compacted granular backfill adjusting for plumb and level. Backfill in even layers around sump with granular backfill.

END OF SECTION

SECTION 22 14 00

FACILITY STORM DRAINAGE PIPING

PART 1—GENERAL

1.01 SUMMARY

- A. Scope: All pipe, fittings, and appurtenances for storm water and subsoil drainage within and to 5 feet beyond building perimeter.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

1.02 SUBMITTALS

- A. See Section 01 33 00—Submittals for shop drawing submittal procedures.

1.03 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, AWWA or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Piping that is not in accordance with ASTM E-84/UL723 for flame spread of <25 and smoke development of <50 shall not be utilized in ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at CONTRACTOR's option. Where the grade or type is not specified, CONTRACTOR may choose from those commercially available.

1.04 WELDER QUALIFICATIONS

- A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, CONTRACTOR to submit their Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.
- B. Welder certifications are required to be renewed every three years. If qualification papers are needed on a project, verify that they are current.
- C. Before any polyethylene fusion welding is performed, CONTRACTOR to submit certification that the welders to be used on this project have successfully demonstrated proper welding

procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 STORM AND CLEARWATER WASTE AND VENT

- A. Interior Above Ground: PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- B. Interior Below Ground 10-Inch and Smaller: PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- C. Exterior Below Ground 15 Inch and Smaller:
 - 1. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM 2564.
 - 2. Type PSM PVC sewer pipe and fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM 2564; or integral bell and flexible elastomeric seal, ASTM D3212.
 - 3. Corrugated PVC pipe and fittings with smooth interior, ASTM F949; gasketed joint, ASTM D3212; elastomeric gasket, ASTM F477.

PART 3—EXECUTION

3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.03 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult Drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6-inch to 12-inch below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.
- E. Provide clearance for installation of insulation, access to valves and piping specialties.
- F. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.04 WELDED PIPE JOINTS

- A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.

3.05 THREADED PIPE JOINTS

- A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.06 SOLVENT WELDED PIPE JOINTS

- A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10 to 15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.

- B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3 inches and smaller piping only) or clean natural bristle brushes about one-half the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4 to 5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of two installers is required on piping 4 inches and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by ENGINEER.

3.07 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.08 STORM AND CLEARWATER WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/8 inch per foot where possible and in no case less than 1/16 inch per foot for piping 3 inches and larger.
- B. Install exterior piping below predicted frost level and not less than 5-foot bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with Illinois Plumbing Code.

3.09 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- C. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. Entire test must be witnessed by ENGINEER. All pressure tests are to be documented on forms to be provided to CONTRACTOR.

System	Test Medium	Final Test	
		Pressure	Duration
Storm and Clearwater Waste	Water	10' Water	2 Hr

END OF SECTION

Section 22 14 00-4

1110.037/1224-W-125

SECTION 22 15 13

GENERAL SERVICE COMPRESSED AIR PIPING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: All pipe, fittings, and appurtenances for general service compressed air piping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall provide schedule indicating the ASTM, AWWA, or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- C. CONTRACTOR shall provide statement from manufacturer on their letterhead that pipe furnished meets the ASTM, AWWA, or CISPI specification contained in this section.

1.05 DELIVERY AND STORAGE

- A. CONTRACTOR shall promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. CONTRACTOR shall cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Materials shall not be stored directly on grade. Pipe, tube, and fitting ends shall be protected so they are not damaged. Where end caps are provided or specified, CONTRACTOR shall take precautions so the caps remain in

place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.
- D. Deliver, store, and protect in accordance with Section 01 60 00—Materials and Equipment.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 PIPE AND PIPE FITTINGS-NONPROCESS SPACES

- A. Piping 2-Inch and Smaller:
 - 1. Steel Pipe: ASTM A53 Type F Schedule 80 carbon steel.
 - 2. Fittings: ASTM A197 malleable iron threaded and coupled, Class 300.
 - 3. Flanges: ASTM A105 carbon steel, flat face, threaded, Class 150.
 - 4. Gaskets: Garlock Blue-Guard 3700, 1/16-inch, ring type, nonasbestos.

PART 3—EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.

- B. Install piping to conserve building space and not interfere with use of space, other work, or equipment.
- C. Provide clearance for installation and access to valves and fittings.
- D. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- E. Use fittings for all changes in direction and all branch connections.
- F. Install branch connections to mains using tee fittings in main with takeoff out the top of the main.

3.03 APPLICATION

- A. Install unions in pipes 2 inches and smaller, downstream of valves and at equipment or apparatus connections or elsewhere as indicated. Install dielectric unions where joining dissimilar materials. Unions are not required on flanged devices.
- B. Install flanges on valves, apparatus, and equipment having 2 1/2 inch and larger connections.

3.04 FIELD QUALITY CONTROL

- A. Site Tests:
 1. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price bid.
 2. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
 3. All piping shall be flushed or blown out after installation prior to testing.
 4. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents as required for testing.
 5. Pressure tests:
 - a. The test pressure in all lines shall be held for 1 hour during which time the leakage allowance shall be zero. In the case where repairs are required, the pressure test shall be repeated.
 - b. Pressure tests shall be made in the presence of OWNER or OWNER's representative.
 6. Should any leaks develop during the test, they shall be repaired. If necessary, piping shall be taken down and reassembled with new piping and fittings. Caulking or temporary repair is not permitted. After repairs, piping system shall be retested.
 7. Add all required valves and takeoffs for system flushing and pressure testing.

3.05 CLEANING

- A. Cleaning and test report forms together with applicable on-site SDS shall be reviewed with OWNER prior to performing the work.

- B. Schedule flushing and cleaning of piping systems to be done prior to connection to equipment. Perform system cleaning after pressure tests or as approved by OWNER or method below.
- C. Isolate systems to be flushed or cleaned from equipment. Install temporary connections, strainers, temporary screens and other equipment as necessary.
- D. Cleaning work shall not be performed until the systems are thoroughly flushed, and hydrostatically or pneumatically tested.
- E. Gas Systems:
 - 1. Blow system with plant air or by other means with adequate volume so that all debris is removed.
 - 2. OWNER project team will determine that the system appears to be satisfactory.
 - 3. CONTRACTOR is to clean all temporary or permanent strainers until the strainers are cleaned at least twice. Time and date to be verified by project team and documented on the test form.

END OF SECTION

SECTION 22 15 19

COMPRESSED AIR EQUIPMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation an air compressor, receiver tank, refrigerated dryer, appurtenances, and controls.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, 250.
 - 2. ASME B16.5—Pipe Flanges and Flanged Fittings.
 - 3. ASME BPVC Section VIII, Division 1—Boiler and Pressure Vessel Code Section VIII, Division 1.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. All proper electrical connections, discharge and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and to ENGINEER.
- C. Compressor, dryer and all accessories shall be in accordance with the schedule on the Drawings.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.

- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. The compressor shall be Quincy Model QT-7.5, or equal.
- B. The Drawings and Specifications were prepared based on Quincy. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay for any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

2.02 RECIPROCATING AIR COMPRESSOR

- A. The air compressor shall be a splash lubricated, single-acting, two-stage, air-cooled, reciprocating type. The crankcase and cylinders shall be individual piece construction made of cast iron, with deep cooling fins on the cylinders. A ductile iron crankshaft shall have integral counterweights and shall be supported on both ends by industrial ball bearings that will provide precise shaft alignment and take both radial and thrust loads. The B10 bearing life shall be 60,350 hours. Automotive style two-piece connecting rods will be aluminum with cast-on dippers to provide ample lubrication to the wrist pin area. A needle bearing will be used on the high pressure rod pin ends. The low- and high-pressure pistons shall have three automotive-type cast iron compression rings and one automotive-type oil ring. Stainless steel reed valves shall be secured to the aluminum valve plate by screws. The movement of the valves shall be limited to their most efficient distance by powdered metal bumpers. A fin-and-tube intercooler shall be located in the direct blast of the 19-inch cast iron fan-type flywheel. There shall be an ASME-coded pressure relief valve at the entrance of the intercooler, between the first and second stages.

2.03 AIR RECEIVER

- A. The system shall include an 80-gallon, ASME-rated air receiver, rated for 200 psi MAWP. The tank shall be equipped with a pressure gauge, safety relief valve, discharge shutoff valve, and a 115 V "No-loss"-type automatic tank drain.

2.04 MOTORS

- A. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
 - 1. Physical Construction:
 - a. Copper windings with ball or roller bearings in end brackets of steel or cast iron, or aluminum brackets with steel bearing sleeves. Motor shall be constructed with two windings for all two-speed motors.
 - b. Motor shaft shall be high strength steel protected by a bronze shaft sleeve secured to the shaft to prevent rotation. The maximum allowable no-load shaft runout shall be 0.002 inch.
 - c. Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
 - 2. Mounting: Horizontal.

3. Enclosure: ODP.
4. Efficiency: Premium efficiency as noted in schedule below.
5. Service Factor: 1.15.
6. Power requirements: 60 Hertz, three-phase, 208-volt, factory-wired for 208-volt connection, $\pm 10\%$ voltage variation.
7. Load type: Constant torque.
8. NEMA Design: B.
9. Insulation: Class F.
10. Nominal operating speed: Single speed, 1,800 rpm.

2.05 CONTROLS

- A. Regulation: The standard method of regulation is automatic start-stop control. Loadless starting is achieved by means of a combination discharge line pressure release valve/pressure switch and check valve. The pressure switch set at 125 psig starts and stops the compressor on pressure demand.
- B. Low Oil Level Shutdown Switch: A low oil level shutdown switch shall automatically shut down the unit when the oil level drops below an acceptable level to provide proper lubrication. This shutdown shall not require a 120-volt control relay.

2.06 AIR DRYER

- A. Provide air dryer of the mechanical refrigeration type, equipped with an automatic temperature shutdown switch to prevent freezing, a regenerative air to air exchanger, and a main compressed air cooling exchanger. Provide internal tubing, wiring, and piping complete, such that only connections to air inlet and outlet, to refrigerant compressor contactor, and to condensate drain are necessary. Provide drain line with exterior-mounted condensate trap to facilitate servicing. Performance parameters as scheduled.
- B. Dryer Controls: Capable of automatic 0 to 100% capacity control. Refrigeration controls shall maintain pressure dew point within the specified range without freezing of condensate. Controls shall include such devices as capillary tube, expansion valve, suction pressure regulator, thermostat, or other approved devices as standard with the manufacturer. Dryer shall have automatic shutdown switch sensor located at point of lowest temperature to prevent freezing. Provide refrigerant dryer and suction strainer.
- C. Control Panel: Indicators for inlet air pressure gauge, discharge air pressure gauge, inlet air temperature gauge, main exchanger temperature gauge, refrigeration compressor suction pressure gauge, refrigeration compressor discharge pressure gauge, green "Power On" light, power interruption light, and high-temperature light.

2.07 MISCELLANEOUS

- A. Safety Valves: Safety valves shall be provided in compressor discharge piping and on the receiver to protect the receiver or compressor from overpressure in the event of any connecting valves being closed. Valves shall be temperature compensated.
- B. Belt Guard: The compressor flywheel, motor pulley, and V-belts shall be totally enclosed within a metal belt guard.

- C. Air-cooled Aftercooler: An air-cooled fin-and-tube air-cooled aftercooler shall be connected between the compressor discharge and the receiver inlet.
- D. Intake Filter/Silencers: Each compressor shall be provided with suction pipe supported, bottom outlet, dry tape intake filter/silencer close coupled to the compressor intake connection. Intake filter/silencers shall have an outer cover, replaceable filter element and shall be constructed of steel.
- E. Single Cartridge Type Filters: 125 psig operating pressure and filter housing of brass or bronze. Provide cellulose cartridge filters of graded density construction capable of removing liquids and solids of 5 microns and larger. Filter capacity shall be compatible with rated flow of equipment or pressure reducing valves provided.

2.08 FINISHES

- A. The compressors, motors, skid-mounted equipment and piping, and control panels shall be supplied with the manufacturer standard prime and finish coat for the service intended.
- B. It is the intent of this specification that unless otherwise specified, all equipment, supports and appurtenances shall be furnished shop primed and factory finished. Preparation and painting shall conform to all requirements and provisions specified in Division 09. All surfaces of the mechanical equipment and accessories (except galvanized, stainless steel, rubber, copper, PVC) shall be prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the equipment once assembled. Cleaned surfaces shall then be shop primed. Shop priming shall be with one coat of Tnemec N69-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. Shop Finish system shall consist of two coats of Tnemec N69-Hi-Build Epoxoline II, or equal, applied to a minimum of 5.0 mils dry thickness each. Touch-up paint shall be provided by manufacturer.

2.09 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be of ample strength for the intended service. Anchor bolts shall be in accordance with Division 05.

PART 3-EXECUTION

3.01 GENERAL INSTALLATION

- A. CONTRACTOR shall install the equipment and accessories in accordance with manufacturer's recommendations and as indicated on the Drawings.
- B. All equipment shall be installed plumb and level and anchored to structure.
- C. Proper access space around equipment shall be left for servicing the equipment. Follow manufacturer's recommendations for clearance and maintenance access requirements. Provide no less than a minimum of three feet, not including piping and piping appurtenances.
- D. Provide an adequate number of isolation valves for service and maintenance of the system and its components.

- E. Install the compressor under the direct supervision of an authorized representative of the manufacturer.
- F. All piping shall be brought to equipment connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping.
- G. All piping shall be fitted to equipment connections even though piping adjustments may be required after the pipe is installed.
- H. Lubricate equipment before startup.
- I. CONTRACTOR shall furnish the services of the equipment manufacturer's authorized representative to supervise prestart checkout, initial start-up, performance testing, and operator instruction. Time available shall be as required to properly start up but not less than 4 hours.
- J. Any operational deficiencies noted in equipment start-up shall be promptly corrected.

END OF SECTION

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1–GENERAL

1.01 SCOPE

- A. This section includes specifications for water heaters, garbage disposals, and other equipment used for plumbing applications.
- B. Related Sections and Division: Applicable provisions of Division 01 shall govern work under this section.

1.02 QUALITY ASSURANCE

- A. Field inspection and testing to be performed under provisions of Section 01 45 00–Quality Control.
- B. Inspect completed installation for physical damage.

1.03 SHOP DRAWINGS

- A. Submit under provisions of Section 01 33 00–Submittals. Included in submittals shall be detailed control wiring diagrams that show logic circuits for the unit, as well as all external connections.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 WATER HEATERS

- A. Power Vented Gas Fired Water Heater (WH-80-01 and WH-90-01):
 - 1. Manufacturers: A.O. Smith, Bradford White, and Lochinvar.

2. Type: Power vented natural gas fired atmospheric storage water heater. Design to be AGA certified with 1 year commercial tank and parts warranty.
3. Water heater performance shall be as listed on Drawings.
4. Tank: Steel glass lined tank rated for 150 psig complete with removable magnesium anode rod, plastic diffuser type dip tube, inlet and outlet heat trap fittings, polyurethane foam insulation, painted steel jacket, drain valve and temperature and pressure relief valve.
5. Burner: Construct burner of cast iron, aluminized steel (natural gas only) or stainless steel.
6. Controls: 120-volt, single-phase, 60 Hz controls consisting of operating thermostat with adjustable temperature control, energy cutoff, gas valve, integral pressure regulator, intermittent spark ignition, blower pressure switches, blower interlock and 6-foot power cord and plug.
7. Vent: Schedule 40 PVC with DWV solvent weld fittings with weatherproof screened outlet tee or elbow as recommended by manufacturer.

2.02 EXPANSION TANKS

- A. Manufacturer: Amtrol, Bell and Gossett, Wessels.
- B. Vertical steel precharged hydro-pneumatic expansion tank, 125 psi construction, complete with replaceable flexible butyl rubber bladder, system connection fitting, Schrader type air charge fitting, steel base ring stand, factory prime and enamel painted exterior finish. Materials exposed to water to be NSF or FDA approved for potable water service.

2.03 GARBAGE DISPOSAL

- A. Garbage disposal shall be In-Sink-Erator Model Evolution Excel, Kitchen Aid, or equal. Unit shall be the continuous feed type with a 1 horsepower motor, stainless steel grinding elements, and stainless steel mounting hardware.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Set commercial water heaters and storage tanks on concrete housekeeping pads. Adjust and level equipment.
- C. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- D. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief valves to floor drain or floor as indicated.
- E. Startup and test equipment adjusting operating and safety controls for proper operation.

- F. Adjust expansion tank precharge to scheduled minimum operating pressure prior to connecting to system.
- G. Provide isolation valves at plumbing equipment.

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1—GENERAL

1.01 SCOPE

- A. This section includes specifications for plumbing fixtures, faucets, and trim.

1.02 REFERENCE

- A. Applicable provisions of Division 01 shall govern work under this section.

1.03 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC—General Conditions of the Contract, Equals and Substitutions.
- B. Plumbing products requiring approval by the Illinois Plumbing Code must be approved or have pending approval at the time of shop drawing submission.

1.04 SHOP DRAWINGS

- A. Include data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.05 ENERGY EFFICIENCY REQUIREMENTS

- A. Plumbing fixtures must meet the following maximum water usage requirements which are based upon Federal Energy Management Program (FEMP) performance requirements.
 - 1. Lavatory Faucets: Flow of 2 gpm or less and .25 gallon per cycle or less (based on inlet pressure of 60 psi.)
 - 2. Showerheads: Flow of 2.2 gpm or less (based on inlet pressure of 80 psi).
 - 3. Urinal Flush Valves: 1.0 gallon per flush or less.
 - 4. Water Closet Flush Valves: 1.6 gallons per flush or less.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material,

with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 PLUMBING FIXTURES

- A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features, and size. Products of the following manufacturers determined to be equal by ENGINEER will be accepted.
1. Water Closets: American Standard, Kohler, Zurn.
 2. Water Closet Seats: Bemis, Beneke, Centoco, Olsonite Sperzel.
 3. Urinals: American Standard, Kohler, Zurn.
 4. Lavatories: American Standard, Kohler, Zurn.
 5. Faucets: Chicago Faucet, Kohler, or Zurn.
 6. Sinks: American Standard, Elkay, Just, Kohler.
 7. Service Sinks: American Standard, Crane, Kohler.
 8. Mop Basins: Fiat, Mustee, Stern-Williams.
 9. Modular Shower Unit: Kohler, Ella's Bubbles, Fiat.
 10. Showers: Leonard, Powers, Speakman, Symmons.
 11. Drinking Fountains: Elkay, Halsey Taylor, Haws, Filtrine, Oasis, Sunroc.
 12. Electric Water Coolers: Elkay, Halsey Taylor, Haws.
- B. Water Closets (WC-1): Wall hung back outlet white vitreous china siphon jet water closet with elongated bowl, 1 1/2-inch top spud, 2 1/4-inch passageway and 1.6-gallon flush, barrier free adjusted for 16 1/2-inch bowl height. Operating handle of the flush valve to be ADA compliant for activation force and located to the wide side of the stall. Flush valve handle 13 inches above rim.
1. Fixture: Kohler Kingston K-4325.
 2. Flush Valve: Sloan Royal 113-1.5-YK.
 3. Seat: Bemis 1655-SS/C white solid plastic open front seat.
- C. Urinals (UR-1): Wall-mount white vitreous china washout urinal with 3/4-inch top inlet spud, 2-inch outlet, removable strainer, and 1-gallon flush, Kohler Bardon K-4991-ET, or equal. Provide a Sloan Royal 8186-1 battery-powered sensor-operated flush valve, or equal. Carrier shall be Smith commercial grade adjusted for 24-inch lip height.
- D. Lavatories (L-1): K-2030 (20-inch by 18-inch), A 0356.015, wall-hung with pop-up drain, supplies, and cast iron hanger. Provide ADA-approved faucets. Faucet: Provide ADA-approved, Chicago Faucet 2200-4E2805 ABCP, or equal, with 0.5 gpm vandalproof nonaerating spray, polished chrome-plated solid brass construction, and temperature limit stop.
- E. Sinks (SK-1): Kohler K-3260 19-inch by 19-inch self-rimming, 18-gauge stainless steel sink. Sink shall include strainer and Chicago Faucet 1100-HA8ABCP.
- F. Service Sinks (SS-1): K 6719 (24-inch by 20-inch), A 7692.023, with Chicago Faucets 782 VBCP for behind wall supplies fittings, wall brace, and wall hangers. Faucet shall include cross-connection prevention device.

- G. Mop Basins (MB-1): Floor mounted molded polyester resin and stone mop basin, 24 inch by 36 inch by 10 inch, with 3 inch drain, stainless steel strainer and vinyl bumper guards.
 - 1. Fixture: E.L. Mustee & Sons, Inc., Zurn, or Fiat.
 - 2. Faucet: Chicago Faucet No.911-ISCP.
 - 3. Accessories: Hose, hose holder, mop hanger, bumper guards, wall guards, and quick drain connector.
- H. Showers–Shower Fittings:
 - 1. Manufacturers: Bradley (B), Speakman (S), or equal.
 - 2. SH-1:
 - a. ADA-compliant barrier-free showers: Shower shall be (B) HN300.
 - b. Shower unit shall include the following standard equipment: Hand-held shower spray with 24-inch slide bar, 1/2-inch NPT stainless steel hose (for hand spray) to be 60 inches with elevated inline backflow preventer and quick disconnect, wall-mounted. Include pressure balanced mixing valve with individual stops, diverter valve, and fixed institutional/deluxe shower head with ball joint.
 - 3. SD-1: Shower drain shall be Kerdi-Drain as manufactured by Schluter. Provide stainless steel floor drain with integral bonding flange with no-hub outlet and grate assembly. Grate assembly shall include stainless steel grate, height adjustment collar, and lateral adjustment ring. Drain housing material shall be stainless steel, grate shall be 304 SS.
- I. Electric Water Coolers (EWC-1): Dual level, wall mounted, barrier free and standard height, stainless steel finish water cooler/drink fountain station with front pushbar operators. Single recessed steel mounting box with refrigeration system and stainless steel removable front grille for access. Rated for 8.0 gph at 80-degree inlet water at 90°F ambient temperature, and 50-degree outlet water, 1/5 hp compressor, 380 watts, 120/60/1. Mount so upper unit spout is at 40 inches above floor, Elkay EMABTFTL8C.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.
- B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Install barrier free fixtures in compliance with IBC 1108 and 3408, COMM 52, 69 and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27 inches above floor to avoid contact by wheelchair users.
- D. Provide unions at water connections to drinking fountains and electric water coolers.
- E. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.

- F. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass, same items in concealed locations may be of rough brass finish.
- G. Set mop basins to floor and wall with grout or silicone sealant.
- H. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.
- I. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise or overflow. Adjust self-closing lavatory faucets to 15 second cycle. Adjust shower valve temperature limit stops to 110-degree maximum outlet temperature.
- J. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.
- K. Existing Fixtures: Where existing fixtures and fittings are indicated to be reused or relocated, CONTRACTOR is responsible for documenting condition prior to construction and for damages incurred during construction.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1—GENERAL

1.01 SCOPE

- A. This section includes specifications for supports of all HVAC piping and equipment and materials as well as piping system anchors.

1.02 RELATED WORK

- A. Section 23 07 13—Ductwork Insulation for Heating, Ventilation, and Air Conditioning.

1.03 REFERENCE

- A. Applicable provisions of Division 01 shall govern work under this section.

1.04 REFERENCE STANDARDS

- A. MSS SP-58—Materials, Design, Manufacture, Selection, Application, and Installation

1.05 DESCRIPTION

- A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.
- B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
- C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- D. Protect insulation at all hanger points; see Related Work above.

1.06 SHOP DRAWINGS

- A. Refer to Division 01, General Conditions, Submittals.
- B. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service.

1.07 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58, unless noted otherwise.

- B. Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.
- C. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.
- D. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- E. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 PIPE HANGER AND SUPPORT MANUFACTURERS

- A. Acceptable manufacturers include Anvil, B-Line, G-Strut, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

2.02 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

2.03 PIPE HANGERS AND SUPPORTS

- A. Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.
- B. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods, if calculations are submitted.
- C. Wall Support:
1. Welded steel bracket with hanger. B-Line B3068 Series, Anvil 194 Series.
 2. Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil cushion clamp assembly.
- D. Vertical Riser Support: Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121 for copper pipe.
- E. Floor Support for Pipe Sizes Through 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- F. Copper Pipe Support: Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.
- G. Insulation Protection Shields: Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2 1/2-inch and larger. Minimum shield length is 12 inches. Anvil figure 167.
- H. Steel Hanger Rods:
1. Continuous threaded, black finish.
 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (pounds)	Rod Diameter (inches)
(650°F Maximum Temperature)	
610	3/8
1,130	1/2
1,810	5/8
2,710	3/4
3,770	7/8
4,960	1

Maximum Load (pounds)	Rod Diameter (inches)
(650°F Maximum Temperature)	
8,000	1 1/4

4. Provide rods complete with adjusting and lock nuts.

2.04 CONCRETE INSERTS

- A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.05 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Piping shall be supported independently from ductwork and all other trades.
- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.
- D. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

3.02 HANGER AND SUPPORT SPACING

- A. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers. Provide minimum of 3 inches between piping systems (flanges, insulation, valves, etc.)
- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain the slope specified in the piping section of this specification.

- E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Spacing
Copper	1/2" through 1 1/4"	5'-0"
Copper	1 1/2" and larger	8'-0"

3.03 VERTICAL RISER CLAMPS

- A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

3.04 ANCHORS

- A. Install where indicated on the Drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Balancing air systems.
 - 2. Thermal performance testing.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASHRAE 11—Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
 - 2. SMACNA—HVAC Systems Testing, Adjusting, and Balancing.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Prior to final balancing, submit a preliminary report that includes the following design information for all control modes. Design information shall be from approved shop drawings. Report shall compare design and field tested data.
 - 1. For each supply, return and exhaust register, and ceiling outlet:
 - a. Room number.
 - b. Type of register and outlet and catalog size.
 - c. Air flow factor.
 - d. Design CFM and velocity.
 - e. Actual CFM and velocity.
 - f. Percent of design CFM.
 - g. Room pressure relationship.
 - 2. For each fan:
 - a. Unit number.
 - b. Fan size and wheel type.
 - c. Motor horsepower.
 - d. Motor nameplate voltage and amps.
 - e. Design CFM and static pressure (total pressure).
 - f. Actual CFM and static pressure (total pressure) (pump GPM and head).
 - g. Actual fan RPM.
 - h. Actual motor voltage and amps (each phase).

- C. Provide summary sheet describing mechanical system deficiencies. Where not physically observable, provide pressure and/or flow readings to demonstrate suspected deficiencies. Describe objectionable noise or drafts found during testing, adjusting, and balancing. All deficiencies shall be corrected prior to final balancing.
- D. Upon completion of final balancing, provide updated report indicating thermal performance testing and changes to system during final balancing for all control modes including updated airflows, pressures, velocities, etc. Final report shall be submitted prior to substantial completion.

1.04 QUALITY ASSURANCE

- A. Obtain services of an independent testing organization to perform testing and balancing work. The organization shall have a certified membership in the Associated Air Balance Council (AABC) or certification by the National Environmental Balancing Bureau (NEBB).
- B. Division 23 shall provide a technician and/or controls contractor to observe and assist in balancing the system. Balancing report must include verification of participation, including name and contact information of assisting party.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 BALANCING EQUIPMENT

- A. CONTRACTOR shall have the following minimum equipment for balancing systems:
 - 1. Duct air velocities below 1,000 fpm: Pitot tube and Micro-Manometer or Alnor velometer and duct-jet using zero to 1,000 fpm range.
 - 2. Supply Register Velocities: Alnor velometer and applicable jet or Anemotherm.
 - 3. Fan Rotative Speed: Timec tachometer or RPM counter and stop watch (1-minute reading, minimum).
 - 4. Contact pyrometer 0 to 300°F range.
 - 5. Amprobe model RS-3, or equal.
 - 6. Calibrated pressure gauge (0 to 100 feet water head).
 - 7. Inclined manometer 0 to 30 inches of water.

8. Instruments used for measurements shall be accurate, and calibration shall be calibrated by the manufacturer or an AABC-approved method.
 9. Instruments shall be applied in accordance with manufacturer's instructions.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

PART 3-EXECUTION

3.01 PRELIMINARY BALANCING

- A. Division 23 shall provide an experienced installer to review the air distribution system with the testing and balancing agency for completion to confirm the test openings and volume dampers indicated on the Drawings or called for in the specifications are installed, that dampers are in the open position, that the fans operate properly during all control modes, air filters are clean, and that the system is ready for balancing. Add test openings, volume dampers, air scoops, deflectrols, turning vanes, etc., as required. Adjust and change fan drives and belts, remove and reinstall ceilings, air terminals, access doors, and air devices as required to balance the system. Maintain the air handling equipment in good operating condition during the testing and balancing procedures.

3.02 PRESSURE DIAGRAM

- A. Provide a diagram indicating, at minimum, the static pressure at the following points while system is operating at 100% airflow.
1. MAU inlet.
 2. MAU outlet.
 3. AHU inlet.
 4. AHU outlet.
 5. Exhaust fan inlet.
 6. Exhaust fan outlet.
- B. Diagram shall include all components in an air handling unit and additional pressure points as required in thermal performance testing.
- C. Coordinate with Division 23 and equipment manufacturer to obtain readings where access is difficult or limited. Lack of readings due to inaccessibility will not be accepted.

3.03 SCHEDULE OF TOLERANCES

- A. Final air system measurements shall be within the following range of specified cfm:
1. Fans: 0% to +10%.
 2. Supply grilles, registers, diffusers: 0% to +10%.
 3. Return/exhaust grilles, registers: 0% to -10%.
 4. Room pressurization air: -5% to +5%.

3.04 GENERAL REQUIREMENTS

- A. Perform testing, balancing, and adjusting procedures in accordance with AABC or NEBB, unless specified below.

- B. Contact the temperature control contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation for all control modes and any deficiencies found.
- C. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- D. Division 23 shall correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work, including sheave and pulley replacement or corrections to the controls system. Test and balance agency shall notify CONTRACTOR of these items and instructions will be issued to Division 23 for correction of the deficient work. Testing and balancing reports shall be submitted only after all deficiencies have been corrected and balancing completed upon the corrected system.
- E. In areas with suspended ceilings, remove ceiling tiles to accomplish balancing work. Replace tiles when work is complete. If ceiling tile is damaged during balancing, it shall be balancing contractor's responsibility to replace at no additional cost to OWNER.
- F. In variable air volume (VAV) systems, airflow readings shall be provided with all VAV boxes in their fully open positions. Diversity shall not be allowed in balancing the overall system. Testing and balancing agency shall coordinate with Division 23 to provide a list of all VAV box "K-values" (gain coefficients) determined and set during balancing, and indicate values on the testing and balancing report.

3.05 THERMAL PERFORMANCE TESTING

- A. Measure and record system measurements for each system described below during all control modes. Measurements shall be taken with airflows at 100% and coils at 100% capacity. CONTRACTOR shall make provisions for seasonal testing.
- B. Direct Expansion (DX) Coils:
 - 1. Coil location.
 - 2. Actual airflow during testing.
 - 3. Design and actual entering air temperature (dry bulb and wet bulb).
 - 4. Design and actual leaving air temperature (dry bulb and wet bulb).
 - 5. Actual pressure drop across the coil.
 - 6. Refrigerant saturated suction temperature.
 - 7. Designation of wet or dry coil.
- C. Natural Gas Burners in Make-up Air Units:
 - 1. Coil location.
 - 2. Actual airflow during testing.
 - 3. Design and actual entering air temperature (dry bulb and wet bulb).
 - 4. Design and actual leaving air temperature (dry bulb and wet bulb).
 - 5. Actual pressure drop across the coil.
- D. Electric Heating Coils:
 - 1. Coil location.
 - 2. Actual airflow during testing.

3. Design and actual entering air temperature (dry bulb and wet bulb).
4. Design and actual leaving air temperature (dry bulb and wet bulb).
5. Actual pressure drop across the coil.
6. Actual voltage and amperage (each phase).

END OF SECTION

SECTION 23 07 13

DUCTWORK INSULATION FOR HEATING, VENTILATION, AND AIR CONDITIONING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes:
 - 1. Wrap type fiberglass insulation.
 - 2. Rigid board fiberglass insulation.
 - 3. Adhesives, mastic, sealants, and reinforcing materials.
 - 4. Jacketing.
 - 5. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM C168—Standard Terminology Relating to Thermal Insulation.
 - 3. ASTM C272—Water Absorption of Core Materials for Sandwich Constructions.
 - 4. ASTM C547—Standard Specification for Mineral Fiber Pipe Insulation.
 - 5. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 6. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 7. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 8. ASTM C916—Standard Specification for Adhesives for Duct Thermal Insulation.
 - 9. ASTM C1071—Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - 10. ASTM C1290—Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
 - 11. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 - 12. ASTM D1000—Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
 - 13. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 14. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
 - 15. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - 16. EPA Method 8260B—Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (Gc/Ms).

17. NFPA 262–Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect insulation before, during, and after installation.
- E. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced at no additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all duct covering, jackets, insulation, vapor barriers, adhesive, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 50 or less when tested in accordance with ASTM E84.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA.

CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 WRAP TYPE FIBERGLASS INSULATION

- A. Acceptable manufacturer is Johns Manville Microlite XG, Owens Corning SOFTR, or Knauf Friendly Feel.
- B. Insulation shall be resin-bonded fiberglass type conforming to ASTM C1290, Type 150.
- C. Minimum nominal density shall be 1.5 lbs/ft³.
- D. K-factor shall not exceed 0.25 (btu-in)/(hr-ft²-°F) at 75°F mean.
- E. Insulation shall be free of formaldehyde.

2.02 RIGID BOARD FIBERGLASS INSULATION

- A. Acceptable manufacturer is Johns Manville Spin-Glas Series 814, Owens Corning Type 703, or Knauf Insulation Board.
- B. Insulation shall be mineral fiber type conforming to ASTM C612.
- C. Minimum nominal density shall be 3 lbs/ft³.
- D. K-factor shall not exceed 0.23 (btu-in)/(hr-ft²-°F) at 75°F mean.
- E. Insulation shall be rated for service to 450°F.

2.03 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. All adhesives used for ductwork insulation shall conform to ASTM C916, Type II.
- C. Fiberglass Insulation Adhesive. Acceptable Manufacturers: Foster 85-60, Childers CP-127, and Duro Dyne SSG.
- D. Vapor Retarding Mastic:
 - 1. Acceptable Manufacturers: Foster 30-65 Vapor Fas, Childers CP-34, and Vimasco 749.
 - 2. For ductwork insulation operating below 50°F, mastic water vapor permeance shall be less than 0.03 perms at 45 mils dry film thickness conforming to ASTM E96.
 - 3. Use insulation joint sealant at all joints. Acceptable manufacturers are Foster 95-50 Flextra, Childers CP-76 Chil-Byl, or Pittsburgh Corning CW Sealant.

- E. Weather Barrier Breather Mastic:
 - 1. Acceptable Manufacturers: Foster 46-50 Weatherite, Childers Vi-Cryl CP-10/CP-11, or Vimasco WC-5.
 - 2. For ductwork insulation operating at 50°F or above, mastic water vapor permeance shall be greater than 1.0 perms at 1/16-inch dry film thickness conforming to ASTM E96.

2.04 JACKETING

- A. Foil Scrim Jackets (FSJ): Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms and minimum beach puncture resistance of 25 units.
- B. Self-Adhering Jackets (SAJ):
 - 1. Acceptable manufacturers are 3M VentureClad 1577CW, or equal.
 - 2. Jackets shall be 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) moisture permeance.
 - 3. Minimum material thickness shall be 6 mils.
 - 4. Minimum puncture resistance shall be 25 lbs conforming to ASTM D1000.

2.05 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4-inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Staples shall be clinch style.
- E. Tack fasteners shall be stainless steel ring grooved shank tacks.
- F. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

PART 3-EXECUTION

3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

- D. All duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required.

3.02 WRAP TYPE FIBERGLASS INSULATION INSTALLATION

- A. Insulation shall be installed per manufacturer's recommendations with mechanical fasteners. Seal all joints and fasteners with UL-labeled vapor-proof tape.
- B. Provide finished edges at all access doors and ends.

3.03 RIGID BOARD FIBERGLASS INSULATION INSTALLATION

- A. Provide finished edges at all access doors and ends of insulation.
- B. Provide additional insulation trim pieces over flanged ductwork joints to completely insulate and seal to the thickness specified.
- C. For exterior ductwork, insulate duct such that minimum thickness is maintained and is sloped/peaked to shed water.
- D. Flexible connections from ducts to HVAC equipment shall not be insulated.

3.04 PROTECTIVE JACKET INSTALLATION

- A. Foil Scrim Jackets (FSJ): Install according to manufacturer's recommendations using factory supplied lap seals and butt strip seals.
- B. Self-Adhering Jackets (SAJ):
 - 1. Install according to manufacturer's recommendations. Cut allowing minimum 4-inch overlap on ends and 6 inches on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.
 - 2. Wrap elbows, fittings, valves and butt joints with two layers of vapor retarding tape. Vapor retarding tape shall be compatible with the jacket material used.

3.05 DUCTWORK INSULATION

- A. Provide insulation on new remodeled ductwork as indicated in the following schedule:

Service	Insulation	Jacket	Thickness
Outside Air Ducts	Rigid Board Fiberglass	FSJ or SAJ	2.0"
Concealed Supply Ducts	Wrap Type Fiberglass	FSJ	1.5"
Exhaust/Relief Ducts from Exterior to 12 Inches Beyond Damper	Rigid Board Fiberglass	FSJ or SAJ	2.0"
Ductwork Exterior to Building or in Unconditioned Spaces	Rigid Board Fiberglass	SAJ	3.0"
Intake and Exhaust Damper Frames	Rigid Board Fiberglass	FSJ	2.0"

END OF SECTION

SECTION 23 07 19

PIPING INSULATION FOR HVAC

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes insulation for all piping provided under Division 23–HVAC.
 - 1. Flexible closed cell pipe insulation.
 - 2. Insulation inserts and pipe shields.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASTM C168–Standard Terminology Relating to Thermal Insulation.
 - 2. ASTM C272–Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
 - 3. ASTM C518–Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 4. ASTM C533–Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 5. ASTM C547–Standard Specification for Mineral Fiber Pipe Insulation.
 - 6. ASTM C591–Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 7. ASTM C612–Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 8. ASTM C1427–Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 - 9. ASTM D1000–Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
 - 10. ASTM E84–Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 11. ASTM E96–Standard Test Methods for Water Vapor Transmission of Materials.
 - 12. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
 - 13. NFPA 262–Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of

each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00—Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced as requested by OWNER without additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all pipe covering, jackets, insulation, vapor barriers, adhesives, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.
- B. All insulation and associated materials shall be free of asbestos.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 FLEXIBLE CLOSED CELL PIPE INSULATION

- A. Acceptable manufacturers are K-flex Insul-tube, Armacell AP/Armaflex, or equal.
- B. Insulation shall be flexible closed cell type conforming to ASTM C534, Type 1, Grade 1.
- C. K -factor shall not exceed 0.25 (btu-in)/(hr-ft²-°F) at 75°F mean.
- D. Insulation shall be rated for service range of -20°F to 220°F on piping or 180°F where adhered to equipment.

2.02 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Load distributing metal shields shall be constructed of aluminum or stainless steel. Minimum thickness shall be 0.015-inch for aluminum and 0.010-inch for stainless steel.
- D. Staples shall be clinch style.
- E. Tack fasteners shall be stainless steel ring grooved shank tacks.
- F. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

PART 3-EXECUTION

3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.

- C. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.
- D. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- E. All pipe insulation shall be continuous through walls, ceiling or floor openings and through sleeves.
- F. All uninsulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

3.02 SUPPORT INSTALLATION

- A. For each pipe hanger, provide a hanger block on the bottom half of the pipe in place of the insulation.
- B. Pipe hangers and supports shall be sized large enough to be installed over the outer surface of the insulation.
- C. Load distributing metal shields shall be installed around the lower one-third circumference of the insulation and jacket.
- D. Blocks and shields shall be provided at all supports regardless of orientation, except inserts may be omitted on 3/4 inch and smaller copper piping provided 12-inch long 22 gauge pipe shields are used.

3.03 FLEXIBLE CLOSED CELL INSULATION INSTALLATION

- A. Where practical, slip insulation on piping during pipe installation while pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces. Cover flexible closed cell insulation on systems operating below 40°F with vapor retarding mastic.

3.04 PIPING INSULATION

- A. Provide insulation and jacketing on new piping as indicated in the following schedule:

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1 1/2"	1 1/2" to < 4"	4" to < 8"	8" and Larger
Refrigerant Suction	Flexible Closed Cell	NA	1.0"	1.0"	1.5"	1.5"	1.5"

END OF SECTION

SECTION 23 09 23

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Materials.
 - 2. Electrical Components.
 - 3. Communication.
 - 4. Operator Interface.
 - 5. Controller Software.
 - 6. Controllers.
 - 7. Input and Output Interface.
 - 8. Power Supplies and Line Filtering.
 - 9. Control Dampers and Actuators.
 - 10. Control Valves and Actuators.
 - 11. Thermostats (TK).
 - 12. Temperature Elements.
 - 13. Pressure Differential Indicating Transmitters (PDIT).
 - 14. Air Flow Measuring Station (FIT).
 - 15. Override Timers.
 - 16. Current Transmitters.
 - 17. Current Transformers.
 - 18. Voltage Transmitters.
 - 19. Current Switches.
 - 20. Control Panels.
 - 21. Control Wiring and Conduit.

1.02 REFERENCES

- A. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- B. Products furnished but not installed under this section: Control dampers, MAU-80-01 controls.

1.03 QUALITY ASSURANCE

- A. System Suppliers are defined as firms regularly engaged in the design and manufacture of temperature control systems of the size and complexity specified herein and whose systems have been in satisfactory use in similar service for not less than 5 years.
- B. Installer is defined as a firm with at least 5 years of successful installation experience on projects with temperature control system design and installation work similar to that required for the project.
- C. Installer shall have an established working relationship with System Suppliers.

- D. Installer shall have successfully completed System Suppliers' control system training. Upon request, Installer shall present record of completed training, including course outlines.
- E. The Base Bid System Supplier shall be Delta Controls, Alerton, Andover/TAC, Trane, Honeywell, or Johnson Controls.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- C. Product Submittal Requirements: Provide submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on magnetic or optical disk (file format: .DWG, .DXF, .PDF, or comparable) and three prints of each drawing on 11-inch by 17-inch paper. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve CONTRACTOR of responsibility to supply sufficient quantities to complete work. Submittals shall include the following as a minimum:
 - 1. Direct Digital Control System Hardware:
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 - (1) Direct digital controllers (controller panels).
 - (2) Transducers and transmitters.
 - (3) Sensors (include accuracy data).
 - (4) Control valve and actuator schedule.
 - (5) Control damper and actuator schedule.
 - (6) Relays and switches.
 - (7) Control panels.
 - (8) Power supplies.
 - (9) Batteries.
 - (10) Operator interface equipment.
 - (11) Wiring.
 - 2. Wiring diagrams, elevation views, and layouts for each control panel. Show termination numbers and wire numbers.
 - 3. Floor plan schematic diagrams indicating field sensor and controller locations.
 - 4. Central System Hardware and Software:
 - a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 - (1) Central Processing Unit (CPU) or web server.
 - (2) Monitors.

- (3) Keyboards.
 - (4) Power supplies.
 - (5) Battery backups.
 - (6) Interface equipment between CPU or server and control panels.
 - (7) Operating System software.
 - (8) Operator interface software.
 - (9) Color graphic software.
 - (10) Third-party software.
- c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
- d. Network riser diagrams of wiring between central control unit and control panels.
- 5. Controlled Systems:
 - a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - c. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - d. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified. Indicate alarmed and trended points.
- 6. Description of process, report formats, and checklists to be used in Part 3–Execution.
- 7. Sample commissioning checklist.
- 8. Project specific operator interface graphics may be submitted separately for approval but prior to downloading to controllers.
- 9. OWNER training preliminary outline and materials.
- 10. All wiring shall be labeled in accordance with Section 20 05 53–Identification for Fire Suppression, Plumbing, and HVAC Piping and Equipment.
- D. Schedules:
 - 1. Schedule of work provided within one month of Contract award indicating:
 - a. Intended sequence of work items.
 - b. Start date of each work item.
 - c. Duration of each work item.
 - d. Planned delivery dates for ordered material and equipment and expected lead times.
 - e. Milestones indicating possible restraints on work by other trades or situations.
 - 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- E. The following information will be considered not approved and require resubmittal:
 - 1. Manufacturer's standard wiring diagrams.
 - 2. Wiring diagrams not labeled in accordance with Section 20 05 53–Identification for Fire Suppression, Plumbing, and HVAC Piping and Equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to Temperature Control Panel components, enclosure, and finish.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.
- B. Project Record Documents: Submit three copies of record (as-built) documents upon completion of installation prior to final completion. Wiring diagrams shall be submitted at final completion. Submittal shall consist of:
 - 1. Project Record Drawings: As-built versions of submittal shop drawings provided as AutoCAD 2012 (or newer) compatible files on thumb drive (file format: .DWG, .DXF, .PDF, or comparable) and 3 prints of each drawing on 11-inch by 17-inch paper.
 - 2. Testing and Commissioning Reports and Checklists: Completed versions of reports, checklists, and trend logs used to meet requirements of Part 3–Execution.
 - 3. Operation and Maintenance (O&M) Manual shall include the following information as a minimum:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs, and database on thumb drive.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees, and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
 - m. As-built point-to-point wiring diagrams showing all connections between controllers, end devices, and equipment.
 - n. All wiring labeled to match field installation.
 - o. Cutsheets for all devices used with model numbers specifically highlighted and applicable specification section clearly marked.
 - p. Panel elevation views.
 - q. Damper and actuator schedules.

- r. Control valve and actuator schedules.
- s. Sequence of operation for all equipment including a record of all setpoints programmed.
- t. System access IP addresses.
- u. All user IDs and passwords.
- v. A copy of the point-to-point wiring diagrams shall be laminated and affixed to the inside face of the control panel enclosure. Hand-written diagrams are not acceptable.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.
- B. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to OWNER. Respond during normal business hours within 24 hours of OWNER's warranty service request.
- C. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve OWNER- and CONTRACTOR-identified software deficiencies at no charge during warranty period. If available, OWNER can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without OWNER's written authorization.
- D. Exception: CONTRACTOR shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of ENGINEER's acceptance.

1.08 GENERAL SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation the temperature controls system for the Administration building and monitoring of Garage Building.
- B. The controls work includes furnishing, delivering and installing all items required, and placing into operation the direct digital control system at the Rockford Water Division for control, integration, programming and screen development of HVAC systems associated with the Project.
 - 1. Systems include:
 - a. Air handling unit and air cooled condensing unit with direct expansion coil.
 - b. VAV boxes with electric heating
 - c. EDH's with electric heating
 - d. Monitoring of makeup air unit (MAU-80-01) running/fail signal.
 - 2. The control system general division of responsibility shall be as follows:
 - a. All sensors and miscellaneous accessories shall be furnished by the integration contractor installed by the mechanical contractor.
 - b. All wiring between sensors and miscellaneous accessories shall be furnished and installed by electrical contractor in conduit furnished and installed by electrical contractor.

- c. Division 26 contractor contracted under this contract/scope of work shall furnish all temperature control panels for electrical contractor to install. Division 26 contractor shall make all final terminations within panel and provide all programming and integration for the systems to the system.
 - d. Wiring between temperature control panels and facility network switches shall be by electrical contractor.
- C. The control system shall consist of networked DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.
- D. The system shall directly control HVAC equipment as specified in Part 3—Execution of this section. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints.
- E. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all required interface hardware and internal wiring, hardware, system drawings, system software, etc.
- F. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- G. CONTRACTOR shall be responsible for the placing of circuits and making of electrical and hydraulic connections in accordance with System Supplier-furnished drawings, instructions, and field supervision so that proper connection is provided. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; to adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in a manner fully satisfactory to ENGINEER. This will include on-site review of software/hardware controls from the central control point.
- H. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier. All switches and control and indicating lights associated with the control panels shall be new and installed in the starter panels.

1.09 SYSTEM PERFORMANCE

- A. Performance Standards: System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstations (server and browser for web-based systems).
- B. Graphic Display: A graphic with 20 dynamic points shall display with current data within 10 seconds.

- C. Graphic Refresh: A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.
- D. Configuration and Tuning Screens: Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
- E. Object Command: Devices shall react to a command of a binary object within seconds. Devices shall begin reacting to a command of an analog object within 2 seconds.
- F. Alarm Response Time: An object that goes into alarm shall be annunciated at the workstation within 15 seconds.
- G. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.
- H. Performance: Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
- I. Multiple Alarm Annunciation: Each workstation on the network shall receive alarms within 5 seconds of other workstations.
- J. Reporting Accuracy: System shall report values with minimum end-to-end accuracy listed in Table 1.
- K. Control Stability and Accuracy: Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.
- L. System shall include provisions to maintain all settings in the event of power loss, for up to 24 hours.

TABLE 1–REPORTING ACCURACY

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15°C (±0.25°F)
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 2)

Note 1: Accuracy applies to 10%–100% of scale.

Note 2: Not including utility-supplied meters.

TABLE 2–CONTROL STABILITY AND ACCURACY

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	± 50 Pa (± 0.2 in. w.g.) ± 3 Pa (± 0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	$\pm 10\%$ of full scale	
Space Temperature	$\pm 1.0^{\circ}\text{C}$ ($\pm 2.0^{\circ}\text{F}$)	
Duct Temperature	$\pm 1.5^{\circ}\text{C}$ ($\pm 3^{\circ}\text{F}$)	

1.10 TRAINING/ENHANCEMENT

- A. Training Materials: Provide course outline and materials for each class at least 6 weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. ENGINEER will review course outlines and materials at least 3 weeks before first class.
- B. System supplier shall provide OWNER with 4 hours of training for the control system. Supplier shall notify ENGINEER of training at least one week prior to training session.
- C. System supplier shall include 20 hours of enhancement time in their Bid to address miscellaneous system modifications and enhancements. Enhancement time shall not be utilized unless authorized by OWNER or ENGINEER.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become OWNER's property. This includes, but is not limited to:
 - 1. Graphics.
 - 2. Record drawings.
 - 3. Database.
 - 4. Application programming code.
 - 5. Documentation.

1.12 FUNCTIONAL PERFORMANCE TESTING

- A. Follow provisions of Section 23 05 93–Testing, Adjusting, and Balancing.

1.13 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by OWNER. Spare parts shall be available for at least 5 years after completion of this Contract.

2.02 ELECTRICAL COMPONENTS

- A. Provide electrical work in accordance with Division 26.
- B. Provide all components necessary to complete the work of this section including, but not limited to relays, transformers, motors, solenoid valves, starters, switches, override controls, operator linkages, and associated low voltage wiring. Outdoor wiring and equipment shall be NEMA 4X, or as indicated.
- C. All relays, time clocks, transformers, motors, operator linkages, wiring, etc., not specifically mentioned herein but necessary to make the control system complete and operative in accordance with the sequence of operation shall be provided as part of this section.
- D. All boxes for thermostats shall be provided by installer, unless noted on the Drawings to be provided by Division 26.
- E. All control and auxiliary relays shall have indicating LEDs. Relays shall be located in control panels.

2.03 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a unified control network. A gateway (translator) shall communicate with third-party equipment furnished or installed by others.
- B. Install new wiring and network devices as required to provide a complete and workable control network.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test

all cross-controller links required to execute control strategies specified in Part 3–Execution. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.

- E. System shall automatically synchronize controller time clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.04 OPERATOR INTERFACE

- A. Operator Interface: Web server shall reside on the high-speed network with the building controllers. Each standard browser connected to a server shall be able to access all system information.
- B. Communication: Workstation or web server and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol.
- C. Hardware Base: Each workstation or Web server shall consist of the following: Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Part 1–General. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Part 3–Execution, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server or workstations shall be OWNER-provided.
- D. Operator Functions: Operator interface shall allow each authorized operator to execute the following functions as a minimum:
 - 1. Operator log-in and interface:
 - a. Operator log-in procedure shall consist of typing an IP address into any one of the PCs logged into OWNER's local area network to access the system's web browser/building level controller. Coordinate IP address with OWNER.
 - b. A user ID and password shall be set for OWNER's designated operators. Each user ID shall be configured to allow various levels of access to setpoint adjustments, scheduling, etc. Provide all system user ID's and passwords to OWNER.
 - c. Coordinate off-site system access requirements with OWNER. Off-site access shall be through a secured firewall.
 - 2. Point-and-click Navigation: Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 - 3. View and Adjust Equipment Properties:
 - a. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
 - b. Values listed as "adjustable" in the sequence of operation and alarm conditions shall display a range value (35°F to 90°F, 0 to 100%, etc.) when the operator adjusts the values.
 - c. All outputs shall have the ability to be manually overridden by the operator for an adjustable period of time.
 - 4. View and Adjust Operating Schedules: Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly

calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.

5. View and Respond to Alarms: Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
6. View and Configure Trends: Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
7. View and Configure Reports: Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
8. Manage Control System Hardware: Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
9. Manage Operator Access: Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software:

1. Operating System: Web server shall have an industry-standard professional-grade operating system.
2. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.
 - a. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation: Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format: Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash). All plugins shall automatically update to the latest version, or shall be capable of being updated by the operators from within the graphical interface.
3. System Tools: System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
 - a. Automatic System Database Configuration: Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 - b. Controller Memory Download: Operators shall be able to download memory from the system database to each controller.

- c. System Configuration: Operators shall be able to configure the system.
- d. Online Help: Context-sensitive online help for each tool shall assist operators in operating and editing the system.
- e. Security. System shall require a user name and password to view, edit, add, or delete data.
 - (1) Operator Access: Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object.
 - (2) Automatic Log Out: Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - (3) Encrypted Security Data: Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
- f. System Diagnostics: System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
- g. Alarm Processing: System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Part 3–Execution.
- h. Alarm Messages: Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
- i. Alarm Reactions: Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
- j. Alarm Maintenance: Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
- k. Trend Configuration: Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Part 3–Execution.
- l. Object and Property Status and Control: Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
- m. Reports and Logs: Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
- n. Standard Reports: Furnish the following standard system reports:
 - (1) Objects: System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - (2) Alarm Summary: Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - (3) Logs: System shall log the following to a database or text file and shall retain data for an adjustable period:
 - (a) Alarm History.
 - (b) Trend Data: Operator shall be able to select trends to be logged.

- (c) Operator Activity: At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
- o. Custom Reports: Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
- p. Graphics Generation: Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
- q. Graphics Library: Complete library of standard HVAC equipment graphics shall include equipment such as air handlers, terminals. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
- r. Custom Application Programming: Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - (1) Language: Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.
 - (2) Programming Environment: Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
 - (3) Independent Program Modules: Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
 - (4) Debugging and Simulation: Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
 - (5) Mathematical Functions: Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
 - (6) Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - (a) Time Variables: Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - (b) System Variables: Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to

enable, disable, and change setpoints of Controller Software as described in Controller Software section.

2.05 CONTROLLER SOFTWARE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System shall provide the following schedule options as a minimum:
 - 1. Weekly: Provide separate schedules for each day of the week. Each schedule shall be able to include up to five occupied periods (five start-stop pairs or ten events).
 - 2. Exception: Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 - 3. Holiday: Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- C. System Coordination: Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- D. Binary and Analog Alarms: See Paragraph 2.04.E.3.g (Alarm Processing).
- E. Alarm Reporting: See Paragraph 2.04.E.3.i (Alarm Reactions).
- F. Remote Communication: System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- G. Demand Limiting:
 - 1. System shall monitor building power consumption from building power meter pulse generator signals or from building feeder line watt transducer or current transformer.
 - 2. When power consumption exceeds adjustable levels, system shall automatically adjust setpoints, deenergize low-priority equipment, and take other programmatic actions to reduce demand as specified in Part 3–Execution. When demand drops below adjustable levels, system shall restore loads as specified.
- H. Maintenance Management: System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Part 3–Execution.
- I. Sequencing: Application software shall sequence equipment as specified in Part 3–Execution.
- J. Proportional-Integral-Derivative (PID) Control: System shall provide direct- and reverse-acting PID algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
- K. Staggered Start: System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.

- L. Energy Calculations:
 - 1. System shall accumulate and convert instantaneous power (kW) or flow rates (L/s [gpm]) to energy usage data.
 - 2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
- M. Anti-Short Cycling: Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- N. On and Off Control with Differential: System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
- O. Runtime Totalization: System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Part 3—Execution.

2.06 CONTROLLERS

- A. General: Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified.
- B. Communication:
 - 1. Service Port: Each controller shall include a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on Drawings.
 - 2. Signal Management: BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 - 3. Data Sharing: Each BC and AAC shall share data as required with each networked BC and AAC.
 - 4. Stand-Alone Operation: Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.
- C. Environment: Controller hardware shall be suitable for anticipated ambient conditions.
 - 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).
 - 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).
- D. Keypad: Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.
- E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.

- F. Serviceability:
1. Controllers shall have diagnostic LEDs for power, communication, and processor.
 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
 3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- G. Memory:
1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- H. Immunity to Power and Noise: Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 meter (3 feet).
- I. Transformer: ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.
- J. Web Server/Building Level Controllers:
1. Web server/building level controller shall be Alerton model AIE-7, LynxSpring model JENE-PC8000, or Honeywell WEB-8000.
 2. Controller shall receive 24 VAC power from a dedicated control power transformer in the control panel.
 3. Controller shall be a microprocessor based CPU with the following minimum features:
 - a. Use 32-Bit architecture.
 - b. 1 GB RAM.
 - c. Real-time clock.
 - d. Replaceable lithium battery.
 - e. Status indicators.
 - f. RS-485 port for BACnet MS/TP and RJ-85 Ethernet port for BACnet/IP.
- K. Application Level Controllers:
1. General:
 - a. Provide controllers and expansion modules as required to perform the control sequences specified in Part 3–Execution and accept I/O as shown on the drawings.
 - b. Controllers shall receive 24 VAC power from a dedicated control power transformer in the control panel.
 - (1) Controllers shall be microprocessor-based CPUs with the following minimum features:
 - (2) Use 32-Bit architecture
 - (3) 256 KB of battery-backed static RAM.
 - (4) 1 MB flash ROM.
 - (5) Real-time clock.
 - (6) Replaceable lithium battery.
 - (7) Status indicators.
 - (8) RS-485 port for BACnet MS/TP and RJ-45 Ethernet port for BACnet/IP.

2. Communication:
 - a. Controller shall include a service communication port for connection to a Portable Operator's Terminal.
 - b. Controller shall provide stand-alone control in the event of a communication failure.
 - c. Controllers shall communicate via BACnet MS/TP at a minimum baud rate of 36,800 bps.
 3. Controllers serving the following equipment shall be Alerton VLX, VLCA-1688, or Honeywell controllers. Controllers shall have H-O-A switches on the digital and analog outputs for manual override at the controller.
 - a. AHU-90-01.
 - b. Structure 90 variable air volume units.
 - c. Structure 90 electric duct heater controls.
 4. Input and Output Interface:
 - a. All inputs and outputs shall be hard-wired to the controller via a terminal strip in the control panel.
 - b. Digital outputs shall be rated for 24 VAC at 0.5 A. Provide interface relays and external power supply as required.
 - c. Controllers shall have a combination of dedicated or field-adjustable (via jumper) universal inputs to accept thermistor, dry contact, 0-5 VDC, 4-20 mA, or 0-10 VDC signals.
 - d. Analog output signals shall be modulating 0-10 VDC or 4-20 mA. Provide external power supply as required.
- L. VAV Box Controllers:
1. VAV box controllers shall be Alerton VAViH-SD, or Honeywell Spyder BACnet series controller with integral damper actuator.
 2. Controller shall receive 24 VAC power from a dedicated control power transformer, provided in VAV box controller.
 3. Controllers shall communicate via BACnet MS/TP at a minimum baud rate of 9600 bps.

2.07 INPUT AND OUTPUT INTERFACE

- A. General: Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection: Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- C. Binary Inputs: Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs: Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- E. Analog Inputs: Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs: Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.

- G. Analog Outputs: Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs: Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs: Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.08 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies: Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Total connected load shall be no greater than 80% of rated capacity. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built-in overvoltage and overcurrent protection and shall be able to withstand 150% current overload for at least 3 seconds without trip-out or failure.
 - 1. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - 2. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering: Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - 1. Dielectric strength of 1000 V minimum.
 - 2. Response time of 10 nanoseconds or less.
 - 3. Transverse mode noise attenuation of 65 dB or greater.
 - 4. Common mode noise attenuation of 150 dB or greater at 40-100 Hz.

2.09 CONTROL DAMPERS AND ACTUATORS

- A. Dampers:
 - 1. Dampers shall be Greenheck Model VCD-23, or equal, low leakage control damper with galvanized steel construction.
 - 2. Dampers for open/closed control shall be parallel blade and modulating dampers shall be opposed blade.
 - 3. Damper frame shall be 16 gauge galvanized steel. Dampers shall have extruded vinyl blade edge seals, flexible metal compression-type jamb seals, nylon bearings, and solid stops.
 - 4. Dampers shall be rated at a leakage of less than 10 cfm per square foot at 4 inches of water column pressure differential.
 - 5. Shaft to actuator shall be hex type, material to match damper construction.
 - 6. Dampers shall be flanged to duct type. Clear opening in damper shall be same size as ductwork.

B. Actuators:

1. Two-position low voltage (<100V) damper actuators shall be Belimo NFBUP, Honeywell MS4110, or Siemens GCA, maintenance-free actuator rated at minimum 88 in-lb. of torque. Dampers shall be power-to-open, spring-closed unless otherwise specified. Actuator shall accept any voltage between 24 VAC and 240 VAC for operation and control.
2. Modulating low voltage damper actuators shall be Belimo NFB24-SR, or equal, rated for 90-inch-lb of torque. Actuator shall accept 2-10 VDC input signal and provide a 2-10 VDC feedback signal. Outside, relief and exhaust dampers shall fail closed on power failure. Return air and VAV box dampers shall fail open on power failure.
3. Actuator shall include electronic overload protection and visual position indication.
4. Actuators shall include a manual override via a manufacturer-supplied hex crank.
5. All actuators shall be direct coupled to damper and mounted outside the airstream.
6. All actuators shall be of the same manufacturer. Manufacturer shall be responsible for furnishing quantity of actuators required to meet minimum damper torque rating, plus an additional 10% torque.
7. If auxiliary switch is not used, terminate cord in nearest junction box.
8. All actuators shall be of the same manufacturer. Manufacturer shall be responsible for furnishing quantity of actuators required to meet minimum damper torque rating, plus an additional 10% torque.

2.10 THERMOSTATS (TK)

A. VAV Box Thermostats:

1. Thermostats shall be Alerton Microset 4 controller, or equal.
2. Thermostat shall have digital display of outdoor air, room temperature and setpoint.
3. Thermostat shall allow for room occupant adjustment of setpoint.
4. Thermostat shall communicate setpoint and temperature directly with VAV box controller.
5. Thermostat shall receive 24 VAC/VDC power from associated VAV box controller.

B. Low Limit Thermostats (Freezestats) (TS):

1. Freezestat shall be Johnson Controls Model A70BA, or equal.
2. Freezestat shall be electric two-position type with temperature sensing element and manual reset. Unit shall be capable of opening control circuit if any one-foot length of sensing element is subject to a temperature below the setpoint. Length of sensing element shall be not less than one linear foot per square foot of coil surface area.
3. Unless otherwise noted, set low limit controls at 36°F.

2.11 TEMPERATURE ELEMENTS

- A. Temperature elements shall be thermistor or 100Ω platinum RTD with temperature transmitter. Thermistor shall be ACI model A/10K-CP, or equal, with an accuracy of ±0.36°F. Transmitters shall be ACI model A/TT100, or equal, with a 4-20 mA, loop-powered linear output signal. Transmitter shall have an accuracy of ±0.1°F. Range shall be as specified below.
- B. Outdoor air temperature transmitters (OAT) shall have a range of -30°F to 130°F.
- C. Duct temperature transmitters shall be insertion type, unless noted otherwise, with a range of -30°F to 130°F. All mixed air and coil discharge air sensors shall be averaging type. Temperature sensors for ductwork larger than 8 square feet shall be averaging type.

2.12 PRESSURE DIFFERENTIAL INDICATING TRANSMITTERS (PDIT)

- A. Air differential pressure sensor and transmitter shall be ACI A/DLP, or equal, with 4-20 mA, loop-powered linear output signal. Transmitter shall have an accuracy of $\pm 0.5\%$ of span. Building and space differential pressure sensors shall have a range of ± 0.5 inch water column. Duct pressure sensors shall have a range of 0 to 5 inches water column. Provide 1/4-inch polyethylene tubing and cover plates as required.

2.13 AIR FLOW MEASURING STATIONS (FIT)

- A. Air flow measuring stations shall be Ebtron model GTx116-PA, or equal.
- B. Each air flow measuring station shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor nodes contained in one or more probe assemblies per measurement location.
1. The air flow rate at each sensor node shall be equally weighted and arithmetically averaged by the transmitter prior to output.
 2. Each transmitter shall have a 16-character alpha-numeric display capable of displaying air flow, system status, configuration settings, and diagnostics.
- C. Each sensor node shall independently determine the air flow rate at each measurement point. Each sensor node shall be factory calibrated at a minimum of 16 air flow rates to standards that are traceable to the National Institute of Standards and Technology (NIST).
- D. Air flow accuracy shall be $\pm 2\%$ of Reading over the entire operating air flow range of not less than 0 to 5,000 fpm (25.4 m/s).
- E. Duct and Plenum probes: The number of individual sensor nodes provided for each location shall be as follows:

Duct or Plenum Area (ft ²)	Probes
≤ 1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
≥ 16	16

- F. Transmitters:
1. The transmitters shall have an integral LCD display capable of displaying air flow. The LCD display shall be capable of displaying individual air flow reading of each independent sensor node.
 2. The transmitter shall be capable of field configuration and diagnostics using an onboard pushbutton interface and LCD display.
 3. The transmitter shall have an on-off power switch and operate on 24 VAC. Isolation transformers shall not be required.
 4. The transmitter shall be capable of communicating with other devices using one of the following interface options:
 - a. Linear analog output signals for air flow: Field selectable, fuse protected and electrically isolated from all other circuitry, 0-5 VDC / 0-10 VDC / 4-10 mA (4-wire).
 - b. RS-485: Field selectable BACnet-ms/TP, BACnet-ARCNET, Modbus-RTU, or Johnson Controls N2-Bus.

- c. BACnet Devices shall provide analog variables for air flow containing individual sensor air flow rate and temperature data.
 - d. 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP, and TCP/IP.
 - e. LonWorks Free Topology.
 - 5. The transmitter shall be capable of providing an infrared interface for manually downloading air flow data or for uploading transmitter configuration data using a handheld PDA (Palm or Microsoft Windows Mobile operating systems).
 - 6. The transmitter shall be capable of identifying a “damaged” sensor node, ignore it, and continue to operate by correctly averaging the remaining sensor nodes.
- G. Install air flow devices in accordance with manufacturer’s instructions at the locations indicated on the Drawings.

2.14 OVERRIDE TIMERS

- A. Unless implemented in control software, override timers shall be solid state line voltage, UL Listed, with contact rating and configuration required by application. Provide 0 to 6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

2.15 CURRENT TRANSMITTERS

- A. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
- B. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
- C. Unit shall be split-core type for clamp-on installation on existing wiring.

2.16 CURRENT TRANSFORMERS

- A. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
- B. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
- C. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.
- D. Control Power Transformers: Power supplies shall be protected against short circuits and contain their own overcurrent and overvoltage protection. 12 and 24 VDC power supplies shall be provided as required.

2.17 VOLTAGE TRANSMITTERS

- A. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.

- B. Adjustable full-scale unit ranges shall be 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
- C. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

2.18 CURRENT SWITCHES

- A. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.
- B. Current Switches (IS) shall be Veris Industries Hawkeye H800 HV, or equal, fixed trip solid core current switch. Status output shall be rated for 0.5A at 250 VAC/VDC. Current sensing range shall be 0.75 to 200 A. Switch shall be UL Listed.

2.19 CONTROL PANELS

- A. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable subpanels as required. A common key shall open each control panel and subpanel.
- B. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
- C. Each local panel shall have a control power source power switch (on-off) with overcurrent protection and convenience receptacle located within the panel.
- D. All devices located within control panel shall be mounted on DIN rail.

2.20 CONTROL WIRING AND CONDUIT

- A. Control wiring and conduit shall comply with the requirements of Division 26. Division 26 contractor shall utilize a licensed electrician for installing wiring and conduit. Submit proof of licensure, including license number, as part of submittals.
- B. All line voltage wiring and conduit shall be provided by Division 26 Contractor. All low voltage wiring (100 volts and below) and conduit shall be provided by Division 26 contractor.
- C. All control wiring shall be terminated on terminal strips.
- D. Low voltage (<100 volts) and line voltage wiring shall be installed in separate conduits.
- E. Communication and VAV box wiring above suspended ceilings shall be run "free-air" in a neat, workmanlike manner parallel or perpendicular to building structure. Wiring shall be routed in bridal rings, supported a maximum of 5 feet apart.
- F. Acceptable wiring manufacturer is Windy City, or equal, meeting the requirements of the following table.

TEMPERATURE CONTROL WIRING REQUIREMENTS

Input Type	Cable Type	Cable Color	Shield	Plenum Rated	Cable Part Number
Analog In (4-20 mA, resistance)	18 AWG/ 2 Cond	Yellow	Yes	Yes	0023230
Analog In (0-10 VDC or 2-10 VDC)	18 AWG/ 3 Cond	Yellow	Yes	Yes	0023330
Analog Out (4-20 mA)	18 AWG/ 2 Cond	Tan	Yes	Yes	WCW-18/2 Tan
Analog Out (0-10 VDC or 2-10 VDC)	18 AWG/ 3 Cond	Tan	Yes	Yes	WCW-18/3 Tan
Digital In	18 AWG/ 2 Cond	Orange	Yes	Yes	0023240
Digital Out	18 AWG/ 2 Cond	Violet	Yes	Yes	0023250
Digital Out (Floating Point)	18 AWG/ 3 Cond	Violet	Yes	Yes	WCW-18/3 VLT
BACnet Communication	22 AWG/ 2 Cond	Raspberry	No	Yes	0043280ALR-S

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations and Division 26.
- B. Coordinate location of exposed devices prior to rough-in. Thermostats shall be mounted where shown on the Drawings. Thermostats on exterior walls shall have insulated bases.
- C. Temperature controls to be installed in or on insulated ductwork shall be installed after the insulation has been applied.
- D. Thermostats adjustable by occupants shall be installed 48 inches above floor (top of box), unless otherwise noted. Non-adjustable room temperature sensors, thermostats, or elements shall be installed 60 inches above floor (top of box). Notify ENGINEER of conflicts.
- E. Install all dampers and actuators in accessible locations with ample space to install direct coupled actuator, housing and accessories.
- F. Coordinate with Division 26 Contractor the activation of duct smoke detectors. Upon activation, associated unit shall shut down and outside air and relief dampers shall close for the following units:
 1. MAU-80-01.
 2. AHU-90-01.
- G. Low Limit Thermostats (Freezestats):
 1. Install low limit controls on AHU-90-01. Unless otherwise indicated, install sensing element on the downstream side of cooling coils.

2. Mount units using flanges and element holders. Provide duct collars or bushings where sensing capillary passes through sheet metal housings or ductwork; seal this penetration to eliminate air leakage. Mount the units in an accessible location as to allow for resetting after low limit trips while still meeting manufacturer's installation requirements for proper function.
 3. Distribute (serpentine) sensing element horizontally across the coil to cover every square foot of coil; on larger coils this may require more than one instrument. Install controls at accessible location with mounting brackets and element duct collars where required.
- H. Control power transformers (voltage transformers) for VAV box applications shall be sized such that the load on the transformer is no greater than 80% of the rated load and the voltage drop to the furthest serviced equipment is no greater than 3%. No greater than 5 VAV boxes shall be served by the same control power transformer.
- I. Data Trending: Control system shall have adequate capacity to store all temperature, pressure, and status feedback points for seven days when recorded at 15-minute intervals.
- J. Division 23 contractor shall coordinate with testing and balancing agency to adjust setpoints and operate system as testing and balancing agency requires to complete their scope of work. Record and provide all setpoints established during balancing and provide a list of those setpoints to the testing and balancing agency.

3.02 OPERATOR INTERFACE PROGRAMMING

- A. Values listed as "adjustable" in the sequence of operation and alarm conditions shall display a range value (35°F to 90°F, 0% to 100%, etc.) When the operator adjusts the values.
- B. All outputs shall have the ability to be manually overridden by the operator for an adjustable period of time.

3.03 SEQUENCE OF OPERATIONS

- A. Gas unit heaters (GUH) shall be controlled by a low-voltage remote-mounted thermostat furnished by the manufacturer with a fan on when room temperature falls below thermostat setpoint. Provide wiring between thermostat and unit heater. Control power shall be from control power transformer at unit.
- B. Electric wall heaters (EWH) shall be controlled by an integral thermostat.
- C. Controls for electric unit heaters (EUH) and electric radiant heating panels (RHP) shall be provided by Division 26 contractor. Thermostats shall be suitable to meet room electrical rating. Control power shall be from control power transformer at unit.
- D. Makeup-Air Unit microprocessor controller shall be supplied with a manufacturer provided protocol card for BACnet/IP for monitoring of the unit's status COM signal through the DDC. See 23 74 23-Packaged Outdoor Heating Only Make-Up Air Units for additional information.
- E. High volume Low Speed Fan (HVLS) shall be controlled by a line voltage manual control switch furnished by the manufacturer. Division 26 contractor shall provide wiring between switch and fan.

- F. Electric duct heaters (EDH) shall be controlled by a duct thermostat furnished by the manufacturer and installed by the Division 26 contractor in raceways provided by Division 26 contractor.
- G. Split system (SS) shall be controlled by a standalone wireless thermostat furnished by the manufacturer. The associated air-cooled condensing unit shall start and the fan shall cycle when room temperature rises above room setpoint. The fan and associated air-cooled condensing unit shall be off when the room temperature is below the setpoint.
- H. For additional information about the inputs and outputs related to the building automation system (BAS) see the controls diagram drawings.
- I. Administration Building Ventilation:
 - 1. Main Air Handling Unit (AHU 90 01): AHU 90 01 system consists of draw through single path air handling unit with a mixing box, variable volume supply fan, direct expansion cooling coil, and powered exhaust/return controlled by the DDC system.
 - 2. The unit shall be controlled by a controller and sensors as follows:
 - a. Scheduling Control: Unit controls shall include an occupied/unoccupied sequence based on a time of day schedule
 - b. Supply Fan:
 - (1) Unless otherwise set by Trim and Respond logic below, fan speed shall vary to maintain Supply Air Duct Pressure Setpoint (1.0 inch w.c.) relative to the conditioned space.
 - (2) Unoccupied Mode:
 - (a) The supply and return fans shall be normally off.
 - (b) Supply fan, return fan, and cooling shall cycle to maintain unoccupied room temperature setpoints (80°F for cooling and 60°F for heating) for spaces.
 - (3) Occupied Mode: The supply fan shall be controlled to maintain a supply duct static pressure as set during balancing and the return fan shall track the supply fan speed of 5 Hz.
 - c. Mixing Box Control:
 - (1) Unoccupied Mode: Damper shall move to 100% return air open position. Outdoor air and return air damper shall move to 100% closed.
 - (2) Occupied Mode:
 - (a) Outdoor air damper shall modulate to maintain minimum outside airflow based on the airflow meter unless economizing. Return air damper shall modulate inverse of the outdoor air damper. Exhaust air damper shall then modulate to the same percentage open as the outdoor air damper.
 - (b) Economizer Control: While outside air temperature is below an Economizer Enable Setpoint (60°F) the economizer shall be enabled.
 - i. Outside and return air dampers shall modulate to maintain supply air temperature setpoint.
 - ii. AHU exhaust damper shall modulate to control building pressure (+0.03 inch w.c. adjustable relative to the conditioned space).
 - d. Supply Air Temperature Setpoint:
 - (1) Unoccupied Mode: Supply Air Temperature Setpoint shall be set based on outdoor air temperature. If outdoor air temperature is less than 60°F, Supply Air Temperature Setpoint shall be 60°F. If OAT is greater than 75°F, Supply Air Temperature Setpoint shall be 75°F. Otherwise, Supply Air Temperature shall equal Outdoor Air Temperature.
 - (2) Occupied Mode: Supply Air Temperature Setpoint shall be controlled by either the "Trim and Respond" sequence outlined below or reset based on room air

temperature. "Trim and Respond" shall be considered the default operation. If Supply Air Temperature Setpoint is to be reset based on the Room Air Temperature, it shall be based upon the open office area and shall vary linearly as dictated by the following schedule:

Room Air Temperature (RAT)	Supply Air Temperature (SAT)
<68°F	68°F
>72°F	50°F

- e. Cooling:
 - (1) Cooling shall be enabled only while:
 - (a) Outside air temperature is above the Supply Air Temperature Setpoint;
 - (b) AND the supply fan status is on.
 - (c) AND the AHU is not economizing.
 - (2) Unoccupied Mode: Cooling shall modulate to maintain 75°F.
 - (3) Occupied Mode: Cooling shall modulate to maintain Supply Air Temperature Setpoint.
- f. Trim and Respond Controls:
 - (1) Summary: AHU controls shall include a "Trim and Respond" sequence. The objective of this sequence is to adjust supply air temperature and pressure setpoints to increase energy efficiency and occupant comfort.
 - (2) Startup:
 - (a) On start up or changeover to "Occupied" mode, the AHU shall maintain 'start up' supply air temperature and supply air duct pressure setpoints as outlined above.
 - (b) After 30 minutes (adjustable) Trim and Respond logic shall be enabled.
 - (3) VAV box positions shall be analyzed on at least 15 second intervals and the VAV with the most open damper identified as the controlling VAV.
 - (4) Temperature Control:
 - (a) If the controlling VAV is more than 95% open, the supply air setpoint shall be reduced by 0.2°F every minute until damper position falls to less than 95% open or the supply air temperature setpoint reaches the low limit scheduled above.
 - (b) The calculated supply air temperature setpoint shall remain until the controlling VAV position changes below 85% open or above 95% open, at which time pressure controls shall be adjusted as outlined below.
 - (5) Pressure Control:
 - (a) If controlling VAV damper position is above 95% and the supply air temperature setpoint is at its low limit, the supply air static setpoint shall increase by 0.05 inch w.c. every minute until the controlling VAV damper position falls below 95% open or the supply air static setpoint reaches its high limit.
 - (b) The calculated supply air pressure setpoint shall remain until the controlling VAV position falls below 85% open or rises above 95% open.
 - i. If the controlling VAV position falls below 85% open, the supply air static setpoint will decrease by 0.05 inch w.c. every minute until the damper position is between 85% and 95% or until the setpoint reaches its low limit.
 - ii. If the supply air static setpoint has reached its low limit and the damper position is still below 85%, the supply air temperature setpoint shall increase by 0.2°F every minute until the damper

position is between 85 and 95% or until the setpoint reaches its high limit.

- (c) All values shall be adjustable.
 - (d) Each VAV box control screen shall include a check box enable/disable to allow operator to exclude any VAV box from this process. This shall allow the operator to exclude 'problem' zones from driving the system.
- (6) Upon mixed air temperature of 45°F, the outside air damper starts to close, and an alarm is generated. Upon mixed air temperature of 38°F, the outside air damper closes fully, and an alarm is generated.

J. Variable Air Volume (VAV) Boxes:

1. The BAS shall schedule occupied/unoccupied modes based on time of day scheduling of each area served by a VAV box.
2. Each VAV box shall be controlled by a VAV controller. VAV box manufacturer shall provide flow ring with VAV box.
3. Each VAV's box damper and reheat coil valve shall modulate as required to maintain room temperature setpoint. VAV box shall utilize a dual maximum control sequence. Room sensor shall provide setpoint adjustment and unoccupied override.
4. In Unoccupied mode, the following shall occur:
 - a. The box damper shall be at the minimum position.
 - b. On a call for heating the reheat coil valve shall move to is 100% open position to maintain space unoccupied heating setpoint.
5. In Occupied mode, the following shall occur:
 - a. When room temperature is above set point the box damper shall modulate open from minimum position and the reheat coil valve shall be closed.
 - b. When room temperature is below setpoint the reheat coil valve shall modulate to satisfy space temperature setpoint. If the reheat valve is fully open and the room temperature setpoint is not satisfied the box damper shall modulate open from minimum to the reheat airflow as indicated in the drawing schedules.

K. Exhaust Fans:

1. Devices and control logic for the following fan shall be provided by the Division 23 contractor. Refer to Section 23 74 23—Packaged Outdoor Heating Only Make-Up Air Units. EF-80-01.
2. The following fans shall be controlled by a room fan switch. Provide all required interfaces with the switch and coordinate switch type. Speed control for fans shall be for balancing only and shall be inaccessible to room occupants.
 - a. EF-80-03.
 - b. EF-90-02.
 - c. EF-90-03.
 - d. ICF-90-01.
3. The following fans shall run continuously. No means of shut off shall be provided except at the equipment disconnect or lighting panel circuit breaker. The motor-operated damper at the fan and the associated dampers shall be open when the fan is running and closed when the fan is off. EF-80-02.
4. EF-90-01:
 - a. The DDC shall schedule occupied/unoccupied modes based on time of day scheduling of the space.
 - b. In unoccupied mode, the fans shall be off.
 - c. In occupied mode, fans shall operate continuously. While fan is operating, associated damper shall be open.
 - d. The DDC shall monitor the exhaust fan for operations. See control drawings for additional information.

- e. If associated AHU 90 01 is off, fans shall be turned off.

END OF SECTION

SECTION 23 11 23
FACILITY FUEL GAS PIPING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: All facility fuel gas pipe and fittings unless otherwise noted.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. NFPA 54–National Fuel Gas Code (Current Edition).
 - 2. ANSI B16.3–Malleable Iron Threaded Fittings.
 - 3. ASTM A53–Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - 4. ASTM A234–Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 5. 2015 International Fuel Gas Code.

1.03 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept piping on-site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- C. Protect piping systems from entry of foreign materials by installing temporary covers, completing sections of the work and isolating parts of completed system.
- D. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.

1.06 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.
- D. Use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at CONTRACTOR's option. Where the grade or type is not specified, CONTRACTOR may choose from those commercially available.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Natural gas pressures shall not exceed 5 psig on customer side of the meter.

- C. Buried natural gas shall be in accordance with Section 33 52 16–Fuel Gas Distribution Utilities.

2.02 NATURAL GAS

- A. 2-Inch and Smaller: ASTM A53, type E or S, standard weight (Schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- B. 2 1/2-Inch and Larger: ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- C. Exposed piping shall be painted in accordance with Section 09 91 00–Painting. All aboveground piping shall be labeled in accordance with Section 20 05 53–Identification for Fire Suppression, Plumbing, and HVAC Piping and Equipment. Where not labeled on manufacturer nameplate, regulator tags shall indicate inlet pressure, outlet pressure, and flow. Appliance regulators provided by equipment manufacturer as part of a manufacturer's gas train are not required to be tagged.

2.03 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

2.04 UNIONS AND FLANGES

- A. 2-Inch and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.
- B. 2 1/2-Inch and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2 1/2-inch may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.
- C. Provide ASTM A 193 B7 grade bolts and A 194 2H grade nuts and hardened washers for connections (star washers for grounding).

2.05 GASKETS

- A. Fuel Oil and Natural Gas Systems: Branded, compressed, non-asbestos sheet gaskets. Klingsil C4401, Garlock 3000, or JM Clipper 978-C.

PART 3-EXECUTION

3.01 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

3.02 INSTALLATION

A. Support:

1. All interior or exposed pipelines shall be securely supported by adjustable metal saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile.
2. Strap hangers, tin clips, or U-hooks will not be acceptable.
3. In general, the maximum spacing of supports shall not exceed 10 feet on centers.
4. Insulation saddles shall be used. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
5. The weight of the piping shall be supported independently of connected equipment.
6. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so that stress will not be transferred to them.
7. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
8. The following maximum spacings shall be provided for supports:

MAXIMUM HORIZONTAL PIPE
HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Black Steel (See Note 1) ft
3/4	8
1	8
1 1/4	8
1 1/2	8
2	10
2 1/2	10
3	10

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

9. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are

concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.

10. Provide saddles or shields under piping hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under stainless steel piping to prevent indentation of piping from the support or clamp.
11. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.

B. Penetrations:

1. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping.
2. The sleeve diameter shall not exceed the pipe O.D. (or flange O.D. where applicable) plus 2 inches, unless otherwise shown on Drawings.
3. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with an approved mechanical seal.
4. The annular space between the wall sleeve and pipe shall be sealed with an approved mechanical seal.
5. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and grouted full (walls), remain open (floors).
6. Plug abandoned pipes and wall pipes, after pipe and fitting removal, flush to the concrete surface with nonshrinking mortar, or as otherwise acceptable, to achieve a watertight seal.
7. All openings for pipe work shall be neatly patched in a workmanlike manner.

C. Layout:

1. Install all piping parallel to building walls and ceilings and at heights that do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult Drawings for location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
2. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings and floors, to permit access for covering of pipe and painting work.
3. Care shall be taken in laying out piping that there is no interference with the proper location of piping for other purposes or other equipment, and shall be run with regard to the requirements of each service.
4. Piping shall not interfere with headroom or clear floor space.
5. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings, constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
6. An ample number of unions shall be provided in all threaded, soldered, and glued pipelines and at all equipment to facilitate removal and replacement. Install a shutoff valve at each appliance.

3.03 ERECTION

- A. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- B. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

- C. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.
- D. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

3.04 WELDED PIPE JOINTS

- A. Welding of pipe in normally occupied buildings is prohibited. Off-site welding is acceptable.
- B. If welding is required in a normally occupied building for connecting to an existing welded system, written approval from OWNER shall be obtained and shall comply with building's fire and life safety, as well as hot work requirements.
- C. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI latest editions of B31 for all systems from the Code for Pressure Piping. Machine beveling in CONTRACTOR's shop is preferred. Field beveling may be done by flame cutting to recognized standards.
- D. Provide complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal.
- E. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37 1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction shall not be permitted.
- F. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- G. CONTRACTOR shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same procedure as the completed weld. Otherwise, remove tack weld during welding operation.
- H. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- I. Remove dirt, scale or other foreign matter from the inside of the piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
- J. Schedule 40 pipe shall in no case be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 shall be welded with no less than four passes, including one stringer/root, two filler and one lacer. In all cases, the weld must be filled before the cap weld is added.
- K. Weld Testing:
 - 1. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. OWNER will at OWNER's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial

visual and x-ray inspections will be provided by OWNER. CONTRACTOR shall be responsible for all labor, material and travel expenses involved in the reinspection and retesting of any welds found to be unacceptable. In addition, CONTRACTOR shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1 and B31.3 because of the discovery of poor, unacceptable or rejected welds.

2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accordance with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

3.05 THREADED PIPE JOINTS

- A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.06 NATURAL GAS

- A. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow. Install a 4-inch minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- B. Do not install gas pipe in a ventilation air plenum.
- C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.
- D. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.
- E. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- F. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

3.07 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Install vent and relief valve discharge lines as indicated on the Drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than 6 feet above a roof line. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- B. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminate with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least 7 feet abovegrade or pedestrian traffic and a

minimum of 3 feet above or 10 feet horizontally from all air intakes or building openings. Provide stainless steel insect screens on vent outlets.

3.08 UNIONS AND FLANGES

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.
- B. Provide dielectric isolation device where nonferrous lines connect to ferrous lines or equipment, such as dielectric union, coupling, or dielectric flange fitting.

3.09 PIPING SYSTEM LEAK TESTS

- A. Piping system shall be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section and test medium in an adjacent section, unless two valves in series are installed with a valved "telltale" located between these valves.
- B. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- C. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required by local code. Tester shall submit pneumatic tests to ENGINEER.
- D. Conduct pressure test with air. Test time and pressure shall be as indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by ENGINEER. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

System	Pressure	Medium	Duration
Natural Gas	Test pressure shall be no less than 1.5 times the proposed maximum working pressure, but not less than 3 psi. Where the test pressure exceeds 125 psi, test pressure shall not exceed 50% minimum yield strength of pipe.	Air, carbon dioxide, nitrogen, or inert gas.	1/2 hour per 500 cubic feet pipe volume not to exceed 24 hours. Test duration shall be not less than 1/2 hour for each 500 cubic feet of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet the test duration shall be a minimum of 60 minutes. The duration of the test shall not be required to exceed 24 hours.

- E. Gradually increase the pressure to not more than one half of the test pressure; then increase pressure in steps of approximately one-tenth of the test pressure until the required test

pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. After testing is complete, slowly release the pressure in a safe manner.

- F. All necessary piping, fittings, blind flanges, and apparatus for conducting tests shall be furnished by CONTRACTOR and shall comply with the requirements of NFPA 54 and as required by local codes.
- G. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed in table above. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.
- H. Test pressure shall be measured with a manometer or with a pressure-measuring device designed and calibrated to read, record or indicate a pressure loss caused by leakage during the pressure test period.
- I. Piping system shall withstand test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate a leak unless can be attributed to some other cause.
- J. Leakage shall then be located by means of a gas detector, a noncorrosive leak detection fluid, or other leak detection method. Matches, candles, open flames or other methods that provide a source of ignition shall not be used.
- K. When placing system into operation, appliances and equipment shall not be placed into operation until piping system has been checked for leakage with above requirements.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1—GENERAL

1.01 SCOPE

- A. This section contains specifications for all refrigerant piping for this project. Included are the following topics:
 - 1. Refrigerant piping.
 - 2. Refrigerant piping accessories.
 - 3. Refrigerant.

1.02 REFERENCE

- A. Applicable provisions of Division 01 govern work under this section.

1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ANSI B16.22—Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASHRAE 15—Safety Standard for Refrigeration Systems.
 - 3. ASHRAE 32—Sustainable, High-Performance Operations and Maintenance.
 - 4. ASHRAE 34—Designation and Safety Classification of Refrigerants.
 - 5. ASME B31.5—Refrigeration Piping and Heat Transfer Components.
 - 6. ASTM B280—Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 7. NFPA 70—National Electrical Code.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

1.05 COPPER TUBE

- A. Statement from manufacturer on their letterhead that the pipe furnished meets the ASTM specification contained in this section.

1.06 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Order all copper refrigeration tube with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.
- D. Storage and protection methods must allow observation to verify products.

1.08 DESIGN CRITERIA

- A. Use only new material, free of defects and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

1.09 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 REFRIGERANT PIPING

- A. Acceptable manufacturer is Streamline ACR Copper Tube, or equal.
- B. Piping shall be hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper solder-type fittings. The piping shall have an operating pressure of 700 psi at 250°F.
- C. Precharged tubing line sets may be used on systems 3 1/2 tons and less in size.

2.02 REFRIGERANT PIPING ACCESSORIES

- A. Acceptable manufacturers are Sporlan, Alco, or equal.
- B. Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to no less than the pressure vessel.
- C. Flexible Pipe Connectors: Double braided bronze hose flexible pipe connectors with solder end connections.
- D. Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.
- E. Sight Glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.
- F. Solenoid Valves: Two-way, normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.
- G. Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.
- H. Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.
- I. Charging Valves: Provide 1/4-inch SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.
- J. Check Valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

2.03 REFRIGERANT

- A. Refrigerant shall be as noted on Drawing schedules.

PART 3-EXECUTION

3.01 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

3.02 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult Drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- C. Do not install piping running through any elevator shaft, public stairway, stair landing, or means of egress.
- D. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.03 REFRIGERANT PIPING

- A. Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the International Mechanical Code.
- B. All brazing filler metals shall have a melting temperature above 1,400°F and contain a minimum of 6 percent silver.
- C. Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before brazing. Avoid prolonged heating and burning during brazing. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.
- D. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- E. Systems erected on site which use A1 refrigerants and no piping larger than 0.62 inch in diameter shall be leak tested with refrigerant in accordance with ASHRAE 15 as follows. All other systems shall be leak tested with dry nitrogen or nonflammable, nonreactive, dried gas in accordance with ASHRAE 15. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.

- F. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.
- G. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

3.04 REFRIGERANT PIPING ACCESSORIES

- A. Install accessories in accordance with the manufacturer's written instructions and recommendations.

END OF SECTION

SECTION 23 31 00

DUCTWORK AND DUCTWORK SUPPORTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Duct Pressure/System Class.
 - 2. Duct Materials.
 - 3. Insulated Flexible Ductwork.
 - 4. Fasteners, Hangers and Supports.
 - 5. Duct Sealants and Gaskets.
 - 6. Ductwork Fabrication.

1.02 REFERENCES

- A. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Provide layout drawing for review prior to ductwork fabrication. Layout drawings shall be coordinated between all other trades prior to review.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00—Contract Closeout.
- B. Record actual locations and sizes of ducts and duct fittings. Record changes in fitting location sizes and types. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA—HVAC Duct Construction Standards—Metal and Flexible.

1.06 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain recommended minimum temperatures during and after installation of duct sealants.

- C. Ductwork shall be stored indoors or in durable, waterproof, abovegrade packing.

1.08 DUCTWORK DESIGN

- A. Duct layout and design shown on the Drawings are based on design of supply, return and exhaust system components. Any changes to the design for installation shall be submitted to and approved by OWNER and ENGINEER. Proposed changes shall be submitted with layout and pressure drop calculations. CONTRACTOR shall be responsible for the cost of any changes to the duct system or any system components.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Store products inside and protect from weather.

1.10 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 DUCT PRESSURE/SYSTEM CLASS (METAL DUCTWORK)

- A. Ductwork shall be constructed to the static pressure class as shown below, unless otherwise noted:
 - 1. Supply ductwork: 2-inch positive pressure class.
 - 2. Supply ductwork upstream of VAV boxes: 2-inch positive pressure class.
 - 3. Supply ductwork downstream of VAV boxes: 2-inch positive pressure class.
 - 4. Exhaust air ductwork: 2-inch negative pressure class.
 - 5. Return air ductwork: 2-inch negative pressure class.
 - 6. Outside air ductwork: 2-inch or 4-inch negative pressure class.

2.02 DUCT MATERIALS

- A. All sheet metal used for construction of duct shall be 24 gauge, or heavier, except for round ductwork 12 inches and smaller shall be 26 gauge where allowed by SMACNA.

- B. Galvanized steel ducts shall be ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating of 1.25 ounces per square foot in conformance with ASTM A90. Sheet metal for ductwork noted or specified to be painted shall include "Paint Grip" finish.

2.03 INSULATED FLEXIBLE DUCTWORK

- A. Insulated flexible ductwork shall be Atco Model 76 Series, or equal, with 1 1/2-inch, 3/4-pound density fiberglass insulation, reinforced polyester or foil-type vapor barrier, polyester or vinyl film with bonded galvanized steel helix core liner, and zinc-coated high carbon steel helix. Thermal conductance shall not exceed 0.23 btu/h-ft-°F minimum negative working pressure rating shall be 3/4 inches of water and minimum positive pressure rating shall be 6 inches of water. All items shall comply with UL-181, NFPA 90A, and 90B. Flame spread-25 maximum, smoke development-50 maximum.

2.04 FASTENERS, HANGERS, AND SUPPORTS

- A. Ductwork shall be supported in accordance with SMACNA-HVAC Duct Construction Standards-Metal and Flexible. Secure wire method of support is not acceptable.
- B. Inserts and Fasteners:
 - 1. Concrete inserts installed prior to pouring shall be manufactured inserts. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Acceptable manufacturers include Hilti, Rawl, and Redhead.
 - 2. Concrete fasteners installed after pouring shall be epoxy-type.
 - 3. Fasteners for structural steel shall be beam clamps.
 - 4. Fasteners to ductwork shall be 316 stainless steel, unless otherwise indicated.
- C. Hangers:
 - 1. Strip hangers shall be only used in concealed areas and shall be galvanized steel.
 - 2. Hanger rod shall be ASTM A36 galvanized steel for galvanized ducts or 316 stainless steel for ducts other than galvanized, unless noted otherwise. Rods shall be continuously threaded.
- D. Supports:
 - 1. Duct support material shall be galvanized steel for galvanized duct. Material for supports in corrosive spaces shall be as noted below.
 - 2. Acceptable supports for trapeze hangers are steel angles. Exposed ductwork shall be supported by steel angle supports painted to match duct.
 - 3. Riser supports shall be angles or channels secured to the sides of the duct with welds or fasteners.
 - 4. Provide all supporting steel required for the installation of ductwork and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support.
 - 5. For ground or equipment pad mounted support stand, use galvanized structural steel members and use duct rollers fastened to the structural member. Supports shall be secured to the ground or equipment pad.
- E. Beam Clamps:
 - 1. MSS SP-58 Type 23 malleable black iron clamp for attachment to beam flange to 0.62-inch-thick for single threaded rods of 3/8-, 1/2-, and 5/8-inch diameter. Furnish with a hardened steel cup point set screw. Acceptable manufacturer includes Anvil Figure 86.

2. MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1 1/2-inch diameter. Acceptable manufacturer includes Anvil Figure 228.
- F. Duct Penetrations Through Roof—Prefabricated Metal Curb: Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3-pound density rigid fiberglass insulation, integral deck mounting flange, nominal 2-inch wood nailer, galvanized steel counter flashing. Do not use built-in metal base flashings or cants. An 8-inch high (minimum) curb height is required.

2.05 DUCT SEALANTS AND GASKETS

- A. Duct sealant shall be United McGill—United Duct Sealer, or equal for indoor applications and United McGill—Uni-Weather Duct Sealer, or equal for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.
- B. Gaskets at flanged joints shall be butyl rubber or EPDM.

2.06 DUCTWORK FABRICATION

- A. Rectangular Field and Shop Fabricated Ductwork:
1. Fabricate and support in accordance with SMACNA—Duct Construction Standards—Metal and Flexible. Duct material, gauges, reinforcing, joint types and sealing shall be in accordance with required pressure class in the standard.
 2. Construct tees, bends, and elbows with radius of not less than 1 1/2 times width of duct on centerline. Where not possible, rectangular elbows may be used with turning vanes in accordance with Section 23 33 00—Air Duct Accessories.
 3. Increase duct sizes gradually, not exceeding 15 degree divergence wherever possible; maximum 30 degree divergence upstream of equipment and 45 degree convergence downstream.
 4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets, unless otherwise noted.
 5. Provide reinforcement and rigidity required for pressure class.
 6. Provide cross breaking or cross beading on duct sides larger than 18 inches.
 7. Seal all joints airtight with gaskets and sealants.
- B. Round Manufactured Ductwork and Fittings:
1. Fabricate and support in accordance with SMACNA—Duct Construction Standards—Metal and Flexible. Duct material, gauges, reinforcing, joint types and sealing shall be in accordance with required pressure class in the standard.
 2. Ductwork shall be fabricated spiral seam round.
 3. Ductwork shall be constructed with locktight spiral grooved seams, gored elbows with centerline radius of 1 1/2 times the duct diameter, and male/female fittings. Conical tees, conical 45 degree laterals, conical bellmouth taps, and fittings shall be used.
 4. Seal all joints airtight with gaskets and sealants.
 5. Where grilles and registers are shown to be tapped into ductwork sides, the entire assembly including the round duct section and the rectangular tap shall be fully welded and provided by the manufacturer.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards-Metal and Flexible.
- C. Duct sizes are inside clear dimensions. For lined or double-wall ducts, maintain sizes inside lining.
- D. Provide openings in ductwork to accommodate testing equipment and controllers. Where openings are provided in insulated ductwork, install a metal insulation sleeve of same material as ductwork.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Make all necessary incidental changes in cross-section, offsets, etc., to avoid interference with other equipment and supports.
- F. Supports:
 - 1. Use double nuts and lock washers on threaded rod supports.
 - 2. Strip hangers are acceptable in concealed spaces only.
 - 3. Inserts shall be coordinated with CONTRACTOR for installation in concrete.
 - 4. The weight of the ductwork shall be supported independently of connected equipment.
 - 5. Roof Mounted Supports: Use for all ductwork on roof. Secure bottom of support flat on roof deck. Apply two coats of zinc rich paint to cut edges of all galvanized steel elements. Flashing and counter flashing by the Division 07 Contractor.
 - 6. Secure ducts to supports with metal straps over ductwork and insulation and jacketing, if applicable.
- G. Duct Roof Curbs:
 - 1. Secure bottom of support flat on roof deck. Secure equipment to curb in accordance with equipment manufacturer's instructions. Flashing and counter flashing by the Division 07 Contractor.
 - 2. Fill the entire void space with compressible fiberglass insulation.
- H. Duct Penetration Through Roof: Install at points where ducts penetrate roof. Install as shown on the Drawings, as detailed and according to the manufacturer's installation instructions. Fill the entire void space with compressible fiberglass insulation. Flashing and counterflashing by the Division 07 Contractor.
- I. Connect air diffusers, registers, and grilles to supply and return ducts directly. Where registers and grilles are to be mounted on exposed ductwork, provide flanged opening for finished appearance.
- J. For flexible ductwork, follow manufacturer's installation instructions with particular attention to fully extending duct. Ducts shall be supported to prevent sags in excess of 4 inches in 10 feet. No more than one long turn (radius = 1 1/2 times diameter) will be allowed in any single run. Use round sheet metal stub ducts with conical bell mouth inlet and damper attached to trunk or branch duct for starting flexible duct run and provide insulated guard. Furnish and install a rigid elbow at the inlet to each diffuser of same diameter as flexible

duct. Steel strap clamp bands or plastic draw bands with self-lock may be used for connection of flexible ducts to other materials. Maximum duct lengths shall be 6 feet for any runout.

- K. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- L. Provide an experienced installer to go through the air distribution system with the balancer.
- M. Any modifications to the ductwork shown on the Drawings must be reviewed by ENGINEER prior to installation.
- N. Where ducts pass through non-fire rated partitions in interior or exterior walls, provide stainless steel flange on four sides on both sides of partition concealing opening. Flange shall overlap opening all around by 2 inches. Fill space with insulation if duct is insulated on either side of partition.
- O. Where ducts pass through fire rated partitions in interior or exterior walls, install fire damper sleeve in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Air turning devices.
 - 2. Duct access doors.
 - 3. Duct test holes.
 - 4. Fire dampers.
 - 5. Flexible duct connections.
 - 6. Duct screens.
 - 7. Balancing dampers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
 - 2. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
 - 3. UL 33—Heat Responsive Links for Fire-Protection Service.
 - 4. UL 555—Fire Dampers and Ceiling Dampers.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Damper submittals shall include actual pressure drop, free area, and torque requirements for each type of damper provided.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00—Contract Closeout.
- B. Record actual locations of access doors, fire dampers, flexible duct connections, dampers, and screens.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products in accordance with manufacturers recommendations and Section 01 60 00—Materials and Equipment.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 AIR TURNING DEVICES

- A. Provide factory-fabricated metal air turning vanes in all square elbows and bends according to SMACNA Standards. Turning vanes shall be constructed of the same material specified for the ductwork.

2.02 DUCT ACCESS DOORS

- A. Provide Ductmate Model FD&H, or equal, access doors for ductwork. Access door hinge and cover shall be constructed of material similar to that specified for ductwork. Provide insulated access doors where ductwork is insulated. All access doors shall be gasketed.

2.03 DUCT TEST HOLES

- A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps. Coordinate test hole height with insulation thickness.
- B. On uninsulated ductwork only, plastic pull-tab centered tapered plugs may be used. Plugs shall be Caplugs CPT-3, or equal, with minimum diameter of 0.36 inch.

2.04 FIRE DAMPERS

- A. Provide fire dampers equal to Greenheck Model DFD-150, Type B or Type C, or Model DFD-350, of sizes and locations as indicated on the Drawings. Dampers shall have a

1 1/2-hour fire rating unless indicated on the Drawings to have a 3-hour rating. Fire dampers shall meet NFPA 90A and shall be UL555 listed and labeled. Blades shall be located out of the airstream. Dampers shall be of stainless steel construction where indicated.

2.05 FLEXIBLE DUCT CONNECTIONS

- A. Flexible duct connections in unrated spaces shall be Ventfabrics, Inc. "Ventglas®", or equal, neoprene-coated glass fabric. Fabric shall be suitable for continuous operation up to 200°F. Fabric shall have zero leakage at ±10 inches water column.

2.06 DUCT SCREENS

- A. Provide screens equal to Ryerson Ryex Standard, 3/4 inches, 12-gauge sheet metal with border frame for protection on open duct inlets and outlets, and as indicated on the Drawings. Frame and screen shall be of similar material to ductwork.

2.07 BALANCING DAMPERS

- A. All balancing dampers shall be provided with locking devices to hold the dampers in a fixed position without vibration. Single blade dampers shall be stiffened to operate in a stable manner.
 - 1. Balancing dampers for rectangular metal ductwork 12 inches high or less and for round metal ductwork shall be single blade manual balancing dampers of same material as specified for the ductwork. Dampers shall conform to SMACNA standards for single blade-type volume dampers.
 - 2. Balancing dampers for rectangular ductwork over 12 inches high shall be Greenheck VCD-20, or equal, multi-blade volume dampers of same material as specified for the ductwork. Damper blades shall be 3V type of 16-gauge construction. Bushings shall be nylon. Axles shall be 1/2-inch diameter. Blade operation shall be opposed. Damper shall include an indicator to show position of the blades. Where dampers are installed in vertical ductwork, provide dampers with jamb seals designed for vertical duct installation.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards—Metal and Flexible. Refer to Section 23 31 00—Ductwork and Ductwork Supports for duct construction and pressure class.
- B. Provide duct access doors for inspection and cleaning before and after intake louver screens, filters, coils, fans, automatic dampers, at fire dampers, underneath duct smoke detectors, and elsewhere as indicated. Duct access doors shall be provided every 10 feet on supply, return, and exhaust ductwork associated with production area units, including MAU-80-01 and AHU-90-01. Provide minimum 8-inch by 8-inch size for hand access, 18-inch by 18-inch size for shoulder access.

- C. Division 23 shall be responsible for coordinating with testing and balancing agency and providing test holes in all locations required for testing and balancing agency to complete their scope of work.
- D. Provide fire dampers at locations indicated and where ducts and outlets pass through fire-rated components. Install with perimeter mounting angles, sleeves, breakaway duct connections, corrosion-resistant springs, bearings, bushings, and hinges.
- E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Metal-to-metal gap shall be approximately 4 inches.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts for air balancing and where indicated on the Drawings. Install minimum two duct widths from duct takeoff.
- G. Provide balancing dampers on duct takeoff to diffusers, grilles, and registers regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Centrifugal sidewall fans.
 - 2. Ceiling or cabinet fans.
 - 3. Centrifugal inline fans.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. AMCA 99–Standards Handbook.
 - 2. AMCA 210–Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 3. AMCA 300–Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA 301–Method for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 5. ASTM B117–Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 6. NFPA 70–National Electrical Code.
 - 7. NEMA MG 1–Motors and Generators.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Submittal shall include fan-specific performance curves showing airflow, head, and motor horsepower.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements shall follow the recommendations in the manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Fans shall bear AMCA-certified rating seals.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.
- F. Motors, shafts, and bearings shall be protected from weather and dust.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule, and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be

included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 CENTRIFUGAL SIDEWALL FANS

- A. Acceptable manufacturers are Greenheck, Cook, or Twin City Fans.
- B. Centrifugal sidewall fans shall be of drive type listed on drawing schedules. Fan installation shall include drain trough, and bird guard. Fan performance shall be as indicated on drawings schedules. Fans shall be UL listed.
- C. The fan housing shall be aluminum with all fasteners either aluminum or stainless steel.
- D. All fan wheels shall be aluminum construction, have backward-inclined or forward-curved blades, and the fan wheel shall be statically and dynamically balanced.
- E. The entire drive assembly shall be mounted on neoprene vibration isolators to provide quiet, vibration-free operation. Fan performance shall include AMCA-certified air and sound ratings, and fans shall bear the AMCA seal.
- F. The fan motor shall be totally enclosed, fan-cooled, and shall be NEMA-approved. Motor shall be provided with a 1.15 service factor. Starters and disconnects shall be provided as noted on equipment schedules. Motors 1 hp and higher shall have NEMA premium efficiency rating. Where drawing schedules indicate, provide electronically commutated motor capable of varying speed based on external 0 to 10 VDC control signal. Motors operating on VFDs shall be inverter ready, meet the requirements of NEMA MG1, Part 31 for motor insulation, and be capable of a minimum speed turndown of 4:1. Provide shaft grounding split ring kit as manufactured by AEGIS, or equal, for motors operating on VFDs. Thermostats shall be applied to motor windings, capable of shutdown and manual reset by external controls (by Division 26).
- G. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- H. Provide an aluminum wire bird guard on the fan’s discharge.
- I. Manufacturer shall provide a prefabricated, insulated aluminum sidewall mounting bracket.
- J. All surfaces of fan, bird screen, and curb liner shall be coated with 2 to 3 mils of Hi-Pro Polyester powder coating. Wheel shall be rebalanced statically and dynamically by the fan manufacturer after application of coating. Color to be selected by OWNER. Submit color chart with shop drawings.

2.02 CEILING FANS OR CABINET FANS

- A. Acceptable manufacturers are Greenheck, Cook, or Twin City Fans.
- B. Fans shall have acoustically insulated housings and shall have maximum sound level rating not to exceed 4.0 sones in accordance with AMCA Bulletin 300-74. Fans shall bear the AMCA-certified ratings and seal for air capacity, sound, and UL label.
- C. Unit shall be equipped with integral chatter proof backdraft damper.
- D. Fans shall have centrifugal wheel with inlet perpendicular to grille. Ceiling grille shall be aerodynamically designed and shall provide 80% free area.
- E. Terminal box shall be furnished with cord, plug, and receptacle inside housing. Entire fan, motor, and wheel assembly shall be removable without disturbing the housing. Motor speed shall not exceed 1,100 rpm.
- F. Fan shall be mounted on vibration isolators furnished by fan manufacturer.
- G. Manufacturer shall furnish line voltage internally-mounted and wired variable speed controller for fan. Controller shall be used for balancing only and shall be inaccessible to room occupants unless otherwise indicated on the Drawings. The fan motor shall be open drip proof as indicated on Drawings. Starters and disconnects shall be provided as noted on equipment schedules. Where indicated on equipment schedules, provide electronically commutated motor (ECM) capable of varying speed based on external 0 to 10 VDC control signal.

2.03 CENTRIFUGAL INLINE FANS

- A. Acceptable manufacturers are Greenheck, Cook, or Twin City Fans.
- B. Centrifugal inline fans shall be of drive type indicated on drawing schedules. Fan performance shall be as indicated on equipment schedules. Fans shall be UL listed.
- C. The fan wheel shall be centrifugal with backward-inclined blades. The fan wheel shall be statically and dynamically balanced.
- D. The fan shall be quiet-operating and vibration-free. Fan performance shall include AMCA-certified air and sound ratings and AMCA seal. Furnish and install spring-type vibration isolators provided by fan manufacturer.
- E. The fan shaft shall be mounted in prelubricated ball bearing pillow blocks. Bearings shall be sealed and have a minimum L₁₀ life of 100,000 hours.
- F. The fan housing shall be all aluminum construction with square inlet and discharge collars. Provide access panels for servicing drives and motors. All fasteners shall be either stainless steel or aluminum.
- G. Fans shall be mounted on vibration isolators furnished by fan manufacturer.
- H. Belt drives shall have a sliding or pivoting motor plate for belt tensioning. The belt and motor shall be totally enclosed by a guard with tachometer holes. The motor shall be mounted out

of the airstream. The fan motor shall be totally enclosed, fan-cooled, and NEMA-approved ball-bearing type. Starters and disconnects shall be provided as noted on equipment schedules. Motors shall be provided with a 1.15 service factor. Where indicated on drawing schedules, provide electronically commutated motor capable of varying speed based on external 0 to 10 Vdc control signal. Motor operating on VFDs shall be inverter ready, meet the requirements of NEMA MG1, Part 31 for motor insulation, and be capable of a minimum speed turndown of 4:1. Provide shaft grounding split ring kit as manufactured by AEGIS, or equal, for motors operating on VFDs.

- I. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Install units with vibration isolators as recommended or supplied by manufacturer.
- D. Provide flexible duct connections on all duct connections to unit in accordance with Section 23 33 00—Air Duct Accessories.
- E. Provide lubrication line extenders as required to allow regreasing of bearings without removal of equipment components.
- F. Provide all mounting hardware and accessories necessary for complete installation.
- G. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- H. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- I. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 23 34 39

HIGH VOLUME-, LOW-SPEED PROPELLER FANS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Industrial paddle-type ceiling fans.
 - 2. High-volume low-speed fans.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. AMCA 99—Standards Handbook.
 - 2. AMCA 210—Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 3. AMCA 300—Reverberant Room Method for Sound Testing of Fans.
 - 4. AMCA 301—Method for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 5. NFPA 70—National Electrical Code.
 - 6. NEMA MG 1—Motors and Generators.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Fans shall bear AMCA-certified rating seals.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Submittal shall include fan-specific performance curves showing airflow, head, and motor horsepower.

- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.
- F. Motors, shafts and bearings shall be protected from weather and dust.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material,

with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 INDUSTRIAL PADDLE-TYPE CEILING FANS (IFC)

- A. Acceptable manufacturers are TPI Industrial Model E-56CF, or equal.
- B. Provide permanently sealed, double radial, ball bearing motor.
- C. Provide 3-paddle polymer, moisture-resistant blade assembly.
- D. Provide white powder-coated finish on steel motor housing and downrod.
- E. Provide an 18-inch downrod.
- F. Provide conduit chase within down rod for electrical connection.
- G. Provide multispeed and reversing switch fan controller, Model Number KBWC-15SK.

2.02 HIGH VOLUME LOW SPEED FANS (HVLS)

- A. Acceptable manufacturer is Big Ass Solutions, or equal.
- B. Airfoils:
 - 1. Each fan shall have eight low speed airfoils of extruded 6063 T5 aluminum alloy.
 - 2. Each airfoil shall be of the high performance PowerFoil™ design.
 - 3. The foils shall be connected to the hub section of the fan by means of two locking bolts per foil. The locking bolts shall be SAE grade 8 only, 5/16-inch diameter with 150,000 psi tensile strength.
 - 4. The airfoils shall be interlocked with airfoil retainers to prevent an individual airfoil from becoming accidentally disconnected from the hub. The straps shall consist of 1008 steel with a clear zinc chromate finish.
- C. Winglets:
 - 1. Powerfoil plus winglets shall redirect outward airflow into downward airflow.
 - 2. Winglets shall be attached to the tip of each foil by means of a No. 10 barrel screw.
 - 3. Each winglet shall be colored as specified by OWNER, nominally measure 8 1/2 inches by 3 inches, and be made of No Break Polypropylene.
- D. Motor: The fan motor shall be Baldor/Reliance, 1750 RPM, 460 VAC, 60 Hz, three phase, inverter rated with Class F insulation, 40°C ambient continuous. Model PPX4-14 shall be 1.9 horsepower or 1.4 kW.
- E. Bevel Gear Reducer:
 - 1. The gear reducer shall be a high efficiency helical gear reducer with a cast iron housing.
 - 2. Gearing shall be precision finished for low noise and long service life with a backlash of less than 20 arc minutes. Output shaft diameter shall be 1 1/4 inch 17 4 PH stainless steel.

3. Gear reducer shall be assembled with double lip seals to prevent contamination or oil leakage and shall be lubricated for life.
- F. Motor Frame: The fan motor frame and mount shall be constructed of 3/16 inch powder coated steel.
- G. Hub:
1. The fan hub assembly shall be constructed of a precision cast of prime 713 aluminum zinc magnesium alloy.
 2. The hub shall incorporate six safety clips made of 1/4-inch steel that shall restrain the hub/airfoil assembly in case of shaft failure.
- H. Mount:
1. The fan mount shall be designed for quick and secure mounting of the fan from a structure's supported beams.
 2. The mounting system of the fan shall allow easy removal and relocation, if required.
 3. The fan mount shall be constructed of 3/16-inch powder coated steel.
- I. Safety Cable:
1. The safety cable shall provide an additional means of securing the fan assembly to the building structure.
 2. The safety cable shall be 1/4-inch in diameter and consist of 7 by 19 galvanized steel with swaged Nicopress end loops. The ends shall be secured by 7/16-inch screw in shackles.
 3. The safety cable shall have a breaking strength of at least 7,000 pounds.
- J. Fan Controller:
1. Fan controller shall be UL listed as Industrial Control Panels and built pursuant to construction guidelines set forth by UL Article 508A and the National Electrical Code.
 2. Each fan controller shall include a factory programmed Variable Frequency Drive (VFD) to provide a soft start for the fan, as well as infinite speed control capability for the fan.
 3. Multiple motor systems shall include a Solid State Overload relay for each motor.
 4. Load reactors shall be included for 575 to 600 V single fan controls, and 400 to 600 V multifan controls.
 5. Each fan controller shall be constructed of durable UV-resistant materials and equipped with an ON/OFF/AUTO switch, speed control potentiometer, safety disconnect, and properly sized fuse block.
 6. The controls shall be housed in a NEMA Type 1 enclosure to prevent accidental contact with the enclosed equipment, and to exclude entry of unwanted substances.
 7. Provide one controller to control both HVLS-80-01 and HVLS-80-02. Controller shall be located as shown on the Drawings.
- K. Fan Controller Program: Controllers and VFD shall be factory programmed to minimize starting and braking torques.

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 ENGINEER of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- E. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- F. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.
- G. Fan controllers shall be installed on wall 48 inches above finished floor (top of box), unless otherwise noted.

END OF SECTION

SECTION 23 36 16

VARIABLE AIR VOLUME (VAV) UNITS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Single-duct units for VAV Systems.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ARI 410—Forced Circulation Air-Cooling and Air-Heating Coils.
 - 2. ARI 880—Performance Rating for Air Terminals.
 - 3. NFPA 70—National Electrical Code.
 - 4. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
 - 5. NFPA 90B—Installation of Warm Air Heating and Air Conditioning System.
 - 6. UL181—Factory-Made Air Ducts and Air Connectors.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.
- E. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation and UL 181 requirements for antierosion, corrosion, and fungus properties.
- F. Coil performance shall be tested to 250 psig with coil submerged in water and certified in accordance with ARI 410 for Forced Circulation Air-Cooling and Air-Heating Coils.
- G. Sound power levels shall be ARI-certified in accordance with the requirements of ARI-880-89.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Submit manufacturer's installation instructions and recommendations.
- D. Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers are Enviro-Tec, Titus, or equal.

2.02 VAV BOXES

- A. General:
 - 1. VAV Boxes shall be a factory-assembled, externally-powered control terminal. Unit shall be complete with a damper assembly, flow sensor, externally-mounted volume controller, collars for duct connection, and all required features. Control box shall be clearly marked with an identification label that lists such information as nominal cfm, maximum and minimum factory-set airflow limits, and coil-type.
 - 2. Units shall be furnished with factory-installed actuators suitable for DDC controls and heating coil-type (hot water or electric).
- B. Unit Cabinet shall be constructed of 22-gauge galvanized steel with round, rectangular, or flat oval inlet collar, and rectangular discharge with slip and drive connection. Cabinet shall be insulated with 1-inch closed cell foam.
- C. The damper assembly shall be composed of multiple 16 gauge damper blades located in a 16 gauge damper frame, utilizing steel damper linkages, and mounted on nylon self-lubricating blade bearings. Damper assembly shall consist of either four or six blades with a 90-degree travel, and shall provide uniform air delivery over the entire face of the unit at all flows.
- D. VAV box manufacturer shall factory mount and wire the DDC VAV controls and actuator package as furnished by the Division 26. Coordinate with control contractor. The cost of factory installation of the DDC control package shall be included in the VAV box price. VAV boxes will receive 24-volt power from the temperature control panel for damper and valve control. Provide terminal strip in control box for field wiring of thermostat and power source.
- E. Electric heating coil shall be factory-provided and mounted, UL-recognized, resistance open-type heater with airflow switch, disk-type automatic thermal primary safety device, non-fused disconnect, and manual reset thermal secondary safety device. Heater element shall be nickel-chromium material. Terminal connections shall be plated-steel with ceramic or phenolic insulators.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Touch-up, repair or replace damaged products at no additional cost to OWNER.

- D. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer.
- E. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 23 37 08

LOUVERS AND VENTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Louvers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ADC 1062—Certification Rating and Test Manual.
 - 2. AMCA 500—Test Method for Louvers, Dampers, and Shutters.
 - 3. ARI 650—Air Outlets and Inlets.
 - 4. ASHRAE 70—Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
 - 5. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.

1.03 QUALITY ASSURANCE

- A. Performance of air terminals shall be in accordance with ADC 1062.
- B. Louvers shall be tested and certified in accordance with AMCA 500 and shall bear the AMCA seal.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include a louver schedule that includes louver model, screen type, screen location, louver size, finish type, free areas, face velocity, and pressure drop for each louver.
- C. Submit manufacturer's installation instructions and recommendations.
- D. Submit color selection chart with submittal for selection by OWNER.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.

- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. Scratched, dented, and otherwise damaged units shall be repaired or replaced with no additional cost to OWNER.

PART 2–PRODUCTS

2.01 LOUVERS (EXTRUDED ALUMINUM)

- A. Acceptable louvers are Greenheck ESD 635, or equal. See Drawings for sizes and locations.
- B. Blades and frame shall be extruded aluminum 6063-T5 alloy and 0.08-inch thickness.
- C. Blades shall be 35-degree drainable type spaced at 4 inches on center. Louver shall be capable of a velocity of 1,077 fpm with no water penetration. Performance shall include AMCA-certified air and moisture penetration data and louver shall bear the AMCA seal. Vertical and horizontal mullions and connections between panels shall not be exposed.
- D. Provide channel frame unless noted otherwise on the Drawings.
- E. Provide aluminum screen on louver (type and location) in accordance with louver schedule and detail on the Drawings. All fastenings shall be stainless steel or aluminum. Screen frame shall be painted to match louver. Paint shall be by manufacturer or per Section 09 91 00–Painting.
- F. Louver free area shall be equal to or greater than attached ductwork and damper free area.
- G. Louvers shall be furnished with 3 coats of 70% Kynar 500 finish with custom color selected by OWNER. Submit manufacturer's standard color chart with shop drawings.

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 ENGINEER of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions, drawing details, and approved submittals.
- C. Clean surface of louvers and vents after installation.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Diffusers, registers, and grilles.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ADC 1062—Certification Rating and Test Manual.
 - 2. AMCA 500—Test Method for Louvers, Dampers, and Shutters.
 - 3. ARI 650—Air Outlets and Inlets.
 - 4. ASHRAE 70—Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
 - 5. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Performance of air terminals shall be in accordance with ADC 1062.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittal shall include a schedule that includes model, size, and finish type.
- D. For product requiring color selection, provide a hard copy color chart to OWNER for color selection.
- E. CONTRACTOR shall provide all required sizes and quantities as shown on Drawings.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 DIFFUSERS, REGISTERS, AND GRILLES

- A. Acceptable manufacturers are Carnes (C), Price (P), Nailor (N), or Titus (T). Submit standard color chart with shop drawings for selection by OWNER.
- B. CD-1: Ceiling supply diffusers for lay-in ceilings shall be (C) SFAB, (N) ARNS, (T) TMS-AA or (P) ASCDA. 24 by 24 diffusers shall be fixed aluminum stamped-type with round neck duct connection.
- C. SD-1: Slot diffusers shall be (C) DFSB, (N) 5800 Series, (T) T-slot, or (P) TBDI7. Diffuser plenum shall be lined with 1/4-inch 3 pcf density fiberglass matte-faced insulation with round duct inlet connection.
- D. RG-1 and EG-1: Eggcrate-type return, transfer, and exhaust grilles for lay-in ceilings shall be (C) RAPB, (N) 4260AA, (T) 50F, or (P) 80. Grilles shall be full-face egg crate with

1/2-inch by 1/2-inch by 1/2-inch aluminum core and frame. Ducted grille connection shall be round neck duct connection. Grilles open to plenum shall be provided with a light shield painted flat black.

- E. RG-2 and EG-2: Return, exhaust, and transfer grilles for sidewall and surface mounting shall be (C) RSLA, (N) 6145H, (T) 350RL, or (P) 530. Grilles shall be steel construction with 45-degree horizontal louvered blades.
- F. SG-1: Supply grilles for sidewall and surface mounting shall be (C) RSDB, (N) 61DH, (T) 300RL or (P) 520. Grilles shall be steel construction with double deflection blades.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Clean surface of diffusers, grilles, and registers after installation.
- E. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 23 37 23

HVAC GRAVITY VENTILATORS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Gravity roof ventilators.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references: NFPA 90A—Installation of Air Conditioning and Ventilating Systems.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Performance of air terminals shall be in accordance with ADC 1062.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Submittal shall include a ventilator schedule that includes ventilator model, screen type, ventilator size, finish type, free area, face velocity, and pressure drop for each ventilator.
- D. For product requiring color selection, provide a hard copy color chart to OWNER for color selection.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.

- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 GRAVITY ROOF VENTILATORS

- A. Acceptable manufacturers are Greenheck, Carnes, or equal.
- B. Gravity roof ventilator shall be heavy gauge aluminum construction and provided with roof curb and bird screen.
- C. Manufacturer shall furnish, and CONTRACTOR shall install, a prefabricated insulated aluminum roof curb with wood blocking to match roof pitch to allow for a level curb on roof. Curb shall be sized for 1/4-inch clearance on all sides between curb and ventilator mounting flange. Curb insulation shall be 1-inch thick, 3 pounds per cubic foot rigid fiberglass board. Curb height for low side of curb shall be 12 inches unless otherwise indicated. For roof ventilators on pitched roof, manufacturer shall furnish a pitched crickets roof curb. Roof curb shall be provided with a foam seal and an aluminum liner.
- D. All surfaces of the gravity roof ventilators including curb liner shall be coated with 2 to 3 mils of Hi-Pro Polyester powder coating. Color shall be selected by OWNER. Submit color chart with shop drawings.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 23 51 00

BREECHINGS, CHIMNEYS, AND STACKS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Single Wall Special Gas Vent.
 - 2. CPVC Vent Piping.
 - 3. Breechings/Connector Vents.
 - 4. Terminations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following reference.
 - 1. ASTM A167—Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 2. ASTM A525—Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.
 - 3. ASTM A527—Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
 - 4. ASTM D1784—Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 5. NFPA 54 (ANSI Z223.1)—The National Fuel Gas Code.
 - 6. NFPA 211—Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.
 - 7. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
 - 8. UL 103—Standard for Factory Built Low Heat Chimneys.
 - 9. UL 441—Standard for Gas Vents.
 - 10. UL 641—Standard for Low Temperature Venting Systems.
 - 11. UL 959 (ANSI Z181.1)—Medium Heat Appliance Factory Built Chimneys.

1.03 QUALITY ASSURANCE

- A. Factory-built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.

- B. Engineered generator exhaust systems shall be submitted with layout and section drawings by the manufacturer.

1.05 REGULATORY REQUIREMENTS

- A. Conform to NFPA 54 and local codes for installation of natural gas appliances and equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products in accordance with manufacturers' recommendations and Section 01 60 00–Materials and Equipment.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 GENERAL

- A. For each fuel-fired appliance, provide venting of category recommended by manufacturer.
- B. Size vents in accordance with manufacturer's recommendations.

2.02 SINGLE WALL SPECIAL GAS VENT

- A. Acceptable manufacturers are DuraVent Duraseal; Metal-Fab Corr/Guard; or Z-Flex Z-Vent.
- B. Maximum rated continuous temperature shall be 550°F.

- C. Vent shall be listed for an internal static pressure of at least 8-inch w.g. and tested to at least 15-inch w.g.
- D. Material shall be corrosion resistant Type 316 stainless steel, AL29-4C, or superior as approved by ENGINEER. Gaskets shall be of Viton material.
- E. Vent connections shall be secured by lock tabs. Joints shall be sealed with factory installed gasket.
- F. All joints and seams shall be gas-tight. Vents shall be leak tested in accordance with UL 1738.
- G. Provide all necessary accessories including flashing, counter flashing, storm collar, insulated thimble, rain cap with bird screen, clean out, fittings and all necessary supports. Where roof pitch exceeds 12:12, provide roof curb.

2.03 CPVC VENT PIPING

- A. Schedule 40 pressure rated CPVC may be used as allowed by the equipment manufacturer for condensing appliances or pressurized venting systems serving Category II, III or IV appliances.
- B. The material used in the manufacture of the pipe shall be a rigid chlorinated polyvinyl chloride (CPVC) compound, Type IV Grade 1, with a Cell Classification of 23447 as defined in ASTM D1784, and be light gray in color.
- C. Pipe sizes shall be in compliance with ASTM F441. Fittings shall meet requirements of ASTM F437.
- D. All joints and seams shall be gas-tight. Vents shall be leak tested in accordance with UL 1738. Solvent cement shall be specifically designed for higher temperature applications.
- E. Any CPVC piping subject to sunlight shall be formulated with ultraviolet light blocking additives to provide for long-term exposure with no deleterious effects.
- F. Pipe shall have a flame spread rating less than 25 and a Smoke Development rating less than 50 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88.

2.04 TERMINATIONS

- A. Small (<500 MBH) gas appliance vent terminations shall be as allowed by the appliance and vent system manufacturers.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Install stack, breeching, and accessories in accordance with the manufacturer's recommendations, maintaining minimum clearances from combustibles specified in UL listing, NFPA 54, and local codes.

- B. Level and plumb chimney and stacks.
- C. Install breechings with as few joints as possible. Align connections accurately and maintain smooth internal surfaces. All joints of positively pressurized exhaust vents shall be leak tight.
- D. Clean breeching, chimneys, and stacks internally during and after installation to remove dust and debris. Clean external surfaces to remove welding slag and mill film.
- E. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.
- F. Provide minimum 2-foot length of breeching to connect appliance to chimney.
- G. Insulate breechings in accordance with Section 23 07 13–Ductwork Insulation for Heating, Ventilation, and Air Conditioning.
- H. Pitch breechings with 1/4 inch per foot slope up from fuel-fired equipment to chimney or stack.
- I. At ends of breeching and chimneys which are not completed or connected to equipment, provide temporary closure which will prevent entrance of dust and debris until final connections are made.
- J. Support breechings from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support per manufacturer's recommendations and refer to SMACNA HVAC Duct Construction Standards–Metal and Flexible for equivalent duct support configuration and size. At minimum, support vertical sections at each floor penetration. Support from floor structure, roof structure, or adjacent structural surfaces. Verify load bearing capacity of support points with ENGINEER.
- K. Locate exhaust termination and combustion air intake in accordance with appliance manufacturer's recommendations to prevent re-entry of products of combustion.
- L. Termination of exhaust within 10 feet of operable windows, other building openings, or air intakes will not be accepted.
- M. Locate terminations with respect to normal wind direction so that the products of combustion are not likely to enter the building, regardless of the distance from the vent to the building openings or air intakes. Provide adequate termination height to avoid contamination of building recirculation zones in accordance with guidelines of ASHRAE Fundamentals.
- N. Seal all joints of positive pressure stacks and breeching in accordance with manufacturer's recommendations, using only sealants recommended by stack manufacturer.
- O. Provide drain points as indicated and per the manufacturer's recommendation to allow proper draining of condensate. Provide Flue Gas Condensate pH Neutralization at each drain piping termination point.

3.02 AIR INLETS AND VENT TERMINATIONS

- A. Coordinate air intakes with other vent terminations, plumbing vents, and HVAC exhaust openings.
- B. Terminations shall not be within 10 feet horizontally or less than 3 feet above openings for HVAC intakes or combustion air inlets.

END OF SECTION

SECTION 23 55 33

FUEL-FIRED UNIT HEATERS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Gas-fired unit heaters (GUH).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASHRAE 103—Heating Seasonal Efficiency of Central Furnaces and Boilers, Methods of Testing.
 - 2. NFPA 54 (AGA Z223.1)—National Fuel Gas Code.
 - 3. NFPA 70—National Electrical Code.
 - 4. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
 - 5. NFPA 90B—Installation of Warm Air Heating and Air Conditioning Systems.
 - 6. NFPA 211—Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.
 - 7. ASHRAE 90A—Energy Conservation in New Building Design.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, amperage readings, and all proper electrical connections. A copy of the start-up report shall be made and sent to both CONTRACTOR and to ENGINEER.
- C. All gas-fired heating equipment shall be design-certified by the American Gas Association.
- D. All control panels shall be UL listed.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.

- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals. Included in submittals shall be detailed control wiring diagrams that show logic circuits for the unit, as well as all external connections (i.e., thermostats, SCADA, etc.)
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 GAS-FIRED UNIT HEATERS (GUH)

- A. Acceptable manufacturers are Modine, Sterling, or Reznor.
- B. The unit cabinet shall be constructed of 22-gauge galvanized steel with a baked-enamel finish.
- C. The unit fan shall have a propeller fan with a direct-drive motor and fan guard.
- D. The unit heat exchanger shall be an indirect-fired, power-vented heat exchanger constructed of 409 stainless steel.
- E. Unit shall have an indirect-fired burner with power venting constructed of 409 stainless steel. Burner shall be furnished with a solid-state intermittent-spark electronic ignition system with electronic flame supervision and stack damper. Unit heaters shall have an 80% thermal efficiency.
- F. Burner shall be sealed combustion, direct vent. Provide all combustion air and vent piping, including concentric vent terminals, in accordance with Drawings and manufacturer's recommendations.
- G. Provide a gas train including 24-volt solenoid gas valve, main and pilot regulators, On-Off gas valve, transformer, high limit, stack damper, and fan On-Auto switch to operate fan without firing the burner.
- H. All burner and blower controls including motor starters shall be furnished by unit manufacturer and shall be factory-prewired. Equipment disconnect shall be provided by Division 26 contractor. Unit shall be equipped with controls for two-stage heating.
- I. Manufacturer shall furnish low-voltage thermostat. Thermostat shall be Honeywell Model Number CT53, or equal, with fan auto-on selector switch with room temperature setpoint adjustment. Control range shall be from 50°F to 90°F. Provide adaptor plate with thermostat for mounting to junction box.
- J. Provide two-way adjustable air deflector louvers.
- K. Mount units to provide 8 feet 0 inch clearance below, unless otherwise shown on the Drawings.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide vent connections in accordance with NFPA 211. Refer to Section 23 51 00-Breechings, Chimneys, and Stacks. Provide combustion air intake and vents in accordance with Drawings and manufacturer's recommendations.

- B. Drawings are based on the scheduled equipment make and model number. Any changes because of substitutions shall be provided and coordinated at no additional cost to OWNER.
- C. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- D. CONTRACTOR shall install the equipment and accessories in accordance with manufacturer's recommendations, NFPA 54, NFPA 90A, and as indicated on the Drawings. Provide connection to gas system.
- E. All equipment shall be installed plumb and level and anchored to structure.
- F. Proper access space around equipment shall be left for servicing the equipment. Follow manufacturer's recommendations for clearance and maintenance access requirements. Provide no less than a minimum of three feet, not including piping and piping appurtenances.
- G. Provide an adequate number of isolation valves for service and maintenance of the system and its components.
- H. Install the equipment under the direct supervision of an authorized representative of the manufacturer.
- I. All piping shall be brought to equipment connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping.
- J. All piping shall be fitted to equipment connections even though piping adjustments may be required after the pipe is installed.
- K. CONTRACTOR shall furnish the services of the equipment manufacturer's authorized representative to supervise prestart checkout, initial start-up, performance testing, and operator instruction. Time available shall be as required to properly start up.
- L. Any operational deficiencies noted in equipment start-up shall be promptly corrected.

END OF SECTION

SECTION 23 62 13

PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSER UNITS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Modulating compressor air-cooled condensing units.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASHRAE 15—Safety Code for Mechanical Refrigeration.
 - 2. ARI 210/240—Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 3. ARI 270—Sound Rating of Outdoor Unitary Equipment.
 - 4. UL 207—Refrigerant-Containing Components and Accessories, Nonelectrical.
 - 5. UL 900—Test Performance for Air Filter Units.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Project specific wiring diagrams for power, signal and control.
- D. Submit manufacturer's installation instructions and recommendations.

- E. Submittals must be specific to this project. Generic submittals will not be accepted.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MODULATING COMPRESSOR AIR-COOLED CONDENSING UNITS

- A. Acceptable manufacturers are AAON, ClimaCool, or Addison.
- B. General Description:
 - 1. Condensing unit shall include compressors, air-cooled condenser coils, condenser fans, suction and liquid connection valves, and unit controls.
 - 2. Unit shall be factory assembled and tested including leak testing of the coil and run testing of the completed unit. Run test report shall be supplied with the unit.
 - 3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - 4. Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
 - 5. Installation, Operation and Maintenance manual shall be supplied within the unit.
 - 6. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's access door.
- C. Construction:
 - 1. Unit shall be completely factory assembled, piped, and wired and shipped in one section.
 - 2. All cabinet walls, access doors, and roof shall be fabricated of G90 galvanized steel panels.
 - 3. Unit shall be specifically designed for outdoor application.
 - 4. Access to compressors and control components shall be through hinged access doors with quarter turn, lockable handles. Access to condenser coils and fans is through removable access panels.
 - 5. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 - 6. Unit shall include lifting lugs.
 - 7. Unit shall include forklift slots.
- D. Electrical:
 - 1. Unit shall be provided with standard power block for connecting power to the unit.
 - 2. Control circuit transformer and wiring shall provide 24 VAC control voltage from the line voltage provided to the unit.
 - 3. Unit shall have a 5kAIC SCCR.
- E. Refrigeration System:
 - 1. Compressors shall be R-454B scroll type with thermal overload protection, individually circuited and carry a 1 year non-prorated warranty, from the date of original equipment shipment from the factory. Each compressor shall be furnished with a crankcase heater.
 - 2. Compressors shall be mounted in an isolated service compartment. Lockable hinged access doors shall provide access to the compressors.
 - 3. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators and mounted on an elevated compressor deck, to reduce any transmission of noise from the compressors into the building area.
 - 4. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and service valves for liquid and suction

- connections. Liquid line filter driers shall be factory provided and installed. Field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line, insulated hot gas bypass line and insulated suction line.
5. Unit shall include a factory holding charge of R-454B refrigerant and oil. Adjusting the charge of the system will be required during installation.
 6. Refrigeration circuits with non-variable compressors shall be provided with external hot gas bypass to protect against evaporator frosting and to prevent excessive compressor cycling.
 7. Each capacity stage shall be equipped with a 5 minute off delay timer to prevent compressor short cycling. Each additional capacity stage shall be equipped with an adjustable, 20 second delay timer to prevent multiple capacity stages from starting simultaneously.
 8. Condensing unit shall be provided with adjustable compressor lockout.
 9. Each refrigeration circuit shall be equipped with a liquid line sight glass.
 10. Units shall be provided with a suction pressure transducer on each refrigeration circuit.
 11. Each compressor shall be provided with a compressor sound blanket.
- F. Fans:
1. Condenser fans shall be vertical discharge, axial flow, direct drive fans.
 2. Condensing unit shall be provided with an electrically commutated motor (ECM) condenser fan, condenser head pressure controller, and discharge pressure transducers for modulating head pressure control to allow cooling operation down to 35°F. Fan motor shall be weather protected, single phase, direct drive, and totally enclosed air over (TEAO) with electronic protection.
- G. Coils:
1. Condenser fans shall be vertical discharge, axial flow, direct drive fans.
 2. Condensing unit shall be provided with an electrically commutated motor (ECM) condenser fan, condenser head pressure controller, and discharge pressure transducers for modulating head pressure control to allow cooling operation down to 35°F. Fan motor shall be weather protected, single phase, direct drive, and totally enclosed air over (TEAO) with electronic protection.
- H. Controls: Unit shall be provided with a terminal block for field installation of controls. Option shall include factory installed isolation relays.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. All electrical wiring and interconnections shall be furnished and installed as part of Division 26.
- D. Provide connection to refrigerant piping system and evaporators.

- E. Protect installed products until completion of project.
- F. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- G. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- H. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

3.02 CLEANING

- A. Unit shall be cleaned and new filters shall be furnished and installed prior to final acceptance by OWNER. One spare set of filters shall remain for OWNER.

END OF SECTION

SECTION 23 73 13

MODULAR INDOOR CENTRAL STATION AIR-HANDLING UNITS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Modular air-handling units (AHU).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASHRAE 15—Safety Code for Mechanical Refrigeration.
 - 2. ASHRAE 62—Ventilation for Acceptable Indoor Air Quality.
 - 3. ASHRAE 84-87P—Method of Testing Air-to-Air Heat/Energy Exchangers.
 - 4. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 5. ARI 410—Forced Circulation Air-Cooling and Air-Heating Coils.
 - 6. ARI 430—Central Station Air-Handling Units.
 - 7. ARI 1060—Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery.
 - 8. NFPA 70—National Electrical Code.
 - 9. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
 - 10. UL181—Factory-Made Air Ducts and Air Connectors.
 - 11. UL900—Test Performance for Air Filter Units.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.
- E. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.
- F. Unit performance shall be certified in accordance with ARI 430 for Central Station Air-Handling Units.

- G. Direct expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration, latest edition.
- H. Fan motors shall be sized such that the fan brake horsepower shall be less than 90 percent of the motor's rated horsepower, excluding service factor.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Provide project specific wiring diagrams for power, signal and control.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements shall follow the recommendations in the manufacturer's installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year

from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MODULAR AIR-HANDLING UNIT (AHU)

- A. Acceptable manufacturers are Daikin, York, or Trane.
- B. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.
- C. Air handling unit shall be factory-assembled air-handling units consisting of the following sections:
 - 1. Supply fan.
 - 2. Economizer/mixing section.
 - 3. Direct expansion coil.
 - 4. Combination filter section.
 - 5. Return fan.
- D. Unit Casing:
 - 1. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.
 - 2. Panels and access doors shall be constructed as a 2-inch nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13.
 - a. The inner liner shall be constructed of G90 galvanized steel.
 - b. The outer panel shall be constructed of G90 galvanized steel.

- c. The floor plate shall be constructed as specified for the inner liner.
 - d. Unit will be furnished with solid inner liners.
 - 3. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.
 - 4. The casing leakage rate shall not exceed 0.50 cfm per square foot of casing surface area at design static pressure up to a maximum of +5 inches w.c. in positive pressure sections and -6 inches w.c. in negative pressure sections.
 - 5. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
 - 6. Access doors shall be flush mounted to cabinetry, with minimum of two six-inch-long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.
 - 7. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section.
- E. Fan Assemblies:
- 1. Acceptable fan assembly shall be a single width, single inlet, class II, belt-drive type plenum fan dynamically balanced as an assembly, as shown in schedule. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Provide access to motor, drive, and bearings through hinged access door.
 - 2. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2-inch deflection spring vibration type isolators inside cabinetry.
- F. Electrical:
- 1. Fan motors shall be manufacturer provided and installed, Open Drip Proof, single speed, 480V / 60HZ / 3P. Complete electrical characteristics for each fan motor shall be as shown in schedule.
 - 2. The air handler(s) shall be ETL and ETL-Canada listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.
 - 3. All electrical connection components shall be field provided and mounted as shown on project schedule.
- G. Cooling Coils: Direct expansion refrigerant cooling coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 3 inches beyond unit casing for ease of installation. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly.
- 1. Sweat type copper suction headers shall be provided.
 - 2. Fins shall have a minimum thickness of 0.0075-inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer.
 - 3. Coil tubes shall be 5/8-inch OD seamless copper, 0.020-inch nominal tube wall thickness, expanded into fins on 1 1/2-inch centers, brazed at joints.

4. Sweat type copper suction connections located at the bottom of the suction headers for gravity oil drainage. Pressure type liquid distributors used. Coils shall be tested with 315 pounds air pressure under warm water, and suitable for 250 psig working pressure.
5. Coil casing shall be a formed channel frame of galvanized steel.

2.02 FILTERS

- A. Furnish flat panel filter section with 2-inch filter. Provide side loading and removal of filters.
- B. Filter media shall be UL 900 listed, Class I or Class II.

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 ENGINEER of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Pipe and trap condensate to nearest floor, hub, or roof drain and as shown on Drawings.
- D. Install units with vibration isolators as recommended or supplied by manufacturer.
- E. Provide flexible duct connections on all duct connections to unit in accordance with Section 23 33 00-Air Duct Accessories.
- F. Provide lubrication line extenders as required to allow regreasing of bearings without removal of equipment components.
- G. Protect installed products until completion of project.
- H. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- I. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation,

and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

- J. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

3.04 CLEANING

- A. Unit shall be cleaned and new filters shall be furnished and installed prior to final acceptance by OWNER. One spare set of filters shall remain for OWNER.

END OF SECTION

SECTION 23 74 23

PACKAGED OUTDOOR HEATING ONLY MAKE-UP AIR UNITS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Direct-fired make-up air units.
 - 2. Control panel requirements.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASHRAE 62—Ventilation for Acceptable Indoor Air Quality.
 - 2. ASHRAE 90A—Energy Conservation in New Building Design.
 - 3. NFPA 54 (AGA Z223.1)—National Fuel Gas Code.
 - 4. NFPA 70—National Electrical Code.
 - 5. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
 - 6. UL181—Factory-Made Air Ducts and Air Connectors.
 - 7. UL900—Test Performance for Air Filter Units.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.
- E. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.
- F. Unit shall be designed to meet the ANSI Z83.4 standards for direct fired gas heating equipment and shall be ETL listed.
- G. All gas-fired equipment shall be design-certified by the American Gas Association.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Project specific wiring diagrams for power, signal and control.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements shall follow the recommendations in the manufacturer's installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers are Greenheck, or equal.
- B. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

2.02 DIRECT-FIRED MAKE-UP AIR UNIT (MAU)

- A. Unit casing shall be double wall fabricated of galvanized steel with 1-inch fiberglass insulation and Hi-Pro Polyester powder finish. Provide gasketed hinged access panels for all internal controls and components. Provide observation ports for main and pilot flame. The casing shall be designed for interior mounting (see Drawings for configuration). Unit shall be provided with 24-inch access section to facilitate unit access from one side of unit.
- B. Blower section shall include forward-curved centrifugal belt drive blower and be statically and dynamically balanced. Blowers 18 inches and smaller shall have permanently sealed bearings. Blowers larger than 18 inches shall have field-regreasable bearings.
- C. Motor shall be premium-efficiency, totally-enclosed, fan-cooled type with adjustable base. Motors operating on VFDs shall be inverter duty rated, meet the requirements of NEMA MG1, Part 31 for motor insulation, and be capable of a minimum speed turndown of 4:1. Provide shaft grounding split ring kit as manufactured by AEGIS, or equal, for motors operating on VFDs. Thermostats shall be applied to motor windings, capable of shutdown and manual reset by external controls (by manufacturer).
- D. Provide V-Bank filter box with 2-inch-thick permanent filters. Box shall be complete with guides and access doors.

- E. All burner and blower controls, including motor starters and VFDs, shall be furnished by unit manufacturer and shall be factory-prewired for single-point power connection and housed in a weatherproof enclosure. All electrical components shall be UL listed or recognized where applicable, and wired in compliance with the National Electrical Code. Disconnect shall be provided with the unit. Starter shall be combination type, NEMA rated, with solid-state adjustable overload relay; single-phase protection shall be standard. All wiring shall be numbered and routed in plastic wiring ducts. Plastic spiral wrapping may be substituted for plastic wiring ducts. All components within control panels shall be labeled on the enclosure back panel and all labels shall match the schematic drawings.
- F. Burner gas train and controls shall include main gas shutoff valve, main and pilot regulators, modulating electronic gas valve with 25:1 turndown, air-proving differential switch, freezestat, high and low gas pressure switches, high and low limit and operating thermostats, flame safeguard, flame sensor, and control transformer.
- G. Provide a factory-mounted and wired two-position intake damper and electric actuator.
- H. Unit controls shall be provided to allow control from the system/temperature control panel as described below.
 - 1. The unit controls shall be configured so that it can function as a stand-alone heating system controlled by internal control panel with thermostats and sensors.
 - 2. Unit shall be provided with microprocessor controller with integral LCD screen that provides text readouts of status, operating settings, and alarm conditions. Microprocessor controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices, or software. DDC controllers that require the use of equipment or software that are not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable.
 - 3. Sensors below are to be factory installed and wired within the unit:
 - a. Heating Air Inlet Sensor.
 - b. Dirty Filter Sensor.
 - c. Discharge Air Temperature Sensor.
 - 4. The unit shall provide a dry contact from the airflow providing switch, rated at 120 volts, for fan running.
 - 5. The microprocessor controller shall provide a dry contact, rated at 120 volts, for common fail.
 - 6. The microprocessor controller shall accept a dry contact for start/stop control of the fan.

2.03 CONTROL PANEL REQUIREMENTS

- A. Unit controls and control devices shall be mounted on an equipment back panel within the unit. Each device on the back panel shall be labeled to match the shop and O&M wiring diagrams for the unit. Labels shall be permanently attached to the back panel and in typewritten format. Labels shall not be installed on devices or wireways.
- B. All control wiring shall be routed through wireways installed on the back panel. In the event wireways are not used, wiring may be wrapped in continuous spiral bindings and attached to the back panel. All control wiring within the unit shall be numbered at each end. All numbering shall match the shop and O&M wiring diagrams.

- C. Terminal strips shall be provided for all external wiring connections. All terminals shall be numbered. Splices shall not be allowed within the unit control panel.
- D. All starters shall be NEMA-rated, sized based on fan horsepower according to the NEC, and include solid-state overload relays.
- E. Wiring diagrams shall be included in each unit control panel. Provide laminated sheet attached to control enclosure door/cover.

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 ENGINEER of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Install gas piping to unit in accordance with NFPA 90A and NFPA 54 (AGA Z223.1). Provide connection to fuel gas system.
- D. Pipe gas regulator vents to an exterior location with sufficient clearances to air inlets and building openings in accordance with Section 23 11 23–Facility Fuel Gas Piping.
- E. Provide flexible duct connections on all duct connections to unit in accordance with Section 23 33 00–Air Duct Accessories.
- F. Provide lubrication line extenders as required to allow regreasing of bearings without removal of equipment components.
- G. Protect installed products until completion of project.
- H. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- I. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation,

and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

- J. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

3.04 CLEANING

- A. Unit shall be cleaned and filters shall be replaced prior to final acceptance by OWNER. One spare set of filters shall remain for OWNER.

3.05 SEQUENCE OF OPERATIONS

- A. The MAU supply fan shall be interlocked with EF-80-01 to run whenever the exhaust fan is running.
- B. Dampers: While the unit supply fan is running, associated dampers, including the internal intake damper and external discharge damper, shall be open.
- C. When the unit is called to run, the fan shall start, the outside air damper shall open, and the gas-fired burner shall modulate to maintain discharge air temperature setpoint as determined by a dial on the MAU microprocessor.
- D. MAU shall be called to run when occupancy sensor is enabled. Unit shall run until occupancy system is disabled.
- E. When the outside air temperature rises above an operator-adjustable "MAU Heat Disable" setpoint (55°F to 95°F), this microprocessor shall disable the burner. When the outside air temperature falls below this setpoint, this microprocessor shall enable the burner. When the burner is enabled, this microprocessor shall modulate the burner firing rate based on the discharge air temperature to maintain an operator-adjustable "MAU Discharge Air Temperature" setpoint (40°F to 90°F). Coordinate scaling of the burner firing rate signal with the make-up air unit manufacturer.

END OF SECTION

SECTION 23 81 26

SPLIT-SYSTEM AIR CONDITIONERS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Split systems (SS).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ASHRAE 15—Safety Code for Mechanical Refrigeration.
 - 2. ASHRAE 62—Ventilation for Acceptable Indoor Air Quality.
 - 3. ASHRAE 90A—Energy Conservation in New Building Design.
 - 4. NFPA 70—National Electrical Code.
 - 5. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
 - 6. UL900—Test Performance for Air Filter Units.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.
- E. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.
- F. Direct expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration, latest edition.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's

performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

- C. Project specific wiring diagrams for power, signal, and control.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements shall follow the recommendations in the manufacturer's installation instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 SPLIT SYSTEM (SS)

- A. Acceptable manufacturers are Daikin, Sanyo, or Mitsubishi.
- B. Indoor Unit:
1. General: The indoor unit shall be factory assembled and pre-wired with all electronic and refrigerant controls. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.
 2. The cabinet shall include an indoor unit ON/OFF switch, capable of being used when the remote controller is missing. When switch is used, the default setting is COOL mode, 76°F temperature setting, and AUTO airflow rate. A Signal Receiver that receives signals from the remote controller. The cabinet shall be supplied with a mounting plate to be installed onto a wall for securely mounting the cabinet.
 3. Fan: The evaporator fan shall be an assembly consisting of a direct-driven fan by a single motor. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings. An auto-swing louver for adjustable air flow (vertically) is standard via the wireless remote control furnished with each system. The indoor fan shall offer a choice of three speeds, plus quiet and auto settings. The indoor fan shall be removable without the need to detach the heat evaporator coil or blower.
 4. Filter: The return air filter provided will be a removable and washable filter. Two titanium apatite air-purifying filters are included for additional air filtration.
 5. Coil: The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger. All tube joints shall be brazed with silver alloy or phoscopper. All coils will be factory pressure tested. A detachable condensate pan shall be provided under the coil with a drain connection. The unit shall be provided with a factory-installed condensate drain pump. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film, rated for up to 500 hours salt spray.
 6. Control:
 - a. The unit shall have a wired controller to operate the system. It shall have Cooling Operation, Dry Operation and Fan Only Operation.
 - b. The controller shall be able to display two-digit fault codes extracted from the indoor unit to aid in troubleshooting.
 - c. Temperature range on the remote control shall be 60°F to 86°F in cooling mode. The temperature shall be controlled in 1° increments.
 - d. The indoor unit microprocessor has the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote control.
- C. Outdoor Unit:
1. General: The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be complete factory assembled and pre-wired with all necessary electronic and refrigerant controls. The outdoor shall be controlled by a

- microprocessor and dedicated EEV's shall be provided for capacity control during part load of the indoor unit.
2. Unit Cabinet: The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish. The outdoor unit will come furnished with four mounting feet, mounted across the base pan, to allow bolting to a cement pad or optionally supplied mounting bracket.
 3. Fan: The fan shall be a direct drive, propeller type fan. The motor shall be inverter driven, permanently lubricated type bearings, inherent. A fan guard is provided on the outdoor unit to prevent contact with fan operation. Airflow shall be horizontal discharge.
 4. Coil: The outdoor coil shall be nonferrous construction with corrugated fin tube. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film, rated for up to 500 hours salt spray. Refrigerant flow from the condenser will be controlled via a metering device.
 5. Compressor: The outdoor compressor shall be a patented, variable speed swing inverter-driven compressor. The outdoor unit shall have an accumulator and four-way reversing valve. The compressor shall have an internal thermal overload.

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 ENGINEER of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Pipe and trap condensate to nearest hub drain in accordance with Section 22 13 16—Sanitary Waste and Vent Piping and as shown on Drawings.
- D. Protect installed products until completion of project.
- E. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- F. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation,

and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.

- G. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

3.04 CLEANING

- A. Unit shall be cleaned and filters shall be cleaned prior to final acceptance by OWNER.

END OF SECTION

SECTION 23 82 16

AIR COILS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Electric duct coils (EDH).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ARI 410—Forced Circulation Air-Cooling and Air-Heating Coils.
 - 2. NFPA 70—National Electrical Code.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Electrical components shall be UL listed for the service specified.
- C. Electrical components and work shall be in accordance with the National Electrical Code.
- D. Coil performance shall be certified in accordance with ARI 410.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.

- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ELECTRIC DUCT COILS (EDH)

- A. Acceptable manufacturer is Thermolec, or equal.
- B. Coil shall be size and capacity as listed in Drawings.
- C. Coils shall be of nickel chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminal pins shall be stainless steel insulated by nonrotating ceramic bushings. Control box shall be gasketed.
- D. Heaters shall be slip-in type. Heaters shall be suitable for insertion into the duct through an opening on its side, and shall have a flange for securing it to the duct side. Mounting flanges shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.

- E. All duct heaters shall be equipped with fail-safe, automatic reset and manual reset disc-type thermal cutouts.
- F. Cutouts shall be shielded from impact and shall deenergize the heater in case of insufficient air flows.
- G. Duct heaters shall be nonsensitive to airflow direction.
- H. Duct heaters shall be equipped with magnetic contactors, 24-volt transformer, airflow sensor, room thermostat (TK).
- I. Heater shall be equipped with a built-in disconnect to switch the power off at the heater location.
- J. Load fuses shall be supplied as required by local codes.
- K. Pilot lights shall be provided for power on (Green), and no air flow (Red).
- L. Heater control cabinet shall be equipped with door interlock to disconnect power to the unit while door is open.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- E. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Electric Unit Heaters.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ARI 410—Forced Circulation Air-Cooling and Air-Heating Coils.
 - 2. NFPA 70—National Electrical Code.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Electrical components shall be UL listed for the service specified.
- C. Electrical components and work shall be in accordance with the National Electrical Code.
- D. Coil performance shall be certified in accordance with ARI 410.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.

- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ELECTRIC UNIT HEATERS

- A. CONTRACTOR shall provide electric heaters of the type, size, capacity, and accessories as listed on the equipment schedule. All units shall be UL listed.
- B. All electric unit heaters shall be factory-assembled and tested.
- C. Electric Unit Heaters (Standard) (EUH):
 1. Acceptable manufacturers are Chromalox, QMark, Indeeco, or equal.
 2. The cabinet shall be constructed of heavy gauge, die-formed steel with baked enamel coating. Manufacturer shall provide mounting bracket.
 3. Provide a propeller fan with direct-drive, totally enclosed motor.
 4. Provide an aluminum-finned copper-clad steel sheath heating element.
 5. Provide an automatic reset thermal cutout to protect the element.

6. Unit-mounted equipment disconnect shall be ABB OT Series, or equal, provided by manufacturer and meet the requirements of Division 26.
 7. Mount units to provide 8 feet 0 inch clearance below, unless otherwise shown on the Drawings.
 8. Unit shall include a thermal fan delay to dissipate heat when coil deenergizes, and prevent cold air drafts when it starts.
 9. Unit control voltage shall be 120 V. Line voltage (120 V) thermostat shall be provided by Division 26.
- D. Electric Wall Heaters (EWH):
1. Acceptable manufacturer is QMark, or equal.
 2. Furnish and install a steel cabinet for recessed mounting in standard 2 by 4 stud wall or surface mounting on a standard block wall as shown on Drawings. Provide a cabinet with 16 gauge steel grille bars and finished in baked enamel.
 3. Provide a direct-drive propeller fan and permanently lubricated totally enclosed motor.
 4. Provide steel-finned metal sheath electric heating elements.
 5. Provide manual reset thermal overload protection to disconnect power in the event of overheating. Provide an integral, tamper-resistant thermostat. Provide integral contactors and disconnects.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- E. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 23 82 40

RADIANT HEATING PANELS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Electric radiant heating panels (RHP).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. ARI 410—Forced Circulation Air-Cooling and Air-Heating Coils.
 - 2. NFPA 70—National Electrical Code.

1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.
- B. Electrical components shall be UL listed for the service specified.
- C. Electrical components and work shall be in accordance with the National Electrical Code.
- D. Coil performance shall be certified in accordance with ARI 410.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.

- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 ELECTRIC RADIANT HEATING PANELS (RHP):

- A. Furnish and install radiant heating panels constructed of graphite heating element with 1-inch fiberglass insulation installed on the top side. Panel shall be suitable for recessed mounting in a drop ceiling.
- B. Equipment disconnect shall be provided as noted in Section 23 09 23–Direct-Digital Control System for HVAC.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- E. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

SECTION 26 05 00

GENERAL ELECTRICAL REQUIREMENTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes general requirements for all electrical work.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

1.02 REFERENCES

- A. ANSI/NFPA 70—National Electrical Code (NEC).
- B. ANSI/IEEE C2—National Electrical Safety Code.

1.03 CONTRACT DOCUMENTS

- A. Any equipment roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.
- B. The Drawings are generally diagrammatic, and CONTRACTOR shall coordinate the Work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.

1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to ANSI/IEEE C2.
- C. The rules and regulations of the federal, state, local, and civil authorities and utility companies in force at the time of execution of the Contract shall become a part of this specification.
- D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be paid by CONTRACTOR.

1.05 CODES AND ORDINANCES

- A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.

- B. In preparing a Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the Drawings and Specifications. All cases of apparent conflicts between the Drawings, Specifications, and codes shall be brought to ENGINEER's attention, as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.
- C. When requested by ENGINEER, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, handhole sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

1.07 ELECTRICAL DISTRIBUTION SYSTEM

- A. Provide a complete electrical distribution system consisting of components indicated on the Drawings or specified herein including, but not limited to:
 - 1. Primary service entrance conduit raceways for power company conductors.
 - 2. All miscellaneous equipment coordination and related appurtenances required by power company.
 - 3. 208-volt, three-phase, 4-wire service entrance conductors.
 - 4. Feeders, branch wiring, and electrical distribution equipment.
 - 5. All control wiring.
 - 6. Access panels and access doors for access to equipment installed by Division 26.
 - 7. Wiring between system components if equipment is not prewired.
 - 8. Lighting fixtures, lighting controls, and associated wiring.
 - 9. Support system design and supports for electrical raceways.
 - 10. Code-required disconnects.
- B. CONTRACTOR shall connect all equipment furnished by other Divisions consisting of components indicated on the Drawings or specified herein.
- C. Provide balancing and adjusting of electrical loads.
- D. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.
- E. Provide miscellaneous items for a complete and functioning system as indicated on the Drawings and specified herein.
- F. A partial list of work not included in Division 26 is as follows: Painting (except as otherwise specified herein).

1.08 NOISE

- A. Eliminate any abnormal noises that are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

1.09 DRAWINGS

- A. The Drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.
- B. Prior to locating equipment, confer with ENGINEER as to desired location in the various areas. In no case should equipment locations be determined by scaling drawings. Relocate equipment and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.
- C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on the Drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.
- D. The Drawings are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.

1.10 EXISTING UNDERGROUND UTILITIES

- A. The Drawings show approximate location of existing underground utilities based on OWNER-provided record drawings. CONTRACTOR shall excavate and verify the location of all underground utilities prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground utilities to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

1.11 SUBMITTALS

- A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01 33 00–Submittals for requirements.
- B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project: Electrical interconnection wiring diagrams; see Section 26 09 00–Controls and Instrumentation and Section 26 24 19–Motor Control.

- C. These drawings and diagrams shall show applicable electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.
- D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
 - 1. Proper sizes and capacities.
 - 2. That the item will fit in the available space in the manner that will allow proper service.
 - 3. Construction materials and finishes.
- E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.
- F. When equipment and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.
- G. See additional requirements of shop drawings under Division 01—General Requirements.

1.12 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 STANDARD PRODUCTS

- A. All equipment and products shall be of new manufacture per applicable specifications.
- B. All equipment shall be UL and NEMA approved.
- C. Unless specified otherwise, major distribution equipment such as panelboards, VFDs, SPD, transformers, etc., shall each be by the same manufacturer.
- D. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, dustproof, or any other special type).

2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment sufficient data to show conclusively that it is equivalent to that specified in the following respects:
 - 1. Performance:
 - a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
 - b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
 - c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
 - 2. Materials of construction.
 - 3. Gauges, weights, and sizes of all portions and component parts.
 - 4. Design arrangements, methods of construction, and workmanship.
 - 5. Coatings, finishes, and durability of wearing parts.
 - 6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
 - 7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.
- B. Requests for substitution shall include CONTRACTOR's reason for the request.
- C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.
- D. See General Conditions for additional requirements.

2.03 LOW-VOLTAGE WIRING (LESS THAN 100 VOLTS)

- A. Low-voltage wiring specified in this section shall be applicable to all systems installed that utilize low-voltage wiring where such wiring is not specified in other technical sections.
- B. All wiring shall have copper conductors with 300-volt insulation rating and meet the requirements of NEC Article 725.
- C. All conductors must be suitable for the application intended. Conductors 16 AWG and larger shall be stranded. Conductors 18 AWG and smaller may be solid or stranded.
- D. Control Cable for Class 1 Remote Control and Signal Circuits: Individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the National Electrical Code.
- E. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the NEC Article 725.

PART 3-EXECUTION

3.01 UTILITY SERVICES

- A. Utility connection requirements shall be determined. All costs for coordinating utility service shall be included in the price bid as described in Section 26 21 00-Electrical Service System of these specifications.
- B. All costs for temporary service, temporary routing of piping, or any other requirements of a temporary nature associated with the utility service shall be included in the Base Bid.
- C. It is the intent that in the latter stages of construction, the permanent electrical service will be used and the temporary construction service discontinued. The following requirements shall govern the use of the permanent services:
 - 1. No permanent service shall be available until structure is enclosed, watertight, and heated.
 - 2. Only permanently connected and protected circuits and outlets shall be available.
 - 3. Temporary wiring shall not be connected to permanent distribution equipment.
 - 4. Under the above conditions, the use of permanent service equipment shall in no way affect the Contract conditions of the guarantee.
- D. It shall be CONTRACTOR's responsibility to police this situation and protect its equipment.

3.02 CONTINUITY OF SERVICE

- A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.
- B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.
- C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

3.03 CLEANUP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards and disconnect switch enclosures, VFD enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off before installation of covers.
- B. All lighting fixture lenses (interior and exterior fixtures) shall be cleaned at the time of installation, and all lens exteriors shall be cleaned just prior to final inspection.
- C. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

3.04 CONCRETE WORK

- A. All cast-in-place concrete for new electrical equipment bases shown on the Drawings shall be provided by CONTRACTOR, except where specifically noted to be provided by others.

All new equipment shall be set on 3 1/2-inch minimum leveling slabs including free-standing enclosures, etc. Pads shall be 3 inches larger than equipment being supported.

- B. Concrete shall comply with Section 03 30 00—Cast-In-Place Concrete.
- C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

3.05 PAINTING

- A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.
- B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.
- C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR.
- D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

3.06 CAULKING

- A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.
- B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.
- C. Caulking sealant shall contain no acid or ingredients that will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

3.07 BUILDING ACCESS

- A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.
- B. When the installation requires openings and access through existing construction and the openings are not provided, CONTRACTOR shall provide the necessary openings.

3.08 COORDINATION

- A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.
- B. All VFDs, disconnects, relays, wire, conduit, push buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the Drawings.
- C. Where VFDs and other devices are provided by others, they shall be connected and wired by CONTRACTOR.

- D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.
- E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters VFDs as specified herein or under the various trades' sections of these specifications.
- F. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above), including temperature control wiring for operation, control, and supervision of all motorized equipment, including wiring between VFDs and control devices as specified herein and as shown on the Drawings. Low-voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment that has low-voltage wiring, unless otherwise noted. CONTRACTOR shall provide raceways for all low-voltage wiring.
- G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.
- H. Motors 1/2 hp and larger shall be NEMA rated 208 volts, three-phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volts, single-phase, 60 Hz, unless otherwise shown.

3.09 EXCAVATION AND BACKFILL

- A. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 31 23 00–Excavation, Fill, Backfill, and Grading. Refer to Section 26 05 33–Conduit for additional requirements associated with PVC conduit installed in earth.
- B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.
- C. Care shall be taken so that there is no disturbance of bearing soil under foundations.
- D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 31 for rock excavation requirements.

3.10 EQUIPMENT ACCESS AND LOCATION

- A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems that are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.

- B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials that will fit properly the types of finishes actually installed.
- C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.
- D. Electrical equipment, devices, instruments, hardware, etc., shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment that is to be installed or that is already in place.
- E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

3.11 WORKMANSHIP

- A. All work shall be performed in compliance with the NEC.
- B. Install work using procedures defined in NECA Standard of Installation.
- C. Location of process equipment as shown on the Drawings is approximate.
- D. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- E. Locations of utilization equipment and control devices as shown on the Drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance shall be performed at no additional cost to OWNER.
- F. Unless otherwise noted, conduit shall be fastened to building structure or equipment framework and not placed on the floor.
- G. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.
- H. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listings shall be so labeled and shall be used by CONTRACTOR.

3.12 AREA CLASSIFICATION

- A. Where referenced herein, damp and wet locations shall include, but not be limited to, structures and areas below grade, and exterior locations.

3.13 MODIFICATIONS TO EXISTING CONSTRUCTION

- A. Alterations:
 - 1. Alter, extend, and reconnect conduits as necessary.
 - 2. Reconnect existing conduits that were reused, cut, or exposed because of construction as quickly as possible.
 - 3. Where wiring is involved, new wires shall be “pulled in” between the nearest available accessible reused outlets to the extent allowed by the governing code.
 - 4. Provide new conduits for wires if they cannot be “pulled in” to existing conduits.
 - 5. All new conduits, wiring, and electrical items shall be connected to the existing systems so as to function as a complete unit.
 - 6. Where existing electrical equipment, devices, fixtures, electrically operated items, etc., interfere with any remodeling work, they shall be removed and reinstalled in another location to avoid such interferences. All existing and relocated equipment shall be left in good operating condition.
- B. CONTRACTOR shall remove all electrical equipment, conduit, and wiring associated with the structures, equipment, and control systems specified herein and/or shown on the Drawings to be removed.
- C. Include in Bid removal of existing electrical material and equipment as specified hereinafter, as noted on the Drawings, or as needed by field conditions.
- D. Provide stainless steel cover plates for all existing recessed outlet and junction boxes not being reused. Seal or cap all existing conduit penetrations not being reused.

END OF SECTION

SECTION 26 05 19

WIRE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wire.
 - 2. Wiring connections and terminations.
 - 3. Terminal blocks and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, which has been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01 33 00—Submittals.
- B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- C. Submit manufacturer's instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

- B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 WIRE

- A. All wire for permanent installation shall be new stranded copper delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductor cable is not allowed, except where specified below for VFDs.
- B. Motor circuit branch wiring and associated control wiring:
 - 1. Insulation type shall be THHN (indoors, nonVFD application).
 - 2. Minimum size for motor control wiring shall be 14 AWG.
 - 3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on Drawings.
- C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2.
- D. All wiring within control panels and supervisory control centers that does not extend outside of the enclosure shall be insulation-type MTW, minimum size 16 AWG.
- E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be XHHW-2.
- F. Refer to Section 26 05 53—Electrical Identification for required wire insulation color coding and conductor labeling requirements. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.
- G. Branch circuit wiring for exit lights, emergency lights, and exterior lights in excess of 75 feet shall be minimum 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

2.02 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide crimp type UL or ETL listed terminations for 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-kon, or equal.
- B. Provide insulated, silicone-filled spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating motor conductors.
- C. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of one-hole copper compression lugs for 6 AWG and larger, split-bolt connector for 8 AWG and smaller, and motor-lead pigtail splice kit. Individual components shall be as follows:
 - 1. Split-bolt connectors shall be for use with copper conductors only.
 - 2. One-hole copper compression lugs shall be as manufactured by 3M, or equal, 30000 series. Lug size shall be selected based on motor and feeder wire sizes installed.
 - 3. Pigtail splice kit shall consist of one-hole lug cover, silicone grease, and mastic sealing strip. Pigtail splice kit shall have locking pins for conductors 2 AWG and larger. Kit shall be as manufactured by 3M, or equal, 5300 series, and be selected based on motor, feeder, and lug sizes installed.
- D. No splices will be allowed unless reviewed by ENGINEER. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice compression connectors for installation above grade shall be UL listed in-line copper barrel-type as manufactured by Burndy Type YS-TC, or equal, with heat shrink tubing to match the conductor size. Splice compression connectors for installation below grade shall be UL listed in-line copper barrel-type as manufactured by Burndy Type YS, or equal, with heat shrink tubing to match the conductor size. Splice compression shall be made with a manufacturer-recommended crimp tool.
- E. Above-ground reducing adapters shall be UL listed in-line copper barrel reducers as manufactured by Burndy Type YSR-TC, or equal, with heat shrink tubing to match the conductor size.
- F. Heat shrink tubing for splices and reducing adapters shall be UL listed, heavy wall type as manufactured by Burndy Type HS-H-PF, or equal, to match the conductor size.

2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed or UL recognized under UL 467, UL 486E, UL1059, and UL 1953 (power terminals only).
- B. Power Terminal Blocks: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts as manufactured by Allen-Bradley 1492-PDL, or equal.
- C. Signal and Control Terminal Blocks:
 - 1. General-Purpose Terminal Blocks:
 - a. Terminal blocks shall be rated up to 600 volts AC/DC.

- b. Terminal blocks shall accept center-mounted jumper bars without increasing the installed space.
 - c. Terminal blocks shall be Allen-Bradley Bulletin 1492-J, or equal.
 - d. Terminal block color shall be gray.
- 2. Grounding Terminal Blocks:
 - a. Terminal blocks shall be Allen-Bradley Bulletin 1492-JG, or equal.
 - b. Terminal block color shall be green/yellow.
- 3. Disconnect-type Terminal Blocks (300-Volt Class):
 - a. Terminal blocks shall be feed-through type with a knife-blade disconnect.
 - b. Terminal blocks shall be Allen-Bradley Bulletin 1492-JKD, or equal, depending on the application.
 - c. Terminal block color shall be gray.
- 4. Fuse-type Terminal Blocks with Indicator (300-Volt Class):
 - a. Terminal blocks for applications from 100 to 300 volts AC shall be Allen-Bradley Bulletin 1492-H4, or equal, with neon blown-fuse indicator.
 - b. Terminal blocks for applications from 10 to 50 volts AC/DC shall be Allen-Bradley Bulletin 1492-H5, or equal, with LED blown-fuse indicator.
 - c. Terminal block color shall be black.
- 5. Terminal Blocks for Power Meters and Current Transformers: Provide test-disconnect terminal blocks for disconnecting, shorting, and testing current transformers and for disconnecting and testing voltage sensing inputs. Provide test-disconnect terminals for individual current transformer or voltage sensing installations, and provide a group of terminals for all current transformer and voltage sensing inputs for each power meter installation.
 - a. Provide a pair of terminal blocks for each current transformer including one feed-through terminal block, one sliding disconnect terminal block with a cross-connection short-circuit slider. The pair of terminal blocks shall include the following:
 - (1) Feed-through terminal block shall be Weidmüller Model WTD 6/1 EN, or equal.
 - (2) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
 - (3) Short-circuit slider shall be Weidmüller Model WKS 2/2, or equal. The short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position, and expose the terminal block conductor screws when slid into the shorting position.
 - (4) Provide two cross-connection sliders Weidmüller Model STB, or equal, with connecting sleeves Weidmüller Model VH, or equal. Provide one slider fixing screw Weidmüller Model BS, or equal. Connecting sleeves and fixing screws shall be color coded for each current transformer.
 - b. Provide disconnecting terminal blocks for each voltage sensing and neutral connection. The terminal blocks shall include the following:
 - (1) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
 - (2) Provide one cross-connection slider Weidmüller Model STB, or equal, with connecting sleeve Weidmüller Model VH, or equal, for each voltage sensing and neutral connection terminal block. Provide one slider fixing screw Weidmüller Model BS, or equal. The neutral connecting sleeve shall be a different color than the voltage sensing connecting sleeves.
 - c. Terminal block colors shall be gray. Provide end plates and end brackets as required to complete the test-disconnect terminal block assembly.

6. Terminal blocks shall have self-locking screw compression clamps rated for the size of conductors being terminated and upstream overcurrent protection for each application.
7. The same manufacturer and style of terminal block shall be used throughout the entire project for all applications.
8. Terminal blocks shall have tin-plated copper current bars and tin-plated steel screws. Terminal housings shall be completely finger safe from all live circuits and be constructed of self-extinguishing material with minimum UL 94-V0 flammability rating.
9. Terminal blocks shall accept pre-printed, snap-in labeling cards on both sides without increasing the installed space. Provide terminal block manufacturer's end barriers and screw-type retainers for all terminal block groupings.
10. Terminal blocks shall mount on standard DIN rail and shall be able to be removed without removing adjacent terminal blocks.
11. Multi-level terminal blocks and stacked, single-level terminal block installations are not acceptable.

D. Refer to Section 26 05 53—Electrical Identification for terminal block labeling requirements.

PART 3—EXECUTION

3.01 GENERAL WIRING METHODS

- A. Install electrical wire and connectors in accordance with the manufacturer's written instructions, applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices so that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.
- B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.
- C. Place an equal number of conductors for each phase of a circuit in the same raceway.
- D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values. Provide permanent marking on lug, bolt, nut, or connection for conductors larger than 4 AWG.
- E. Splice only in junction or outlet boxes. Splicing is not allowed in disconnects, panelboards, control panels, equipment, etc. Avoid splices between terminals of interconnecting power and control wiring.
- F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g., panelboards, disconnects, etc.), and control panels shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.
- G. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, control panels, and panelboards.
- H. Make conductor lengths for parallel circuits equal.
- I. The same color shall be used for each numbered wire throughout its entire length.

- J. Terminate all wiring on terminal blocks in control panels, VFD enclosures, and similar equipment. This shall include all spare or unused wires.
- K. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder.
- L. Do not use a pulling means that can damage the raceway.
- M. Signal wiring (below 100 volts) must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop-powered devices, voice and data communications, and communication wiring (i.e., Ethernet, serial, etc.). Analog wiring shall be in a conduit separate from all other wiring.
- N. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.
- O. Provide junction or pull boxes to facilitate the “pulling in” of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.
- P. Thoroughly clean wires before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- R. Terminate spare conductors within equipment, control panels, etc., on terminal strips and label as “SPARE.” Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as “SPARE.” All spare conductor labels shall indicate where the conductors terminate. Refer to Section 26 05 53—Electrical Identification, for additional requirements.
- S. Feeder connections to motors shall be installed within the motor junction box utilizing factory engineered kits as specified herein. Spring wire connectors are not allowed for connections to motors.

3.02 GENERAL LOW-VOLTAGE WIRING METHODS (LESS THAN 100 VOLTS)

- A. Low-voltage wiring installation requirements specified herein shall be applicable to all systems installed that utilize low-voltage wiring where such wiring installation is not specified in other technical sections.
- B. Low-voltage wiring shall be installed in conduit. Unless noted in other specification sections, low-voltage wiring located in office buildings above suspended ceilings shall be allowed to be installed free air, as specified herein if the cable meets NEC requirements for the application.
- C. Control wiring for HVAC and lighting equipment connected to emergency power shall be installed in conduit.
- D. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts. All sizes subject to NEC 725 requirements.
- E. Low-voltage cable splices shall only be allowed in junction boxes.

3.03 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.
- B. Install wire in raceway after interior of building is enclosed, watertight, and dry, and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Conductors No. 6 AWG and larger shall be pulled into conduits by hand or by utilizing a tugger with built-in tension meter. Other motorized machines of any type are not allowed for any wire pulling. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension.
- E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.
- F. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation or provide larger boxes approved for additional capacity.
- G. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.
- H. Circuiting is indicated diagrammatically on the Drawings.

3.04 TERMINAL BLOCK INSTALLATION

- A. A maximum of one conductor shall be installed on the field-wired side of each terminal block. If rated to accept more than one conductor, a maximum of two conductors shall be installed on the enclosure-wired side of each terminal block. Provide additional terminal blocks and shorting jumpers as required.
- B. Provide a separate ground-type terminal block for each shielded-cable drain conductor.
- C. Provide ten percent spare terminal blocks for each type of connected terminal block, minimum five spare terminal blocks total. For each grouping of terminal blocks, provide 25% spare DIN rail space.
- D. Maintain a minimum of 1 1/2 inches between terminal blocks and adjacent devices and enclosure wireways.
- E. For current transformer shorting terminal blocks, the short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position, and expose the terminal block conductor screws when slid into the shorting position.

3.05 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.
- C. Subsequent to wire hookups, energize circuitry and demonstrate functionality in accordance with these specifications.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- E. Perform field inspection and testing according to provisions of this section.

3.06 ACCEPTANCE TESTS

- A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.
- B. CONTRACTOR shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.
- C. Operation Test: By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the Drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.
- D. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and Drawings, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.
- E. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.
- F. The transformer, feeder, and subfeeds to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
 - 1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
 - 2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

3.07 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as temperature control, instruments, network, fiber optic, etc.

END OF SECTION

SECTION 26 05 23

INSTRUMENT AND COMMUNICATION WIRE AND CABLE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this section as listed in Division 01.
- B. Qualifications of Installers: Workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

1.03 PRODUCT HANDLING

- A. Instrument cable shall be furnished in lengths as necessary.
- B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Submit an electronic copy of the fiber optic cable testing report.
- C. Furnish three hard copies and one electronic copy of the final approved fiber optic cable test report to OWNER.

1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 10 years of experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.

- D. CONTRACTOR shall utilize and have technicians trained in the utilization of fiber optic cable certification equipment.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

- A. Shielded cabling shall have stranded, tinned-copper conductors, No. 16 AWG, twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.
- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils thick for shielded pair cables and 42 mils thick for shielded triad cables, with an 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power-limited circuit cable.
- E. A 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A stranded, tinned-copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single-pair shielded cables installed in above-grade conduits shall be Belden 9316, or equal.
- G. Single-pair shielded cables installed in below-grade conduits shall be Belden 9342, or equal.

2.02 HEAT SHRINK TUBING FOR SHIELDED INSTRUMENT CABLES

- A. Heat shrink tubing for sealing the ends of all shielded instrument, cables shall be heavy-wall, low-voltage tubing as manufactured by Raychem Type WCSM, or equal.

PART 3–EXECUTION

3.01 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

- A. Shielded pair cabling specified in this section shall be installed in conduit, and may not be run free-air or in nonmetallic tubing such as innerduct.

3.02 GROUNDING

- A. Shielded cabling shall be installed in accordance with manufacturer's instructions and to minimize electrical noise and interference to associated instruments. Refer to instrument manufacturer's instructions for additional requirements.
- B. Ends of signal wires shall be sealed to prevent the migration of moisture into the cable and to prevent unintentional grounding of the shield at the open end. Seal signal wires using a minimum 1-inch piece of heat-shrink tubing installed over PVC jacket and individual wires, and heat-shrink to a watertight fit.
- C. All shields must be grounded.
- D. Shields shall be grounded at one point only. Shielded cabling shall be isolated and left open at the instrument.
- E. Cable shield grounds shall be isolated from control system signal grounds, except at instrument system grounding electrodes.

END OF SECTION

SECTION 26 05 26

SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Power system grounding.
 - 2. Electrical equipment and raceway grounding and bonding.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Ground Rods: Copper-bonded, 5/8-inch diameter; minimum length 10 feet.
- B. Ground Connections Below Grade: Exothermic type by Cadweld, compression type by ABB (Thomas & Betts), or equal. Compression connectors shall be prefilled with an oxide inhibitor.

- C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, GBL, or equal.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Compression-type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss an index on the connector when installed correctly. An indenter crimp shall be made on ground rods prior to connection of grounding conductor.
- B. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- C. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.
- D. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, and structural reinforcing bars, using suitable ground clamps. Make connections to flanged piping at a point ahead of meter or service shutoff valve. Provide jumper connection across meter or service shutoff valve.
- E. Ground system, transformer neutrals, and equipment as required by code and local ordinances.
- F. All feeder neutrals shall be connected to neutral at only one point in the panelboard.
- G. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- H. Water system grounds and a minimum of three ground rods at 15-foot separations near service or feeder entrance of each building shall be provided and ground wires must attach to point ahead of meter or service shutoff valve. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.
- I. Bends in grounding electrode conductors shall not exceed 90 degrees and shall have a minimum 8-inch bend radius.
- J. Grounding electrode conductor terminations on ground rods shall be made at a minimum depth of 2 feet below grade.
- K. Ground rods shall be installed a minimum of 2 feet horizontally from any below-grade footing or wall.
- L. All grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90-degree bends are not allowed.
- M. Include ground for grounded receptacles, light fixtures, motors, and equipment items shown on the Drawings.

- N. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.
- O. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.
- P. Separately derived systems as defined by the National Electrical Code shall be grounded as such. This shall include, but not be limited to, 4-wire transformers.
- Q. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for additional grounding requirements.
- R. Exposed exterior terminations of grounding electrode conductors shall be completely sealed with the same anti-corrosion joint compound specified in Section 26 05 33—Conduit to be used on conduit threads.

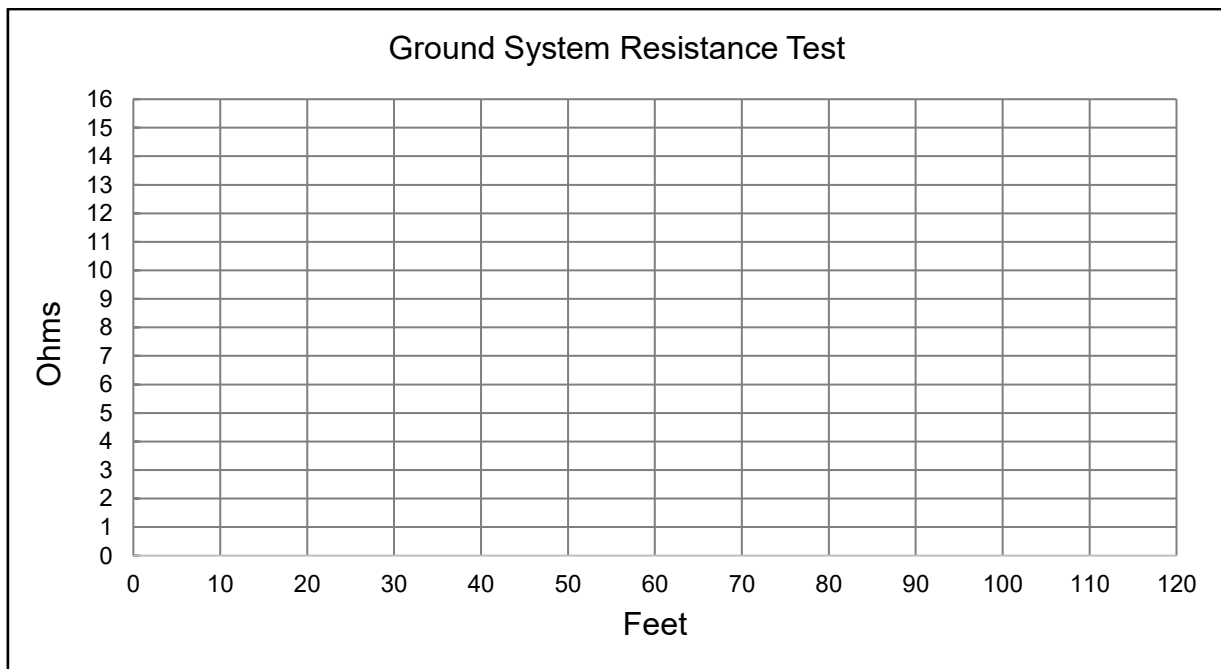
3.02 TESTING

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point “Fall-of-Potential” test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system potential/current probe (P1/C1) or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10% intervals starting at 0% and ending at 100% of the distance between P1/C1 and C2, 11 points total. A single point of measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient “open earth” area to use the three-point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by ENGINEER or OWNER. ENGINEER shall be notified a minimum of 72 hours in advance of all ground system testing.
- C. The test meter shall be Associated Research Vibroground test set with null balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test equipment.
- D. Ground resistance testing shall be performed with all rods connected and shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.
- E. Multiple ground rod grids shall be isolated from all metallic connections such as from grid under test to other grounded structures and electrical system neutrals.
- F. Provide test report using the attached Form 26 05 26. Each ground grid, including service entrance transformers, etc., shall have a form submitted.

END OF SECTION

GROUND ROD RESISTANCE TO EARTH TEST RECORD

1. DATE _____
2. PROJECT NAME _____
3. LOCATION OF TEST _____
4. GROUND ROD TYPE _____
DIAMETER _____ LENGTH _____
5. TEST METHOD _____
INSTRUMENT TYPE _____
SERIAL NO. _____
6. REQUIRED MAXIMUM RESISTANCE TO EARTH _____
7. MEASURED RESISTANCE TO EARTH _____
GROUND ROD SYSTEM _____



TEST PERFORMED BY: _____
Signature

TEST WITNESSED BY: _____
Signature

SECTION 26 05 29

SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Conduit and equipment support members.
 - 2. Fastening hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members:
 - 1. 316 stainless steel in exterior locations, and damp and wet locations.
 - 2. Hot-dipped galvanized steel in all other areas.

- B. Hardware:
 - 1. 316 stainless steel in exterior locations, and damp and wet locations.
 - 2. PVC-coated steel clamps and stainless steel hardware with 316 stainless steel members where used to support PVC-coated rigid steel conduits.
 - 3. Hot-dipped galvanized steel in all other areas.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

PART 3—EXECUTION

3.01 INSTALLATION

- A. All supporting devices and support structures shall be constructed such that the structure adequately supports the load of the equipment installed on it including any wind and/or snow loads. Provide additional support members to those shown on the Drawings to adequately support load.
- B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or support members. Do not use spring steel clips and clamps. Provide standoffs as specified in other technical sections.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. The ends of all support members shall be ground smooth.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- F. Do not use powder-actuated anchors.
- G. Do not drill structural steel members.
- H. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.
- I. Install surface-mounted cabinets and panelboards with a minimum of four anchors.
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Do not use chain, wire rope, or perforated strap hangers.
- L. All welds shall be continuous and ground smooth.

END OF SECTION

SECTION 26 05 33

CONDUIT

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Rigid metal conduit and fittings.
 - 2. Rigid aluminum conduit and fittings.
 - 3. Polyvinyl chloride (PVC) externally and internally coated galvanized rigid metal conduit and fittings.
 - 4. Intermediate metal conduit and fittings.
 - 5. Electrical metallic tubing.
 - 6. PVC conduit and fittings.
 - 7. Liquidtight flexible conduit and fittings.
 - 8. Conduit seals and special fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI C80.1—Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.3—Steel Electrical Metallic Tubing (EMT).
- C. ANSI C80.5—Electrical Rigid Aluminum Conduit (ERAC).
- D. ANSI C80.6—Electrical Intermediate Metal Conduit (EIMC).
- E. ANSI/NEMA FB 1—Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- F. NEMA RN 1—Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal.

1.03 QUALITY ASSURANCE

- A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.

- D. UL Labels: Provide electrical materials, which have been listed and labeled by Underwriters Laboratories.
- E. Prior to shipment to the site, all conduit provided shall be new, unused material, and shall not have been stored outdoors or exposed to weather.
- F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.
- B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.
- C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1 and UL6. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, or equal, and be constructed of stamped steel for sizes 2 inches and under, and cast malleable iron for sizes over 2 inches. Conduit bodies shall have domed gasketed covers and stainless

steel screws. Conduit bodies sizes 1 1/4-inch and larger shall have built-in pulling rollers. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.

- C. Rigid Aluminum Conduit: ANSI C80.5 and UL6A. Heavy wall.
- D. Conduit bodies for rigid aluminum conduit shall be as manufactured by Appleton, Form 85, or equal, and be constructed of pressure-cast, copper-free aluminum for sizes 2 inches and under, and sand-cast, copper-free aluminum for sizes over 2 inches. Conduit bodies shall have domed gasketed covers, and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size per application.
- E. PVC-coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot dipped galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil urethane coating. Acceptable manufacturers shall be Plasti-bond RedH₂OT by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal. All installers shall be field-certified from the factory for installation and shall provide proof of certification. PVC-coated conduit and fittings shall meet the following listings and manufacturing standards, without exception:
 - 1. ANSI C80.1.
 - 2. UL6.
 - 3. NEMA RN1.
- F. Conduit bodies for PVC-coated rigid conduit shall be as manufactured by Plasti-bond RedH₂OT by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 8 style or pulling elbow and include domed, gasketed covers and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- G. Fittings and Conduit Bodies: ANSI/NEMA FB 1 and UL 514B; threaded-type material to match conduit. For hazardous locations, fittings and conduit bodies shall meet the requirements of UL 886. Split couplings are not allowed.
- H. Supports: One-hole straps with conduit clamps and backspacers shall be used for surface-mounted conduit. Where standoffs are required, provide conduit clamps and supporting devices as specified in Section 26 05 29—Supporting Devices. One-hole straps with conduit clamps and backspacers for PVC-coated rigid steel conduit shall be PVC-coated rigid steel material.

2.02 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit: ANSI C80.6 and UL797. Intermediate grade metallic tubing, seamless, with hot-dipped galvanized coating.
- B. Fittings and Conduit Bodies: Use fittings and conduit bodies specified above for rigid steel conduit.

- C. Supports: One-hole or two-hole pipe straps shall be used for surface-mounted conduit. Where one-hole straps are used, provide conduit clamp and back spacer. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices.

2.03 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Conduit: ANSI C80.3 and UL797. Thin wall seamless tubing with hot-dipped galvanized coating. Maximum size 2 inches.
- B. Fittings: Compression-type only.
- C. Supports: Mineralac with nut and clamping bolt; one hole straps.

2.04 PVC AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40, Schedule 80 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.
- B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 or Schedule 80 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.
- C. Supports: Two-hole nonmetallic clamps shall be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices. Support material shall match that of the conduit type being provided.

2.05 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Liquidtight Flexible Metal Conduit:
 - 1. Conduit: Spiral-wound, electrogalvanized, single-strip steel with integral grounding conductor continuously enclosed within the entire length of the convolutions. The flexible PVC jacket shall be sunlight-resistant, flame-retardant, and resistant to damage from mild acids. Conduit shall be Liquatite Type LA, or equal.
 - 2. Fittings: UL listed with thermoplastic elastomer sealing gasket.
 - a. Provide stainless-steel fittings in exterior, and damp and wet locations, unless noted otherwise.
 - b. Provide electro-zinc plated steel fittings in all other areas, unless noted otherwise.

2.06 CONDUIT SEALS AND SPECIAL FITTINGS

- A. Conduit Seals: Duct sealing compound, OZ Gedney Type DUX, or equal.
- B. Expansion Fittings: Crouse Hinds or Robroy Type XJG (non-hazardous location) or equal, for rigid or PVC-coated rigid conduit. Carlon E945 Series, or equal for PVC conduit.
- C. Expansion Deflection Fittings: O-Z type "DX," Crouse Hinds, type XD (PVC conduit only), or Appleton.

- D. Ground Bushings: Crouse Hinds Model GLL, or equal.
- E. Mechanical Seals: 316 stainless steel, Link Seal, or equal. Link seals shall be provided with 316 stainless steel bolts, nuts, and fasteners.
- F. Watertight Hubs: Diecast, insulated and gasketed, rated for wet or dry locations indoors or outdoors. Watertight hubs shall be Appleton HUBXXXDN, Crouse-Hinds Myers Hubs, or equal.
- G. Conduit Plugs: Kwik N Sure pipe plug as manufactured by Cherne Industries, or equal. Plug shall include natural rubber O-ring with galvanized wing nut and hex nut.
- H. Conduit Threads Joint Compound: Kopr-shield conductive, anti-corrosion joint compound as manufactured by Thomas & Betts, or equal.
- I. Conduit Riser Grips: Grips installed in vertical conduit for supporting conductors shall be O-Z/Gedney Type R or Type S, or equal. Grips installed in vertical conduit for supporting cables over 1/4 inch in diameter shall be Hubbell Dust-Tight Strain Relief Grips, or equal.

PART 3-EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4-inch minimum size. Minimum size for liquidtight flexible metal conduit is 1/2 inch.
- B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).
- C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types, including flexible conduit.
- D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.
- E. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or ductwork.
- F. Conduits shall be attached to building surfaces and not suspended unless installed in a Unistrut-type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.
- G. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal to or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed one-third the slab thickness for each run of conduit 1 1/4 inches or

larger. Provide shop drawings when conduit will be installed in structural slabs. Conduits shall not be run in slabs-on-grade or structural topping slabs.

- H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice.
- I. Conduit installed in metal stud walls must be secured to prevent rattling.
- J. Conduit attached to building surfaces that may be damp or wet shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back straps on all conduit in damp and wet locations, or mount conduit with Unistrut straps, or equal. Watertight hubs shall be used in all damp and wet locations.
- K. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet.
- L. Vertical conduit runs 1 1/4 inches and larger passing through floors shall be supported at each floor with conduit riser grips.

3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

- A. Interior conduit shall be run concealed in walls, building cavities, chases, attic spaces, and buried below floor slabs. Exterior conduit shall be buried below grade and concealed in structure walls. Exposed conduit runs shall be avoided. Conduit may be run exposed only where it is impossible to conceal.
- B. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over boilers or other high-temperature machinery nor in contact with such equipment.
- C. All conduit installed below grade shall be buried a minimum of 2 feet 0 inch. All conduit installed below floor slabs shall be buried a minimum of 1 foot below slab.
- D. PVC-coated rigid steel conduit and PVC conduit installed in earth (interior and exterior) shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.
- E. In all PVC conduit runs below grade 200 feet and longer, PVC coated rigid steel conduit shall be used for all 90 degree bends.
- F. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, splicing chambers, disconnect switches, and all other components of the raceway system.
- G. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty conduits shall be threaded, capped and flush with finished floor or wall. Exposed conduits shall be threaded and capped.

- H. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, float cables, etc.
- I. Conduit seals shall be provided where conduits pass from the interior to exterior of the building and any conduit entering a wet location.
- J. Liquidtight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.
- K. Provide conduit expansion-deflection fittings as specified herein in all conduit runs where movement perpendicular to axis of conduit may be encountered.
- L. Conduits shall be pitched so that drainage is away from all structures.
- M. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.
- N. The PVC-coated rigid conduit manufacturer's touch-up compound shall be used on all conduit interior and exterior bare steel exposed because of nicks, cuts, abrasions, thread cutting, and reaming; minimum six coats.
- O. Where below-grade PVC conduit is connected to rigid metal conduit, the length of PVC conduit shall be a minimum of 10 feet. For short, below-grade conduit runs where required lengths of rigid metal conduit limit the length of PVC conduit to less than 10 feet, rigid metal conduit shall be used for the entire run.
- P. Conduit bodies shall not be used for fiber optic cable routing. Provide pull boxes sized as required for fiber optic cable bending radius.
- Q. Routing of conduits on exterior of buildings shall be avoided to the extent possible and shall not cover or interfere with lighting, signage, windows, louvers, or other openings. All conduit routing on exterior walls shall be reviewed with ENGINEER for approval prior to installation.
- R. Conduits installed in damp and wet locations shall have all threads coated with conduit threads joint compound.
- S. Install conduit riser grips in vertical conduits where needed to comply with the maximum vertical support spacing intervals required by the NEC.

3.03 CONDUIT PENETRATIONS AND TERMINATIONS

- A. Where fittings are brought into an enclosure with a knockout, a gasket assembly consisting of an O-ring and retainer shall be installed on the outside. Fittings shall be insulated throat type.
- B. Conduit penetrations for control panels or enclosures containing electronic equipment shall utilize watertight hubs and, if entering the top of the enclosure, shall be located at the front of the enclosure and not over any electronic equipment (e.g., PLC, power supplies, etc.).
- C. Conduit penetrations for all exterior enclosures (e.g., disconnects, junction boxes, control panels) shall utilize watertight hubs and enter the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.

- D. Provide conduit expansion fittings as specified herein in all conduit runs that cross a structural expansion joint and for conduits protruding from earth.
- E. Provide firestopping for all conduits penetrating fire barriers as specified in Section 07 84 00–Firestopping.
- F. All conduits that protrude from poured concrete shall be PVC-coated rigid conduit. Conduit shall extend continuously (i.e., no joints) a minimum of 4 feet beyond the poured concrete (both sides). Where an underground conduit joint or coupling is located within 4 feet of the face of the penetration, the conduit shall be provided with reinforced concrete encasement doweled into the structure wall and continuing a minimum of 1 foot past the connection. The encasement construction shall conform with the encasements indicated for duct banks. PVC-coated rigid conduit 4-foot minimum projection requirement shall begin at, and extend from, the end of the encasement. The intent of this paragraph is to permit CONTRACTOR to use couplings at the inside face of the formwork.
- G. Conduits passing through masonry, concrete, or similar construction shall be cast in place using PVC-coated rigid conduit extending completely through the construction.
- H. Where above-grade conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand cement mortar.
- I. All spare conduits that terminate in a building or structure below grade shall be plugged with conduit plugs as specified herein.

3.04 CONDUIT INSTALLATION FOR EMERGENCY LIGHTING CIRCUITS

- A. All emergency egress lighting circuits shall be installed in dedicated conduits.
- B. Conduits for emergency egress lighting circuits shall be installed and permanently marked in accordance with the NEC.

3.05 CONDUIT INSTALLATION SCHEDULE

- A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:
 - 1. Rigid steel:
 - a. Structural slabs.
 - b. Interior locations requiring mechanical protection.
 - c. All exposed interior locations.
 - d. All concealed interior locations.
 - 2. IMC:
 - a. Slabs, except slabs on grade.
 - b. All concealed interior locations.
 - c. Interior locations requiring mechanical protection.
 - d. All exposed interior locations.
 - 3. EMT:
 - a. Interior partitions in the Administration Building.
 - b. Above suspended ceilings.
 - 4. Rigid aluminum:
 - a. All exposed interior locations.
 - b. Interior locations requiring mechanical protection.

- c. Exterior locations (except in earth) and locations exposed to weather.
 - d. Above suspended ceilings.
 - e. All locations where attached to aluminum railings or aluminum structural members.
- 5. PVC-coated rigid steel:
 - a. Conduits protruding from concrete.
 - b. Interior and exterior locations requiring mechanical protection.
 - c. Earth.
 - d. Exterior locations and locations exposed to weather.
 - e. Within 4 feet of building or structure footing, or wall.
- 6. PVC:
 - a. Earth and within 4 feet of a building or structure footing, or wall. PVC conduit under pavement or roadways shall be Schedule 80.
 - b. Grounding electrode conductors.
 - c. Buried below slabs on grade.
- 7. Liquidtight flexible metal conduit not over 3 feet in length for final connections to:
 - a. Equipment with sliding bases or flexible positioning.
 - b. Equipment with vibration isolation mounting.
 - c. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including motors.

END OF SECTION

SECTION 26 05 34

SURFACE RACEWAY

PART 1–GENERAL

1.01 SUMMARY

- A. Work included: Furnish and install surface raceways, including surface metal raceway, multioutlet assemblies, auxiliary gutters (wireways) and wall duct.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Surface raceway sections and fittings shall be UL labeled.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 SURFACE METAL RACEWAY

- A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway; 4000 Series manufactured by Legrand Wiremold, or equal.
- B. Size: 4 3/4 inches by 1 3/4 inches.

- C. Faceplate and Activation Fittings: Legrand Wiremold 4047 faceplates, corresponding components and "Open Connectivity Solutions Modules" shall be installed for all 4000 Series locations. Adapter CM-ARA with Insert CM2-U2ATT shall be used for all voice and data jack locations.
- D. Finish: Ivory, or to match existing, as approved by OWNER.
- E. Fittings: Couplings, elbows, ceiling trim rings and connectors designed for use with raceway system.
- F. Boxes and Extension Rings: Designed for use with raceway systems.
- G. Description: Sheet metal channel with fitted cover, suitable for use as surface raceway, manufactured by Wiremold Series V700 is acceptable at locations with two or less data, or power drops. Provide deep box and Lucent M14L faceplates for voice and data locations.

PART 3-EXECUTION

3.01 INSTALLATION-SURFACE METAL RACEWAY AND MULTIOUTLET ASSEMBLY

- A. Use flathead screws to fasten channel to surfaces every 24 inches. In addition, mount plumb and level per the manufacturer's recommendations.
- B. Unless otherwise stated, all devices shall be approximately 24-inch AFF.
- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Install trim rings at the ceiling when the raceway passes through the ceiling.
- E. Maintain grounding continuity between raceway components to provide a continuous grounding path per the manufacturer's installation requirements.
- F. Fastener Option: Use clips and straps suitable for the purpose. Use two hole straps for 700 size wiremold.

END OF SECTION

SECTION 26 05 35

BOXES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Switch, outlet, and small junction boxes.
 - 2. Pull and junction boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

1.02 REFERENCES

- A. ANSI/NEMA OS 1—Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. NEMA 250—Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation Work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc. that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with

each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel, 4-inch square or octagon, minimum 2 1/8 inches deep, Raco, Appleton, or equal. Boxes with knockouts for multiple size conduits are not allowed. Suspended ceiling grid support bridges shall be as manufactured by Caddy, Model 512 HD, or equal.
- B. Masonry and Partition Boxes: Galvanized steel, nongangable. ABB (Thomas & Betts), MB Series, or equal. Provide number of gangs for devices shown on the Drawings.
- C. Cast Boxes: Aluminum or cast ferrous, deep-type, gasketed cover, threaded hubs, Eaton FD Series, or equal.
- D. PVC-Coated Cast Boxes: Boxes shall be deep type and be by the same manufacturer as the conduit.
- E. NEMA 4X Boxes:
 - 1. Switch and Outlet Boxes: PVC or FRP, Carlon FD Series, or equal with proper cover and gasket. 316 stainless steel, Calbrite FDC Series, or equal where specified herein.
 - 2. Small Junction Boxes: PVC or FRP, Carlon HS Series, or equal with proper cover and gasket.
- F. Covers for junction boxes shall have covers that match box type.

2.02 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1: Code gauge steel with galvanized or sheradised finish, secured by galvanized machine screws. Hoffman ASG Series without knockouts, or equal. Boxes of this type are not allowed to have any dimensions equal to or greater than 12 inches.
- B. Cast Boxes: NEMA Type 3/3R/4X/7/9, surface-mounted junction box rated for Class I, Divisions 1 and 2, Groups C and D locations and Class II, Divisions 1 and 2, Groups E, F, and G locations. Box material shall be copper-free, cast aluminum and include a hinged cover with ground flange, neoprene gasket, and stainless-steel cover bolts. Boxes shall be Crouse-Hinds ECB Series, or equal. All box hardware shall be stainless steel, and the aluminum parts shall have an external epoxy powder-coat finish to achieve a NEMA 4X rating.

- C. PVC-Coated Cast Boxes: Provide PVC-coated cast boxes in areas where PVC-coated conduit is used; in nonhazardous locations, provide cast boxes. Boxes shall be by the same manufacturer as the conduit. Boxes in nonhazardous locations larger than 12 inches in any dimension shall be NEMA 4X boxes.
- D. NEMA 4X Boxes: PVC or FRP, Carlon HS Series, or equal with hinged cover, gasket, and locking system. Boxes shall be 316 stainless steel with hinged cover, recessed quarter-turn padlocking latches, and gasket, Saginaw Control and Engineering Enviroline Series, or equal, where specified herein.
- E. NEMA 12 Boxes: Painted steel with hinged cover, recessed quarter-turn padlocking latches, gasket, and locking system. Boxes shall be Hoffman CSD, or equal.
- F. Where terminal blocks or other devices are mounted in a pull or junction box, provide a 14-gauge steel back panel with a white enamel finish for mounting.
- G. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

2.03 RECESSED WALL BOXES FOR LARGE-FORMAT DISPLAYS

- A. Wall boxes shall be able to be recessed and be provided with a cable pass-through cover. The box shall accept externally-mounted and recessed back boxes for power receptacles and data jacks and also provide conduit connections for video and audio cables.
- B. Wall boxes mounted directly behind the display shall be as manufactured by FSR Model PWB-200, or equal, with white pass-through cover plates for power, video, and audio cables routed to the associated display.
- C. Wall boxes mounted below the workstation desk for audio and video cable conduits to the boxes mounted directly behind the display shall be as manufactured by FSR Model PWB-100, or equal, with white pass-through cover plates for video and audio cables routed to the associated display.
- D. Provide back boxes on each wall box as specified in this section for all receptacles and data jacks.
- E. Provide back boxes on each wall box as specified in this section for each video and audio cable conduit routed to the box. Provide cable pass-through bushings as manufactured by FSR Model IPS-B010D inside the wall box for each back box opening.

PART 3-EXECUTION

3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the Drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.
- B. Electrical box locations shown on the Drawings are approximate. Verify location and size of floor boxes and outlet boxes in all work areas prior to rough-in.

- C. Where dedicated raceways are provided for different voltage systems or wiring, separate boxes shall also be provided unless acceptable to ENGINEER. Where acceptable to ENGINEER, combined boxes shall be physically divided to separate the wiring.
- D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.
- E. Locate and install to maintain headroom and to present a neat appearance.
- F. All boxes attached to building surfaces that may be damp or wet shall be spaced to avoid rust and/or corrosion. All boxes in damp and wet locations shall be on 1/2-inch standoffs.

3.02 SWITCH, OUTLET, AND SMALL JUNCTION BOX INSTALLATION

- A. Locate boxes in masonry walls for cutting of masonry unit corners only. Coordinate masonry cutting to achieve neat openings for boxes.
- B. Provide knockout closures for unused openings.
- C. Support boxes independently of conduit.
- D. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. Install boxes in walls without damaging wall insulation.
- F. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- G. Position outlets to locate luminaires as shown on reflected ceiling plans.
- H. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring and wiring for emergency egress lighting shall each have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24 V, 120 V, 480 V) shall have dedicated pull and junction boxes for each voltage.
- I. In inaccessible ceiling areas, position outlet boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling opening.
- J. Provide sheet metal recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall and adjustable steel channel fasteners for flush ceiling outlet boxes.
- K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- L. All concealed lighting outlet boxes shall be sheet metal octagon boxes.
- M. In plaster or concrete walls, single receptacle, single- or double-switch outlets, use 4-inch-square masonry boxes fitted with raised plaster covers.

- N. In unplastered brick or block walls, use masonry boxes.
- O. In metal door frames, use partition boxes.
- P. For weatherproof switches, devices, and exterior fixtures, use cast boxes with proper cover and gasket.
- Q. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- R. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- S. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so that they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- T. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.
- U. Sheet metal boxes installed in suspended ceilings for free-air splices or devices installed through the suspended ceiling shall be supported by the suspended ceiling grid system using grid support bridges. Provide mounting hardware, accessories, extensions, etc., based on ceiling grid installed for this project.
- V. Provide PVC-coated cast boxes in all areas where PVC-coated conduit is used. Boxes shall be by the same manufacturer as the PVC-coated conduit.
- W. PVC or FRP NEMA 4X boxes shall be provided only where noted on the Drawings.

3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable, except when used in conjunction with EMT conduit in areas where allowed.
- D. Refer to Section 26 05 53—Electrical Identification for junction box labeling requirements.
- E. All interior exposed boxes and all interior boxes with a dimension equal to or greater than 12 inches, including boxes above suspended ceilings, shall be NEMA 12, unless noted otherwise.
- F. All exterior boxes shall be NEMA 4X stainless steel.
- G. In inaccessible ceiling areas, position boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling opening.
- H. PVC or FRP NEMA 4X boxes shall be provided only where noted on the Drawings.

3.04 LARGE-FORMAT DISPLAY SCREEN WALL BOX DISPLAY INSTALLATION

- A. Coordinate the installation of all recessed wall boxes for large-format displays with ENGINEER so that the boxes are at the correct heights. The wall boxes shall be completely concealed behind the displays and mounted as centered as possible while not interfering with the display mounting brackets.

END OF SECTION

SECTION 26 05 44

HANDHOLES

PART 1—GENERAL

1.01 DESCRIPTION

- A. Work Included: Precast polymer concrete handholes.
- B. Related Sections: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/SCTE 77—Specification for Underground Enclosure Integrity.
- B. ASTM A48—Specification for Gray Iron Castings.
- C. ASTM A615—Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- D. ASTM D4101—Specification for Polypropylene Injection and Extrusion Materials.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawing submittals shall include the following:
 - 1. Interior elevations of each wall of all handholes provided under this Contract. Each conduit shall be identified as to what it serves.
 - 2. Product data (handholes): Manufacturer's technical information for handholes and accessories proposed for use.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 PRECAST POLYMER CONCRETE HANDHOLES

- A. Material and Construction:
 - 1. Precast polymer concrete.
 - 2. Duct entrances sized and located to suit duct banks.
 - 3. Enclosures, boxes and covers are required to conform to test provisions of ANSI/SCTE 77 for Tier 22 applications.
 - 4. Handholes shall be a minimum of 30 inches deep. Handholes shall be sized in accordance with the NEC.
 - 5. Covers shall have the following stamped logo:

“ELECTRIC”
 - 6. Handholes shall be Hubbel, Quazite, PG-Style, or equal.

PART 3–EXECUTION

3.01 INSPECTION AND COORDINATION

- A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 HANDHOLE INSTALLATION

- A. Coordinate handhole installation with piping, sheeting, and other underground systems and structures, and locate clear of interferences.
- B. Install handholes where shown and verify locations in field. Perform excavation and backfilling required for installation. Excavation and backfilling shall be in accordance with Section 26 05 00–General Electrical Requirements.
- C. Install handholes on a 3/4-inch crushed stone foundation 1 foot under all handholes, and within 2 feet of handholes. Handhole bases shall be set at the proper grade and carefully leveled and aligned.
- D. All conduits must enter the sides of handholes. Hole saw one opening for each conduit entry closely sized to the outside diameter of the conduit, and provide stainless-steel locking nuts and washers on the inside and outside faces of the handhole to secure the conduit to the wall of the handhole. Provide an insulated throat bushing with ground lug on the conduit end inside the handhole. Conduits entering the bottom will not be permitted. Conduits shall enter handholes a minimum of 6 inches above bottom of handhole. Provide handhole depth as required.
- E. Handholes shall be considered wet locations for purposes of equipment selection.
- F. All conduits shall be pitched so that drainage is towards handholes and away from all structures.

- G. Provide a ground rod as specified in Section 26 05 26—Secondary Grounding inside each handhole. Bond the ground rod to the ground lugs on all insulated throat bushings installed on the ends of each conduit entering the handhole using a bare copper conductor sized per the NEC.

3.03 GRADING AT HANDHOLES

- A. Handholes in unpaved areas shall be built as shown to a rim elevation higher than the original ground. The ground surface shall be graded to drain away from the handhole. Fill shall be placed around handholes to the level of the upper rim of the handhole frame, and the surface evenly graded on a one (vertical) to five (horizontal) slope to surrounding ground, unless otherwise shown.
- B. CONTRACTOR shall be solely responsible for proper height of handholes necessary to reach final grade. ENGINEER's review of shop drawings for handhole components is general in nature, and CONTRACTOR shall provide random length handhole riser sections to adjust handholes to meet field conditions for final grading.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Nameplates.
 - 2. Labeling tags.
 - 3. Wire and cable markers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide schedule for nameplates and labeling tags with shop drawings. Reference Drawings for type used.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 NAMEPLATES

- A. Nameplate material shall be multi-color, two-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.

- B. Type "A":
1. Use:
 - a. Each separately mounted circuit breaker or disconnect switch.
 - b. SPD.
 - c. Cabinets, enclosures, pull, and junction boxes.
 - d. Field devices (level transmitters, etc.).
 - e. Panelboards.
 2. Size: 2 inches by 4 inches.
 3. Background Color: Black.
 4. Character Color: White.
 5. Character Size: 1/2-inch.
 6. Engraving: See one-line, and I/O list for labels, or as requested by ENGINEER. Label shall include equipment number and description (i.e., SCAL-60-01, Fluoride Scale).
 7. Mounting Location: Front exterior.
- C. Type "B":
1. Use: Thermostats, Conduit fittings, etc.
 2. Size: 1/2-inch by 4 inches.
 3. Background Color: Black.
 4. Character Color: White.
 5. Character Size: 1/4-inch.
 6. Engraving: Control station number and equipment description (e.g., T-15-01, Chlorine Room).
 7. Mounting Location: Device front at top.
- D. Type "C":
1. Use:
 - a. Electrical Distribution System Equipment not previously specified.
 - b. Fire Alarm System.
 - c. Access Control System.
 - d. Video Surveillance System.
 - e. Operator Instructions.
 2. Size: As necessary.
 3. Background Color: Yellow.
 4. Character Color: Black.
 5. Character Size: 1/4-inch.
 6. Engraving and Mounting Location: As requested by ENGINEER.

2.02 LABELING TAGS

- A. Labeling tag material shall be multi-color, 2-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.
- B. Use: Field-mounted devices without surfaces suitable for mounting fixed nameplates (Level Transmitters, etc.).
1. Size: 3/8-inch by 2 inches.
 2. Character Size: 1/4-inch.
 3. Engraving: As requested by ENGINEER.

2.03 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.
 - 1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
 - 2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.
 - 3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.
- B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Affix nameplates with weatherproof, UV-resistant adhesive in outdoor locations and sticky back adhesive in indoor locations.
- D. Affix labeling tags with stainless steel leaders; vinyl locking wire ties are not acceptable. Provide 3/8-inch hole to accommodate wire tie.
- E. Prepare and install neatly-typed circuit directories and schedules in all panels, including, but not limited to, panelboards, fiber optic patch panels, and existing panels where Work is done under this Contract.
- F. Labeling tags shall only be used for equipment enclosures without surfaces suitable for mounting fixed nameplates.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Neutral conductor labels shall include the associated branch circuit number. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.
- B. Conductors in pull boxes, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- C. Where terminal blocks are factory provided with non-project-specific labels by equipment manufacturers in VFDs, control panels, and similar equipment and are wired to terminal blocks in control panels with project-specific labels, the interconnecting wiring shall be labeled at both ends to match the project-specific terminal blocks in the control panel.

Provide an additional label on the end of each wire that is connected to a terminal block with a non-project-specific label to indicate the associated terminal block.

D. Power Conductor Insulation Color Code:

1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination and at accessible locations such as handholes, junction and pull boxes, panelboards, motor control centers, switchboards, switchgear, etc. Apply tape with at least six full, overlapping wraps; minimum 2 inches wide.
2. 8 AWG and Smaller: Provide conductors with color-coded insulation.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
120/208 Volts Three-Phase, Four-Wire	Grounded Neutral	White*
	Phase A	Black
	Phase B	Red
	Phase C	Blue
Note: Phase A, B, C implies direction of positive phase rotation.		
* When installed as part of a 120-volt or 277-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation.		

E. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination and at accessible locations such as junction and pull boxes, panelboards, etc.
2. Conductors for panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.
4. Circuits Not Listed in Circuit Directories:
 - a. Assign circuit name based on unique device or equipment at load end of circuit.
 - b. Where unique device or equipment names are not available or apparent, add a unique number or letter modifier to each otherwise identical circuit name.

3.03 DATA CABLE AND COMMUNICATION EQUIPMENT IDENTIFICATION

- A. Individual labels shall be placed on all information outlets, patch panels, and communications cabinets, and both ends of all cables.
- B. Each component shall be clearly labeled using a code identifying each device's location throughout the facility along with a unique identifier. The Record Drawings shall identify the numbering at each rack, communication cabinet, and jack location. Each media type shall be uniquely labeled as follows:
1. Wall-Mounted Communications Cabinets:
 - a. Mounting structure type (R=floor-standing rack, CC=communications cabinet), structure number, rack/cabinet number.
 - b. For example: "R-80-01" represents Rack No. 1 in Structure 80. "CC-10-01" represents Communications Cabinet No. 1 in Structure 10.
 - c. Racks shall be labeled on the top and bottom, both front and back of rack.
 - d. Nameplates are not required in structures with a total of one rack or cabinet installed.
 2. Patch Panels:
 - a. Rack/cabinet number, patch panel type (C=copper, F=fiber) and top position of patch panel in rack units from bottom of rack/cabinet.
 - b. For example: "R-80-01:C07" represents a copper patch panel mounted in top RU space 7 of Rack No. 1, which is located in Structure 80.

- c. For structures with a total of one rack or cabinet installed, the patch panel labels shall not include a preceding rack number.
- 3. Cables:
 - a. Patch panel number, cable type (D=data)-jack number.
 - b. For example: "R-80-01:C07.D-001" represents the first data jack served from a copper patch panel mounted in top RU space 7 of Rack No. 1, which is located in Structure 80.
 - c. For structures with a total of one rack or cabinet installed, the cable labels shall not include a preceding rack number.
- 4. Jacks:
 - a. Provide a label on the top or bottom of the faceplate identifying the patch panel serving the associated jacks, as specified herein.
 - b. Label each jack with the cable type (D=data): jack number.
 - c. For example: "D-001" represents the first data jack served from the associated patch panel.
- 5. All labels shall comply with ANSI/TIA/EIA-606-A-1.

- C. Refer to Section 26 05 23—Instrument and Communication Wire and Cable and Section 27 10 00—Structured Cabling for cable insulation and jack color requirements.

3.04 JUNCTION BOX IDENTIFICATION

- A. All junction boxes shall be labeled with permanent nameplates. Nameplates shall indicate circuit or load served, as well as the power source and highest voltage present on any conductor.

3.05 CONDUIT FITTINGS IDENTIFICATION

- A. All conduit fittings that contain splices of any kind shall be labeled with permanent nameplates indicating "splice within." Nameplates shall be clearly visible at location installed. Nameplates shall be fastened to each conduit fitting with heavy duty, UV-resistant, cold weather cable ties.

3.06 TERMINAL BLOCK IDENTIFICATION

- A. Terminal blocks shall be labeled on both sides of each terminal block. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
- B. Fused terminal blocks labels shall be located on top of the terminal blocks and include the fuse voltage and ampere rating.

3.07 COMPONENT IDENTIFICATION

- A. All components (e.g., relays, timers, power supplies, etc.) within enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels. Labels shall be installed on the enclosure back panel and not on the device itself, wireway covers, or any other removable devices. Labels shall be included on the as-built drawings.

3.08 LABELING FONT REQUIREMENTS

- A. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.

- B. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

END OF SECTION

SECTION 26 09 00

CONTROLS AND INSTRUMENTATION

PART 1–GENERAL

1.01 SUMMARY

A. Related Sections and Divisions:

1. Applicable provisions of Division 01 shall govern work in this section.
2. Section 26 09 10–Controls and Instrumentation Drawings.
3. All other sections of Division 26.

PART 1–GENERAL	1
1.01 SUMMARY.....	1
1.02 SYSTEM DESCRIPTION	2
1.03 QUALITY ASSURANCE.....	2
1.04 SUBMITTALS.....	3
1.05 OPERATION AND MAINTENANCE DATA	3
1.06 DELIVERY, STORAGE, AND HANDLING	4
1.07 SYSTEM ENGINEERING	4
1.08 DESCRIPTION OF THE WELL NO. 45 TREATMENT FACILITY AND BOOSTER STATION MODIFICATIONS	4
1.09 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS	5
1.10 ON-SITE FUNCTIONAL ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES	6
1.11 COMMON REQUIREMENTS ALL EQUIPMENT.....	8
1.12 GENERAL CONTROL ALGORITHMS.....	9
1.13 WARRANTY	10
1.14 BUILD AMERICA, BUY AMERICA REQUIREMENTS	10
PART 2–PRODUCTS	11
2.01 FLOAT SWITCHES.....	11
2.02 SUBMERSIBLE LEVEL TRANSMITTERS	11
2.03 EQUIPMENT ENCLOSURES	12
2.04 INDUSTRIAL CONTROL RELAYS AND CONTACTORS	13
2.05 CURRENT TRANSDUCERS	14
2.06 GAS MONITORING AND DETECTION SYSTEMS FOR VEHICLE STORAGE AREAS	14
PART 3–EXECUTION	15
3.01 EXHAUST FAN (EF-80-01) AND GAS DETECTOR CONTROL PANEL.....	15
3.02 EXTERIOR LIGHTING CONTROL PANEL.....	16
3.03 RESERVOIR MIXER (45-MX-1) CURRENT TRANSDUCER JUNCTION BOX....	17
3.04 FLOATS AND LEVEL TRANSMITTER JUNCTION BOXES	17
3.05 MODIFICATIONS TO EXISTING SCADA SYSTEM HMI GRAPHICS.....	17
3.06 EXISTING WELL 45 TREATMENT FACILITY AND BOOSTER STATION SCADA CONTROL PANEL (45-SCP-1).....	17
3.07 EXISTING WELL 45 TREATMENT FACILITY AND BOOSTER STATION HMO CONTROL PANEL (45-HMOCP-1).....	17

1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation modifications to the Supervisory Control and Data Acquisition (SCADA) System for the Well No. 45 Treatment Facility and Booster Station.
- B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all required PLC interface hardware and internal PLC cabinet wiring, hardware, system drawings, new exterior lighting control panel, new exhaust fan and gas detector control panel, and SCC modification drawings as necessary. SCADA System computer is located in the Public Water Laboratory Building.
- C. System Supplier shall be responsible for development of the SCADA System computer HMI graphics as specified herein. System supplier shall be responsible for all OIP graphics programming.
- D. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in, or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- E. CONTRACTOR shall be responsible for the placing of circuits and making of electrical connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to provide proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise the making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in an acceptable manner. This shall include on-site review of software/hardware controls from the central control point.
- F. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier.

1.03 QUALITY ASSURANCE

- A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA systems of the size and complexity specified herein, and whose systems have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA System design and installation work similar to that required for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, and connectors that have been listed and labeled by Underwriters Laboratories.

- E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- D. Shop drawing submittals shall be assembled in phases.
 - 1. The first submittal shall include the following:
 - a. Detailed catalog information, descriptive literature, and specifications of hardware and software. All items being provided must be specifically noted on this literature, including all field devices and instruments.
 - b. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, startup, and maintenance services. Plan shall include key personnel on project, point of contact, and communication protocol.
 - c. Overall network schematic showing all controllers and hardware addresses applicable to the system.
 - d. Wiring diagrams for all control panels, including modification drawings for existing equipment. Modification drawings shall be completed using electronic CAD software. Handwritten or PDF markups of any kind will not be allowed.
 - 2. Subsequent submittals shall include control narratives.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provision of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.
- C. Submit Operation and Maintenance Manuals in accordance with Division 01. The following additional information shall apply:
 - 1. Manuals shall contain, but not be limited to, the following:
 - a. System Hardware.
 - b. System Software.
 - 2. Hardware section shall include:
 - a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
 - b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.
 - c. Listing of all hardware timers installed in control panels, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of startup.
 - 3. Software section shall include: Program documentation (i.e., existing PLCs and OIPs) shall include programs, documentation files, database and configuration as installed. Provide two USB flash drives with this information.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle equipment carefully to avoid damage to SCC components, enclosure, and finish.

1.07 SYSTEM ENGINEERING

- A. System Supplier shall provide all engineering necessary to accomplish and document the requirements of this specification and be in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:
 - 1. PLC system layouts.
 - 2. Panel layouts.
 - 3. I/O configuration and wiring diagrams.
 - 4. PLC programming.
 - 5. Network configuration.
 - 6. OIP programming.
 - 7. HMI computer programming.
- B. Installation: CONTRACTOR shall install all system equipment, including all interconnection wiring from new and existing equipment as required for the completion of the system.
- C. It shall be the responsibility of System Supplier to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
 - 1. Equipment size and available space.
 - 2. Power levels.
 - 3. Power sources.
 - 4. Logic schemes.
 - 5. Signal types and levels.
 - 6. Interface devices where required.
 - 7. All other aspects of field devices impacting the design of the system.
- D. The system shall be programmed to implement the control sequences and to provide monitoring according to this specification. It shall be the responsibility of System Supplier to include all inputs and outputs required to meet all aspects of this specification, regardless of whether they are specifically included in the I/O listing in this specification.
- E. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for 3 years from startup.

1.08 DESCRIPTION OF THE WELL NO. 45 TREATMENT FACILITY AND BOOSTER STATION MODIFICATIONS

- A. System Supplier shall be responsible for the development of all required process control functions based on the algorithms described in this specification.

- B. Well No. 45 Treatment Facility and Booster Station SCC and the listing of controls and monitoring functions are shown on the Drawings. All equipment specified herein shall be provided in this contract.
- C. System Supplier will be able to obtain a copy of shop drawings for the existing control system wiring diagrams for development of the required loop drawings, interface requirements, and wiring requirements.

1.09 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

- A. This specification, along with the Contract drawings, defines the requirements of modifications to an existing PLC-based process monitoring and control system. System Supplier shall modify the existing process monitoring and control system specifically for the demanding requirements of a real-time municipal water system pumping station.
- B. It is the intent of this specification to define modifications to an existing fully integrated open-type process monitoring and control system. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER, in writing, any deficiencies noted during this review. Any changes required by CONTRACTOR because of a failure to complete this review shall be the responsibility of CONTRACTOR, at no increase in cost to OWNER.
- C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, and sensors, supplied with input and output signals, and contacts that are compatible with the existing system. The Contract Drawings and I/O Listing are symbolic representatives of the required work. It is not intended that the Drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the Drawings, Specifications, and standard industry practices.
- D. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar networked PLC-based monitoring and control systems of the same complexity and size for municipal water distribution and treatment systems shall provide the specified equipment and services. The system proposed to meet this specification shall be of field-proven design incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.
- E. Design and specification of devices and the completed system shall conform to the applicable portions of the latest edition of the National Electrical Code (NEC).
- F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- G. System Supplier shall meet the following minimum requirements:
 - 1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of networked computer systems and the PLCs being provided.
 - 2. System Supplier shall have a minimum of one Microsoft-certified engineer.
 - 3. System Supplier shall have an adequate inventory of spare parts.
 - 4. System Supplier shall have a full-time staff of qualified service technicians.

5. System Supplier shall be responsible for the programming and documentation of the system.
6. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
7. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.
8. System Supplier shall have a UL panel shop located inside the System Supplier's own facilities.
9. System Supplier shall have experience with the specified HMI software on past projects of similar size and complexity.

H. All components shall be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The System Supplier shall be Concentric Integration (Contact James Gramhofer) (815) 788-3600 or (815) 355-5174, no equal.

1.10 ON-SITE FUNCTIONAL ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES

A. Permit ENGINEER and OWNER to observe vendor's staging records or other quality assurance records relating to system(s) supplied. System Supplier shall assemble the system components as a complete process monitoring and control system.

B. On-Site Functional Acceptance Testing:

1. After all equipment has been installed and is placed in full-time operation or after all equipment scheduled for on-site functional acceptance testing has been installed and placed in full-time operation, CONTRACTOR and System Supplier shall demonstrate that all equipment operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
2. All control wiring, hardwired interlocks, HMI screens, control programming, etc., shall be checked out and functionally tested by System Supplier prior to ENGINEER's on-site functional acceptance testing. All functional errors shall be corrected prior to ENGINEER's on-site functional acceptance testing.
3. CONTRACTOR shall submit updated versions of all HMI screens developed by this System Supplier to ENGINEER for review at least one month prior to the functional acceptance testing of equipment controlled through the associated HMI screens.
4. Coordination Videoconferences:
 - a. CONTRACTOR shall schedule and conduct an initial functional acceptance testing coordination videoconference at least two months prior to the anticipated functional acceptance testing. The videoconference shall include CONTRACTOR, System Supplier, Division 26 contractor, OWNER, and ENGINEER, and all other parties responsible for the equipment and controls scheduled for functional acceptance testing.
 - b. CONTRACTOR shall schedule and conduct additional functional acceptance testing coordination videoconferences one month prior to the date for functional acceptance testing of each group of equipment to confirm status of equipment installation and System Supplier checkouts, and updates to the functional acceptance testing schedule, after which ENGINEER will finalize reservations for travel and accommodations. All parties shall agree on a date for functional acceptance testing of the next group of equipment at this videoconference, or schedule an additional

videoconference to establish a testing date one month prior to the delayed testing date. If the functional acceptance testing is rescheduled within one month of the agreed upon date, there will be deducted from payments due to CONTRACTOR the amount of penalties paid by ENGINEER for travel and accommodation cancellations. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.

- c. CONTRACTOR shall provide the following information in written form at each videoconference. All information shall be updated prior to each videoconference.
 - (1) Equipment installation and manufacturer's startup schedule.
 - (2) Status of all power and control system wiring for the equipment scheduled for functional acceptance testing.
 - (3) Schedule and status of System Supplier's on-site checkout and functional testing.
 - (4) Anticipated delays and the cause of each delay.
 - (5) Conflicts with OWNER's operation of the facility.
 - (6) Proposed dates for acceptance testing of all equipment and controls.
 - (7) Proposed dates for future acceptance testing coordination videoconferences.
 - 5. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for ENGINEER's functional acceptance testing, ENGINEER will make one 1-day trip to check operation. CONTRACTOR and System Supplier shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to control system and HMI programming, as necessary. If the equipment and controls do not operate according to the Contract Documents, or if CONTRACTOR and System Supplier are not present during the scheduled testing, there will be deducted from payments due to CONTRACTOR the amount of \$1,500 a day for ENGINEER's time plus travel and expenses, and for all additional field and office time spent by ENGINEER checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
 - 6. System Supplier shall provide functional acceptance testing support through one or more on-site field service engineers and the project control system programmer. Time for the on-site field service engineers and programmer scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- C. Final acceptance and payment will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. CONTRACTOR shall include in the Bid field follow-up to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
- 1. Satisfactory operation of I/O control loops.
 - 2. Satisfactory operation of software.
 - 3. Satisfactory operation of control program.
 - 4. Satisfactory operation of peripheral equipment.
 - 5. The necessary debugging programs have been performed.
 - 6. Data output is reliable.
 - 7. Control loops are operational.
 - 8. Checking and calibrating of systems have been completed.
 - 9. Communication systems are reliable.
- D. CONTRACTOR, through System Supplier, shall provide the following support services:
- 1. Field Service Engineer: Field service engineer shall be responsible for programming of system PLCs in the factory and at the site. Field service engineer shall be present for startup of all systems and available throughout the entire construction process until final

- completion. Service technicians sent for system startup will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
- a. Commissioning, installation, startup, and testing of equipment.
 - b. Revising or rewriting manuals to incorporate an installed and accepted system.
 - c. On-site training.
 - d. Software modifications.
2. In-factory support shall include consultation following shipment. Services shall include, but not be limited to:
 - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
 - b. Program modifications.
 - c. Revising or rewriting manuals.
 3. Post-startup support shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include 8 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. In addition to the 8 hours, include one trip to the site.
- E. CONTRACTOR shall not install any hardware or software to enable remote access or control without written permission from OWNER and ENGINEER.

1.11 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All indicating and control devices mounted on control panel, enclosure doors (e.g., gauges, electronic indicators, pilot lights, VFD HIMs, selector switches, etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device.
- C. All motor control power shall be 120 volts with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- D. Devices powered at 120 volts from supervisory control panels shall be fused.
- E. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided, even though the detailed enumeration at various control points may omit listing that equipment.
- F. Where a certain accuracy of sensing and transmitting levels or other process conditions and controlling operations are called for, means shall be provided to read or determine that the process conditions are within the limits or accuracy specified for the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of process conditions is necessary to set operating points, provide accuracy consistent with the requirements for operation of the system.
- G. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.
- H. Status signals for motors powered from VFDs and associated equipment shall communicate to the associated TCP-90-01 via Ethernet shall be wired to inputs on the VFD and communicated to/from the TCP via the Ethernet/IP network.

- I. Hardwired Motor Controls:
 - 1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
 - 2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.

1.12 GENERAL CONTROL ALGORITHMS

- A. In general, the following is a definition of I/O at each MCC:
 - 1. Run from auxiliary starter or VFD contact (dry contact) or Ethernet.
 - 2. Fail from starter overload or VFD auxiliary contact (dry contact) or Ethernet.
 - 3. Start/Stop maintained signal to starter or VFD, or as required (dry contact) or Ethernet.
 - 4. In Auto/In Remote from selector switch on motor controller (dry contact) or Ethernet.
 - 5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.
- B. Definitions:
 - 1. The "Main PLC" for the SCADA System shall be the PLC located in the Public Water Laboratory building. The existing PLC logic common to all networked PLCs resides in the Main PLC.
 - 2. The "Master Telemetry PLC" for the SCADA System shall be the PLC located in the Public Water Laboratory building. This existing PLC sends and receives information to and from all remote PLCs connected to the PLC via radio telemetry and makes this information available to other networked PLCs and available for display at the SCADA System. The PLC logic common to all remote Telemetry-Connected PLCs resides in the Master Telemetry PLC.
 - 3. Where referenced herein, a "remote Telemetry-Connected PLC" includes any PLC located at a facility remote from the Master Telemetry PLC location that communicates information back to the SCADA System via the Master Telemetry PLC via radio communications.
- C. Remove all existing PLC programming associated with the items being removed as shown on the Drawings and specified herein.
- D. Programming algorithms described herein and in Part 3–Execution shall reside within the PLC associated with that equipment and not in the Main PLC.
- E. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate an alarm at the SCADA System.
- F. All analog and digital inputs shall be monitored in the PLC. This shall include, but not be limited to, levels. Instantaneous values shall be read by the HMI software and be reset on a daily basis as described below. Values shall be stored in the PLC for the current day and previous day.
- G. Indication of time remaining for all timers (hardcoded and operator adjustable) within PLCs shall be made available for indication at the SCADA System.
- H. Float switches shall include time delays to prevent intermittent starting and stopping and/or alarming because of bouncing floats (including hardwired relay logic).

- I. All analog signals shall be scaled to engineering units in the PLC with real or floating-point data types to prevent scaling values in the existing HMI. System.
- J. For all analog input signals to the PLC I/O cards, provide a Transmitter Fail alarm at the SCADA System for each transmitter. Transmitter fail shall be defined as the signal from the transmitter being out of range.
- K. The following analog signals shall have associated high and low setpoints and alarms: all levels.
- L. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the existing HMI software. Provide two operator-adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. This feature is intended to be used for startup and calibration purposes.
- M. The SCADA System shall allow the operator to change all setpoints and operating parameters within the PLCs as described herein. All control algorithms and alarms for equipment shall be programmed in the associated PLC and not in the Master Telemetry PLC. There shall be no control algorithms or alarms in the SCADA computers. Control of each piece of equipment shall be accomplished as described herein and in Part 3–Execution of this section.
- N. Each alarm shall have a discrete PLC tag that is able to be toggled at the SCADA System HMI to enable or disable the associated alarm from being activated.
- O. Provide a hardcoded minimum speed within the associated PLC for each pump operating on a VFD. The minimum speed shall be the minimum speed at which the pump will still produce flow. Coordinate the minimum speed with the pump manufacturer during startup.

1.13 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.14 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 FLOAT SWITCHES

- A. Float switches when specified herein, shown on the Drawings, or necessary to complete an operating system shall be as follows:
 - 1. The float switches shall be mercury free and consist of a polypropylene housing 2 3/4 inches in diameter, stainless steel mounting clamp, a flexible three-conductor cable with a CPE jacket, and a potted SPST magnetic reed switch. Provide switch configuration (NO or NC) as required. The electrical load for the switch contacts shall be 5 amps at up to 250 volts. Float switches shall include a three-conductor cable 18 AWG with fine strands made for heavy flexing service and underwater use. Provide cable length as required for a continuous run to the terminating control panel. Provide a minimum 10 feet of slack in all cables in tanks. A green grounding wire shall connect internally to the float housing. Floats shall be SJE Rhombus Signalmaster Control Switch, or equal.
 - 2. Weight and buoyancy shall be such that contaminants will not result in the float switch changing operating level more than 1 1/2 inches.
 - 3. Operating temperature range shall be -31°F to 110°F.
 - 4. Float switch shall meet NSF Standard 61 requirements.
- B. Floats shall be mounted on a stainless steel cable with PVC-covered anchor according to manufacturer's instructions. All mounting hardware shall be stainless steel and provided with the floats.
- C. Provide stainless steel kellum grips for each float cable.

2.02 SUBMERSIBLE LEVEL TRANSMITTERS

- A. Where indicated on the Drawings, levels shall be sensed by a submersible pressure transmitter. The transmitter shall be a VEGAWELL 52, no equal, loop powered submersible pressure transmitter. The transmitter shall be of the head-pressure sensing type, suitable for continuous submergence and operation, and shall be installed in accordance with manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed 6 inches above the floor. The sensor shall be mounted using a self-supporting cable system; location shall be determined in the field. Cable shall be vented, reinforced, and rated for full weight of transmitter. A separate support cable or anchor shall not be required.
- B. If necessary for the installation/application, transmitter shall include a terminal connection box. Moisture protection shall be provided for all units through an aneroid bellows.
- C. The transmitter shall sense water level (pressure) variations and transform these variations directly into a standard process signal of 4-20 mA over the desired level range (span). The transmitter shall be completely solid-state, with no mechanical linkages or moving parts. Supply voltage shall be as required by CONTRACTOR. Accuracy shall be $\pm 0.25\%$ of full scale. Transmitter shall be backed by a minimum 2-year warranty.
- D. Sensor body shall be all titanium 316L stainless steel construction with external Teflon-coated Nitrile rubber or elastomeric measurement diaphragm, backed by a minimum

two-year warranty. A variable-capacitance element shall convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against a diaphragm that flexes minutely so as to vary its proximity to a ceramic substrate to vary the capacitance of an electrical field created between the two surfaces. The transmitter shall incorporate laser-trimmed, temperature compensation and high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory calibrated range.

- E. The transmitter shall be available in multiple operating ranges that are precalibrated at the factory. Operating pressure range of the transmitter shall be as specified herein or shown on the Drawings.

2.03 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 14 gauge steel, with continuously-hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter turn latches. Enclosures larger than 24 inches in any dimension shall be equipped with 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each door, data pocket for wiring diagrams, and minimum 12-inch, bolt-on, LED light and door switch. Panels over 48 inches wide shall have two lights. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, and white interior. All doors and panels shall be gasketed. All louvers shall be filtered and forced-air cooling shall be provided as necessary for conditions where installed. Provide enclosure dimensions as specified herein. Enclosures shall be as manufactured by Hoffman or Saginaw.
- B. All wiring within the enclosure shall be through plastic wiring troughs. Plastic wiring troughs shall have removable covers. Maximum fill for wiring troughs shall be 60%. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal strip and wiring trough. All wiring labels shall be able to be read without removing wiring trough covers. Wiring troughs shall be provided for all field wiring.
- C. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located either at the bottom or on the side of the enclosure, depending on where the conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. The field wiring terminals shall be clearly identified as to which terminals they are wired. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer. All wiring shall be labeled at each end with corresponding numbers matching the associated terminal block. This numbering shall be shown on the shop and Record Drawings.
- D. All door-mounted devices shall be furnished flush-mounted, and an exterior-engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each component, device, and light. All components within the enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels with white background and black text; minimum size 12 font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.

- E. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
- F. Enclosures that include motor controllers shall have a main disconnect for the enclosure.

2.04 INDUSTRIAL CONTROL RELAYS AND CONTACTORS

- A. Industrial control and power relays shall be installed in motor controller enclosures where required by System Supplier. Relays used to interface with motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Contactors for lighting circuits, branch circuits, or loads greater than 15 amps shall be industrial, electrically-held lighting contactors. Contactors for motor power control shall be industrial, electrically-held power contactors.
- B. Relays shall meet the following requirements:
 - 1. Interposing/Isolation Relays:
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC, or as required by System Supplier.
 - d. Contact Rating: 8 A (DPDT), 16 A (SPDT).
 - e. Mechanical Operating Life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
 - 2. General Purpose Relays:
 - a. Configuration: DPDT or 3PDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC.
 - d. Contact Rating: 15 A, minimum; 3/4 hp.
 - e. Mechanical Operating Life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
 - 3. Lighting Contactors:
 - a. Configuration: Electrically-held, 2-12 poles.
 - b. Mounting: DIN rail.
 - c. Voltage: 120 VAC.
 - d. Contact rating: 30 A continuous.
 - e. UL listed.
 - f. Manufacturer: Square D, Class 8903L, or equal.
 - 4. Power Contactors:
 - a. Configuration: Electrically-held, 3 poles.
 - b. Mounting: DIN rail.
 - c. Voltage: 120 VAC.
 - d. Minimum Contact Rating: 20 A continuous, 1 hp.
 - e. Mechanical Operating Life: 1.3 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen-Bradley, Bulletin 300, or equal.

2.05 CURRENT TRANSDUCERS

- A. Current transducers where called for shall be Veris Industries, Hawkeye H971, or equal, with current measurement accuracy rating of $\pm 0.5A$ for 100 amps and below. Include DIN rail mounting hardware for mounting of the current transducer.

2.06 GAS MONITORING AND DETECTION SYSTEMS FOR VEHICLE STORAGE AREAS

- A. Gas detection systems for vehicle storage areas shall consist of room sensors with integral transmitters and displays connected to a remote, multi-channel, gas monitoring and alarm controller. Detectors shall be capable of detecting carbon monoxide (CO) and nitrogen dioxide (NO₂) gases. Provide transmitters as shown on the Drawings and multi-channel gas monitoring and alarm controllers as specified herein.
- B. Gas Transmitters:
 - 1. CO transmitters shall use electrochemical sensors with a sensing range of 0 to 125 ppm with a minimum 49-foot radial coverage area. Transmitter accuracy shall be minimum 2.5% of the reading.
 - 2. NO₂ transmitters shall use electrochemical sensors with a sensing range of 0 to 10 ppm with a minimum 49-foot radial coverage area. Transmitter accuracy shall be minimum 2.5% of the reading.
 - 3. Transmitter enclosure shall be rated NEMA 4X and be constructed of ABS plastic.
 - 4. Transmitters shall be powered at 24-volts DC, maximum 100 mA, and shall provide a scaled 4-20 mA output signal.
 - 5. Transmitters shall be suitable for use in -4°F to 104°F ambient temperatures and 0% to 99% relative humidity (non-condensing).
 - 6. Transmitter shall be guaranteed throughout the correction period as a complete unit.
 - 7. CO transmitter shall be as manufactured by ACI, Model CO-R-4X, or equal. NO₂ transmitter shall be as manufactured by ACI, Model NO2-R-4X, or equal.
 - 8. Provide two calibration adapters as manufactured by ACI, Model 83830-020-000, or equal; and one gas calibration kit as manufactured by ACI, Model CAL-GAS-KIT, or equal.
- C. Multi-Channel Gas Monitoring Controller:
 - 1. Multi-channel controller shall accept up to eight 4-20 mA analog inputs and minimum three SPDT Form C relay outputs. Relays shall be factory-configured to activate one relay when any of the connected CO gas transmitter signals rises above an adjustable high alarm level setpoint, and to activate another relay when any of the connected NO₂ gas transmitter signals rises above an adjustable high alarm level setpoint. There shall be adjustable time delays for each alarm to prevent nuisance alarms.
 - 2. Programming shall be completed using a front-door-mounted key pad and 2x16-character, backlit LCD display.
 - 3. Controller enclosure shall be painted steel rated NEMA 1.
 - 4. Controller shall be powered at 24-volts DC, maximum 1 amp, and shall provide a scaled 4-20 mA output signal.
 - 5. Controller shall be suitable for use in -4°F to 122°F ambient temperatures and 5% to 95% relative humidity (non-condensing).
 - 6. Controllers shall be guaranteed throughout the correction period as a complete unit.
 - 7. Controller shall be as manufactured by ACI, Model M-CONTROLLER, or equal.

PART 3-EXECUTION

3.01 EXHAUST FAN (EF-80-01) AND GAS DETECTOR CONTROL PANEL

- A. Provide a NEMA 12, wall-mounted, enclosure including, but not limited to, the following:
1. 20-amp main circuit breaker disconnect with door-interlocked, padlockable handle. Provide a defeater to allow opening the door without disconnecting the power feed. Power to the control panel shall be 208 volts, three phase.
 2. The control panel fault current interrupting rating shall be minimum 10,000 amps. Provide fusing for individual motor branch circuits where necessary to limit the available fault current to the rating of the branch circuit
 3. Power distribution and overcurrent protective devices for all internal and external equipment powered from this control panel. External equipment powered from this control panel shall consist of the following:
 - a. 120-volt, 5-amp circuit to associated exhaust air damper actuator.
 - b. 24-volt DC, 1-amp circuit to each associated gas transmitter (4 total).
 4. Motor starters and overcurrent protective devices for the following equipment:
 - a. Exhaust fan (EF-80-01).
 - b. Multi-channel gas monitoring controller.
 5. Relays, terminal blocks, and control devices as needed for the ventilation system.
- B. The following devices shall be mounted on the front door of the enclosure:
1. Multi-channel gas monitoring controller. Provide a nameplate identifying the remote gas transmitter equipment tags with the assigned gas sensor controller channel.
 2. The following pilot devices shall be provided for exhaust fan (EF-80-01) controlled from this control panel:
 - a. Hand-Off-Auto selector switch.
 - b. Elapsed time meter.
 - c. Green "Running" indicating light.
 - d. Red "Starter Overload" indicating light.
 - e. Red "High CO Gas Concentration Alarm" indicating light.
 - f. Red "High NO₂ Gas Concentration Alarm" indicating light.
 - g. Amber "Purge Mode Active" indicating light.
 - h. Blue "Ventilation Mode Active" indicating light.
- C. Hardwired Motor Controls for EF-80-01 and associated damper: H-O-A Selector Switch:
1. With the H-O-A in the "Hand" position, the motor shall start and run continuously and the associated damper shall open.
 2. With the H-O-A in the "Off" position, the motor shall be inoperable and the associated damper shall close.
 3. With the H-O-A in the "Auto" position, the motor and associated damper shall be controlled as described below.
 - a. The fan shall be started from any gas transmitter in the garage (AIT-80-01 through AIT-80-04), either occupancy sensor, or from the repeat cycle time delays. Any time the CO or NO₂ concentration in the garage rises above the limits indicated in the following schedule, the fan shall start and run continuously until the CO and NO₂ concentration fall below the limits. Any time either occupancy sensor in Garage 80101 or Work Shop 80102 are activated, the fan shall start and run continuously until both occupancy sensors are inactive.

<u>CO LIMIT</u>	<u>NO₂ LIMIT</u>
35 PPM	1 PPM

- b. There shall be repeat cycle time delay relays to allow the fan to operate intermittently based on On-time (0 to 60 minutes) and Off-Time (0 to 240 minutes) setpoints. When the off-time time delay has expired, the fan shall start and run continuously until the on-time time delay has expired. If the fan is started from a gas transmitter, an occupancy sensor, or the fan is placed in the "Hand" position, the time delay relays shall be reset and the repeat cycle restarted once the fan is shut down.
 - c. The associated damper shall open when the fan is running and close when the fan is off.
 - d. Provide an auxiliary run contact for interlock with the make-up air unit (MAU-80-01) supply fan such that the supply fan runs whenever the exhaust fan is running. Provide interface relays as needed.
- 4. There are two CO gas transmitters (AIT-80-01 and AIT-80-03) and two NO₂ gas transmitters (AIT-80-02 and AIT-80-04) that each have 4-20mA DC outputs that shall be wired to the multi-channel NO₂/CO gas monitoring controller on the front door of this control panel. The gas controller shall have one of its relays configured to indicate a high NO₂ gas concentration alarm and another one of its relays shall be configured to indicate a high CO gas concentration alarm. When either of the high gas concentration alarms are active, a purge mode shall be enabled, and the exhaust fan shall run continuously. When all gas concentration alarms are inactive, the purge mode shall be disabled and the exhaust fan shall be shut down. Provide interface relays as needed to send each alarm signal to the future SCADA System and Fire Alarm System.
- 5. Provide terminal blocks and relays to send and receive the following field-wired signals:
 - a. Analog Inputs (4-20mA):
 - (1) AIT-01 and AIT-03 (2 total CO).
 - (2) AIT-02 and AIT-04 (2 total NO₂).
 - b. Discrete Outputs (dry contact):
 - (1) Exhaust fan damper open/close command to damper actuator.
 - (2) MAU-80-01.
 - (3) FACP.
- 6. All of the above controls shall be hardwired.

3.02 EXTERIOR LIGHTING CONTROL PANEL

- A. Provide NEMA 12 enclosure, sized as needed, suitable for wall mounting where shown on the Drawings. The enclosure shall have two 20-amp, three-pole lighting contactors that shall be wired to the exterior lighting circuits associated with the site lighting and maintenance garage. One contactor pole shall be used for control of each associated exterior lighting branch circuit, one pole shall be used for status indication and the spare contactor poles shall be wired to terminal blocks for future use. Provide terminal blocks as needed for all field wiring.
- B. The associated exterior light fixtures shall be controlled from a Hand-Off-Auto selector switch on the front of the enclosure as follows:
 - 1. With the H-O-A selector switch in the "Hand" position, the lights shall turn on.
 - 2. With the H-O-A selector switch in the "Off" position, the lights shall turn off.
 - 3. With the H-O-A selector switch in the "Auto" position, the lights shall be controlled from the building's photocell (PC-80-01) such that when the photocell is energized, the lights shall turn on. When the photocell is de-energized, the lights shall turn off.

3.03 RESERVOIR MIXER (45-MX-1) CURRENT TRANSDUCER JUNCTION BOX

- A. Provide a junction box, sized as needed, where shown on the Drawings with a current transducer and terminal blocks. The junction box NEMA rating shall be as shown on the drawings.

3.04 FLOATS AND LEVEL TRANSMITTER JUNCTION BOXES

- A. Provide two junction boxes, sized as needed, where shown on the Drawings with terminal blocks, one for the Reservoir Float Switches and one for the level transmitter. The junction box NEMA rating shall be as shown on the Drawings.

3.05 MODIFICATIONS TO EXISTING SCADA SYSTEM HMI GRAPHICS

- A. Provide all programming required to modify the existing SCADA System HMI graphics to meet the requirements of these Specifications. The existing SCADA System HMI software is iFIX, version 5.5. The SCADA server is located in the Administration Building.
- B. Remove or replace all existing information associated with the equipment being removed or modified as part of this project with new controls and graphics to match the complexity and clarity of the existing SCADA System HMI graphics, where applicable. The existing HMI tag naming standard shall be strictly adhered to.
- C. Where existing HMI tags will be reused, the PLC tag linked to the HMI tag shall be updated to use the new PLC tag, where applicable. Remove all existing HMI tags associated with equipment being removed or modified that will not be reused.

3.06 EXISTING WELL 45 TREATMENT FACILITY AND BOOSTER STATION SCADA CONTROL PANEL (45-SCP-1)

- A. This existing SCC contains an Allen Bradley CompactLogix 1769-L33ER PLC, an Allen Bradley Panelview Plus 1000 OIP, and communicates with the SCADA System via Ethernet/IP. Modify the existing PLC and OIP programming as required for the controls specified herein.
- B. The existing PLC control logic for the well pump (P4501) and five booster pumps (P4511 through P4515) shall be modified as required to replace the signals from the existing reservoir level transmitter with dry contacts for high and low levels with the new reservoir level transmitter and high and low level switches. The existing functionality of the well pump and booster pump controls shall be maintained.

3.07 EXISTING WELL 45 TREATMENT FACILITY AND BOOSTER STATION HMO CONTROL PANEL (45-HMOCP-1)

- A. This existing SCC contains an Allen Bradley CompactLogix 1769-L33ER PLC, an Allen Bradley Panelview Plus 1000 OIP, and communicates with the SCADA System via Ethernet/IP. The PLC has 7 spare 24-volt DC digital inputs, 14 spare 24-volt DC digital outputs, 0 spare analog inputs, and 3 spare analog outputs. Modify the existing PLC and OIP programming as required for the controls specified herein and to accommodate the additional I/O listed in Section 26 09 90–SCADA System I/O Listing. Provide additional relays, interface wiring, fuses, etc. to incorporate the signals as specified herein.

- B. Provide interface relays and power supplies as needed to monitor the position switches from both fence gate operators. The position switch relay outputs in each fence gate operator are specified to be rated for 1 amp at 24 volts DC.
- C. The West and East Gate Operators (G-01-01 and G-01-02) shall be controlled from this PLC with dedicated SCADA Open button for each gate such that once the button is pressed, the associated gate shall open. The gate shall close from internal controls within the gate operator as described in Section 32 31 11–Fence Gate Operator.

END OF SECTION

SECTION 26 09 10

CONTROLS AND INSTRUMENTATION DRAWINGS

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit drawings in accordance with provisions of Section 01 33 00–Submittals.

1.03 COORDINATION

- A. The requirements set forth in this section are intended to apply to the drawings provided as specified in Section 26 09 00–Controls and Instrumentation.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A bound set of as-built drawings shall be provided in the associated equipment enclosure.
- B. All drawings shall have the following information:
 - 1. Project information, including name of OWNER and specific project name.
 - 2. Drawing title, accurately representing what is on the drawing.
 - 3. Unique drawing identifier, consisting of a unique drawing number or drawing number with individual sheet number. If sheet numbers are used, total number of sheets must be identified on each sheet.
 - 4. System Supplier company name, address, and phone number.
 - 5. Original design information, including person responsible for design, date of original design, person responsible for checking of design, and date of design check.
 - 6. Revision block indicating revision number, date, description of revision, and person responsible for revision.
- C. All drawings shall have line numbers that can be uniquely referenced from other drawings.
- D. All drawings showing wiring shall include unique wire numbers assigned to wiring that is installed between devices in the panel. The wire number shall be shown on the drawings.
- E. All drawings showing relays shall include reference to the drawings where the relay contacts are shown. Spare relay contacts that are not used shall be identified.

3.02 DRAWINGS REQUIRED

- A. Index of Drawings: Index of Drawings shall list drawing number, sheet number (if applicable), and drawing title for each drawing in drawing package.
- B. Symbol Sheet: Symbol Sheet shall include:
 - 1. Explanation of all symbols used on the drawings, including, but not limited to, normally open/normally closed contacts, flow switches, limit switches, pressure switches, selector switches, pushbuttons, timers, control relays, solenoids, fuses, circuit breakers, terminal blocks, and contactors. Symbol sheet does not need to be specific to project, but must contain explanation of all symbols used on the drawings (i.e., special symbols used for a particular project must be added to standard symbol sheets).
 - 2. List of abbreviations used on the drawings.
 - 3. Explanation of continuation method for circuits that cannot be shown on a single sheet.
- C. Exterior Enclosure Layout Drawing: Exterior layout drawing shall show location of all externally-mounted equipment. Exterior layout drawing shall include:
 - 1. Enclosure dimensions, enclosure NEMA rating (i.e., NEMA 1, NEMA 4X stainless steel, NEMA 4X nonmetallic, etc.), and enclosure color or finish.
 - 2. Location and actual depiction of panel latches, hinges, mounting holes and lifting eyes.
 - 3. Location and accurate representation of equipment mounted on enclosure (i.e., switches should look like actual switches being installed; indicating lights should look like actual lights being installed).
 - 4. Equipment nameplate location.
 - 5. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
 - 6. Nameplate list including nameplate wording, size, construction (i.e., lamicoid with Black background and White letters), and mounting method (i.e., stainless steel screws). Label size must include size in inches or reference to standard sizes included on symbol sheet, or elsewhere in drawing package.
 - 7. Identification of area reserved for equipment located inside enclosure, but not actually mounted on enclosure back panel, such as UPSs, fiber optic patch panels, and lighting packages.
- D. Interior Enclosure Layout Drawing: Interior layout drawing shall show location of all internally-mounted equipment. Interior layout drawing shall include:
 - 1. Back panel dimensions and finish.
 - 2. Location and accurate representation of equipment (i.e., terminal blocks should look like actual terminal blocks; receptacle should look like actual receptacle, etc.).
 - 3. Dimensions of internally-mounted equipment are not necessary, but equipment should be drawn to scale such that an accurate representation of the way equipment will be mounted is shown on the drawing.
 - 4. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
- E. Interconnection Diagram, Network Diagram or Block Diagram: Interconnection Diagram, Network Diagram or Block Diagram shall show all cabling between system components and identify any station addressing or node numbers that are assigned to equipment. All cables shall be identified by cable type, including specific manufacturer and model/part number. Party responsible for furnishing and installing cable shall also be included. Some examples of cables that must be shown are:

1. Communications cables between system components (copper). This includes fiber optic jumpers between fiber patch panels and equipment, and Ethernet patch cables between switches and devices.
 2. Communications cables (copper) between PLCs, controllers, operator interface equipment and security devices (e.g., card readers, electric strikes, and motion detectors) that are not shown on the elementary schematics.
- F. Elementary Schematic: Elementary schematics shall be developed for each motor or supplied equipment and shall include:
1. Nominal voltage, AC or DC designation, number of phases (if AC), and frequency in hertz (if AC) for each source of electrical supply to the enclosure.
 2. Prospective short-circuit current available at the point of electrical supply to the enclosure.
 3. Type of power supply system grounding (e.g., wye phase midpoint grounded, delta phases corner grounded, wye phases midpoint grounded, delta phases ungrounded, etc.).
 4. Complete documentation of electrical circuit from supply to motor or supplied equipment. Documentation shall include disconnecting means, main overcurrent protection (when supplied), branch overcurrent protection (when supplied), control circuit and special purpose control protection, motor control, overload protection, local disconnect (when supplied) and motor horsepower, and full load amps from nameplate or supplied equipment full load amps.
 5. Documentation of PLC or controller inputs and outputs.
 6. Documentation of all circuit breaker/motor protector ratings, fuse sizes, control power transformer VA ratings, dip switch settings, etc.
 7. Documentation of all VFD settings (e.g., under-voltage shutdown, ramp time, overload, excessive starts/hour, etc.) which have been changed from the factory default setting.
- G. Wiring Diagram: Wiring diagrams shall show all terminations for all cables external to the enclosure. Terminations may be shown on the elementary schematics as long as the termination information is concise and easily understood by the personnel installing the field wiring. Termination information shall be shown for all devices, including devices that are not part of System Supplier's scope of supply. A box with two dots or continuation arrows indicating continuation to a piece of equipment are not acceptable. Information shown on System Supplier's wiring diagrams shall include a description of the drawings where terminations are found (i.e., drawing title), drawing number where the terminations are found, and terminal blocks referenced on the drawing. System Supplier shall coordinate with supplier of other wiring diagram to provide information on System Supplier's wiring diagrams.
- H. Calculations Summary: Calculations summary shall include calculations performed to:
1. Determine size of UPS.
 2. Determine air conditioning equipment requirement.
 3. Determine control power transformer sizing. Control power transformer sizing calculations may be generic based on typical circuits.
- I. Functional Testing Recommendations: Testing recommendations shall include description of functional tests that must be performed by operators. Functional test description shall be included for UPS, indicating lights, and other devices whose condition can only be determined by testing.

3.03 SAMPLE DRAWINGS

- A. Sample drawings showing an acceptable format are included in the appendix. The samples included in the appendix do not represent the only acceptable method of showing the required information.

END OF SECTION

SCADA SYSTEM I/O LISTING

STRAND ASSOCIATES, INC.®
CITY OF ROCKFORD
ROCKFORD, ILLINOIS
WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS
CONTRACT 1224-W-125
SCADA SYSTEM I/O LISTING - 45-HMOCP-1 ADDITIONS

SCC	EQUIPMENT NAME	NUMBER	DI	DO	AI	AO	WIRE	COMMENTS
	RESERVOIR MIXER	45-MX-1						
	AMPS		0	0	1	0	SH. PR.	FROM CURRENT TRANSDUCER JUNCTION BOX
	RESERVOIR							
	LEVEL (0.0-35.0 FT)	45-LT-1	0	0	1	0	SH. PR.	FROM LEVEL TRANSMITTER
	LOW LEVEL	45-LSL-1	1	0	0	0	2~#14	FROM FLOAT SWITCH
	HIGH LEVEL	45-LSH-1	1	0	0	0	2~#14	FROM FLOAT SWITCH
	WEST GATE	G-01-01						
	OPEN		1	0	0	0	2~#14	FROM GATE OPERATOR
	OPEN COMMAND		0	1	0	0	2~#14	TO GATE OPERATOR
	EAST GATE	G-01-02						
	OPEN		1	0	0	0	2~#14	FROM GATE OPERATOR
	OPEN COMMAND		0	1	0	0	2~#14	TO GATE OPERATOR
	TOTALS		4	2	2	0		

SECTION 26 21 00
ELECTRICAL SERVICE SYSTEM

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Utility company.
 - 2. Secondary service characteristics.
 - 3. Definitions.
 - 4. Underground electrical service.
- B. Allowances: CONTRACTOR shall include in the Bid the cost of the following items specified in this Section. Refer to the individual sections listed below for a complete description of the Work required. Electric Utility Service Entrance, Paragraph 1.07–Underground Electrical Service.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- D. See Division 01 for temporary service requirements. This section applies to permanent services only.

1.02 UTILITY COMPANY

- A. The Utility Company is ComEd.

1.03 SECONDARY SERVICE CHARACTERISTICS

- A. The secondary service for the Maintenance Garage will be 120/208-volt, 4-wire, three-phase.

1.04 DEFINITIONS

- A. Service: As defined in the NEC, Article 100.
- B. Primary Voltage: Above 600 volts.
- C. Secondary Voltage: 600 volts and below.

1.05 UNDERGROUND ELECTRICAL SERVICE

- A. Provide complete underground electrical service except for items provided by the Utility Company.
- B. Provide electrical service system for the Maintenance Garage, except the Utility Company will provide:
 - 1. Transformer (pole mounted).
 - 2. Meter (socket by CONTRACTOR).

- C. Provide work to relocate existing electrical service for the Booster Station and WTP building, except the Utility Company will provide primary cable between terminal pole and utility transformer.
- D. Coordinate the new electrical service for the Maintenance Garage and relocation of the existing electrical service for the Booster Station and WTP Building with the Utility. An allowance of \$50,000 shall be included in the Lump Sum Bid for the work provided by the Utility and will be adjusted at final payment in accordance with actual Utility charges. All other costs for the electrical service shall be included in the Lump Sum Bid.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

NOT APPLICABLE

PART 3—EXECUTION

3.01 UTILITY COORDINATION

- A. Division 26 Contractor shall obtain all required permits and licenses, pay all charges and fees, and give all notices necessary for utilities to perform the Work. Division 26 Contractor shall comply with all permit requirements whether the permit is issued to CONTRACTOR, the state, or the maintaining authority.
- B. Division 26 Contractor shall complete all required electrical service applications and forms based on the Drawings and Division 26 Contractor's means and methods for the work required.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Lighting and appliance panelboards.
 - 2. Power distribution panelboards.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electrical equipment, cable, and wire products of the types and ratings necessary, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical equipment installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. UL Labels: All electrical equipment and material shall be listed and labeled by Underwriters Laboratories, except where UL does not include the equipment in their listing procedures.
- E. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material, construction, and testing, where applicable.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All electrical equipment and material shall be received and stored with the factory tamperproof wrapping intact. Provide factory-wrapped waterproof flexible barrier material for factory packaging of equipment and material to protect against physical damage in transit. Do not install damaged equipment or material; remove from project site. Store equipment in factory coverings in a clean, dry, indoor space that provides protection against weather.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR

shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Square D.
- B. Eaton.
- C. Substitutions: Under provisions of the General Conditions.
- D. The Drawings and Specifications were prepared based on Eaton. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including but not limited to structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of drawings and/or specifications by ENGINEER.

2.02 PANELBOARDS

- A. Lighting and appliance and power distribution panelboards shall be provided as indicated on the Drawings and as scheduled. Panelboards shall be factory-assembled and constructed in accordance with latest NEMA, UL, and NEC requirements and shall bear the UL label. Panelboard cabinets, including boxes and fronts, shall be code gauge galvanized steel. Front covers shall be hinged to allow access to wiring gutters without removal of panel trim (door-in-door type). All fronts shall be complete with cylinder-type lock and catch, and all cylinders shall be keyed alike. Provide two keys per panelboard to OWNER.
- B. Gutter and wiring space shall be provided according to NEMA and UL standards, except provide additional 6-inch-wide or -high wiring space for all double-lugged two or more section panels, feed-through panels; or panels that subfeed other panels at 100 amperes or more. CONTRACTOR shall instruct manufacturer as to where additional wiring space is needed, i.e., top, bottom, right, left, or combination. Where oversized cabinets are necessary for one section of a panelboard, all sections of the panelboard shall be the same size.
- C. Panelboards shall have full ampacity bussing throughout (full length of panel) and shall be full-size in regard to number of possible pole spaces. All lighting and appliance panels shall have poles as shown on the Drawings. Power distribution panels shall have number of poles as scheduled or shown on the Drawings. Panelboards shall be identified with phases reading left to right and circuits alternately numbered left to right, odd numbers on the left, even numbers on the right.

- D. Panelboards shall have copper bussing. Provide copper ground bus in all panelboards. Ground bus shall be isolated from the panelboard with insulated standoffs.
- E. Lugs for incoming feeders shall be UL listed for use with copper conductors. Lugs shall be sized by CONTRACTOR in accordance with feeder sizes shown. Main lugs or main breakers shall be top- or bottom-mounted to coordinate with incoming feeder entrance location. Location shall be selected by CONTRACTOR.
- F. Branch circuit breakers shall be quick-make, quick-break, with thermal magnetic trip bolt-on type. Multipole breakers shall have common internal trip, UL listed as multipole units; handle ties are not permitted. All breakers shall be of the same manufacturer as the panelboard and provided at ampere capacity as scheduled.
- G. Main and feeder circuit breakers 225 amps and smaller shall be thermal magnetic trip type.
- H. Lighting and appliance and power distribution panelboards shall be provided as follows:

Type	Maximum Voltage	Maximum Bus Amps	Maximum Brk. Amps	Minimum I.C.
Pow-R-Line 1X	240	600	100	10,000
NF Series	600	250	250	18,000

- I. All panelboards scheduled with main circuit breakers shall be individually mounted main circuit breaker panels. Main circuit breakers installed in the location of branch circuit devices (branch-mounted mains) are not acceptable.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be provided as indicated. Final locations, sizes, and mounting of panelboards shall be reviewed with ENGINEER prior to installation.
- B. Each panelboard shall have a typewritten circuit schedule provided on the inside cover. This schedule shall be covered with clear plastic in a metal frame and shall include room numbers, room name, and area or item served by each branch circuit. Room numbers used shall be those used by OWNER, except as otherwise requested by ENGINEER.
- C. Prior to final inspection, clean all panelboard interiors, adjust trims, covers, hinges and locks, and refinish covers to original condition.
- D. Panel trim shall have enamel finish as selected by OWNER.
- E. Balance load on all panelboards so phases are balanced to 15% of each other. Reconnect or redistribute circuits and/or circuit breakers to achieve balanced condition. Submit ammeter readings for all panelboard feeders indicating normal operating load and phase balance.

END OF SECTION

Section 26 24 16-3

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SECTION 26 24 19

MOTOR CONTROL

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Motor control devices, accessories, and general requirements.
 - 2. Manual motor starters.
 - 3. Magnetic motor starters.
 - 4. Solid-state starters.
 - 5. Variable frequency drives.
 - 6. Motor control centers.
- B. Related Sections and Divisions:
 - 1. Applicable provisions of Division 01 shall govern work in this section.
 - 2. All other sections of Division 26.

PART 1–GENERAL	1
1.01 SUMMARY.....	1
1.02 REFERENCES	1
1.03 QUALITY ASSURANCE.....	2
1.04 SUBMITTALS.....	2
1.05 OPERATION AND MAINTENANCE DATA	2
1.06 DELIVERY, STORAGE, AND HANDLING	2
1.07 COORDINATION	2
1.08 WARRANTY	3
1.09 BUILD AMERICA, BUY AMERICA REQUIREMENTS	3
PART 2–PRODUCTS.....	3
2.01 ACCEPTABLE MANUFACTURERS	3
2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS	3
2.03 MANUAL MOTOR CONTROLLERS	5
2.04 MAGNETIC MOTOR STARTERS	5
2.05 VARIABLE FREQUENCY DRIVES	6
PART 3–EXECUTION	9
3.01 INSTALLATION	9

1.02 REFERENCES

- A. ANSI/NEMA ICS 6–Enclosures for Industrial Controls and Systems.
- B. NEMA AB 1–Molded Case Circuit Breakers.
- C. NEMA ICS 2–Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS-18–Motor Control Centers.
- E. NEMA KS 1–Enclosed Switches.

F. NEMA PB 1–Panelboards.

G. NEMA PB 1.1–Instruction for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

1.03 QUALITY ASSURANCE

A. Manufacturers of Motor Control Equipment: Firms regularly engaged in the manufacture of motor control equipment of the types and capacities required whose products have been in satisfactory use in similar service for not less than 10 years.

B. UL Labels: Provide motor control devices, manual motor controllers, magnetic motor starters, solid-state starters, variable frequency drives, combination motor starters, motor control centers, etc., which have been listed and labeled by Underwriters Laboratories.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

B. Provide product data on motor starters and combination motor starters, VFDs, relays, pilot devices, and switching and overcurrent protective devices.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.07 COORDINATION

A. To provide proper coordination between Section 26 09 00–Controls and Instrumentation, and equipment specified herein, all equipment specified in this section shall be supplied as part of the Controls and Instrumentation package described in Section 26 09 00. This shall include, but not be limited to, equipment such as stand-alone motor controllers. Drawings for motor controllers, and motor control equipment shall be provided by the Section 26 09 00 System Supplier. Drawings from equipment manufacturers will not be accepted as shop drawings or O&M documents.

1.08 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.09 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices and motor starters shall be as manufactured by Allen-Bradley, or equal, as approved by ENGINEER and in accordance with substitutions under provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.
- B. The Drawings and Specifications were prepared based on Allen-Bradley. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

- A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.
- B. Push buttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as specified herein and shown on the Drawings.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as specified herein and shown on the Drawings.

- D. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as specified herein and shown on the Drawings.
- E. Contactors: NEMA ICS 2. All contactors for starters specified herein shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.
- F. Control Power Transformers: 240/120-volt secondary. Each motor controller shall have a dedicated control power transformer.
- G. Elapsed Time Meters: Redington/Engler 722 series, or equal, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.
- H. Industrial control and power relays shall be installed in control panels and motor controller enclosures where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Relays for lighting circuits or loads greater than 15 amps shall be industrial, electrically held power relays. Relays shall meet the following requirements:
 - 1. Interposing/isolation relays:
 - a. Configuration: SPDT or DPDT as required by System Supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC, or as required by System Supplier.
 - d. Contact Rating: 8A (DPDT), 16 A (SPDT).
 - e. Operating Life: 10 million cycles.
 - f. Status: On-Off flag-type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700 HK, or equal.
 - 2. General purpose relays:
 - a. Configuration: DPDT or 3 PDT as required by system supplier.
 - b. Mounting: DIN rail with screw terminal base socket.
 - c. Voltage: 120 VAC.
 - d. Contact Rating: 15 A, minimum; 3/4 hp.
 - e. Operating Life: 10 million cycles.
 - f. Status: On-Off flag type or LED indicator.
 - g. UL listed.
 - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
 - 3. Power relays.
 - a. Configuration: Electrically-held, 2-12 poles.
 - b. Mounting: DIN rail, square base.
 - c. Voltage: 120 VAC.
 - d. Contact Rating: 20 A continuous; 1 hp.
 - e. Operating Life: 10 million cycles.
 - f. UL listed.
 - g. NEMA rated.
 - h. Manufacturer: Allen-Bradley, 700-PK, or equal.
 - 4. All timing relays shall have On and timing Out LEDs. Timing relays shall be Allen-Bradley, 700-HN, or equal.
- I. Manufacturer of Accessories:
 - 1. Terminal blocks shall meet the requirements of Section 26 05 19–Wire.

- 2. Wire markers shall meet the requirements of Section 26 05 53—Electrical Identification.
- J. All motor control power shall be 120 volts with suitable protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- K. All motor controllers shall be equipped with the auxiliary devices to meet the requirements of the Drawings and Specifications. Each motor controller operating at other than 120-volt, single-phase shall be equipped with a control transformer providing 120-volt secondary for control power. Transformer shall have fused primary and secondary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all motor controllers shall be 120 volts.
- L. Enclosures for Stand-Alone Controllers, Starters, and Control Devices:
 - 1. Enclosures in indoor dry locations shall be NEMA 1 gasketed.
 - 2. Enclosures in indoor damp or wet locations, outdoor locations, or locations below grade shall be NEMA 4X, stainless steel.
 - 3. Starters and disconnect devices for motors shall be installed in common enclosures, combination type, with all accessories such as terminal blocks, push-to-test pilot lights, and H-O-A switches.
 - 4. All wiring within motor controller enclosures shall be landed on terminal blocks. This shall include internal control wiring, field wiring, and any spare or unused wiring.

2.03 MANUAL MOTOR CONTROLLERS

- A. Where noted on the Drawings, controllers for motors rated 2 hp or less, for operation at 120 V or 240 V single-phase, shall be specification grade wall switches as specified in Section 26 27 26—Wiring Devices.

2.04 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solid-state overload relay. Starters for motors installed outdoors shall include ground fault protection.
- B. Full-Voltage Starting: Reversing or nonreversing type as shown on the Drawings.
- C. Coil Operating Voltage: 120 volts, 60 Hz.
- D. Size: NEMA ICS 2; size as shown on the Drawings. Contactors shall be Allen-Bradley or Bulletin 509 (Nonreversing), or equal.
- E. Overload relays shall be Allen-Bradley E100, Bulletin 592-1EF, or equal, and have the following features:
 - 1. Self-powered, solid-state.
 - 2. Up to 5:1 adjustment range.
 - 3. DIP switch settings for trip class and reset mode.
 - 4. Current transformers (no heaters).
 - 5. Thermal memory.
 - 6. Ambient temperature compensation.
 - 7. Visible trip indicators.
 - 8. Phase loss protection.

9. Low energy consumption.
 10. Ground fault protection as specified herein.
- F. Magnetic motor starters in motor control centers shall be combined with magnetic only molded case circuit breakers. Magnetic motor starters in combination motor starters or control panels shall be combined with thermal-magnetic molded case circuit breakers.
 - G. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in motor control centers and combination motor starters.

2.05 VARIABLE FREQUENCY DRIVES

- A. VFDs shall be provided to match the load type (constant or variable torque) of the specified application, as well as the full load amps of the motor furnished for the project.
- B. System Operating Conditions:
 1. 208 VAC $\pm 10\%$.
 2. Three-phase, 3-wire, any phase sequence.
 3. 60 Hz $\pm 2\%$.
 4. Storage temperature -25°C to $+55^{\circ}\text{C}$.
 5. Operating temperature 0 to 40°C .
 6. Altitude: 3,300 feet above sea level maximum.
 7. Humidity: 95% noncondensing maximum.
- C. Variable Frequency Unit:
 1. Conform to NEMA and NEC standards.
 2. CSA and ETL approved and/or UL approved.
 3. Overall VFD efficiency shall be a minimum of 96.5%, $\pm 1\%$, at 100% speed and motor load at nominal line voltage. Efficiency rating shall include control power supplies, control circuits, and all cooling fans.
 4. Input:
 - a. Withstand without component failure line voltage transients up to 3,000 volts per ANSI C37.
 - b. Design shall include DC bus chokes (two) used in conjunction with one or more capacitors. The DC bus chokes shall be incorporated in the design to minimize line-side harmonics. Magnetic-only designs shall include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
 - c. Include MOV line-side protection.
 - d. Inverter input for six pulse VFDs shall have a true power factor of 0.95 or better at rated load and nominal line voltage throughout the entire speed range.
 - e. Units shall be capable of operating attached to the same power bus without affecting each other's operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
 - f. Three percent line reactors (drives smaller than 100 hp).
 5. Inverter Output:
 - a. Inverter shall utilize latest generation IGBTs, be microprocessor based, and isolated from power circuits.
 - b. Match motor specified.
 - c. Three-phase, 3-wire.
 - d. Pulse width modulated wave form with selectable Sensorless Vector, Flux Vector, Volts/Hertz, and adjustable voltage control modes.
 - e. Maximum output 460 volts.

- f. Frequency 2 to 650 Hz.
 - g. Frequency accuracy $\pm 1\%$ of setting at any point in the specified speed range in a 24-hour period.
 - h. Full load output current shall be rated in excess of the AC motor selected.
 - i. Motor performance:
 - (1) 3% regulation in the manual speed control mode.
 - (2) Normal duty overload rating: 110% continuous current for 1 minute; 150% for 3 seconds.
 - (3) Heavy-duty overload rating: 150% continuous current for 1 minute; 180% for 3 seconds.
 - (4) 110% starting torque minimum.
6. AC drive features:
- a. Embedded I/O for discrete and analog signals. Analog signals shall include 4-20 mA circuitry mounted on separate printed circuit board to include offset, slope, minimum clamp, and separate acceleration and deceleration adjustments from 0 to 3600 seconds. An internal manual speed potentiometer is to be provided for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
 - b. Embedded 100BASE-TX Ethernet port supporting the EtherNet/IP protocol.
 - c. Slot-based architecture for expansion control and communication cards.
 - d. Real-time clock with battery for date/time stamping of events.
 - e. Integral thermostat control of door-mounted cooling fans.
 - f. Current limit circuitry: 20% to 160% of drive-rated amps.
 - g. Additional features for constant torque units shall include:
 - (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input kW.
 - (2) Slip compensation to provide 0.5% regulation with a 100% load change.
 - (3) Inner current loop regulator.
7. Enclosures:
- a. The VFD system shall be furnished with NEMA-rated (as previously specified) wall mounting enclosure.
 - b. Items to be mounted in the VFD structure or structures:
 - (1) Inverter.
 - (2) Incoming door interlocked, thermal-magnetic, molded-case circuit breaker.
 - (3) Bypass circuitry when specified with incoming circuit breaker and NEMA-rated mechanically interlocked contactors with separate overload.
 - c. NEMA 4/13 items to be door-mounted on the enclosure:
 - (1) Control devices, pilot lights, selector switches, etc., as shown on the Drawings and specified herein.
 - (2) Interface to the drive shall be via a removable human interface module (HIM) with integral display. This unit shall be a 7-line by 21-character backlit LCD display with graphics capability. HIM shall be used to display drive-operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow drive programming or operating functions to be accessed directly without knowledge of programming structure. The HIM unit shall be mounted on the front of the enclosure door so the operator does not have to open the enclosure to access the HIM.

8. VFD protection:
 - a. Adjustable current limit of 20 to 160% minimum.
 - b. Instantaneous overcurrent trip.
 - c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground- and short-circuit protection to be functional with an input line of 480 VAC $\pm 10\%$. The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
 - d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.
 - e. Shut down on loss of any input phase for longer than 3 cycles.
 - f. Output phase sequence to be independent of input phase sequence.
 - g. High- or low-sustained voltage.
 - h. 120 VAC grounded control circuits.
 - i. Electrically and/or optically isolated low voltage logic.
 - j. Corrosion protection:
 - (1) Gold-plated plugs (male and female section) on all printed circuit boards.
 - (2) Protective board coating (conformal coating).
 - k. MOV converter protection.
 - l. DC bus chokes to minimize line side current harmonics.
 - m. Additional features for constant torque units:
 - (1) I^2T protection to provide 150% current for one minute.
 - (2) Regenerative override protection.
9. VFD adjustments:
 - a. Maximum speed: 50 to 100%.
 - b. Minimum speed: 0 to 70%.
 - c. Current limit: 20 to 110%, 160% on constant torque units.
 - d. Linear acceleration 0 to 3,600 seconds.
 - e. Linear deceleration 0 to 3,600 seconds.
 - f. Output volts/Hz trim.
 - g. Voltage boosts.
 - h. Additional features for constant torque units:
 - (1) Slip compensation.
 - (2) IR compensation.
 - i. All drives shall attempt to restart three times prior to indicating failure.
10. Inverter digital or LED diagnostic features:
 - a. Current limit signal.
 - b. Regenerative override signal.
 - c. External fault (e.g., motor overload).
 - d. Low line voltage.
 - e. High line voltage.
 - f. Current overload.
 - g. High DC bus voltage.
 - h. Current trip.
 - i. Short-circuit.
11. Inverter construction: Modular construction for ease of maintenance.
12. Mount modules on enclosure subpanel:
 - a. Easily accessible from front.
 - b. Interconnect with plugs.
 - c. Construct boards of fire-retardant materials in accordance with NEMA grade FR4 specifications.

- D. Inverter Quality Control:
 - 1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
 - 2. Test integrated circuits for programmed parameters at rated temperature.
 - 3. Treat printed circuit boards for corrosion resistance (conformal coating).
 - 4. Provide gold-plated connections at all points where plugs are used.
 - 5. Thermal cycle all printed circuit boards for 10 cycles between 0°C to 65°C prior to installation in inverter.
 - 6. All units to be tested at a rated load and temperature after assembly.
- E. The 6-pulse variable speed drives shall be Allen-Bradley, or equal, Powerflex 525. All drives shall be by the same manufacturer.
- F. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served. CONTRACTOR shall provide a table listing the minimum, maximum, and skip setpoints programmed into each VFD on the project to ENGINEER and OWNER.
- G. Provide manufacturer certified start-up and warranty service for each VFD. Service shall be for 2 years and include all travel and expenses. Warranty service shall commence at the date of substantial completion.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer's instructions and Drawings.
- B. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the Drawings is not acceptable. Where power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current because of improved power factor.
- C. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.
- D. Wireways in control panels shall be used only for routing of conductors. Splices are not allowed within wireways.
- E. Motor Data: Provide neatly typed label inside each motor controller enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.
- F. All motors will be provided by other divisions, ready for connections. CONTRACTOR shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- G. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, disconnect switches, etc.

- H. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 26 05 19–Wire.
- I. Provide motor controllers as specified for all motors, unless shown or specified that motor controllers or control equipment will be furnished by others.
- J. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Cover plates.
 - 4. Wall-mounted occupancy sensors.
 - 5. Ceiling-mounted occupancy sensors.
 - 6. Indoor photo cells.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NEMA WD 1–General-Color Requirements for Wiring Devices.
- B. NEMA WD 5–Specific-Purpose Wiring Devices.
- C. Drawings–Bill of Materials.

1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 WALL SWITCHES

- A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Eaton 122*, Leviton 122*, or Pass and Seymour PS20AC*.
- B. Provide white-colored handles.
- C. Manual motor switches or manual motor controllers for 120 V or 240 V motors on circuits 20 amps or less shall be specification grade snap switch as specified above. Manual motor switches or manual motor controllers for 120-volt, 208-volt, or 240-volt motors and single-pole or two-pole switches for other equipment up to 277 volts on circuits 30 amps or less shall be Eaton 303*, Leviton 303*, or Pass and Seymour PS30AC*. Manual motor switches for three-phase motors 30 amps or less shall be as specified in Section 26 28 16—Disconnect Switches.

*Complete catalog number for pole arrangement necessary.

- D. Dimmer switches shall be rated for LED, fluorescent, and incandescent use.

2.02 RECEPTACLES

- A. Twenty ampere, 125-volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Eaton 5362, Leviton 5362, Pass and Seymour 5362. Provide white color.
- B. Weather-Resistant Receptacle: Weather-resistant receptacles shall include GFCI protection and be UL 498 listed, 20 ampere, 125-volt, NEMA 5-20R, heavy-duty, commercial grade, with WR marking on the face, Eaton WRS GF20, or equal.

- C. GFCI Receptacle: GFCI receptacles shall be UL 943 listed, Pass and Seymour 2097, Eaton TRSGF20 receptacle with integral ground fault current interrupter. Provide white color.
- D. Automated Control Receptacle: Split control receptacles shall be marked as controlled on top half per NFPA 70 requirements, Hubbell SNAP5362C1WTRA, or equal.

2.03 COVER PLATES

- A. Indoor outlet and switch boxes that are surface mounted or recessed in non-hazardous, unfinished spaces shall be provided with standard 302 series stainless steel cover plates. Provide blank 302 stainless steel cover plates for unused outlet and switch boxes and where noted on the Drawings. Indoor outlet and switch boxes that are recessed in non-hazardous, finished spaces shall be provided with thermoplastic, white cover plates. Finished spaces shall be defined as areas with boxes recessed in gypsum board walls.
- B. NEMA 4X and weatherproof switch covers shall be Thomas and Betts, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, Eaton S2983 or equal.
- C. While in use receptacle covers for exterior use shall be Leviton IUM1V-GY, or equal. Receptacle covers for NEMA 4X locations shall be Leviton 5980, Eaton WIU-1VX, or equal.
- D. Cover plates for manual motor switches, manual motor controllers, and NEC required equipment disconnects shall have provisions for locking the switch in the On or Off position.

2.04 WALL-MOUNTED OCCUPANCY SENSORS (SINGLE POLE [TYPE 1] AND DOUBLE POLE [TYPE 2])

- A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard single-gang switchbox and shall require two wires and a grounded box for proper operation.
- B. The sensor shall utilize a temperature compensated, dual element sensor and a multielement Fresnel lens. The lens shall be Poly IR4 material to filter short wavelength IR, such as those emitted by the sun and other visible light sources.
- C. Sensor shall have selectable DIP switches to adjust automatic time delay to fit occupant usage patterns.
- D. The sensor shall operate at universal voltages of 100 to 300 VAC. Sensor shall be capable of switching line voltage loads without the use of relay power packs.
- E. Sensor shall have no minimum load requirement and shall be capable of switching from 0 to 800 watt incandescent, 0 to 800 watt fluorescent or 1/6 hp @ 120 VAC, 60 Hz.
- F. Double pole sensors shall have the capability of switching two independent line voltage circuits. Each pole shall have no minimum load requirement and shall be capable of switching from 0 to 800 watts incandescent, 0 to 800 watts fluorescent or 1/6 hp @ 120 VAC, 60 Hz.
- G. Sensor shall not protrude more than 3/8 inch from the wall.
- H. Sensor shall have a 28-segment, two-level, Fresnel injection molded lens.

- I. Sensor shall cover up to 1,000 square feet for walking motion, with a field view of 180 degrees.
- J. In automatic mode, sensor shall be able to automatically return to Automatic-on after lights are turned off manually.
- K. Sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
- L. Sensor shall have a service switch to allow end-users to operate the sensor in the event of a failure, set by a DIP switch.
- M. Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage, and fluorescent loads.
- N. Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have ground wire and grounded strap.
- O. The PIR wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch.
- P. Single-pole wall-mounted passive infrared occupancy sensor shall be Model DSW-301 as manufactured by Wattstopper, Eaton OSD10N, or equal.
- Q. Double-pole wall-mounted passive infrared occupancy sensor shall be Model DSW-302 as manufactured by Wattstopper, Eaton OSD10DH, or equal.

2.05 CEILING-MOUNTED OCCUPANCY SENSORS (TYPE 3)

- A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard octagon box and shall require two wires and a grounded box for proper operation.
- B. Sensors shall have selectable DIP switches to adjust sensitivity settings to fit occupants usage patterns.
- C. Sensors shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360 degrees of coverage.
- D. Sensor shall utilize a temperature compensated dual element sensor and a multielement Fresnel lens. Fresnel lens shall be a Poly IR 4-based material to filter short wavelength infrared, such as those emitted by the sun and other visible light sources.
- E. The sensors shall feature terminal-style wiring.
- F. The sensor shall have a 34-element Extended Range lens.
- G. Sensor shall cover 360 degrees, up to 2,000 square feet of walking motion with the Standard Lens mounted at 8 feet AFF.
- H. Sensors shall operate at 24 VDC/VAC and half-wave rectified and utilize a power pack.

- I. Power pack shall be a self-contained transformer and relay module and shall meet the following requirements:
 - 1. Power and auxiliary relay packs shall have 1/2-inch snap-in nipple for 1/2-inch knockouts. Power and auxiliary relay packs shall be mounted inside of junction boxes above suspended ceilings. If the occupancy sensor is installed in an unfinished exposed location, sensor shall be installed within a junction box. The junction box cover shall be permanently labeled "OS Control."
 - 2. Power and auxiliary relay packs shall have dry contacts capable of switching 20 amp ballast load, 13 amp incandescent, 1 hp @ 120 VAC, 60 Hz.
 - 3. Power packs shall provide a 24 VDC, 150 mA output.
 - 4. Power packs shall be capable of parallel wiring without regard to AC phases on the primary.
 - 5. Auxiliary relay packs shall be identical in physical size to power packs and contain no transformer power supply and shall switch 120 VAC.
 - 6. Power pack and auxiliary relay packs shall be UL 2043 listed, use UL 94 V-O plenum rated plastic, and have low voltage Teflon-coated leads, rated for 300 volts.
 - 7. Power and auxiliary relay packs shall be UL and CUL listed.
 - 8. Power and auxiliary relay pack shall be Model OPP20 as manufactured by Leviton, Eaton AHSP20-MV, or equal.
- J. The sensor shall have an additional single-pole, double-throw isolated relay with normally open, normally closed, and common outputs.
- K. Sensors shall have a time delay that is adjusted automatically or shall have a fixed time delay of 5 to 30 minutes set by DIP switches.
- L. The sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED shall be able to be disabled for applications that require less visibility.
- M. Ceiling-mounted motion sensor shall be Model OSC20-M0 as manufactured by Leviton, Eaton AHAC-DT-2000, or equal.

2.06 SURFACE-MOUNTED HIGH BAY OCCUPANCY SENSORS (TYPE 4)

- A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard octagon box and shall require two wires and a grounded box for proper operation.
- B. Sensors shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360 degrees of coverage.
- C. Sensor shall utilize a temperature compensated dual element sensor and a multielement Fresnel lens. Fresnel lens shall be a Poly IR 4-based material to filter short wavelength infrared, such as those emitted by the sun and other visible light sources.
- D. The sensors shall feature terminal-style wiring.
- E. The sensor shall have a 360-degree high-bay lens.

- F. Sensor shall cover 360 degrees, up to 2,400 square feet of walking motion with the Standard Lens mounted at 40 feet AFF.
- G. Sensors shall operate at 120 VAC.
- H. Sensors shall have a time delay that is adjusted automatically or shall have a fixed time delay of 0.5 to 30 minutes set by DIP switches.
- I. The sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED shall be able to be disabled for applications that require less visibility.
- J. Ceiling-mounted motion sensor shall be Model OSFHS as manufactured by Leviton, or equal.

2.07 OUTDOOR PHOTOCELLS

- A. Photocell type shall be silicone diode and shall have electronic photocontrols. Photocell shall accept an input voltage range from 120 volts AC to 277 volts AC, be rated for a 1000 watts tungsten range, and be rated for 1,650 watts at 277 volts AC for LED installations. Photocell controller shall be gasketed for outdoor installation.
- B. Photocell shall instantly turn on when activated and shall have an adjustable sensor-off time delay (2 to 5 seconds) to prevent false off switching. On activation shall occur at 1.5 foot-candles and off activation shall occur at 4.5 foot-candles. In the event the photo controller fails, the photo controller shall fail on.
- C. Operational temperature range shall be -40°F to 158°F. Photocell shall be UL listed and include an 8-year warranty.
- D. Photocells for new construction shall be model EK4336S, as manufactured by Intermatic, or equal. Photocell mounting shall be suitable for installation in an approved in-wall, outdoor outlet box with weatherproof wall plate model K43-WP-KIT, as manufactured by Intermatic, or equal. Provide a light shield accessory model 6LV1352, as manufactured by Intermatic, or equal.

2.08 INDOOR PHOTOCELLS

- A. Provide relay packs to switch line voltage to inboard ballasts. Photocell output signal shall be rated at 24 VDC and a maximum of 120 mA.
- B. Photocell sensitivity shall be fully adjustable and shall include an on-delay time with adjustable delays from 3 to 30 minutes.
- C. Operational temperature range shall be 32°F to 120°F (0°C to 49°C) and up to 90% relative humidity. All photocells shall be UL listed and include a 5-year warranty.
- D. Photocell shall be Watt Stopper LS-102, or equal. Install where shown on Drawings.

2.09 FLOOR BOXES

- A. Assembly shall include service fitting, electrical component, firestops, and smoke barriers.

- B. Fire Rating: 2 hours.
- C. Service Fitting:
 - 1. Type: Flush.
 - 2. Housing: Metallic, carpet inlay cover.
 - 3. Flange: Brushed aluminum.
 - 4. Configuration: Refer to drawings for device type and quantity.
- D. Large capacity power/communications floor boxes shall be as manufactured by Legrand 800MP Series, or equal. Box to be fully recessed in floor with feed-through access cover.

2.10 THERMOSTATS

- A. Line voltage thermostats for single-stage heating shall be PECO Model TF115-001, or equal. Thermostats shall be rated NEMA 4X with a 40°F to 110°F temperature range and fixed 3°F deadband.
- B. Thermostats shown on the Drawings shall be single-stage unless otherwise noted.

PART 3-EXECUTION

3.01 INSTALLATION

- A. Weather-resistant receptacles shall be provided in all damp and wet locations.
- B. GFCI receptacles shall not be series wired.
- C. Install wall switches 48 inches above floor (top of box), "Off" position down, unless otherwise noted.
- D. Install wall dimmers 48 inches above floor (top of box) and derate ganged dimmers as instructed by the manufacturer. Do not use common neutral.
- E. Install receptacles vertically with the grounding pole on the top and at the heights shown on the Drawings, unless otherwise noted. Heights listed on the Drawings are to the bottom of the box.
- F. Install thermostats 48 inches above floor (top of box).
- G. Install devices and cover plates flush and level.
- H. Back wiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.
- I. Individual labels shall be placed on the back of all switch faceplates and receptacle faceplates indicating the lighting panel and circuit from which the switch or receptacle is fed. Labels shall be white background with black lettering no smaller than 12-point font. Provide permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal.

All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.

- J. Individually adjust each occupancy sensor's sensitivity and install sensor shields as required such that the sensor properly serves movement in all areas of the room, but does not energize lighting due to movement in adjacent rooms or due to ambient noise in the space when unoccupied (e.g., noise from pumps, refrigerators, HVAC equipment, servers, etc.). Adjust off-delay timers as required so that sensors operate in a manner that is acceptable to OWNER.

END OF SECTION

SECTION 26 28 00

OVERCURRENT PROTECTIVE DEVICES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Provide overcurrent protective devices as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Submit shop Drawings and product data in accordance with provisions of Section 01 33 00—Submittals, including electrical ratings, physical size, interrupt ratings, trip curves, I²t curves, and manufacturer's detailed specifications.

1.03 QUALITY ASSURANCE

- A. Comply with the following requirements:
 - 1. NFPA 70 National Electrical Code (NEC).
 - 2. Local codes and ordinances.
 - 3. Provide overcurrent protective devices by same manufacturer for each type of device.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 01 60 00—Materials and Equipment.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 CIRCUIT BREAKERS

- A. General:
 - 1. Comply with UL 489 requirements.
 - 2. Provide thermal and magnetic protection unless noted otherwise.
- B. Main Breakers:
 - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
 - 2. Provide solid-state circuit breakers with an integral LED ammeter, electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
- C. Feeder Breakers:
 - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
 - 2. Field-Adjustable Thermal-Magnetic Trip Circuit Breaker: NEMA AB1. Provide circuit breakers with frame sizes less than 400 amperes with adjustable instantaneous pickup setting for automatic operation. Range of adjustment shall be three to ten times the trip rating.
- D. All lugs shall be rated to accept copper conductors.

2.02 ENCLOSURES

- A. Circuit breakers shall be installed within panelboard as shown on the Drawings.

2.03 ACCESSORIES

- A. Provide accessories as scheduled as listed below:
 - 1. Handle Lock: Include provisions for padlocking.
 - 2. Mechanical trip device.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

3.02 ADJUSTMENT

- A. Set and record adjustable settings on circuit breakers to provide selective coordination and proper operation.

END OF SECTION

SECTION 26 28 16
DISCONNECT SWITCHES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Disconnect switches.
 - 2. Fractional hp motor switches.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NEMA KS 1–Enclosed Switches.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

1.04 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Disconnect Switches: Square D Class 3110 or Eaton Type DH.

- B. Substitutions: Under provisions of the General Conditions.

2.02 DISCONNECT SWITCHES

- A. Nonfusible Disconnect Switches: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in "On" position. A defeater shall be provided to bypass this interlock. Handle lockable in "Off" position. Provide auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.

2.03 SINGLE-PHASE MOTOR SWITCHES (2 HP OR LESS)

- A. Where noted on the Drawings, motors rated 2 hp or less, for operation on 120 V or 240 V, single-phase, shall be provided with a specification-grade wall switch as disconnecting means. See Section 26 27 26—Wiring Devices for additional information.

2.04 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the Drawings:
 - 1. Indoor dry locations: NEMA 12, steel.
 - 2. Outdoor, corrosive, or wet locations: NEMA 4X, stainless steel.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Provide disconnect switches where indicated on the Drawings. Maximum mounting height shall be 42 inches above finished floor unless noted otherwise, or acceptable to ENGINEER based on field conditions.
- B. Provide wall switch for each single-phase fractional horsepower motor where indicated on the Drawings.
- C. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the "Off" position.
- D. Wiring within disconnects shall only be for loads or equipment served by that disconnect. Foreign wiring within disconnect enclosures is not allowed. All wiring within disconnect enclosures shall be landed on lugs or terminals provided by the disconnect manufacturer, or on dedicated terminal strips for instrumentation equipment or field devices. Splices and spring wire connectors are not allowed within disconnect enclosures.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES (SPD)

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Service entrance devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI/IEEE C62.41 and C62.45.
- B. NFPA 70, and 75.
- C. UL 1449, most recent issue.

1.03 QUALITY ASSURANCE

- A. Manufacturers of SPDs. Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide surge protective devices which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

1.05 WARRANTIES

- A. Manufacturer shall provide a minimum 10-year warranty from the date of substantial completion to cover repair or replacement of the device.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The Drawings and Specifications were prepared based on MCG. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, upsizing overcurrent protective devices to meet manufacturer recommendations. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

2.02 GENERAL

- A. These specifications describe the electrical and mechanical requirements for high energy SPDs.
- B. The system individual units shall be UL listed under UL1449, latest edition, Standard for Surge Protective Devices (SPD). Surge ratings shall be permanently affixed to the SPD.
- C. Operating Temperature: Operating temperature range shall be -40 to +70°C (-40 to 158°F).
- D. Storage Temperature: Storage temperature range shall be -40 to +85°C.
- E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.
- F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
- G. Design Life: >15 years.

- H. Operating Voltage: Maximum continuous operating voltage shall be no less than 125% of the nominal rated line voltage.
- I. Power Frequency: SPD power frequency shall be rated for use on 50 and 60 Hertz power systems.
- J. All SPDs shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.

2.03 SERVICE ENTRANCE DEVICES

- A. The maximum surge current capacity of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 160 kA per phase. The surge life for WYE models (8/20) shall be at least 10kA for 1,500 occurrences (Lx-N and Lx-G modes) and 30kA for 1,500 occurrences (N-G mode). The surge life for delta models (8/20) shall be at least 20kA for 1,500 occurrences (Lx-G modes) and 20kA for 1,500 occurrences (Lx-Lx mode). The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating (I_n) of 40 kA.
- B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 200 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple fuse protected metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.
- E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.

- H. The SPD shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category C3 environments. Testing shall be per ANSI/IEEE C62.45-2002 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes.
- I. A NEMA 4 powder-coated steel enclosure with corrosion-resistant hardware shall be provided for the unit. Unless otherwise noted, SPDs installed within distribution or control equipment enclosures do not require a separate enclosure.
- J. Service entrance devices shall be as manufactured by MCG 200M Series, Square D EMA/IMA Series, Eaton SPD Series, or equal.
- K. SPD shall be suitable for use in Type 2 locations.
- L. Unit shall provide maximum ANSI/UL 1449 VPRs for 208Y/120-volt, three-phase systems.
 - 1. L-N = 700 V.
 - 2. L-G = 700 V.
 - 3. N-G = 600 V.
 - 4. L-L = 1200 V.

PART 3-EXECUTION

3.01 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.
- B. Each installed device shall be fed by an appropriately sized circuit breaker, per the manufacturer's installation notes, in the protected panel. No SPD shall be installed without an upstream overcurrent device.
- C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for installations with lead lengths greater than, or equal to, 5 feet. Low impedance cabling furnished by the manufacturer or appropriately-sized standard cable, if acceptable to ENGINEER, may be utilized for installations with lead lengths less than 5 feet. SPD leads shall be as short as possible.

END OF SECTION

SECTION 26 51 13

LIGHTING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes a complete functional lighting system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the UL label where practicable. In all cases the lighting fixtures shall be constructed with UL listed components.
- B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.
- E. Lighting Standards:
 - 1. LM-79-08 or latest—IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 2. LM-80-08 or latest—IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - 3. NEMA SSL 1-2016 or latest—Electronic Drivers for LED Devices, Arrays, or Systems.

1.03 SYSTEM DESCRIPTION

- A. Intent: It is the intent of these specifications to obtain a completed lighting fixture and lighting controls installation by CONTRACTOR. Completed means cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above-indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.
- B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features, accessories, and options specified, scheduled or required, are to be included for all fixtures provided.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals. Shop drawings shall include, but not be limited to, the following:
 - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, drivers, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents.
 - 2. Installation instructions.
 - 3. Certified photometric test data and reports.
 - 4. Shop drawings shall not only clearly indicate the assigned fixture type, but also the equipment location.
 - 5. Submittal should include, but not be limited to, wattage, lumen output, color temperature, and CRI value.

1.05 QUALITY ASSURANCE

- A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on Drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.
- B. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.
- C. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices and components necessary for the proper operation of the equipment.
- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.
- C. Timely Purchasing: Luminaires and other appurtenances shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.08 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 LED LUMINAIRES

- A. LED Luminaires shall meet the following technical requirements:
 - 1. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
 - 2. Luminaire efficacy shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 3. Luminaire Color Rendering Index (CRI) shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings; a minimum of 80 for interior luminaires and a minimum of 70 for exterior luminaires.
 - 4. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
 - 5. Luminaire lumen output shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 6. Wattage shall be equal to that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 7. Luminaire color temperature shall match that of the fixture model numbers shown in the fixture schedule on the Drawings.
- B. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- C. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- D. Lumen output shall not depreciate more than 20% after 10,000 hours of use.

- E. Luminaire and driver shall be provided from a single manufacturer to promote compatibility.
- F. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10%.
- G. Luminaire shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across specified voltage range.

2.02 WIRING

- A. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 26 05 19—Wire.
- B. Wiring within fixture construction shall be concealed, except where the fixture design or mounting dictates otherwise.
- C. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
- D. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

2.03 LED DRIVERS

- A. General:
 - 1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated in the model numbers in the fixture schedule shown on the Drawings.
 - 2. Driver shall have a minimum rated life of 50,000 hours.
 - 3. Driver shall have a minimum power factor of 0.9 and a maximum crest factor of 1.5 at full input power and across the specified voltage range.
 - 4. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
 - 5. Driver shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across specified voltage range.
 - 6. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
 - 7. Fuse Protection: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected per Class 2 UL listing.
 - 8. All fixtures located outdoors shall be provided with surge protection.
- B. Dimming Drivers: LED driver shall be compatible with dimming controls where dimming is indicated on the Drawings.
 - 1. Step-Dimming Drivers: One switch-leg input shall control 40% of the luminaire's light output equally, and two switch-leg inputs shall control 100% of the luminaire's light output.
 - 2. Continuous Dimming Drivers: LED luminaires shall dim without visible flicker and buzzing/noise. Continuous Dimming Drivers shall use 0-10 VDC control.

2.04 MARKING OF FIXTURES

- A. Voltage Identification: Fixtures designed for voltages other than 110- to 125-volt circuits shall be clearly marked.

2.05 FIXTURE TRIMS

- A. Trim Details: Provide trim details as shown on the Drawings or as specified. The trim finish and dimensions are subject to the shop drawing approval of ENGINEER. Mitered corners shall be smoothed before shop finish is applied. No lapping of trim metal for all flush-mounted ceiling trims for rectangular or square recessed fixtures.

2.06 EMERGENCY LIGHTING UNINTERRUPTIBLE POWER SUPPLIES (UPS)

- A. UPS input shall be 120/277 VAC, 60 Hz, three-wire (Switched Hot, Common, Unswitched Hot) plus ground. Input shall be protected by PCB-mounted, fast-acting fuses sized for UPS load.
- B. UPS output shall be 120/277 VAC, 60 Hz, two-wire plus ground, suitable for use with fluorescent, LED, and incandescent fixtures.
- C. UPS battery shall be sealed lead calcium. Battery shall be sized appropriately to provide 90 minutes of run time for 91% of rated output lumens.
- D. Provide sonic audible alarm option.
- E. UPS shall be rated for use in ambient conditions of 68°F to 86°F.
- F. UPS output rating shall be minimum 375 watts.
- G. UPS shall be equipped with self-diagnostic circuitry. Circuitry shall check different operating parameters during initial start-up, normal standby, and diagnostic stages. If a fault is detected, the fault indicator shall flash to alert maintenance personnel.
- H. UPS shall automatically initiate a diagnostic cycle every 28 days to test emergency operation. The self-diagnostic circuitry shall not utilize the lighting load (i.e., the emergency fixture(s)) to cycle and test the unit battery. Instead, a built-in resistive load shall be used, thereby eliminating emergency fixture illumination during diagnostic testing.
- I. UPS shall be capable of providing emergency illumination to switched and unswitched lamps. UPS shall monitor the reference voltage from the line (unswitched) side of the control device. In the event the reference voltage is lost the UPS shall power the emergency fixture(s) regardless of control device position.
- J. UPS shall be capable of being mounted a maximum of 1,000 feet from the emergency fixtures.
- K. UPS shall be UL 924 listed.
- L. Inverter module and battery module shall be housed in a NEMA 1 enclosure.
- M. Three-year warranty on all UPS components shall be included (except batteries).
- N. UPS shall be Isolite Model E3, IOTA model IIS, or equal.

PART 3-EXECUTION

3.01 LIGHTING CONTROLS

- A. Day Lighting: Step dimming driver fixtures shall be controlled using occupancy and photocell sensors in conjunction with override wall switches, where applicable.
 - 1. If the override switch is in the "On" position and the occupancy sensor is activated, the associated step-dimming driver switching circuit input shall be controlled through the photocell sensor based on two operator-adjustable light level setpoints. If the light level in the room falls below the "On" setpoint (50 fc), the step-dimming driver switch circuit input shall be energized to 40% when one override switch is in the "On" position and to 100% when both override switches are in the "On" position. If the step-dimming driver switching circuit input is energized and the light level rises above the "Off" setpoint (75 fc), the step-dimming driver switching circuit input shall be de-energized until the level falls below the "On" setpoint as described above.
 - 2. If the override wall switch is in the "On" position and the occupancy sensor is not activated, the associated step-dimming driver switch circuit input shall remain de-energized.
 - 3. If the override wall switch is in the "Off" position, the associated step-dimming driver switching circuit shall be deenergized.
- B. Complex Occupancy: Step-dimming driver fixtures shall be controlled from the occupancy sensor(s) in conjunction with override-off wall switches.
 - 1. The override switches shall control the respective step-dimming driver as designated on the Drawings. Each switching circuit shall control 40% of the fixtures light output.
 - 2. If one or more override switches are in the "On" position, control shall be through the occupancy sensor such that if the occupancy sensor is activated, the step-dimming driver shall be energized to 40% when one override switch is in the "On" position and to 100% when both override switches are in the "On" position.
 - 3. If both override switches are in the "Off" position the fixture shall be deenergized.

3.02 INSTALLATION

- A. Install fixtures, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
- B. All wall-mounted fixtures and all ceiling-mounted surface fixtures including exit lights, shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.
- C. All exterior wall-mounted fixtures shown over doorways shall be mounted centered, 6 inches above doorway, unless otherwise noted.
- D. All fixtures shall be securely and adequately supported and installed. Recessed lighting fixtures in suspended ceilings or in plaster ceilings shall have channel and supports provided by CONTRACTOR. CONTRACTOR shall provide plaster frames. Fixture shall be supported from structure and not from ceiling.
- E. Surface- or pendant-mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fixtures shall be supported by not fewer than two supports for each fixture. Where fixtures are to be suspended, they shall be

mounted on steel channel with the channel supported directly from the structure by a minimum of 3/8-inch rod inside rigid conduit stems. Any fixture which has an individual fixture weight of greater than 25 pounds shall have safety cable installed, in addition to other support means. Cable shall be 3/16-inch airplane cable. All fittings and connectors shall be compression type. Cables must be secured to the building structure and to a point or points on the fixture to protect against falling parts.

- F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room shall be located at the height of the lowest fixture, but not lower than 8 feet 0 inch above the finished floor. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after the installation of other equipment.
- G. Recessed fixtures in suspended ceilings shall have final connections made up of a length of flexible conduit not in excess of 6 feet, with THHN conductors and a green ground conductor.
- H. Provide inscription for exit signs to conform to codes.
- I. Metal decking shall not be pierced for fixture support.
- J. All wiring for dimming circuits shall have an individual neutral provided for each circuit.
- K. All fixture whips shall be constructed of minimum No. 12 AWG conductors.

3.03 SUPPORTS

- A. Mounting Frames: Provide mounting frames (plaster frames for example), as necessary, for installation and as required under other sections. Frames shall be finished matte white baked enamel unless otherwise noted.
- B. Mounting Accessories: Provide bars, angles, or other supporting devices for all recessed fixtures. Fixtures shall be securely attached to prevent movement up, down, or sideways. Fixtures shall be mounted to permit access to wiring. Fastening devices shall be of a positive, locking type, and shall not require the use of special tools to apply or remove. Tie wires shall not be used in place of fastening devices.
- C. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the Drawings and provide appropriate mounting accessories for each lighting fixture.
- D. Pendant Mounting: Provide pendant- or surface-mounted fixtures with required mounting accessories, including hickey, stud extensions, ball aligners, canopies, and stems. Coordinate locations of fixtures in mechanical areas. Provide mounting stems on pendant fixtures of the correct length to uniformly maintain the fixture heights shown on the Drawings, or established in the field.
- E. Adequate rigid, sturdy support shall be provided to prevent the possibility of fixture falling. Surface and pendant fixtures must be supported with two supports per 4-foot section. All pendants must have swivel aligners located at the top ends; pendants shall be minimum 3/8-inch threaded rod inside 3/4-inch rigid steel conduit, unless specifically indicated otherwise on the Drawings, pendant supports shall be painted on jobsite. Support

surface-mounted fixtures from structural members other than ceiling tees by providing Unistrut members spanning main ceiling tees or by mounting directly to structure.

3.04 ADJUSTMENT

- A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units), shall be adjusted after dark under the observation of OWNER.

3.05 CLEANING

- A. Installation Sequence: Lighting fixture mounting frames, plaster rings, etc., shall be installed prior to the finishing assembly which shall not be installed until the Project is at Final Completion. When the fixture location or construction prevents sequential installation, CONTRACTOR shall carefully protect all reflectors, lenses, flanges, and other visible surfaces.
- B. Cleaning: Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

3.06 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first-class operating order and free from defects in condition and finish:
 - 1. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
 - 2. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection, shall be replaced at no expense to OWNER.
 - 3. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

SECTION 26 56 29
EXTERIOR LIGHTING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Exterior lighting fixtures, poles, and controls as shown on the drawings and in schedules.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Manufacturers: Firms regularly engaged in the manufacture of exterior lighting of the types and rating for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with exterior lighting work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.
- E. Lighting Standards:
 - 1. LM-79-08 or latest—IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 2. LM-80-08 or latest—IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - 3. NEMA SSL 1-2016 or latest—Electronic Drivers for LED Devices, Arrays, or Systems.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals. Shop drawings shall include, but not be limited to, the following:
 - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures, including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, drivers, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents. Manufacturers' catalog cut sheets will not be acceptable. Submittal should include, but not be limited to, wattage, lumen output, color temperature, CRI value, and certified photometric test data and reports.
 - 2. Product data for all light poles, luminaire arms, and all accessories.

3. Manufacturer's dimensioned scale drawings of all light pole assemblies showing in complete detail the fabrication of all lighting fixtures together with light poles, arms, and all accessories.
4. Product data and wiring diagrams for all lighting controllers. Wiring diagrams shall include a detailed bill of materials, load center circuit schedule, controller short circuit interrupt rating, interior panel wiring schematic showing all control devices, circuit breakers, lighting contactors, and all accessories specified herein along with terminations, and interior and exterior panel elevations.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver exterior lighting fixtures individually wrapped in factory-fabricated fiberboard-type containers.
- B. Handle exterior lighting fixtures and poles carefully to prevent breakage, denting, and scoring the fixture finish. Do not install damaged lighting fixtures and poles; replace and return damaged units to equipment manufacturer.
- C. Store exterior lighting fixtures in a clean, dry space. Store in original cartons and protect from dirt, physical damage, weather, and construction traffic.

1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 MATERIALS

- A. The Drawings and Specifications were prepared based on the light fixtures and pole types shown in the fixture schedule on the Drawings. The scheduled equipment shall be

considered as establishing the type, function, appearance, and quality required. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate equipment deviating from the scheduled equipment including, but not limited to, photometric analysis and structural and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

- B. All material requests deviating from the scheduled equipment shall show conformance with the following design and performance criteria:
 - 1. LED light fixtures shall provide illumination meeting the lighting design criteria as shown on the Drawings for each portion of the project area. Illumination criteria include, but are not limited to, minimum average maintained illuminance, minimum foot-candle level at any point, and average to minimum uniformity ratio.
 - 2. LED light fixtures shall be mounted on poles matching the heights shown on the Drawings and at the locations shown on the Drawings with no additional light fixtures or poles.
 - 3. LED light fixtures shall meet the material requirements described in Part 2–Products.
 - 4. LED light fixtures shall have similar aesthetics to the scheduled equipment and shall be subject to OWNER approval.
- C. The following information shall be submitted for review if CONTRACTOR chooses to provide LED light fixtures deviating from the scheduled equipment:
 - 1. A computer-generated photometric layout demonstrating the LED light fixture's ability to meet the performance criteria described herein and shown on the Drawings from the pole locations shown on the Drawings with no additional light fixtures or poles. Layout shall be generated using AGI32 software by Lighting Analysts. Submit all correction factors applied to photometric calculations including, but not limited to, luminaire dirt depreciation, lamp lumen depreciation, and total light loss factor.
 - 2. A photometric report in IES format by Independent Testing Laboratories for each light fixture.

2.02 LED LUMINAIRES

- A. LED Luminaires shall meet the following technical requirements:
 - 1. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
 - 2. Luminaire efficacy shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 3. Luminaire Color Rendering Index (CRI) shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings; a minimum of 80 for interior luminaires and a minimum of 70 for exterior luminaires.
 - 4. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
 - 5. Luminaire lumen output shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
 - 6. Wattage shall be as shown in the fixture schedule on the Drawings.
 - 7. Luminaire color temperature shall match that of the fixture model numbers shown in the fixture schedule on the Drawings.
- B. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- C. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

- D. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- E. Luminaire and driver shall be provided from a single manufacturer to promote compatibility.
- F. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10%.
- G. Luminaire shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across specified voltage range.

2.03 LIGHT POLES

- A. Provide light poles and luminaire arms with model numbers as shown in the fixture schedule on the Drawings. Coordinate final light pole, arm, and luminaire color selections with OWNER and ENGINEER prior to shop drawing submittals. Verify luminaire arm orientations with light pole installation locations shown on the Drawings. Pole color shall match fixture color.
- B. Light poles shall include handholes with access cover fastened with stainless steel bolts or stainless steel screws.
- C. Light poles shall include provisions to accept grounding conductor sized as shown on the Drawings. Grounding lug shall be accessible from the handhole described above.
- D. CONTRACTOR shall confirm that each light pole and luminaire arm supports the proposed weight and effective projected area of the luminaire to be installed.
- E. Provide vibration dampeners inside light poles as recommended by the light pole manufacturer.
- F. Provide concrete light pole bases as shown on the Drawings. Coordinate light pole base plate bolt pattern with CONTRACTOR before concrete base installation. Provide bolt covers to prevent anchor bolt exposure to the elements.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Provide exterior lighting poles and fixtures of the types indicated, where shown on the drawings and at the indicated heights, in accordance with the fixture manufacturer's written instructions and with recognized industry practices. Comply with NEMA Standards and requirements of the National Electrical Code pertaining to installation of exterior lighting fixtures, and with applicable portions of NECA's "Standard of Installation."
- B. Entire exterior lighting assembly, including fixtures and poles, shall be capable of withstanding sustained winds of 100 mph.
- C. Fasten fixtures securely to concrete bases as shown on the Drawings and check so that fixtures are plumb and level and installed at the mounting heights shown on the Drawings without interference.
- D. Provide minimum 20 feet of wire slack in lighting control cabinets, 10 feet in pull boxes and handholes, and 3 feet at entrance to and exit from a light pole.

3.02 ADJUST AND CLEAN

- A. Clean exterior lighting fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during the remainder of the construction period.

3.03 FIELD QUALITY CONTROL

- A. When the exterior lighting system is installed and energized, demonstrate system functionality and performance after dark under the observation of OWNER and ENGINEER.
- B. CONTRACTOR is responsible to provide all testing equipment and after-hours labor as required to demonstrate that the exterior lighting installation provides the lighting design criteria shown on the Drawings. Installations that do not meet the design criteria shall be modified at no additional cost to OWNER until the design illuminance criteria are demonstrated.
- C. Coordinate photocell and timeclock activation settings with OWNER and ENGINEER.
- D. Malfunctioning or underperforming luminaires shall be replaced with new units.

END OF SECTION

SECTION 27 10 00
STRUCTURED CABLING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: This specification contains the requirements for telecommunications and data cabling, enclosures, termination components, and related subsystems as part of a structured cabling system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this Section.

1.02 SYSTEM DESCRIPTION

- A. CONTRACTOR shall provide and test all cabling and components necessary for a complete and functional structured cabling system as specified herein and shown on the Drawings. Conduit, raceway, and outlet boxes for the "Information Outlets" shall be provided by CONTRACTOR.
- B. Provide all faceplates, patch panels, equipment racks, equipment trays, and all other items necessary for telephone and computer connections at all specified data outlets and patch panel(s).

1.03 REGULATORY REFERENCES

- A. All Work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the National Electrical Code and present manufacturing standards.
- B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
- C. The cabling system shall comply with the following standards:
 - 1. ANSI/IEEE C2—National Electrical Safety Code.
 - 2. NFPA 70—National Electrical Code (currently-adopted edition).
 - 3. TIA/EIA Standards 526-14A (OFSPT-14A), 526-7 (OFSPT-7), TIA-568-C.0, TIA-568-C.1, TIA-568-C.2, TIA-568.3-D, TIA-569-B-1, TIA-606-A-1, and TIA J-STD-607-A.
 - 4. IEEE/ANSI 142—Recommended Practice for Grounding of Industrial and Commercial Power Systems.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

- B. Provide scaled network rack and network cabinet elevation drawings showing all installed equipment.
- C. Record Drawings:
 - 1. Three complete sets of drawings shall be provided by CONTRACTOR prior to final acceptance.
 - 2. These drawings shall contain the following:
 - a. Any changes made to the system during installation.
 - b. Location of all information outlets including jack number identification.
 - c. Scaled network rack and network cabinet elevation drawings showing all installed equipment.
- D. Installation Reports:
 - 1. Cable pulling tension reports.
 - 2. Telecommunications grounding busbar resistance test reports.
 - 3. Copper and fiber-optic cable acceptance test reports.
- E. Technical Manual: CONTRACTOR shall furnish three complete technical service manuals containing the following:
 - 1. Description of maintenance/programming procedures for all equipment and systems.
 - 2. All warranty information required by manufacturers for submission of warranty claims for all equipment installed.
 - 3. All testing reports according to Paragraph 3.03.

1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 10 years of experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.
- D. CONTRACTOR shall utilize and have technicians trained in the utilization of the following test equipment: Fiber optic cable and copper cable certification equipment.

1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.07 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR

shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 GENERAL

- A. CONTRACTOR shall provide all necessary power supplies, mounting hardware, and accessories required to install the materials specified herein.

2.02 NETWORK CABINETS

- A. Network equipment shown on the Drawings and specified herein to be provided in a network cabinet shall be installed in a double-hinged, tri-fold rack enclosure suitable for wall mounting. The cabinet shall have a hinged front door with scratch-resistant, tinted, safety-glass window. The cabinet shall be minimum 28 inches wide with integral vertical cable management and 19-inch rack mounting rails per EIA universal spacing. Rack-mounted equipment shall be accessible through the front door and through the hinged tri-fold center section for rear access. Rack spaces above or below each network switch and patch panel shall be provided with horizontal cable management as specified herein. The rear-wall section of the cabinet shall include cable management and conduit entries with knockouts. The hinged center cabinet section shall be able to swing open in either direction. The center cabinet section shall also latch to the rear wall section in two locations and unlatch using hand-operated levers located inside the cabinet.
- B. The front door of the cabinet shall include a keyed lock. Provide minimum two keys to OWNER. Where multiple cabinets are installed, all locks shall be keyed alike.
- C. Provide DIN rail, terminal blocks, wireway, circuit breakers, and other devices specified in Section 26 05 19—Wire and Section 26 09 00—Controls and Instrumentation as required for equipment mounted to the rear-wall section of the cabinet (e.g., camera power supplies, power strip/surge suppressor receptacle, etc.).
- D. The cabinet height shall be sized as required to accommodate all equipment specified herein and shown on the Drawings to be located in the cabinet, plus a minimum of 25% spare rack mounting space.
- E. All non-rack mounted components not requiring regular access shall be mounted to the rear-wall section of the cabinet (e.g., receptacles, power supplies, etc.). Provide blank RU plates and shelves, sized as required, to rack mount equipment that is not provided with rack-mounting flanges. Non-rack mounted equipment shall be located to avoid conflicts with

space reserved for future rack-mounted equipment and shall not be mounted on the floor of the cabinet.

- F. Provide a rack-mounted, true-online UPS backup as specified herein in each cabinet that will allow for continuous operation of all installed equipment for at least 30 minutes. All power connections to UPS shall be plug connected.
- G. Provide a rack-mounted power conditioner and distribution units and telecommunications grounding busbar as specified herein in each cabinet. Provide quantity in each rack required to serve the installed equipment.
- H. The cabinet shall be constructed of welded, 14-gauge steel with lightly textured, low-gloss polyester powder paint. The cabinet shall be as manufactured by Hoffman, Model AccessPlus, or equal. Provide two enclosure fan kits Hoffman Model EWMF, or equal, both mounted on one side of the enclosure and directed to positively pressurize the cabinet. Provide washable fan filter kit Hoffman Model AFLTR4LD, or equal, for each fan. Vertical cable management shall be Hoffman Model EWMC24, or equal.

2.03 COPPER CABLE

- A. 300-volt Rated Unshielded Cable:
 - 1. Provide 4-pair, unshielded twisted-pair (UTP) cabling with solid, copper-only conductors meeting EIA/TIA Category 6 requirements for horizontal station cabling. Cable shall be listed as suitable for use in locations indicated on the Drawings. Provide CommScope 2071E Low Smoke PVC, or equal, for Plenum environments, or CommScope 1071E PVC, or equal, for nonplenum environments.
 - 2. Refer to the Execution Section which details the required performance criteria for the permanent link of which the cable is a part. The jacket color for data cables shall be blue. The jacket color for voice cables shall be white.
 - 3. Provide nylon cable ties or reusable hook-and-loop bands, where specified herein, for bundling cables.
 - a. Nylon cable ties for bundling cables above suspended ceilings shall be Panduit Contour-Ty Model CBR, or equal. Provide plenum-rated, natural-color cable ties in plenum environments. Provide black cable ties in all other environments.
 - b. Reusable hook-and-loop bands for all other areas, including equipment racks, shall be Panduit Tak-Ty Model HLT, or equal, black.
- B. Industrial Ethernet Cable:
 - 1. 600-Volt Rated Shielded Cable:
 - a. For communication with plant SCADA Systems and equipment in control panels, etc., over 300 volts, and other areas or raceways with power wiring over 300 volts, provide 600-volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
 - b. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.34 inch. Cable shall be CMR rated, UL listed, 600 V UL AWM rated, and be Belden 7953A or equal.
 - c. Cable jacket color shall be red.
 - d. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.

2. 300-Volt Rated Shielded Cable:
 - a. For communication with plant SCADA Systems and equipment in control panels, etc., under 300 volts, and other areas or raceways with power wiring under 300 volts, provide 300 volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
 - b. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.29 inch. Cable shall be CMR rated, UL listed, and shall be CommScope1271B, or equal.
 - c. Cable jacket color shall be slate.
 - d. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
 3. Below-Grade 300-Volt Rated Shielded Cable:
 - a. Communication cables routed in underground conduit and raceways with power wiring under 300 volts shall be 300 volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard.
 - b. Cable conductors shall be minimum 23 AWG with polyolefin jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be OSP-grade polyethylene. Cable shall be OSP-rated, UL-listed, and shall be Superior Essex Model 04-001-64, or equal.
 - c. Cable jacket color shall be black.
 - d. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
 4. 600-Volt Rated, Shielded, Long-Range Cable:
 - a. For communication with devices requiring cable lengths up to 600 feet and under 600 volts, provide 600 volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568-C.2 standard and shall support up to 2.5 Gbps data rates and up to 100 watts of PoE power for all PoE classes without the use of additional powered devices.
 - b. Cable conductors shall be minimum 22 AWG with HDPE jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade LSZH FR Polyolefin with a maximum overall cable diameter of 0.380 inches. Cable shall be CM rated, UL listed, and shall be Paige Datacom Solutions GameChanger OSP Cable Model 258340804, or equal.
 - c. Cable jacket color shall be black.
 - d. Provide a shielded RJ45 connector on one end of each cable terminating in a patch panel or surge protector and an unshielded RJ45 connector on the other end of each cable.
- C. Category 6 Ethernet patch cables shall be provided premanufactured by the cable manufacturer or connector manufacturer in sufficient length to connect the associated equipment to any port on the equipment, patch panel, or switch. Field-attached plugs shall be insulation displacement type and shall be by the same manufacturer as the cable.
- D. Access Control System Cabling–Wiegand Communication Cabling:
1. For access control system devices using Wiegand serial communications, provide 300 volt-rated, 8-conductor, shielded cables suitable for outdoor installation in conduit.
 2. Cable conductors shall be minimum 18 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a

maximum overall cable diameter of 0.320 inches. Cable shall be CM rated, UL listed, and shall be Alpha Wire Model 5388C, or equal.

3. Cable jacket color shall be gray.

2.04 FIBER OPTIC CABLE

A. Multimode Cables:

1. Provide indoor/outdoor fiber optic cables with fiber counts in each cable as shown on the Drawings. Cable shall be type OFNR and shall be suitable for use inside building and outside plant applications, including duct and conduit installation in accordance with ICEA S-104-696. Installation in building risers shall be in accordance with NEC 770. Cable shall be DX-Series Distribution Riser as manufactured by Optical Cable Corporation, FREEDM One Tight-Buffered Cable Riser as manufactured by Corning, or equal.
2. Individual fibers shall be multimode, 50/125 microns, meeting TIA/EIA 492AAAC and ISO/IEC 11801 type OM3 standards for laser optimized fibers. Primary fiber coating diameter shall be 250 $\mu\text{m} \pm 15$ and the secondary tight buffer coating diameter shall be 900 microns (nominal). All coatings shall be mechanically strippable without damaging the optical fiber. Optical performance shall meet the following requirements:

Wavelength	850 nm	1310 nm
Gigabit Ethernet Distance	1000 m	600 m
10-Gigabit Ethernet Distance	300 m	300 m
Maximum Attenuation	3.0 dB/km	1.0 dB/km

3. Cable shall be all dielectric, tight-buffered, dry water blocking, gel-free, and shall meet UL 1666 and RoHS compliance. The PVC outer sheath shall be flame-retardant and marked with the manufacture's name, date of manufacture, fiber type, flame rating, and sequential length information. Outer jacket shall be black.
4. Connectors shall be provided on all fibers of each fiber optic cable.
5. All cables shall be installed in continuous lengths from endpoint to endpoint. Splices in fiber optic cables shall be allowed only where shown on the Drawings.

B. Fiber Optic Patch Cables:

1. Fiber optic patch cables shall be multimode 50/125 microns and shall meet UL 1666 (OFNR) flame ratings for standard compliant safety as required by the installation environment. All fiber patch cables shall be pre-terminated and tested for insertion loss. Cable performance shall meet or exceed requirements of the TIA/EIA-568.3-D standard for OM3 fiber optic cables. Factory certification test information shall be provided with each cable.
2. Fiber patch cable insulation color shall be aqua for OM3 cables.
3. Fiber connectors shall be LC-type, FOCIS compliant or compatible, and shall exceed the requirements of TIA/EIA-455-21A for 500 mating cycles. Field-coordinate connector types for cables interfacing with existing equipment and existing patch panels. The insertion loss for each connector shall not exceed 0.35 dB for multimode cables.
4. Fiber connector and strain-relief color shall be aqua for OM3 cables per the TIA/EIA-568.3-D standard. Strain-relief color shall match connector color.
5. Fiber optic patch cables shall be provided in sufficient length to connect associated equipment to any port on the network equipment.

2.05 CONNECTORS

- A. Data and Voice Station Cables:
 - 1. Faceplates: CommScope, L-Type flush-mounted, white, or equal, in finished areas and stainless steel, SP-L-Type, flush-mounted, or equal in all other areas.
 - 2. Jacks: CommScope Model MGS400, or equal. Jacks for data/VoIP shall be blue and jacks for analog voice shall be white.
- B. Industrial Ethernet Cable:
 - 1. Faceplates: CommScope, L-Type, flush-mounted, white color, or equal, in finished areas and stainless steel SP-L-Type, flush-mounted, or equal, in all other areas.
 - 2. Jacks: Leviton 5S180-SH5 shielded connector, or equal.
- C. Fiber Optic Cable Connectors:
 - 1. Fiber connectors shall be LC-type, FOCIS compliant or compatible, and shall exceed the requirements of TIA/EIA-455-21A for 500 mating cycles. Field-coordinate connector types for cables interfacing with existing equipment and existing patch panels. The insertion loss for each connector shall not exceed 0.35 dB for multimode cables.
 - 2. Fiber connector and strain-relief color shall be aqua for OM3 cables per the TIA/EIA-568.3-D standard. Strain-relief color shall match connector color.

2.06 PATCH PANELS

- A. Fiber Optic Patch Panels: Provide as shown on the Drawings. Patch panels shall be as manufactured by Siemon Company, or equal, Model SWIC3 for surface-mounted applications and Model RIC3 for rack-mounted applications, or equal. Each patch panel shall include the following:
 - 1. Fiber port designation labels with removable pocket.
 - 2. Dust-proofing grommets, strain relief hardware, cable ties and mounting hardware.
 - 3. Thumb-turn enclosure latch.
 - 4. Bend radius guides to provide proper storage of fiber slack.
 - 5. Adapter plates with LC-type connectors. Adapters shall be universal to accept multimode or single-mode fiber.
 - 6. Port quantities shall be as shown on the Drawings and as necessary to connect all fibers in each connected cable.
- B. Copper (RJ-45) Patch Panels: Patch panels shall be used as a termination point for data jacks as shown on the Drawings and specified herein. Patch panels shall be as manufactured by CommScope, Model 1100GS3, or equal. Each patch panel shall include the following:
 - 1. Jack ports to meet Category 6 Standards.
 - 2. UL listing.
 - 3. Universal T568A and T568B wiring cards for 110-style IDC terminations.
 - 4. Cable retainer at back of panel.
 - 5. Front window labeling for port identification.
 - 6. 19-inch rack mounting.
 - 7. Port quantities shall be as shown on the Drawings and as necessary to connect all data jacks shown on the Drawings.

2.07 POWER DISTRIBUTION AND GROUNDING

- A. Rack-Mounted Uninterruptible Power Supply:
 - 1. The UPS shall be 120-volt AC and true on-line type. UPS batteries shall be sized to provide continuous communication for at least 30 minutes following a power failure.
 - 2. The UPS power shall be provided to all rack-mounted equipment, unless noted otherwise.
 - 3. The UPS shall be plug connected to a line power receptacle and all power connections to the UPS shall be plug connected.
 - 4. Each UPS shall be provided with a relay card that provides a dry contact output to the SCADA System to indicate a common alarm when the UPS batteries need replacement.
 - 5. The UPS and associated batteries shall be located at the bottom of the rack.
 - 6. The UPS shall be APC with relay I/O module, Liebert GXT5 with relay card, or Eaton 9SX.
- B. Rack-Mounted Power Conditioner and Distribution Unit:
 - 1. Provide power conditioner and distribution units in all network racks and network cabinets. Provide quantity required to serve the installed equipment. Power conditioners shall be rack mountable and include 8 rear-panel outlets and 1 front-panel outlet with integral 20-amp circuit breaker protection.
 - 2. The power conditioner shall provide voltage regulation, under/over-voltage protection, and transient protection for line-to-neutral and line-to-ground leakage.
 - 3. The power conditioner shall have a front panel-mounted digital voltmeter/ammeter display to indicate RMS line voltage and current.
 - 4. The power conditioner shall be as manufactured by Furman Model PL-PRO DMC, or equal.
- C. Provide a telecommunications grounding bus bar (TGB) in the rear cable section of network cabinet. The TGB shall be a pre-drilled copper bus bar provided with standard NEMA bolt-hole sizing and spacing and have minimum dimensions of 6 mm thick by 50 mm wide. The connection of the isolated grounding conductor to the TGB shall utilize UL-listed two-hole compression connections.

2.08 DATA LINE SURGE PROTECTION

- A. Rack-Mounted Data Line Surge Protection Panel: Provide a 12-port, modular surge protection panel suitable for use with replaceable data line surge protection modules as manufactured by DITEK Model RM12POE, or equal, where shown on Drawings. Panel shall be suitable for rack mounting in a 1RU space.
 - 1. Surge protection panel shall be UL Listed and have a lifetime warranty.
 - 2. All surge protection modules shall be field replaceable.
 - a. Modules for analog phone lines shall be Model PTEL2R, or equal, and shall have a response time under 1 ns and a peak breakover voltage of 270 volts. Modules for digital phone lines shall have a response time under 1 ns and a breakover voltage of 60 volts DC. Modules shall accept both RJ-45 and RJ-11 connectors.
 - b. Modules for Ethernet data lines up to 1000 Mbps shall be Model PNETR6, or equal, and shall have a response time under 1 ns and a peak breakover voltage of 60 volts. Modules shall be compliant with the applicable safety isolation requirements on IEEE 802.3. Modules shall accept RJ-45 connectors.
 - 3. Provide surge protection module quantities and types as required to protect the data lines shown on the Drawings to be routed through the surge protection panel.

PART 3-EXECUTION

3.01 GENERAL

- A. Install all equipment and components in accordance with manufacturer's written instructions, in compliance with NEC, ANSI/TIA/EIA-569-B-1 and with recognized industry practices so that all items comply with these Specifications and serve the intended purposes.
- B. Refer to Section 26 05 53—Electrical Identification for cable and equipment label requirements.
- C. All cabling shall be installed in accordance with good engineering practices as established by the TIA/EIA and the NEC. Cabling shall meet all applicable local, state, and federal building codes. Voice and data cables shall be terminated according to the TIA-568B standard.
- D. Record serial numbers of all items provided that are serialized prior to final acceptance.
- E. All items must be complete as specified prior to final acceptance.
- F. Copper data cables installed between patch panels and data jacks shall be limited to 90 meters to allow for up to 10 meters of combined patch cable length. CONTRACTOR shall identify any cables that cannot be limited to 90 meters and notify ENGINEER prior to installation of any cabling.

3.02 INSTALLATION

- A. Cabling—General:
 - 1. Provide cabling runs from the patch panel or voice termination blocks to each jack shown on the Drawings. A dedicated cabling run shall be utilized for each jack.
 - 2. Provide faceplates and connections in outlet boxes for all jacks shown on the Drawings.
 - 3. Excess cable behind faceplate connections shall be pulled back into junction boxes in the ceiling space and secured to prevent damage to cabling or connections. Provide minimum 10 feet of slack in all cables within the Server Room and manage slack for future use.
 - 4. Provide grommets and/or bushings in conduit ends to prevent damage to insulation and cables.
 - 5. Use cable tie tool to install cable ties with appropriate pressure to the cable bundles to prevent damage to cables and provide a smooth cut of excess cable tie. Cable ties shall be able to be turned freely around the bundle of cable. Cable bundles shall be limited to a 3-inch diameter. Cable ties shall be used for cable bundles above suspended ceilings and shall be plenum-rated where required.
 - 6. Use hook-and-loop bands to secure cable bundles within Server Room network cabinets. Cable bundles shall be limited to a 3-inch diameter.
 - 7. Tighten connectors and terminals including screws and bolts in accordance with the equipment manufacturer's published torque-tightening values for equipment connectors.
 - 8. Allow sufficient slack in cables to prevent premature deterioration of cable system components, and to assist in the maintenance and servicing of cables and/or other building systems and components. Avoid excessive and sharp bends. Manufacturer's recommended pulling tensions shall not be exceeded.

9. Fittings or connections are allowed only at the input and output devices. Splicing is not acceptable in any cable run.
10. All cables shall be installed in conduit.
11. Conduit, raceways, and outlet boxes shall be provided as required.
12. All copper cables shall be routed and installed to avoid light fixtures and other sources of EMI.
13. All cables shall be concealed within conduit, raceways, or above ceilings. No cables shall be installed where they will be exposed.

B. Fiber Optic Cable Installation:

1. Use cable tie tool to install cable ties to manage cable slack. Cable tie tool shall apply appropriate pressure to the cable bundles to prevent damage to cables and provide a smooth cut of excess cable tie. Cable ties shall be able to be turned freely around the bundle of cable. Cable bundles shall be limited to a 3-inch diameter.
2. Use Velcro bands to secure cable bundles within interior pull boxes and fiber patch panels.
3. Avoid excessive and sharp bends. Manufacturer's recommended bend radius and pulling tensions shall not be exceeded.
4. Fittings or connections are allowed only at the input and output of devices. Splicing is not acceptable in any cable.
5. All cables shall be installed in conduit. Underground installations shall include a 10 AWG, insulated-copper tracer wire. Wire insulation shall be orange and shall be XHHW-2. Wire shall terminate in junction boxes.
6. A minimum of 15 feet of cable slack shall be provided at end of each fiber optic cable. This slack shall be exclusive of the length of fiber required to accommodate terminations and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored to prevent damage and secure cable in the patch panel or a separate enclosure designated for this purpose. Multiple cables may share a common enclosure. Exact cable termination locations shall be field verified with OWNER and ENGINEER.
7. Fiber optic cables shall be pulled into conduits utilizing a tugger with built-in tension meter. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer's maximum pulling tension. Motorized machines of any other type are not allowed for any fiber optic cable pulling.
8. All spare fibers shall be terminated on spare fiber patch panel ports with protective plugs.

C. Grounding:

1. Ground all equipment according to manufacturer's instructions, NEC requirements, EIA/TIA 568B, and EIA/TIA 607.
2. Telecommunications system shall be installed with an isolated grounding system which has only one ground point. That ground point shall be connected to the common grounding electrode via the ground bar in the lighting panel in the Electrical Room. Provide an isolated grounding conductor installed in conduit from the ground bar in the lighting panel to the telecommunications grounding busbar (TGB) located in the network cabinet. This conductor shall be insulated copper with a minimum conductor size of 6 AWG.
3. Telecommunications Equipment Rack Grounding: Bond the TGB to the ground bar on the equipment racks, cabinets, and network cable trays. Use a 6-AWG or larger insulated-copper conductor in conduit from all network cabinets, racks, and cable trays to the TGB.

4. CONTRACTOR shall perform grounding resistance testing on the complete grounding path from the TGB to the service entrance ground. Ground resistance shall not exceed 5 ohms between the TGB and service entrance ground. If the ground resistance test indicates the resistance to be greater than 5 ohms, CONTRACTOR shall provide a larger dedicated, insulated-copper grounding conductor as specified above in conduit from the TGB to the service entrance grounding point.

3.03 TESTING AND ACCEPTANCE

A. General:

1. CONTRACTOR is responsible to perform certification tests as indicated below for each subsystem as it is completed.
2. CONTRACTOR is responsible for supplying all equipment and personnel necessary to conduct the certification tests. Prior to testing, CONTRACTOR shall provide a summary of the proposed test plan for each cable type, including equipment to be used, set-up, test frequencies or wavelengths, results format, etc. The method of testing shall be subject to review by ENGINEER.
3. CONTRACTOR shall visually inspect all cabling and termination points to verify that they are complete and conform to the wiring pattern specified herein. CONTRACTOR shall provide ENGINEER with a written certification that this inspection has been made.
4. CONTRACTOR shall conduct certification testing according to a schedule coordinated with OWNER. Representatives of OWNER may be in attendance to witness the test procedures. CONTRACTOR shall provide a minimum of one week advance notice to ENGINEER to allow for such participation. The notification shall include a written description of the proposed tests, including copies of blank test result sheets to be used.
5. Failure to provide the above information shall be grounds for OWNER/ENGINEER to reject any and all Documentation of Results on related testing, and to require a repeat of the affected test.
6. Tests related to connected equipment of others shall only be done with the permission and presence of CONTRACTOR involved. CONTRACTOR shall ascertain that testing only as required to prove the wiring connections are correct.
7. CONTRACTOR shall provide test results and describe the method of the tests, including the date of the tests, the equipment used, and the procedures followed. At the request of ENGINEER, CONTRACTOR shall provide copies of the original test results.
8. All cabling shall be 100% fault-free. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of CONTRACTOR. The applicable tests shall then be repeated.
9. Should it be found by ENGINEER that the materials or any portion thereof provided under this Contract fail to comply with the Specifications and Drawings, with respect or regard to the quality, amount of value of materials, appliances, or labor used in the Work, it shall be rejected and replaced by CONTRACTOR, and all Work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at CONTRACTOR's expense.

B. Copper Data Cabling:

1. Testing shall be from the jack to the patch panel on which the cables are terminated.
2. Cables shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and compliance with termination standards. Any defective, split or mispositioned pairs must be identified and corrected.
3. In addition to the above, Certification Testing shall be performed on all cables. Testing of the Transmission Performance of station cables (Category 6 and above) shall include the following:

- a. Length.
 - b. Attenuation.
 - c. Pair to Pair NEXT Loss (new limits).
 - d. PSNEXT Loss.
 - e. Return Loss.
 - f. Pair to Pair ELFEXT Loss (Equal Level Far End Cross talk).
 - g. PSEFEXT Loss.
 - h. Propagation Delay.
 - i. Delay Skew.
 - j. Return Loss.
- 4. Cables shall be tested to the maximum frequency defined by the standards covering their performance category. Transmission performance testing shall be performed using a test instrument designed for testing to the specified frequencies. Test records shall verify "PASS" on each cable and display the specified parameters-comparing test values with standards based "templates" integral to the unit.
 - 5. Testing shall be per ANSI/TIA/EIA 568-C.2 Basic Link test configurations.
 - 6. In order to establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an 8-position Category 6 Modular plug (8-pin) to facilitate testing. Net Propagation Velocity (NPV) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable. This requirement can be waived if NPV data is available from the cable manufacturer for the exact cable type under test.
 - 7. In the event results of the tests are not satisfactory, CONTRACTOR shall make the necessary adjustments, replacement, and changes, and then repeat the test or tests which disclosed faulty or defective material, equipment, or installation method, and shall perform additional tests as required by ENGINEER at no additional cost to OWNER.

C. Fiber Optic Cabling:

- 1. Prior to installation, CONTRACTOR shall perform tests deemed necessary by CONTRACTOR to demonstrate integrity of all fiber optic cables.
- 2. Upon completion of cable installation and termination, the fiber optic cabling shall be tested to include:
 - a. Optical attenuation using Optical Loss Test Set (OLTS) testing.
 - b. Verification of link integrity using Optical Time Domain Reflectometer (OTDR) testing.
- 3. OLTS testing shall be performed on all fibers in both directions of transmission after being terminated in the associated permanent patch panels. Measurement shall be inclusive of the optical connectors and couplings installed at the system endpoints, including patch panel terminations. Access jumpers shall be used at both the transmit and receive ends so that an accurate measurement of connector losses is made. Fibers shall be tested in accordance with the IEC 61280-4-1 standard, utilizing 1, 2, or 3 reference cables, as needed.
- 4. In addition to performing OLTS testing on each fiber, an OLTS test shall be performed on all fibers included in the device-to-device link for each network that is expected to experience the highest attenuation due to a combination of distance and the number of patch panel terminations and jumpers throughout the entire link. This worst case device-to-device link testing shall be performed for the highest expected attenuation path for each communication system, including, but not limited to, SCADA network switches, telecommunication network switches, fire alarm control panels, power distribution controllers, etc.
- 5. The attenuation measured during OLTS testing shall not exceed the values calculated as follows: Attenuation (max.) = $2 \times C + L \times F + S$ dB, where C is the maximum allowable

connector loss (in dB), L is the length of the run (in kilometers) and E is the maximum allowable fiber loss (in dB/km). S is the total splice loss (number of splices* max. attenuation per splice). Values referenced herein shall be determined by manufacturer's specifications for approved products.

6. OTDR testing shall be performed in one direction on all fibers after final terminations in permanently-installed patch panels, as well as any fibers planned to remain unterminated. Multimode fibers shall be tested at 850 nm (nominal). The OTDR tests shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive ends shall be used.
 7. OTDR traces revealing a point discontinuity in the fiber greater than 0.2 dB in a multimode fiber at any of the tested wavelengths, or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that fiber by OWNER. The installation of that cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at CONTRACTOR's expense.
- D. Upon completion of the installation, CONTRACTOR shall provide complete test reports to ENGINEER for review. Documentation shall include the following items:
1. Test results submitted in the format specified for submittals under Section 01 33 00–Submittals. Where documentation provided in electronic form requires unique software for viewing test results, CONTRACTOR shall provide one licensed copy of the software along with the above documentation.
 2. Insertion loss test data, including a record of test wavelengths, cable type, fiber and cable (or Outlet) i.d., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
 3. OTDR traces, including individual optical fiber “signatures” obtained as specified above. Trace files shall be named to identify each individual fiber by its location in the cable system and fiber number or color. For OTDR traces, the vertical and horizontal scales shall be set so as to maximize the detail in each backscatter trace. The portion of the trace which depicts the fiber under test shall extend a minimum of 50% of the display area.

END OF SECTION

SECTION 28 46 00

FIRE ALARM SYSTEM

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes providing all labor, equipment, materials, and performance of all operations associated with the installation of the Fire Alarm System as shown on the Drawings and as specified herein to meet the requirements of a complete Fire Alarm System.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. NFPA 72 National Fire Alarm Code.
- B. NFPA 70 National Electrical Code.
- C. ADA.
- D. Underwriters Laboratories.
- E. NFPA 101 Life Safety Code.
- F. NFPA 90.
- G. International Building Code.
- H. International Fire Code.
- I. International Mechanical Code.

1.03 SCOPE

- A. Provide a complete Fire Alarm System. The system shall be UL listed, cross-listed, and compatible for use with individual zone supervision, individual NAC supervision, and incoming and standby power supervision. The project includes providing a system which includes fire alarm control panels, communicators and antennas, manual stations, smoke detectors, heat detectors, audible/visual devices, visual only devices, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.

1.04 QUALITY ASSURANCE

- A. System Supplier shall be a nationally-recognized company specializing in fire alarm systems. This organization shall employ factory-trained and NICET-certified technicians, and shall maintain a service organization within 100 miles of this project location. The

System Supplier and service organization shall have a minimum of 10 years' experience in the fire protective signaling systems industry.

- B. The System Supplier shall provide the final checkout, contractual service, and testing.
- C. The complete installation shall conform to the applicable sections of NFPA-72, NFPA-101 Local Code Requirements and National Electrical Code.
- D. All items of the complete Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer unless the primary equipment provider or manufacturer provides written documentation of compatibility, and assumes responsibility for compatibility with the control equipment.
- E. All items of the complete Fire Alarm System shall be listed under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the UL label.

1.05 MANUFACTURER PROVIDED SERVICES

- A. A manufacturer-trained service technician shall provide the following installation supervision. This technician shall be certified by the equipment manufacturer and shall have a minimum of two years of service experience in the fire alarm industry.
- B. The technician's name shall appear on equipment submittals and a letter of certification from the fire alarm manufacturer shall be sent to ENGINEER. The manufacturer's service technician shall be responsible for the following items:
 - 1. Pre installation visit to the job site to review equipment submittals and verify method by which the system should be wired.
 - 2. Periodic job site visits to verify installation and wiring of system, and to perform any partial system programming required to permit portions of the existing system to be removed.
 - 3. Upon completion of wiring, final connections shall be made under the supervision of this technician, and final checkout and certification of the system.
 - 4. At the time of final checkout, technician shall give operational instructions to OWNER and/or its representative on the system.
 - 5. All job site visits shall be dated and documented in writing and signed by the Division 26 Contractor. Any discrepancy shall be noted on this document and a copy kept in the system job folder that shall be available to ENGINEER any time during the project.

1.06 QUALIFICATIONS

- A. All equipment shall be supplied by a firm, which specializes in fire alarm and smoke detection systems with a minimum of five years-documented experience. The company shall be an authorized distributor of the proposed equipment.
- B. All work shall be performed by a licensed contractor, who is regularly engaged in the installation and servicing of fire alarm systems.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING REQUIREMENTS

- A. Receive equipment at job site; verify applicable components and quantity delivered.

- B. Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of enclosure finish.
- C. Do not install damaged equipment.
- D. Store equipment in a clean, dry space and protect from dirt, fumes, water, and construction debris and physical damage. Make arrangements with OWNER at the pre-construction conference for storage of equipment on the premises.

1.08 SUBMITTALS

- A. Submit shop drawings and product data sheets in accordance with provisions of Section 01 33 00–Submittals.
- B. Submittals shall be sent to and approved by the authority having jurisdiction prior to submitting to ENGINEER. Include copy of approval letters in submittal to ENGINEER.
- C. Provide wiring diagrams, equipment ratings, dimensions, and finishes for all proposed devices and equipment.
- D. Provide battery calculations to indicate both the Standby and Alarm loads because of various field devices and panel components/module. Battery calculations shall illustrate the minimum battery capacity required and the capacity actually provided. Battery shall contain date of installation and not the manufactured date.
- E. Provide a complete site-specific Fire Alarm System plan and riser diagram including: Point of origin of each circuit (usually a Panel, or a Module within a panel), circuit type and labeling, area served by each circuit, wire/cable type and size, locations of panelboards where primary system power is obtained and the device type circuit(s) to which device is connected, and locations of any End-Of-Line Resistor for each field device. Include room name and number for each device.
- F. Provide “worst-case” notification appliance circuit voltage drop calculation.

1.09 RECORD DRAWINGS

- A. Record Drawings shall include the location of all Fire Alarm System devices with their respective labels and the location of all end-of-line device locations.
- B. Upon completion of the work, and final acceptance by the local authority, CONTRACTOR shall submit Record Drawings to OWNER and ENGINEER under the provisions of Division 01.
- C. CONTRACTOR shall submit a copy of the Fire Alarm System; Record of Completion documentation to OWNER, ENGINEER, and authority having jurisdiction. Included with the Record of Completion documentation shall be a copy of final acceptance testing results.
- D. Record Drawings shall be provided to OWNER in electronic PDF format on a USB flash drive, along with the site-specific fire alarm system program.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit Manufacturer data sheets for all equipment installed.
- B. Include operating, installation, and routine maintenance instructions.
- C. Submit a record copy of site-specific computer software for software-based Fire Alarm Systems.
- D. Include manufacturer letter stating the date of installation on which the system is operational.
- E. Operating instructions shall be mounted in a frame next to the FACP.

1.11 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.12 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Fire Alarm System: Provide a complete, supervised, power-limited, fire detection and evacuation system. The existing Fire Alarm Control Panel in the Administration Building garage. The existing panel is Model FireWarden-100-2, Notifier Series by Honeywell. All new fire alarm annunciation and notification devices in the Administration Building shall be compatible with the existing fire alarm control panel.
- B. System Supervision: The fire protective signaling system shall be an electrically-supervised, power-limited system which shall monitor the integrity of circuit conductors and power

supplies. Fire alarm system shall be remotely supervised by Norcomm Public Safety Communications, Inc., an existing OWNER-contracted monitoring agency.

- C. Central Monitoring: Fire alarm system shall be remotely supervised by an OWNER-designated recognized agency. CONTRACTOR shall coordinate with OWNER to establish a monitoring agency. The new Fire Alarm System shall be interfaced to the following systems utilizing a cellular or radio connection, for remote reporting of the various conditions listed below:
 - 1. To OWNER-Provided Security System: See below for required relay output.
 - 2. To an Off-Site Commercial Supervising Station: See below for required relay outputs.
 - 3. The interface between the reporting system(s) listed above and the new Fire Alarm System shall be configured as follows.
 - a. Required relay (contact) outputs:
 - (1) FIRE Alarm: This contact shall actuate in response to any FIRE Alarm status condition, other than Sprinkler Water Flow.
 - (2) Supervisory: This contact shall actuate in response to actuation of any initiating device programed as Supervisory.
 - (3) System Trouble: This contact shall actuate in response to the occurrence of any Trouble status condition on the Fire Alarm System.
 - b. CONTRACTOR shall be responsible for coordination of the Fire Alarm System connections to these system(s), for all wiring and conduit between these system(s), and for all terminations at the Fire Alarm System end of such interface wiring. All such wiring, raceway, and terminations shall be included in the Base Bid.

2.02 ENCLOSURES

- A. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.
- B. Provide cabinets of sufficient size to accommodate the aforementioned equipment.
- C. Cabinet shall be equipped with locks and transparent door panel providing tamperproof enclosure, yet allowing full view of the various lights and controls as required.

2.03 INTELLIGENT FIRE ALARM CONTROL PANEL (FACP)

- A. Intelligent FACP shall be installed where shown on the Drawings.
- B. FACP shall be UL 864 listed, latest edition, manufactured by Fire-Lite, Gamewell, Silent Knight, or equal.
- C. The FACP shall allow for loading or editing special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate facility expansion, building parameter changes, or changes as required by local codes. All software operations shall be stored in a nonvolatile, programmable memory within the FACP. Loss of power shall not erase the instructions stored in memory.
- D. To accommodate and facilitate jobsite changes, initiation circuits shall be individually configurable on-site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a nonlatching circuit, or an alarm verification circuit.

- E. FACP shall be modular, expandable with solid-state, microprocessor-based electronics. It shall display through the front viewing window only those primary controls and displays essential to operation during a fire alarm condition.
- F. The FACP shall meet the following requirements:
 - 1. Support intelligent detection devices.
 - 2. The number of initiating device loops required for the specified quantity of initiating devices, plus one spare loop for each five active loops. Each active loop shall include 5% spare capacity.
 - 3. The number of indicating appliance (strobe) circuits required for the specified quantity of strobes, plus one spare circuit for each ten active circuits. Each active circuit shall include 25% spare capacity.
 - 4. Printer interface.
 - 5. History log file with a minimum of 1,000 events.
 - 6. Field programmable.
 - 7. Drift compensation.
 - 8. Sensitivity display in percent.
 - 9. Sensitivity adjustment.
 - 10. Day/night sensitivity adjustment.
 - 11. Auto detector test to meet NFPA 72.
 - 12. Alarm verification with tally counter.
 - 13. Silent walk test.
 - 14. Maintenance alerts.
 - 15. AC fail delay.
- G. The FACP shall provide the ability to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history.
- H. The FACP LCD shall have the capability of displaying the following information relative to the abnormal condition of a point in the system prior to acknowledgement:
 - 1. 40 characters for:
 - a. Point address and loop number (e.g., 555-L5).
 - b. Type of device (e.g., smoke, pull station, water flow).
 - c. Point status (e.g., alarm, trouble).
 - 2. 40 characters for: Custom location label (e.g., 4th Floor–Room 444).
- I. FACP keyboards or keypads shall not be required to operate the system during fire alarm conditions.
- J. FACP shall have the following software functions:
 - 1. Setting of time and date.
 - 2. LED testing.
 - 3. Alarm, trouble, and abnormal condition listing.
 - 4. Enabling and disabling of each monitor point separately.
 - 5. Activation and deactivation of each control point separately.
 - 6. Changing operator access levels.
 - 7. Walk Test enable.
 - 8. Running diagnostic functions.
 - 9. Displaying historical logs.
 - 10. Point listing.

- K. FACP shall have the following hardware functions:
1. Acknowledge alarm or trouble.
 2. Silence alarm or trouble.
 3. Reset system after alarm.
 4. Connect/disconnect fire department tie.
 5. Provide manual evacuation (drill).
 6. Bypass door holders.
 7. Supervise system.
 8. Allow computer interface.
- L. FACP shall have the following status indicators and displays:
1. Local audible device shall sound during alarm, trouble, or supervisory conditions. This audible device shall also sound during each key-press to provide an audible feedback when the key has been pressed properly. The visual display shall distinguish between alarm, trouble and supervisory conditions.
 2. The following indicators and displays shall be visible through the front viewing window:
 - a. One red system alarm LED.
 - b. One yellow supervisory service LED.
 - c. One yellow trouble LED.
 - d. Green "power on" LED.
 - e. Liquid crystal display.
 3. The liquid crystal display shall be backlit. It shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
 4. The following status data shall be available on this display:
 - a. Initiating device circuits.
 - b. Indicating appliance circuits.
 - c. Auxiliary relays.
 - d. Feedback points.
 - e. Primary state of point.
 - f. Zone information.
 - g. Class "A" status.
 - h. Current priority of outputs.
 - i. Disable/Enable status.
 - j. Verification tallies of initiating devices.
 - k. Automatic/Manual control status of output points.
 - l. Acknowledge status.
- M. Controls:
1. The following controls shall be visible through the front viewing window:
 - a. Alarm Acknowledge key.
 - b. Trouble Acknowledge key.
 - c. Alarm Silence key.
 - d. System Reset key.
 2. The following controls shall be accessible with the front door open, though not visible, through the front viewing window:
 - a. Supervising Station disconnect/switch.
 - b. Manual evacuation (drill).
 - c. Elevator bypass.
 - d. Fan shutdown override/bypass switches.
 - e. Door holder release bypass.
 - f. Key pad for data input and microprocessor control.

- N. FACP shall have the capability of supervising all slave modules LEDs for burnout or disarrangement.
- O. Acknowledgement:
1. All events shall have a global acknowledgement.
 2. Acknowledge one event at a time from an unacknowledged list of events.
 3. After all points have been acknowledged, the LEDs shall glow steadily and the horn shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated by an end of list message "END of LIST."
 4. Systems not capable of password-protected manual command operations shall provide key-operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.
 5. All acknowledge functions shall be behind locked door or pass-code protected. In pass-code protection, if the user has insufficient privilege to acknowledge such conditions, a message shall indicate insufficient privilege, but allow the user to view the points without acknowledging them. Should the user have sufficient privilege to acknowledge, a message shall be displayed informing the user that the condition has been acknowledged.
- P. Silencing:
1. If an alarm condition exists and the "Alarm Silence" button is pressed, all alarm signals shall cease operation. The strobes shall remain active until the system is reset.
 2. If trouble conditions exist in the system and the "Trouble Silence" button has been pressed, the audible trouble signal shall cease, but shall resound at time intervals to act as a reminder that the fire alarm system is not in a normal operating mode. Both the time interval and the trouble reminder signal shall be programmable to suit OWNER's application.
 3. Panel shall be equipped with an alarm silence inhibit function.
- Q. Reset:
1. The system reset button shall be used to return the system to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process.
 2. Should an alarm condition continue to exist, the system shall provide indications that resetting cannot be completed and shall remain in an abnormal state. The horn and the Alarm LED shall remain activated. The display shall indicate the total number of alarms and troubles present in the system along with a prompt to use the acknowledge keys to review the points. These points shall not require acknowledgment if they were previously acknowledged.
- R. Access Levels:
1. There shall be multiple access levels. The lowest access level actions shall not require a passcode. Changes to passcodes shall only be made by authorized personnel.
 2. When a correct passcode is entered, the system shall indicate "Access Granted" to the operator. The new access level shall be in effect until the operator manually logs out or the keypad has been inactive for 5 minutes.
 3. Operator entering an invalid code shall be notified with the message "Incorrect Pass-Code" and shall be allowed up to three chances to enter a valid code. After three unsuccessful tries, the message "Access Denied" shall be displayed. The level shall not be altered, and the operator shall no longer be in the menu option.

4. Access to a level shall allow the operator to perform all actions within that level plus all actions of lower levels but no actions of higher levels.
 5. The following keys/switches shall have access levels associated with them:
 - a. Alarm Silence.
 - b. System Reset.
 - c. Set Time/Date.
 - d. Manual Control.
 - e. On/Off/Auto Control.
 - f. Disable/Enable.
 - g. Programming functions.
 - h. Clear Historical Alarm Log.
 - i. Clear Historical Trouble Log.
 - j. Walk Test.
 - k. Change Alarm Verification.
 6. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an acknowledge key with insufficient access, an error message shall be displayed. The points shall scroll with acknowledge key presses to view the points on the list, but the points shall not get acknowledged in the database.
- S. For maintenance purposes, the following lists shall be available from the point lists menu:
1. All points list by address.
 2. Monitor point list.
 3. Signal list.
 4. Auxiliary control list.
 5. Feedback point list.
- T. History Logging:
1. The system shall be capable of logging and storing the last 400 events (alarm and trouble) in a history log. These events shall be stored in a battery-protected random access memory. Each recorded event shall include the time and date of that event's occurrence. Systems not having discrete alarm and trouble logging memory shall include an alternative supervised (e.g., USB drive) historic recording method with battery backup. Real time and date shall accompany all history event recording.
 2. History logs shall be capable of being viewed separately or shall be selectable for viewing as a combined history log that displays both alarm and trouble events in chronological order.
 3. The following historical alarm log events shall be stored:
 - a. Alarms.
 - b. Alarm Acknowledgment.
 - c. Alarm Silence.
 - d. System Reset.
 - e. Alarm Historical log cleared.
 4. The following historical trouble log events shall be stored:
 - a. Trouble conditions.
 - b. Supervisory alarms.
 - c. Trouble acknowledgment.
 - d. Supervisory acknowledgment.
 - e. Alarm Verification tallies.
 - f. Walk Test results.
 - g. Trouble Historical log cleared.

- U. FACP shall have Silent Walk Test Function with History Logging:
 - 1. The system shall be capable of being tested by one person.
 - 2. The panel shall have the capability of dividing the system into distinctive walk test groups, a minimum of 8 groups.
 - 3. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described above.
 - 4. After testing is considered complete, testing data may be retrieved from the system in chronological order to verify device/circuit activation.

- V. Computer Interface:
 - 1. The FACP shall operate as a proprietary local system with the capability of sending status data to and receiving control data from a Central Processing Unit (CPU) at the central reporting stations.
 - 2. The CPU shall monitor all alarms and troubles and shall control selected functions of each FACP.
 - 3. The CPU shall supervise all data communication wiring between the CPU and FACP for opens, shorts, and grounds.

- W. Field Programming:
 - 1. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All programming may be accomplished through the standard control panel keyboard, or a keyboard at the printer, or the use of a PC. All programs shall be stored in nonvolatile memory.
 - 2. All programming or reprogramming shall be done by the supplier at no charge until the system is accepted by OWNER.

- X. Terminal/Printer Interface:
 - 1. FACP shall be capable of operating remote monitors and/or printers.
 - 2. The output shall be ASCII from an EIA RS-232-C connection with an adjustable baud rate.
 - 3. Each RS-232-C port shall be capable of supporting and supervising up to four remote LCDs and Printers.
 - 4. Data amplifiers shall be used to increase LCD or printer line distance, if required.
 - 5. Each RS-232-C port shall only communicate with one keyboard. The FACP shall support up to five RS-232-C ports.

- Y. Intelligent Network:
 - 1. The system shall provide communications with intelligent initiating and control devices individually. These devices shall be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
 - a. Alarm.
 - b. Trouble.
 - c. Open.
 - d. Short.
 - e. Device missing/failed.
 - 2. All intelligent devices shall have the capability of being disabled or enabled individually.
 - 3. There shall be no limit to the number of detectors, stations, or addressable modules which may be activated or "in alarm" simultaneously.
 - 4. Multiple intelligent devices shall be connected to a single pair of wires. Systems that require factory preprogramming to add or delete devices are unacceptable.

- 5. The communication format shall be a completely digital poll/response protocol to allow T-tapping of the circuit wiring. A high degree of communication reliability shall be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.
- Z. The FACP shall provide a minimum of 6 amps for notification appliances and auxiliary devices. Provisions shall be available to provide additional signal expansion.
- AA. FACP shall communicate alarms to the monitoring agency via a wireless radio network through the wireless radio system specified herein.

2.04 WIRELESS RADIO

- A. Provide wireless radio system as manufactured by Keltron, model RF778F for communicating alarms to OWNER's monitoring agency. Radio system shall accept 12 VDC power and be provided with a backup battery. Provide power supply inside fire alarm control panel as required. Provide integral or remote-mounted antenna, antenna cable, and interface cable between FACP and wireless radio as required to meet City of Rockford Fire Protection District ordinance.

2.05 INTELLIGENT PERIPHERAL DEVICES

- A. All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder the operation of other system devices.

2.06 DEVICE IDENTIFICATION

- A. Each intelligent device shall be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address shall not be acceptable. This address, along with the loop number, shall be indicated and be visible from the ground on the device in the field using machine-generated marking.
- B. Location of the end-of-line (EOL) device shall be indicated on the fire alarm system device containing the EOL device.
- C. Device identification schemes that do not use uniquely set addresses, but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate T-tapping, and the addition of an intelligent device between existing devices requires reprogramming all existing devices beyond the added device.
- D. The system shall verify that the proper type device is in place and matches the desired software configuration.

2.07 INTELLIGENT DETECTOR BASES

- A. Either the base or the head shall contain electronic circuits that communicate the detector's status (normal, alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also provide power to the base and detector.
- B. The base shall be lockable. The locking feature shall be field-removable when not required.

- C. Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.
- D. The detector base shall be sealed against rear airflow entry.
- E. Each detector's base or head shall contain LED(s) which shall flash when the detector is being scanned by the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.
- F. Each base shall provide means to allow for function testing of the detector at the detector's location.
- G. The base shall be common with heat detector and smoke-type detectors and shall be compatible with other intelligent detectors, addressable manual stations, and addressable modules on the same circuit.
- H. The detectors shall be plugin units which mount to a common base, and shall be UL 268 approved.
- I. The detector shall be a 24 VDC type, which is compatible with the fire alarm panel and obtains its operating power from the supervisory current in the fire alarm detection loop. The 24 VDC detector shall be reset by actuating the control panel reset switch.
- J. To minimize false alarms, voltage and RF transient suppression techniques shall be employed.
- K. Detectors shall be installed on circuits with alarm verification modules.

2.08 INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

- A. The detectors shall contain no radioactive material.
- B. Detectors shall be of the solid-state photoelectric type and shall operate on the light-scattering photodiode principle using a pulsed infrared LED light.
- C. Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be logged.
- D. Smoke detectors shall communicate the actual smoke chamber values to the system control panel.
- E. Smoke detectors shall be smoke density measuring devices having no self-contained alarm setpoint (fixed threshold). The alarm decision for each detector shall be determined by the control panel. The control panel shall determine the condition of each detector by comparing the detector's value to the stored value.

2.09 INTELLIGENT THERMAL DETECTORS

- A. The detectors shall be a combination rate-of-rise and fixed temperature (135°F unless noted).

- B. Detectors shall sense within a temperature range of 32°F to 158°F. The control panel shall be capable of sensing either a setpoint of 135°F, or a rate-of-rise of 15°F per minute for fire sensing. For utility sensing, a setpoint may be chosen within the stated range, and the control panel programming shall be capable of using that information to determine specific response such as warning of failure of local temperature controls.

2.10 INTELLIGENT DUCT SMOKE DETECTORS

- A. Duct detectors shall be of the photoelectric smoke or photoelectric smoke telescoping sampling tube type. It shall be possible to alarm the duct detector by using a remote or local test switch.
- B. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housings front cover.
- C. Detector shall include auxiliary SPDT relays and remote keyed test switch and alarm LED indicator.
- D. Alarm LED indicators for duct detectors shall be labeled with the detectors loop and address.

2.11 PULL STATIONS

- A. Pull stations shall contain circuits that communicate the station's status (alarm, normal) to the control panel over two wires, which also provide power to the pull station. The address shall be field programmable at the station.
- B. Manual stations shall be double-action, constructed of high-impact red Lexan with raised white lettering, and a smooth high-gloss finish.
- C. Station shall mechanically latch upon operation and remain so until manually reset by a master key common to all system locks. Stations which use Allen wrenches or special tools to reset are not acceptable.
- D. The manual station shall be fitted with screw terminals for field wire attachment.

2.12 ADDRESSABLE INTERFACE MODULES—GENERAL

- A. Addressable Interface Modules shall receive their 24 VDC power from a separate two-wire circuit provided by an appropriate power supply.
- B. The module shall be available in either a Class B or Class A supervision version.
- C. In the Class B version, the wiring shall be supervised by an end-of-line device.
- D. In the Class A version, the wiring shall be looped back and connected to the module to allow continual operation of the controlled devices even if the wiring sustains a single break.
- E. The interface modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions.

- F. Should the interface modules become nonoperational, tampered with, or removed, a discrete trouble signal unique to the device shall be transmitted to and annunciated at the control panel.
- G. The interface modules shall be capable of being programmed for its “address” location on the intelligent device initiating circuit. The interface modules shall be compatible with addressable manual stations and intelligent detectors on the same intelligent initiating circuit.

2.13 ADDRESSABLE INTERFACE MODULES—SUPERVISED CONTROL

- A. Interface modules shall be suited for control of indicating appliances and HVAC equipment.
- B. For signals and other device control with Class B or Class A wiring supervision, the interface module shall provide double-pole/double-throw relay switching that can be used to connect any of the following through easily replaceable 2-amp fuses:
 - 1. A zone of signals to a power source.
 - 2. Firefighter phone jacks to a communications channel.
 - 3. A variety of controlled devices to the appropriate controlling circuits.
- C. These interface modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and shall receive from the fire alarm control panel a command to transfer the relay.

2.14 FAULT ISOLATOR MODULE

- A. The system shall have a Fault Isolator Module (FIM) on the initiating device circuits in the following situations: Loop has more than 25 devices.
- B. Isolated Loop Circuit Protectors (ILCP) shall be located as close as practical to the point where these conditions occur.
- C. FIM shall automatically reconnect the isolated section of the loop upon correction of the fault conditions. The FIM shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an FIM after its normal operation.
- D. FIM shall include an LED, which shall flash under normal operation and illuminate steady to indicate a short circuit.

2.15 HORN/STROBE UNITS

- A. Horns shall have Lexan housing with field-adjustable output taps, three taps minimum. Sound pressure level output shall be 87 dB at 10 feet. Horns shall have vandal-resistant Lexan grills and sealed backs to protect the phenolic impregnated cone.
- B. The unit shall be complete with a tamper-resistant Lexan lens with “FIRE” lettering visible from a 180-degree field of view. Strobes installed in open areas such as hallways, open office spaces, and assembly areas shall have an adjustable candela rating range from 15-75 candela. Strobes installed in mechanical areas shall have a peak candela rating of 110 candela. All strobes shall be in compliance with ADA requirements.

PART 3-EXECUTION

3.01 INSTALLATION

- A. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70 and the manufacturer's recommendations.
- B. If field conditions require, cover all smoke detection devices with plastic bags immediately after installation to maintain cleanliness.

3.02 FIRE ALARM SYSTEM CONFIGURATION

- A. The existing FACP in the Administration Building shall function as the main panel for the Administration Building. All new fire alarm devices in the Administration Building shall be connected to the existing fire alarm control panel. The FACP in the Maintenance Garage shall function as the main panel for the Maintenance Garage. All alarms and supervisory messages for the Maintenance Garage shall be annunciated through this panel. Notification of alarms to off-site monitoring agency shall be through each panel.

3.03 FIRE ALARM SYSTEM OPERATION

- A. FACP:
 - 1. Under normal condition, the front panel shall display a system status message with current time and date.
 - 2. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.
 - 3. In the event of an abnormal condition, the following three characteristics relative to the condition shall be displayed simultaneously in alphanumeric format:
 - a. Custom location label (40 characters minimum).
 - b. Type of device (e.g., smoke, heat, pull station).
 - c. Status (e.g., alarm, trouble).
 - 4. Pressing the appropriate acknowledge button shall acknowledge the alarm or trouble condition.
 - 5. After all points in alarm have been acknowledged, associated LEDs shall glow steady and the panel audible signal shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated.
 - 6. Alarm Silencing:
 - a. Pressing the "Alarm Silence" button shall cause all notification appliances programmed for "On-Until-Silenced" to be deactivated. A separate panel-mounted yellow LED shall illuminate to indicate the alarm silenced mode.
 - b. All NACs programmed for "On-Until-Reset" shall remain activated until the system is reset.
 - 7. System Reset:
 - a. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied.
 - b. In the event an alarm condition continues to exist following system reset, the system shall remain in an abnormal state. System control relays shall not reset. The panel audible signal and the Alarm LED shall remain on. The display shall indicate the total number of alarms and troubles present in the system along with a prompting to

- review the points. These points shall not require acknowledgment if they were previously acknowledged.
- c. In the event the alarm silence inhibit function is active, the system shall ignore all key presses. An indication of enabling and disabling the inhibit stator shall be provided as a feedback to the operation.
8. Walk Test System Testing:
- a. While in the test mode, the system shall display a trouble condition.
 - (1) While in the walk test mode, the activation of an initiating device shall be silently logged as an alarm in the historical log. The panel shall automatically reset after logging the alarm.
 - (2) The momentary disconnection of an initiating device or notification appliance shall be silently logged as a trouble condition in the historical log. The panel shall automatically reset itself after logging of the trouble condition.
 - (3) Integrity of the installation conductors of IDCs and NACs shall be verified by momentarily opening any circuit.
 - (4) Walk Test of ground fault circuit testing shall be verified by operating the Notification Appliances for 4 seconds.
 - b. The Walk Test sequence shall have the capability of activating NACs to signal with a code associated with the alarmed zone. Any momentary opening of initiating or NAC wiring shall cause the notification appliances to sound for 4 seconds to indicate the trouble condition. The Walk Test feature shall automatically revert to the normal operating mode after 8 hours if it is not manually activated.
9. LED Supervision: All slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur, the panel shall display the module and the LED location numbers to facilitate location of that LED.
10. Active Status Reminder: Should any alarm, supervisory, or trouble condition be present within the system and the audible signal silenced, the local tone alert shall resound every 8 hours as a reminder that the fire alarm system is not 100% operational.

B. Smoke and Heat Detection Operation:

1. The activation of any system smoke or heat detector shall initiate an alarm verification operation whereby the FACP shall reset the activated detector and wait for a second alarm activation. If after 20 seconds and within 1 minute after resetting a second alarm is reported from the same or any other smoke or heat detector, the system shall process the alarm as described previously. If no second alarm occurs within 1 minute, the system shall resume normal operation. The alarm verification shall operate only on single smoke or heat detector alarm. Other activated initiating devices or multiple smoke or heat detector alarms shall be processed and reported immediately. The alarm verification operation shall be selectable by device or zone.
2. The intelligent system shall have the capability of displaying the number of times (tally) a detector has gone into a verification mode.
3. The FACP shall maintain a moving average of the detector's smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain a constant smoke obscuration sensitivity for each detector (via the floating threshold) by compensating for environmental factors. Photoelectric detector's smoke obscuration sensitivity shall be adjustable to within 0.3% of either limit of the UL window (0.5% to 4.0%) to compensate for any environment.
4. The system shall automatically indicate when an individual detector needs cleaning. When a detector's average value reaches a predetermined level, a trouble message shall be audibly and visibly indicated at the FACP for the individual detector. Additionally, the LED on the detector base shall glow steady giving a visible indication at the

detector's location. If the trouble condition is left unattended and the detector's average value increases to a second predetermined value, another trouble message shall be indicated at the FACP for the individual detector. To prevent false alarms, these trouble conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. For scheduling of maintenance, the control panel shall be able to generate a message indication for any detector approaching a trouble condition because of dirt or contamination.

C. HVAC System Interface:

1. Duct Smoke Detectors and Addressable Control Modules, or Supervised Remote Relays shall be provided as specified below. Detectors shall be installed in compliance with the manufacturer's recommendations. Each Addressable Control Module or Supervised Remote Relay for HVAC equipment shall be installed within 3 feet of the FACP. CONTRACTOR shall provide all wiring and terminations required for shutdown of the specified HVAC equipment.
2. The Addressable Control Modules or Supervised Remote Relays provided for this purpose shall be provided by DPDT output contacts. One SPDT set of the DPDT contacts shall be utilized for the specified shutdown function. The second SPDT set of the DPDT contacts shall be available for connection to the associated controls to indicate that unit shut down because duct smoke has been detected.
3. The FACP shall provide an output alarm interface directly to the HVAC equipment or to the SCADA System for equipment controlled from the SCADA System, which in turn shall perform automatic function as specified in the applicable sections of Division 23.
4. An override feature/control switch shall be provided which shall prevent shutdown of HVAC equipment when this function is active.
5. Operation: The associated HVAC shall shut down only upon actuation of the duct smoke detector associated with the particular unit. The HVAC equipment shall remain shut down until a valid system reset occurs.

- D. Garage Gas Detection: The FACP shall monitor the status of high NO₂ gas concentration and high CO gas concentration alarms. CONTRACTOR shall provide all wiring and terminations required for monitoring these alarms from the associated gas monitoring controller.

3.04 ALARM SEQUENCE

- A. The system alarm operation subsequent to the alarm activation of any manual station or automatic detection device shall be as follows:
1. All audible alarm notification appliances shall sound with the following characteristics: Temporal code pattern until silenced by the alarm silence switch at the FACP.
 2. All visible alarm notification appliances: Strobes shall display a continuous (synchronized where indicated on the Drawings) pattern until system is reset. Strobe intensities are indicated on the Drawings for adherence with ADA.
 3. Alarm horns and strobes shall be wired and operate independently.
 4. A supervised signal to notify the central station is to be activated.
- B. The FACP shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
- C. Activation of an auxiliary bypass means shall override the automatic functions either selectively or throughout the system.

- D. The system shall have an alarm list means that shall allow the operator to display all alarms, troubles, and supervisory service conditions with the time of occurrence. This shall allow for the determination of the most recent alarm and may also indicate the path that the fire is taking.

3.05 POWER REQUIREMENTS

- A. The FACP shall receive 120 VAC (as noted on the Drawings) from a dedicated circuit. This branch circuit shall have a “breaker lock” to prevent accidentally deenergizing of the power to the fire alarm panel. Circuit breakers shall be red and labeled “FIRE ALARM.”
- B. The FACP shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC main’s power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- C. The FACP shall include a disconnect switch for the AC power inside an enclosure near the panel or within the panel itself. This switch shall be labeled “Fire Alarm Power Disconnect.”
- D. Isolated Loop Circuit Protectors (ILCP):
 - 1. The FACP shall include Isolated Loop Circuit Protector (ILCP) on all circuits which extends beyond the building. These circuits include, but are not limited to, the initiating device circuits, alarm notification appliance circuits, and signaling line circuits. ILCP shall be located as close as practical to the point where the circuits leave or enter a building.
 - 2. The ILCP grounding conductor shall be a No. 12 AWG wire having a maximum length of 25 feet. It shall be run in a straight line and connected to the building grounding electrode system.
 - 3. The ILCP shall have a line-to-line response time of less than one nanosecond. Spark gap devices or devices incorporated in or installed within the control panel in lieu of the ILCP are not acceptable.

3.06 SUPERVISION

- A. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.
- B. There shall be supervisory service initiation device circuits for connection of all sprinkler flow and tamper switches. Device activation shall be appropriately annunciated at the FACP.
- C. Auxiliary manual controls shall be supervised so that an “off normal” position of any switch shall cause an “off normal” system trouble.
- D. Auxiliary circuits for addressable relays shall be supervised so that a blown fuse or an open in the circuit shall be visibly and audibly annunciated.
- E. Any ground, short, or open in the wiring to the FACP shall be appropriately annunciated at the control panel.

- F. Each independently supervised circuit shall include a discrete visible amber "Trouble" LED to indicate disarrangement conditions per circuit.
- G. The incoming power to the system shall be supervised so that any power failure shall be audibly and visually indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
- H. The system's batteries shall be supervised so that a low battery condition or disconnection of any battery shall be audibly and visually indicated at the control panel.
- I. The system modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- J. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

3.07 RACEWAYS

- A. All wiring shall be in a conduit system separate from all other building wiring. Conduit and boxes shall be painted red. See Section 26 05 33—Conduit for specifications.
- B. All wiring shall be installed in minimum 3/4-inch conduit.
- C. Surface access to existing alarm initiating circuits in public areas shall be via UL listed surface metal raceways (minimum equivalent to 3/4-inch conduit) and box extensions.
- D. There shall be no sharp edges with installed materials.

3.08 CONDUCTORS

- A. All cable shall be installed according to NEC Article 760.
- B. All cables and wires shall be No. 14 AWG and larger and shall be stranded.
- C. All initiation and notification circuit cabling shall be listed Type FPL.
- D. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.
- E. All conductors shall be color-coded. Coding shall be consistent throughout the facility. Green wire shall be used only for equipment ground.
- F. FACP shall be connected to separate dedicated branch circuit from the building emergency panel, maximum 20 amperes. Circuit breaker shall be red and labeled as "FIRE ALARM."
- G. Power wiring for FACP shall be No. 12 AWG.

- H. FACP shall have No. 12 AWG green equipment ground wire. Where fire alarm circuits enter or leave a building, additional transient 75 to 90-volt gas tube protection shall be provided for each conductor.
- I. Leave 8-inch wire tails at each device box and 36-inch wire tails at the FACP.
- J. Cable for intelligent detector loops shall be 18 to 12 AWG twisted pair with a shield jacket installed in 3/4-inch conduit. Shield continuity shall be maintained and connected to earth ground only at the control panel. Intelligent detector wiring shall not be in the same conduit with 120/240 VAC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B intelligent loop circuits.
- K. Wiring of alarm horn circuits and alarm strobe circuits shall be No. 14 AWG minimum.
- L. Fire alarm cables shall be held in place at the device box by means of a two-screw connector (do not use squeeze- or crimp-type connectors).
- M. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and/or labeled "FIRE ALARM SYSTEM" by decal or other approved markings.
- N. Strobe circuits shall have separate conductors and shall operate independently of each other.
- O. Strobe wiring shall be 14 AWG minimum or as recommend by manufacturer.
- P. Tray cable is not acceptable for use as fire alarm systems wiring.

3.09 DEVICE MOUNTING

- A. Unless otherwise noted on the Drawings, the recommended mounting heights and requirements are as follows:
 - 1. FACP: Mount control panels so all visual indicators and controls are at 60 inches above floor level. Cabinet shall be grounded to either a cold water pipe or grounding rod.
 - 2. Audio-Visual Devices:
 - a. Install flush, semiflush, or surface mount at 6 inches below finished ceiling or at 80 inches from the bottom of the device to the highest level of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches.
 - b. All audio/visual devices shall be installed at the same height throughout the facility.
 - c. For surface mounting, use manufacturer-supplied back boxes and trim plates. Mark each device with its circuit number.
 - 3. Manual Stations:
 - a. The operable part of the manual stations shall be installed not less than 3 1/2 feet (42 inches) and not more than 4 feet (48 inches) above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address on the inside and outside of housing. For surface mounting, use manufacturer-supplied backboxes and trim plates
 - b. All pull stations shall be installed at the same height throughout the facility.
 - 4. Heat and Smoke Detectors:
 - a. The location of detectors shown on the Drawings is schematic only. The detectors shall be located according to code requirements.

- b. Surface mounted detectors shall be installed using backboxes equal to the base's size. Standard octagon and square boxes are not acceptable.
 - c. Detectors shall be located on the highest part of a smooth ceiling so that the edge of the detector is no closer than 4 inches from a sidewall. Ceilings with beams, joists, or soffits that exceed 8 inches in depth require special planning and closer spacing.
 - d. If it is necessary to mount a detector upon a sidewall, the top of the detector shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.
 - e. Smoke detectors shall be installed to favor the air flow towards return openings and not located closer than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors shall be installed in direct airflow.
 - f. Heat and smoke detectors shall be located near the center of the open area which they are protecting, thus providing coverage generally for 15-foot radius for smoke detectors and a 25-foot radius for heat detectors.
 - g. Mark the address and loop number on each detector's base.
5. Duct smoke detector installation shall be installed in the locations shown on the Drawings. The duct smoke detectors shall be in serviceable locations. Consult with Division 23 for alternate locations if these are shown in non-serviceable locations. For duct smoke detectors that are associated with shaft smoke dampers, the sampling tubes protruding into the duct shall be located within 5 feet of the smoke damper and where there are no air inlets or outlets between the sampling tubes and the damper. Do not install within 4 feet of a fan discharge.

3.10 IDENTIFICATION

- A. Attach the label containing the address and SLC designation to:
 - 1. Each addressable detector. Label shall be visible and readable from the floor, 3/16-inch minimum character size (1/4 inch is recommended).
 - 2. Each manual pull station. Label shall be placed on the top part.
 - 3. Each addressable module. Label shall be attached to the faceplate.
- B. Label shall consist of black writing on white or clear background.
- C. All fire alarm boxes shall be painted red and labeled "Fire Alarm" or "FA". When red conduit is used for the fire alarm system installation, there is no need to paint the boxes. Non-factory device boxes shall also be painted red.
- D. All circuits shall be labeled with the name of circuit and the area being served by the circuit.
- E. Wire/cable splices in junction boxes shall be labeled indicating where the wire/cable is coming from and where it is going.
- F. All conductors terminated in control panels and extension panels shall be labeled.
- G. All audio-visual devices shall be labeled by each circuit and the order of the device on that circuit such as "Circuit No. 2, strobe No. 05 of 10."
- H. All labels shall be permanent and machine generated. No handwritten or non-permanent labels shall be allowed. Submit a sample for approval before using any labeling schemes.

3.11 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a manufacturer's qualified NICET-certified technician to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional checkout of the equipment. Upon completion of the manufacturer's start-up and checkout, the manufacturer shall generate a site start-up and functional checkout report, documenting all systems checked as well as any incomplete work remaining and operational deficiencies. CONTRACTOR shall provide three copies of the manufacturer's site start-up and functional checkout report to ENGINEER for review.
- C. CONTRACTOR shall be responsible for all costs required to check operation of the system.
- D. The completed fire alarm system shall be fully tested by the manufacturer in accordance with all applicable local codes in the presence of OWNER's representative and the local Fire Marshal. Upon completion of a successful test, a certification shall be issued in writing to OWNER and CONTRACTOR.
- E. CONTRACTOR shall provide a fire alarm control panel that is communicating properly between the FACP and the monitoring agency.

3.12 TRAINING

- A. Upon successful completion of checkout by ENGINEER, a manufacturer's representative shall provide a demonstration of the automated sequences of operation. After this demonstration and acceptance by OWNER, the manufacturer shall provide 4 hours of "hands-on" training for OWNER's operating personnel which shall cover the following topics:
 - 1. Overall System Description and Theory of Operation.
 - 2. Automatic Operation.
 - 3. Manual Operation and Testing of System Devices.
 - 4. Recommended System Check Lists and Log Sheets.
 - 5. Recommended Preventative Maintenance.
- B. Two 4-hour training session for two operators shall be provided. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, controls, protective devices, and other major components. Travel time and expenses to the jobsite shall be over and above the time required to perform the training and shall be included in the Bid.

END OF SECTION

SECTION 31 10 00
CLEARING AND GRUBBING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Cutting and disposing of trees, brush, windfalls, logs, and other vegetation.
 - 2. Removing and disposing of roots, stumps, stubs, logs, and other timber.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

NOT APPLICABLE

PART 3–EXECUTION

3.01 PREPARATION

- A. CONTRACTOR shall identify existing plant life to remain and shall tag accordingly.

3.02 PROTECTION

- A. CONTRACTOR shall protect from damage utilities and structures that are to remain.
- B. CONTRACTOR shall protect trees, plant growth, and features designated to remain as final landscaping.

- C. See Division 01 for protection of survey monumentation.

3.03 CLEARING AND GRUBBING

- A. Clearing and grubbing shall consist of cutting and disposing of trees, brush, windfalls, logs, and other vegetation, and the removing and disposing of roots, stumps, stubs, grubs, logs, and other timber from within the clearing limits as defined on the Drawings, designated to be removed on the Drawings or in the Specifications, or fall within the excavation, embankment, or improved areas of the site.
- B. All roots and stumps shall be removed to a depth of not less than 12 inches below the original ground surface in embankment areas. In cut areas, such material shall be removed to a depth of not less than 12 inches below the subgrade.
- C. Disposal by burning or burying clearing and grubbing items within the project limits is not allowed.

3.04 TREE PROTECTION

- A. Trees shall be protected when construction activities affect the root zones and limbs. Tree protection shall be incidental to area work.
- B. Minimize storage and use of heavy equipment and materials within Critical Root Zone (CRZ), which is considered 1 to 1.5 times the diameter (in) at breast height of tree. For example, a 10-inch-diameter tree would require a 10- to 15-foot diameter of protection.
- C. Any exposed fine roots shall be kept damp. Any damaged roots above 1-inch diameter shall be cut clean.
- D. Tree branches damaged as a result of construction activity shall be cut clean. CONTRACTOR shall make a good faith effort to follow and implement the tree protection plan.
- E. Prior to any demolition or construction work occurring adjacent to trees scheduled to remain, CONTRACTOR shall prepare a tree protection plan for review by ENGINEER and OWNER.

END OF SECTION

SECTION 31 23 00

EXCAVATION, FILL, BACKFILL, AND GRADING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
 - 1. Excavating for footings, foundations, roads, utilities, sidewalks, driveways, parking lots, restoration, and miscellaneous areas.
 - 2. Furnishing and placing all fill and backfill.
 - 3. Provide compaction of all fill and backfill.
 - 4. Furnishing and placing vapor barrier and granular cushion below interior slabs on grade.
 - 5. Furnishing and placing of crushed stone mat below tank slabs and manhole/vault slabs, basement floors, or other structures where required.
 - 6. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Allowances:
 - 1. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 1,200 cubic yards of unsuitable foundation material for structures and roads as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for structures and roads will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 1,000 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting and filling or gravel bedding material required for placing concrete above water level as required under the concrete specifications. The Bid shall include any removal and replacement of excavated material so indicated on the Drawings or specified herein.
 - 2. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 100 cubic yards of unsuitable foundation material for utility trenches as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for utility trenches will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 100 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting, filling, or bedding. The Bid shall include any removal and replacement of excavated material so indicated on the Drawings or specified herein.
 - 3. CONTRACTOR shall INCLUDE in the Bid the cost of removing, hauling, and disposing of in a licensed landfill 20 tons of excavated solid waste fill material as defined in this section. The cost shall include excavation, any testing required by the landfill, transportation, additional safety considerations, and disposal fees. Payment for fill material excavation and disposal will be adjusted, add or deduct, based upon the actual amount of fill material excavation and disposal (more or less than 20 tons) and the unit price for excavation and disposal of solid waste fill materials. Landfill tonnage shall be based on weight tickets. Copies of all weight tickets for landfilled material shall be

provided to OWNER for documentation purposes to calculate actual quantities. Weight tickets shall be duly and accurately completed. Weight tickets with incomplete or illegible information shall not be acceptable.

- D. Payment: All common excavation shall be included in the Lump Sum Bid. Changes which require additions to or deductions from the excavation will be adjusted on the basis of the unit price for changes contained in the Contract.

1.02 REFERENCED STANDARDS

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications within this section shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.
- B. ASTM C33—Standard Specification for Concrete Aggregates.
- C. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- D. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).

1.03 SUBMITTALS

- A. Submit sources and gradations for materials proposed for use as compacted fill, utility trench backfill, trench bedding and cover material, crushed stone mat, and granular cushion.
- B. Submit samples of materials proposed for use in Paragraph 1.03.A to a soils testing laboratory for analysis of its suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.
- C. Submit sufficient samples of each different type or classification of soil to obtain representative values.

1.04 JOB CONDITIONS

- A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.
- B. Soil borings were made and the soils information is included in an appendix to these Specifications. The information contained is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations to determine physical conditions at the site, which may affect the work. See recommendations in report for additional investigation of subgrades after the existing reservoir is removed.

1.01 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR

shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 COMPACTED FILL

- A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well-graded throughout the particle size range. A minimum 65% of the material shall pass the 3/4-inch sieve, and the material shall be capable of being compaction tested in accordance with ASTM D1557, as determined by the Project Soils Engineer. Of that portion of the material passing the No. 4 sieve, not more than 25% shall pass the No. 200 sieve, and material shall have less than 5% clay content. When placing fill during wet weather or in wet areas, this requirement shall be modified to not more than 5% passing the No. 200 sieve. Adequately dewatered areas are not defined as wet areas.
- B. Native material may be used as compacted fill if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

2.02 CRUSHED STONE MAT

- A. Crushed stone mat below tank slabs, manholes, vault slabs and basement floors shall be 3/4-inch clear crushed stone and shall meet all requirements of Illinois DOT Article 351, gradation CA7/11.

2.03 GRANULAR CUSHION

- A. Granular cushion beneath floor slabs-on-grade shall meet requirements of Illinois DOT Article 351, gradation CA6.

2.04 EMBANKMENT FILL

- A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

2.05 CONCRETE FILL

- A. Concrete fill shall be Class X concrete as defined Section 03 30 00–Cast-In-Place Concrete or flowable fill as defined in this section.

2.06 CLAY FILL

- A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

2.07 FLOWABLE FILL

- A. Flowable fill shall be a self-compacting, self-leveling, material consisting of a mixture of fine aggregate and filler (as needed), water, and cementitious materials (Portland cement, fly ash, granulated blast furnace slag) that is in a flowable state at the time of placement meeting the requirements of the National Ready Mixed Concrete Association Guide Specification for Controlled Low Strength Materials (CLSM). The flowable fill shall be proportioned by the ready mixed concrete supplier on the basis of field experience and/or laboratory trial mixtures to produce a cohesive and nonsegregating mixture which has the following properties:
1. Minimum compressive strength: 50 psi.
 2. Maximum compressive strength: 150 psi.
- B. CONTRACTOR shall submit the following information well in advance of fill placement to avoid any delay in construction:
1. Gradation of fine aggregate.
 2. Design mix.
 3. Previous test results with 7- and 28-day compressive strengths.
 4. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
 5. Brand, type, principle ingredient, and amount of each admixture if used.

2.08 TRENCH BEDDING MATERIAL

- A. Bedding material shall be hard and durable and shall be made by crushing sound limestone or dolomite ledge rock, or crushed gravel aggregate. Bedding material shall conform to the requirements of ASTM C33 and shall conform to gradations shown in the following table. No native soil shall be used for bedding material.

PERCENTAGE BY WEIGHT PASSING INDICATED SIEVE

Size	2 1/2 IN	2 IN	1 1/2 IN	1 IN	3/4 IN	1/2 IN	3/8 IN	No. 4	No. 8	No. 16	No. 30	No. 100	No. 200
57			100	95-100		25-60		0-10	0-5				
67				100	90-100		20-50	0-10	0-5				
8						100	85-100	10-30	0-10	0-5			
9							100	85-100	10-40	0-10	0-5		
10							100	85-100				10-30	

- B. All rigid sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.

- C. Concrete and other rigid pipe used in nonsanitary sewer applications may be bedded using the Class C bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- D. Ductile and cast iron pipe shall be bedded in accordance with Class C bedding detail as shown on Drawing 01-975-43A, or the Type 4 laying condition of AWWA C600. Bedding material shall conform to Size No. 57, No. 8, or No. 9. Where ductile iron pipe is polyethylene encased, bedding material shall conform to Size No. 8 or No. 9.
- E. Thermoplastic sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- F. All other sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- G. PVC water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A or in accordance with the Type 4 laying condition of AWWA C605. HDPE water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A or in accordance with ASTM D2774. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used. No native materials may be used.
- H. Bedding material for copper water services shall conform to Size No. 9 or No. 10.

2.09 TRENCH COVER MATERIAL

- A. Material which is to be placed from the bedding material to 1 foot above the top of the pipe shall be termed cover material. All trenches shall be backfilled by hand to 1 foot above the top of the pipe with cover material. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings and appurtenances simultaneously in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. Use special care in placing cover material to avoid injury to or movement of the pipe. Cover material shall consist of durable granular particles ranging in size from fine to a maximum size of 3/4 inch. Unwashed bank run sand and crushed bank run gravel will be considered generally acceptable cover material. Cover material shall generally conform to the following gradation specifications:

COVER MATERIAL GRADATION

Sieve Size	Percentage by Weight Passing
1 inch	100
3/4 inch	85 to 100
3/8 inch	50 to 80
No. 4	35 to 65
No. 30	--
No. 40	15 to 30
No. 200	5 to 15

- B. Native trench materials may be used for cover material if they substantially conform to the above gradation specifications and a suitable credit is extended to OWNER.
- C. All bedding materials may be substituted for cover material when requested by CONTRACTOR except where polyethylene encasement is used. In such case, only those bedding materials specifically noted for polyethylene encasement may be used.
- D. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be Size No. 10. Cover material for PVC pressure or other thermoplastic piping may be Size No. 10.

2.10 TRENCH BACKFILL MATERIAL

- A. Backfill shall be that material placed between the top of cover material up to subgrade for placement of restoration materials. Backfill for storm inlets shall be bedding material.
- B. When the type of backfill material is not otherwise specified or shown on the Drawings, CONTRACTOR may backfill with the excavated material, provided that such material consists of loam clay, sand, gravel, or other materials which, in the opinion of Project Soils Engineer, are suitable for backfilling.
- C. All backfill material shall exceed a temperature of 35°F and be free from frost, cinders, ashes, refuse, vegetable or organic matter, boulders, rocks, or stone, frozen lumps, or other material which in the opinion of Project Soils Engineer is unsuitable. From 1 foot above the top of the pipe to the trench subgrade, well-graded material containing stones up to 8 inches in their greatest dimension may be used, unless otherwise specified. Care should be taken in backfilling so as not to damage the installed pipe.
- D. In refilling the trench, if there is not sufficient material excavated therefrom suitable for refilling, CONTRACTOR shall, without extra compensation, furnish the deficiency. Where indicated on the Drawings, fill shall be provided over projecting conduits. Such fill shall be free of large boulders, and the top 6 inches shall be of suitable material to fit the adjoining ground.
- E. When called for on the Drawings, in the Specifications, or requested by ENGINEER, backfill material shall be granular and shall consist of durable particles ranging in size from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids in the coarse material. No stones over 3 inches or clay lumps shall be present. Unless otherwise allowed by ENGINEER, granular backfill shall generally conform to the following gradation specification:

GRANULAR BACKFILL

Sieve Size	Percentage by Weight Passing
3 inches	100
2 inches	95 to 100
No. 4	35 to 60
No. 200	5 to 10

PART 3—EXECUTION

3.01 GENERAL

- A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

3.02 PROTECTION

- A. CONTRACTOR shall provide all necessary sheeting, shoring, or other soil retention systems including all labor, material, equipment, and tools required, or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheeting, shoring, and other soil retainage systems shall be withdrawn or removed in a manner so as to prevent subsequent settlement of structures, utilities, and other improvements.
- B. Design of sheet piling and other soil retaining systems shall be the sole responsibility of CONTRACTOR. Where such systems are shown on the Drawings, no parameters such as embedment depth, section profile, presence or lack of walers, etc., nor system type or suitability shall be inferred. CONTRACTOR is responsible for designing and providing a fully functional system compatible with construction and site requirements.
- C. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

3.03 FINISH ELEVATIONS AND LINES

- A. CONTRACTOR is responsible for establishing finish elevations and lines.
- B. Where lasers are used, CONTRACTOR shall check the Work against intermediate grade stakes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- C. If existing property stakes, not within the limits of the trench or street slope limits, are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.

3.04 COMMON EXCAVATION

- A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.
- B. All excavated material that does not meet the specification for compacted fill or embankment fill or meets the specification but is not required for backfill or fill shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.
- C. OWNER maintains ownership of any excess material. The hauling cost shall be at CONTRACTOR's expense unless otherwise specified.
- D. All material other than suitable bearing soil or bedrock, as determined by the Project Soils Engineer, shall be removed from under concrete to be poured on ground.
- E. Excavation for all footings, foundation walls, pits, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.
- F. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 31 23 19–Dewatering.
- G. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.
- H. When excavations reach subgrade elevations as shown on the Drawings or as specified herein, the Project Soils Engineer will observe the bottom material. Where, in the opinion of the Project Soils Engineer, unsuitable foundation material is found at the level of the subgrade, unsuitable foundation material shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.
- I. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation 1 foot plus a distance at least equal to the depth of undercut below footing grade.
- J. CONTRACTOR shall backfill and compact all overexcavated areas.
- K. All street excavation shall be performed as called for in Section 205 of the Standard Specifications and as herein modified.
- L. The following items of Work shall be included in common excavation:
 - 1. The excavation to subgrade elevations as detailed in the Drawings including road bed areas, terraces, sidewalks, bike paths, driveways, and other miscellaneous surface improvements.
 - 2. Removal (and stockpiling, if the use of salvaged topsoil is required) of topsoil from all cut areas and fill areas within a 1:1 slope of finished street, sidewalks, bike paths, driveways, and other miscellaneous surface improvements.
 - 3. The preparation, grading, compaction, and proof-rolling of subgrade areas for roadbed, sidewalks, bike paths, driveways, and other miscellaneous surface improvements to the elevations detailed on the Drawings.

4. Excavation and grading required to realign and/or create ditch lines and drainage ways to route drainage to or from storm facilities as shown on the Drawings, or as necessary to maintain positive drainage.
 5. Removal of temporary backfill placed in new utility trenches above the subgrade.
 6. The removal and disposal of all undesirable and surplus materials.
- M. Common excavation may be completed as part of utility construction prior to initiating general street excavation activities.
- N. All subgrade areas in streets and parking lots, including utility trench restoration areas, shall be proof-rolled with a heavily loaded triaxle dump truck or other similar equipment requested by ENGINEER prior to the placement of any fill materials or base course. ENGINEER must be present during proof-rolling to review the Work necessary for the stabilization of any unstable areas identified. Base course placed on unstable or yielding foundation or subgrade shall be removed and then replaced at CONTRACTOR's expense following excavation below subgrade of the affected area.
- O. Saw cuts shall be made in existing pavement, driveways, curb and gutter, and sidewalks to allow restoration to neat straight lines. Saw cuts damaged during construction shall be recut prior to beginning restoration.
- P. CONTRACTOR shall salvage suitable materials from utility and street construction activities to provide fill for street construction. Where sufficient quantities of materials suitable for street construction are not available from areas of the site, CONTRACTOR shall perform borrow excavation to make up the deficit in accordance with Section 208 of the Standard Specifications.
- Q. CONTRACTOR shall be responsible for making its own determination of the common excavation quantity when compiling the lump sum bid.

3.05 UTILITY TRENCH EXCAVATIONS

- A. Caution In Excavation; CONTRACTOR shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures may be determined and shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on its part.
- B. Subsurface Exploration: When determined that it is necessary to explore and excavate to determine the location of existing underground facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is asked to perform additional Work in making the explorations and excavations, extra compensation will be allowed as specified In the General Conditions.
- C. The trench shall be dug so that the utilities can be laid to the alignment and depth specified. Unless otherwise allowed by ENGINEER, trenches shall not be excavated more than 100 feet in advance of pipe laying. Common excavation shall include all excavation except rock. Included in common excavation shall be removal of street paving of all types, existing structures, existing improvements and trees smaller than 4 inches in diameter measured 4 feet above the ground, all as necessary to complete the pipe installation.
- D. The trench shall be finished to the depth necessary to provide a uniform and continuous bearing and support for the pipe on the bedding material provided at every point between bell holes. Any part of the bottom of trench excavated below the specified grade shall be

corrected with bedding material, thoroughly compacted in place. The bedding shall be shaped and finished with hand tools to fit the bottom quadrant to the pipe.

- E. If unstable soil conditions are encountered at subgrade, CONTRACTOR shall replace the unstable soil with special bedding. CONTRACTOR shall be allowed extra compensation for the special bedding, unless the unstable soil conditions are caused by CONTRACTOR's failure to adequately dewater the trench, in which case CONTRACTOR shall bear the entire cost.
- F. All excavated material shall be piled in a manner that will not endanger the Work. Stockpiles not for immediate backfilling shall have silt fences placed around their perimeter for erosion control. The Work shall be conducted in such a manner that pedestrian and motor traffic is not unnecessarily disrupted. Fire hydrants, valve boxes and manholes shall be left unobstructed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed.
- G. Excavated material designated by ENGINEER as being undesirable for backfilling and all surplus excavated material shall be immediately removed as excavation progresses. All such material shall be disposed of in an environmentally safe manner in accordance with local, state, and federal regulations. No such materials shall be disposed of in wetlands, floodplains, or other environmentally sensitive areas. Disposal sites are also subject to approval of OWNER. All undesirable and surplus material disposed of must be leveled off and graded to rough elevations as determined by OWNER. Appropriate erosion control measures shall be provided and maintained at disposal sites until disposal is complete and the disposal site is permanently stabilized.
- H. CONTRACTOR shall remove bituminous pavement and road surface as a part of the trench excavation. The width of pavement removed shall be the minimum possible, and acceptable, for convenient and safe installation of utilities and appurtenances.
- I. All bituminous pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the trench.
- J. Where it is necessary to trench through concrete pavement, a strip shall be sawed and removed in such a manner as not to disturb the remainder of the pavement. Paving and undermining of existing concrete pavement shall be prevented by CONTRACTOR. If CONTRACTOR unnecessarily removes or damages pavement or surfaces beyond limits acceptable to ENGINEER, such pavement and surfaces shall be replaced or repaired at the expense of CONTRACTOR.
- K. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
- L. Pipe shall be placed only on dry foundations.
- M. Excavation shall include all necessary incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling.
- N. CONTRACTOR shall excavate whatever materials, are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown.

- O. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
- P. Any water, drainage, gas, sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance within the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
- Q. CONTRACTOR shall be responsible for determining and providing the minimum width necessary to provide a safe trench in accordance with current OSHA standards and all other applicable standards. The top width of trench excavation shall be kept as narrow as is reasonably possible and acceptable to minimize pavement damage. Pay items related to maximum trench widths shall not limit CONTRACTOR's responsibility to provide safe trench conditions.
- R. Width of Trench—Rigid Pipe: The width of trench below the outside top of the pipe shall be as shown in the following table for the sizes listed. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching. If sheeting is used and is going to remain in place, the trench width shall be measured as the clear distance between inside faces of the sheeting. Otherwise, the trench width shall be based on the width between stable trench walls after sheeting is removed.

MAXIMUM WIDTH OF TRENCH BELOW TOP OF PIPE

Nominal Pipe Diameter (Inches)	Trench Width (Inches)
4	30
6	30
8	36
10	36
12	36
15	36
18 and larger	Pipe O.D. Plus 16 (Minimum 36)

- S. Where the width of trench below the outside top of the pipe barrel cannot be otherwise maintained within the limits shown above, CONTRACTOR, at its own expense, shall furnish an adequate pipe installation for the actual trench width which will meet design conditions. This may be accomplished by furnishing higher class bedding, a stronger pipe, concrete cradle, cap or envelope or by driving sheeting prior to excavation to subgrade. Removal of sheeting below the top of the pipe, if allowed by ENGINEER, shall be gradual during backfilling.

- T. If the maximum trench width is exceeded for any reason other than by request of ENGINEER, the concrete cradle, cap, sheeting, bedding or the stronger pipe shall be placed by CONTRACTOR at its own expense. Where the maximum trench width is exceeded at the written request of ENGINEER, the concrete cradle, cap, sheeting, bedding or stronger pipe will be paid for on the basis of the price bid.
- U. Width of Trench—Thermoplastic and Ductile Iron Pipe: The trench width for flexible pipe shall be minimum three times the pipe outside diameter or the maximum trench width specified for rigid pipe, whichever is greater. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching.
- V. Special bedding shall consist of stone material and filter fabric as described herein. Where the bottom of the trench at subgrade is found to be unstable or of unsuitable material, which should be removed, CONTRACTOR shall excavate and remove such unstable or unsuitable material to the trench width and to a depth of 2 feet. The excavated area shall be lined with filter fabric, Mirafi 140 N, US Fabrics US 120NW, Propex Geotex 401, or equal, and backfilled with bedding material in maximum 12-inch layers. At subgrade the filter fabric shall be wrapped over the special bedding with an 18-inch overlap. Bedding material shall then be placed over the special bedding to support the piping. See Dewatering and Excavation to Subgrade sections for additional conditions.
- W. If soil conditions require it, concrete cradle or encasement shall be placed around the pipe as shown on Drawing 01-975-43A. Excavation shall be carried below the grade line to a depth requested by ENGINEER and concrete cradle or encasement placed. Before the concrete is placed, the pipe shall be laid to line and grade, blocked and braced, and the joint made. The cradle shall then be placed, taking care not to disturb the pipe. Concrete shall have a minimum 28-day compressive strength of 4,000 psi. Concrete cradle shall not be used for thermoplastic piping. See Trench Width section for additional conditions.
- X. Open-cut trenches shall be sheeted and braced as required by any governing federal regulations including OSHA, state laws, and municipal ordinances; and as may be necessary to protect life, property, improvements or the Work. Underground or aboveground improvements to be left in place shall be protected and, if damaged, shall be repaired or replaced at the expense of CONTRACTOR.
- Y. Sheeting and bracing which is to be left in place must be removed for a distance of 4 feet below the present or proposed final grade of the street, road, or land, whichever is lower. Trench bracing, except that which shall be left in place, may be removed after backfilling has been completed or has been brought up to such an elevation as to permit its safe removal.
- Z. Portable Trench Box: Whenever a portable trench box or shield is used, special precautions shall be taken so as not to pull already jointed pipe apart or leave voids around the pipe wall. Whenever possible, the bottom edge of the box shall be kept at a level approximately even with the top of pipe. Cover material shall be placed to at least the top of pipe before moving the box ahead.
- AA. All trenches shall be backfilled using specified material so that excessive lengths of trench are not left open. In general, the backfilling operation shall proceed so that no more than 100 feet of trench is open behind the pipe laying operation.
- BB. Backfill shall be left below the original surface to allow for placement of restoration materials including pavement, base course, concrete, topsoil, sod, plus any pavement replacement

specified in accordance with the Asphaltic Paving section herein. When settlement occurs, CONTRACTOR shall restore the surface improvements at its expense to maintain the finished surface.

3.06 PREPARATION OF SUBGRADE

- A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Project Soils Engineer.
- B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.
- C. All slab-on-grade and road subgrades shall be proofrolled with a heavy rubber-tired construction vehicle (such as a fully loaded tandem-axle dump truck) in the presence of the Project Soils Engineer.
- D. ENGINEER may request the excavation of unsuitable materials in areas of unstable subgrade. The excavation of such materials, except in areas where CONTRACTOR has completed utility construction or placed street fill, shall be measured by ENGINEER for payment.
- E. The excavation and replacement of unstable utility trench backfill and/or street fill placed by CONTRACTOR shall be at CONTRACTOR's expense.
- F. Base course placed on unstable foundation shall be removed and replaced at CONTRACTOR's cost following excavation of the affected area.
- G. Where requested by ENGINEER in the field, excavation below subgrade areas shall be lined with geotextile material as specified in Section 31 32 19–Geotextiles and backfilled with 3-inch crushed stone dense graded base as specified herein.
- H. Geotextile shall be placed where requested by ENGINEER to stabilize street subgrade areas. Fabric shall be as specified in Section 31 32 19–Geotextiles. Vibratory compaction shall not be used in the compaction of base course in areas where geotextile fabrics are used.

3.07 COMPACTED FILL AND BACKFILL

- A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.
- B. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.
- C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.
- D. No fill shall be placed under water or over unsuitable subgrade conditions.
- E. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:
 - 1. Class 1 Compaction: This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter,

and backfill within 10 feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.

2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.

F. No frozen material shall be placed nor shall any material be placed on frozen ground.

G. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

3.08 EMBANKMENT FILL

A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.

B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

3.09 CONCRETE FILL

A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, Class X concrete or flowable fill shall be used as fill material.

3.10 PLACING GRANULAR CUSHION AND VAPOR BARRIER

A. When subgrade is prepared for slab-on-grade areas, CONTRACTOR shall place the vapor barrier and granular cushion.

B. Specific location of vapor barrier (whether directly under slab or under granular cushion) shall be as shown on the Drawings.

3.11 PLACING CRUSHED STONE AND GEOTEXTILE FABRIC

A. The same day that the subgrade is exposed, place geotextile fabric on subgrade, and place 12 inches of crushed stone mat below tank slabs, manholes, vault slabs, and basement floors. Compact in place.

- B. Geotechnical fabric shall extend up the side edge of the stone mat and extend across the top of the stone to a minimum of 12 inches past the edge of base slab.

3.12 PIPE BEDDING AND COVER

- A. Immediately prior to placing the pipe, the trench bottom shall be shaped by hand to fit the entire bottom quadrant of the pipe. If pipe is of the bell and spigot type; bell holes shall be provided to prevent the bell from supporting the backfill load. Bell holes shall be large enough to permit proper making of the joint, but not larger than necessary to make the joint. All adjustments to line and grade must be done by scraping away or filling in bedding material under the body of the pipe. Any fill used must be bedding material. If necessary to obtain uniform contact of the pipe with the subgrade, a template shall be used to shape the bedding material. All pipe shall be placed on bedding material at least 4 inches thick. See Drawing 01-975-43A. Bedding material shall then be placed and tamped into place up alongside the pipe in maximum 6-inch layers shovel slicing the bedding material under the haunches to provide firm contact with the pipe. CONTRACTOR shall perform all necessary excavation and shall furnish all necessary material to provide this bedding.
- B. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.

3.13 TRENCH BACKFILL CONSOLIDATION

- A. All trenches shall be consolidated as specified in this section for the entire depth and width of the trench.
- B. Consolidation shall be achieved by use of smooth surface vibratory compactors or backhoe operated hydraulic compactors for granular materials and rotating sheepsfoot type mechanisms for loam/clay soils. The lift height shall not exceed 8 inches for walk behind, hand operated, vibratory compactors and sheepsfoot. Lift height shall not exceed 24 inches for self-propelled vibratory drum or backhoe operated hydraulic compactors. Smaller lift heights shall be provided as necessary to achieve the degree of compaction specified.
- C. Unless specified otherwise, backfill material beneath paved areas or future paved areas and within 5 feet of paved areas or future paved areas shall be consolidated as follows: Within 3 feet of the surface 95% of maximum dry density, below 3 feet from the surface to 1 foot above the pipe 90% of maximum dry density, as determined by the modified Proctor Test (ASTM D1557).
- D. Unless otherwise specified, backfill material placed in all other areas shall be compacted to the point where no additional consolidation can be observed from the compaction and backfill equipment being used.
- E. Backfill material not meeting the compaction specification shall be recompacted by CONTRACTOR at no cost to OWNER. Cost for additional testing on recompacted material shall be at CONTRACTOR's expense.

3.14 GRADING

- A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the Drawings.
- B. Grading Tolerances:
 - 1. Rough Grade: Buildings, parking areas, and sidewalks—±0.1 feet.
 - 2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs—±0.03 feet.
 - 3. Lawn areas away from buildings, parking areas, and sidewalks—±0.25 feet.

3.15 MAINTENANCE OF SURFACE

- A. CONTRACTOR shall maintain all backfilling, resurfacing, repaving, and other surface improvements constructed under this Contract. CONTRACTOR shall, upon proper notice from OWNER, make all repairs in surfaces of trenches and excavations. All expenses incurred by OWNER and/or CONTRACTOR in making repairs and all expenses in maintaining trench and excavation surfaces shall be at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. OWNER reserves the right to make all emergency repairs necessary to make safe all streets and walks at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. A maintenance guarantee fund, if specified, will be withheld from the final amount due CONTRACTOR for a period of 6 months, after acceptance of the Work, to provide such maintenance.
- B. CONTRACTOR shall be responsible for controlling dust dispersion during utility and street construction. Remedial actions required as a result of inadequate dust control shall be CONTRACTOR's responsibility. To control dust, CONTRACTOR shall apply calcium chloride or ammonium lignin sulfonate in 12 to 14% solution or other dust control palliative acceptable to OWNER. Prior to application of dust palliative, the street shall be graded smooth.

3.16 COMPACTION TESTING

- A. Compaction tests shall be done by the Project Soils Engineer. Location and frequency of the tests shall be as recommended by the Project Soils Engineer and paid for by OWNER.

3.17 EXCAVATED SOLID WASTE FILL MATERIALS TO BE LANDFILLED

- A. If any solid waste fill materials are encountered, they shall be excavated and removed to a licensed sanitary landfill. Solid waste fill material is defined as any construction or demolition debris, household refuse, glass, metal, plastic, or similar material not native to the site, but having been placed on-site during past filling operations and mixed with soil. Allowance as specified shall apply.

3.18 CLEAN CONSTRUCTION OR DEMOLITION DEBRIS

- A. CONTRACTOR shall comply with 35 Ill. Adm. Code 1100 when disposing of clean construction or demolition debris (CCDD) or uncontaminated soil at a CCDD or uncontaminated soil fill operation.
- B. None of the Drawings, Specifications, or geotechnical reports shall be considered a guarantee that excavated material shall meet the requirements of 35 Ill. Adm. Code 1100, and CONTRACTOR shall be responsible for satisfactory removal and disposal of all material

as specified herein. No additional environmental testing of the existing on-site material may be performed without the written permission of OWNER, CONTRACTOR shall be required to properly and legally dispose of all material from the project site, regardless of its suitability for disposal in a CCDD facility, at CONTRACTOR'S expense, without any additional payment for testing, hauling, and disposal as specified below.

- C. CONTRACTOR shall consult at least three CCDD facilities for confirmation of acceptance of material from this project prior to submitting a bid for this project. CONTRACTOR shall base its bid on hauling all CCDD generated by this project and shall provide the name, location, and contact information of intended facilities to OWNER upon award of Contract to CONTRACTOR. No additional compensation will be allowed for hauling to any other facilities, for any reason, unless none of the indicated facilities will accept the material. In the case where none of CONTRACTOR's indicated facilities will accept the material, CONTRACTOR shall attempt to locate an alternate facility, unless the material is classified as unsuitable for disposal in a CCDD facility, in which case it shall be hauled to a landfill and paid for as specified below. Any costs associated with additional sampling, analysis, and/or reporting to meet the acceptance requirements of an intended facility shall be borne by the bidding CONTRACTOR and included within CONTRACTOR's bid. By submitting a bid, CONTRACTOR agrees that the intended facilities will accept the material and shall be used for disposal of all CCDD from this project, unless otherwise determined to be non-hazardous special waste as specified below. In the event that CONTRACTOR needs to alter the CCDD facility used for placement of excavated material, CONTRACTOR shall notify OWNER no less than three days in advance of the planned alteration. In no event shall material be hauled to an alternate facility without the written permission of OWNER.
- D. Construction Requirements:
1. CONTRACTOR shall be responsible for satisfactory removal and disposal of all waste material, asphalt, concrete, stone, dirt, and debris generated or discovered in the course of the work. Removal and disposal of excavation items being disposed of at a CCDD facility shall meet the requirement of 35 Ill. Adm. Code 1100. This work shall be incidental and shall not be paid for separately, with the exception of the NON-CCDD MATERIAL DISPOSAL as specified below.
 2. If material is rejected at the CCDD facility, it shall be returned to the project site and quarantined for further evaluation. No additional compensation shall be allowed for returning a reject load back to the project site or for any other additional hauling, loading, unloading, etc. as may be required. Should it be determined that the material is not suitable for disposal in a CCDD facility, CONTRACTOR shall be responsible for properly disposing of the material at an acceptable landfill and providing OWNER with all the proper paperwork to document the material disposal with the IEPA. This work shall be paid for as specified below.
 3. All work to satisfy these requirements shall be the responsibility of CONTRACTOR. All costs associated with meeting these requirements shall be included in CONTRACTOR's bid for installation of the associated pipe or structure. These costs shall include, but are not limited to, all required testing, lab analysis, and certification by a licensed professional engineer (PE) or licensed professional geologist (PG), if required, in addition to the cost of additional hauling, dump fees, etc.
 4. CONTRACTOR shall INCLUDE in its Bid the cost of removing, hauling, and disposing of in a licensed landfill 20 tons of excavated solid waste fill material not suitable for disposal in a CCDD facility. The cost shall include excavation, any testing required by the landfill, transportation, additional safety considerations, and disposal fees. Payment for non-CCDD material excavation and disposal will be adjusted, add or deduct, based

- upon the actual amount of fill material excavation and disposal (more or less than 20 tons) at the unit price for REMOVAL AND DISPOSAL OF NON-CCDD MATERIAL.
5. Landfill tonnage shall be based on weight tickets. Copies of all weight tickets for landfilled material shall be provided to OWNER for documentation purposed to calculate actual quantities. Weight tickets shall be duly and accurately completed. Weight tickets with incomplete or illegible information shall not be acceptable.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Removal of groundwater to allow belowgrade construction.
 - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
 - 1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
 - 2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.
 - 3. Any permits necessary for the dewatering operations shall be obtained and paid for by CONTRACTOR.

1.02 REFERENCES

- A. Illinois Urban Manual.
- B. See Division 01, Section 01 41 00–Regulatory Requirements for permit requirements and water, erosion, and sediment control.

1.03 SYSTEM REQUIREMENTS

- A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. No water shall flow over the work until the joints are complete or the concrete has set.
- B. Wherever necessary, CONTRACTOR shall excavate in advance of the completed work, lead the water into sumps or pump wells, and provide erosion control measures to prevent water or sediment damage.
- C. CONTRACTOR's dewatering system shall perform so that the soils within the trench will not be destabilized by hydrostatic uplift pressures from adjacent groundwater. If conditions warrant, CONTRACTOR shall furnish and install well point systems or deep wells.

- D. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.
- E. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.
- F. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of “quick” conditions or “boils” shall be prevented.
- G. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

1.04 QUALITY ASSURANCE

- A. All dewatering shall be done in accordance with Illinois Urban Manual Code 813 and with all other applicable federal, state, and local code requirements.
- B. In particular, groundwater observation wells shall be provided and subsequently abandoned in accordance with the Illinois Urban Manual Code 996. CONTRACTOR shall complete all observation well construction and abandonment forms as required and shall submit the forms to OWNER within 15 days of construction or abandonment activities.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

3.01 DEWATERING

- A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.
- B. CONTRACTOR shall provide at least two groundwater observation wells near each area to be excavated to aid CONTRACTOR in determining whether the minimum specified requirements have been met prior to excavation. The observation well shall be a minimum 2-inch-diameter slotted PVC pipe. The observation well shall be installed and backfilled in such a way as to allow an accurate determination of actual groundwater levels. The observation well shall be properly abandoned after use unless specified otherwise.
- C. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages, and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.
- D. CONTRACTOR shall meet all requirements of applicable IEPA permits for construction pit or trench dewatering.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

3.02 PROTECTION

- A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.
- B. Prior to dewatering, CONTRACTOR shall take into account the effect of its proposed dewatering operation on existing private water supply systems and shall make arrangements with property owners for protecting their supplies or providing alternative means of supply.
- C. In the event that CONTRACTOR's dewatering operation adversely affects private water supply systems, CONTRACTOR shall provide property owners with alternative potable and nonpotable supplies until dewatering operations are ceased and groundwater levels return to normal. If the water in private water supply wells is contaminated, through no fault of CONTRACTOR after restoration of original groundwater levels, OWNER will provide measures to restore water potability. CONTRACTOR is responsible for restoration of the water supply, not its potability after restoration.
- D. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences to the greatest extent possible by using

electric-driven pumps, or intake and exhaust silencers or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

SECTION 31 25 00

SLOPE PROTECTION AND EROSION CONTROL

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Erosion control devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 PAYMENT

- A. All costs associated with slope protection and erosion control shall be included in CONTRACTOR's Bid. This work shall include, but is not limited to, erecting fence, excavation, placing posts, backfilling, attaching woven wire and geotextile fabric; placing ditch checks; installing sediment traps; removing the fence at completion of project; cleaning and repairing; removing or spreading accumulated sediment to form a surface suitable for seeding; replacing silt fence and damages caused by overloading of sediment material or ponding of water adjacent to silt fence; and furnishing labor, tools, equipment, and incidentals necessary to complete the work in accordance with the Contract.

1.03 REFERENCES

- A. Illinois Urban Manual published by the Natural Resources Conservation Service (NRCS) in Illinois (<http://www.nrcs.usda.gov>).

1.04 REGULATORY REQUIREMENTS

- A. Land disturbance greater than one acre and CONTRACTOR obtains Notice of Intent (NOI). Unless otherwise specified, CONTRACTOR shall, for land disturbance activities exceeding one acre, develop and implement a Storm Water Erosion and Pollution Control Plan in accordance with conditions of federal and state permits, local ordinances, Best Management Practices, and as required by the NOI.
- B. CONTRACTOR shall pay any fines or other fees resulting from failure of CONTRACTOR to comply with the permit requirements.

1.05 QUALITY CONTROL

- A. Construct and maintain erosion sediment control measures in accordance with the Illinois Urban Manual.
- B. Check facilities weekly and after any rainfall event, and make needed repairs within 24 hours.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 EROSION MATS

- A. Uniform web of interlocking wood excelsior fibers, with a net backing on one side. The wood from which the blanket is produced shall have been properly cured to achieve adequately curled and barbed fibers. The blanket shall be of uniform thickness with the wood fibers evenly distributed over the entire area of the blanket. The blanket shall be furnished in rolled strips. The width of the strips shall be 48 inches, ± 1 inch. Weight of blanket measured under average atmospheric conditions shall be 78 pounds per 80 square yards, $\pm 10\%$. Net backing shall have mesh size not exceeding 1 1/2 by 3 inches and may be woven from twisted paper, cotton cord, a biodegradable plastic, or other alternate method. The blanket shall be nontoxic to vegetation.

2.02 SILT FENCE

- A. Use geotextile fabric consisting of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride with the following requirements. Fabric shall have the minimum strength values in the weakest principal direction. Nonwoven fabric may be needle punched, heat bonded, resin bonded, or combination thereof.

VALUE MINIMUM REQUIREMENTS ⁽¹⁾

Test	Method	Silty Soils ⁽⁴⁾	Sandy Soils ⁽⁵⁾
Grab Tensile-Strength/ Strip-Breaking Force	ASTM D-5034, D5035 ⁽²⁾	100	100
Mullen Burst Strength (psi)	ASTM D-3786	200	200
Equivalent Opening Size	CW-02215-77	50-140	20-50
U.S. Standard Sieve	Corps of Engineers		
Water Flow Rate (gal/min/ft. ²) at 50 mm Constant Head	ASTM D-4491 ⁽³⁾	10	10

Test	Method	Silty Soils ⁽⁴⁾	Sandy Soils ⁽⁵⁾
Ultraviolet Radiation Stability (percent)	ASTM D-4355	90	90

- (1) All numerical values represent minimum average roll values (i.e., the average of test results on any roll in a lot should meet or exceed the minimum values in the table).
- (2) ASTM D-5034 Grab Test and ASTM D-5035 Breakout Force and Elongation Strip Method, Method 16, using a 4-inch by 8-inch sample, 3-inch gauge length clamped in 1-inch by 2-inch long grip, tested at a strain rate of 12 inches/min.
- (3) Water Flow Rate in gal/min/ft shall be determined by multiplying Permittivity in sec. as determined by ASTM D4491 by a conversion factor of 74.
- (4) Silty Soil: More than 15% by weight passing No. 200 sieve.
- (5) Sandy Soil: Less than 15% by weight passing No. 200 sieve.

- B. Furnish geotextile fabric in a wrapping which will protect the fabric from ultraviolet radiation and from abrasion because of shipping and handling. Keep geotextile dry until installed.

2.03 CONCRETE WASHOUT FACILITY

- A. Temporary concrete washout facilities are used to contain concrete liquids when the chutes of concrete trucks are rinsed out after delivery of concrete to the construction site. These washout facilities function to consolidate solids for disposal and prevent runoff liquids associated with concrete. Failure to comply with appropriate washout location requirements will result in monetary deficiency deduction against CONTRACTOR.
- B. Location of pit shall be at a location approved by OWNER or ENGINEER.
- C. Constructed pit shall be made via the use of polyethylene sheeting and sandbags.
- D. CONTRACTOR may propose an alternate facility.

2.04 STABILIZED CONSTRUCTION ENTRANCE

- A. Stabilized pad of coarse aggregate, underlain with geotextiles designed to vibrate accumulated sediment from tires and under chassis. This is to be located at any point where traffic will be entering and leaving the construction site.
- B. See standard details for material information.

2.05 INLET PROTECTION

- A. Flexstorm inlet filters manufactured by Inlet & Pipe Protection, Inc. (or approved equal) with woven monofilament geotextile filter fabric sediment bags shall be installed on the storm sewer inlet structures at all drainage discharge points prior to the excavation. Also, metal plates of adequate size, shape, and thickness shall be installed directly on all drainage structures providing a clean seal hindering debris from entering the drainage system.
- B. Flexstorm inlet filters shall be installed on all storm sewer inlet structure castings with open lids or grates, within or adjacent to the project limits, and shall remain in place until the vegetation is established. The entire frame and sediment bag shall be remove and the structure cleared of all debris prior to OWNER accepting this project.

- C. It is CONTRACTOR's responsibility to review the Drawings and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number or the exact grate size and clear opening size will provide the information necessary to identify the required Flexstorm Inlet Filter part number.
- D. CONTRACTOR shall be responsible for inspecting the sediment bags once per week and after every major rain event (1/2-inch or more), and removing and cleaning the sediment bag if it is more than half full or damaged. This shall be done until the Flexstorm inlet filters are permanently removed.
- E. Excess/waste construction material shall be properly disposed off-site. No cleaning of equipment or tools, including concrete trucks, will be allowed within the project limits or into OWNER's storm sewer drainage system. CONTRACTOR shall provide a concrete truck washout plan at the time of the project pre-construction meeting, which is in compliance with NPDES permit requirements.

2.06 GEOTEXTILE FABRIC

- A. See Section 31 32 19—Geotextiles for fabric under riprap.

2.07 RIPRAP

- A. See Section 31 37 00—Riprap.

PART 3—EXECUTION

3.01 GENERAL

- A. Install devices before construction activities begin.
- B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream. If possible, the work area should be diked off and the volume and velocity of water that crosses disturbed areas be reduced by means of planned engineering works (diversion, detention basins, berms).
- C. Unless noted on Drawings, do not remove trees and surface vegetation.
- D. Expose the smallest practical area of soil at any given time through construction scheduling. Make the duration of such exposure before application of temporary erosion control measures or final revegetation as short as practicable.
- E. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- F. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- G. CONTRACTOR shall provide erosion control protection as necessary, including silt fence, excelsior roll, and temporary ditch checks all to be installed in accordance with IDOT Standard Specifications Article 280.

3.02 EROSION MAT INSTALLATION

- A. Place erosion mat immediately after seeding or sodding operations have been completed. Before mat placement, remove all material or clods over 1 1/2 inches in diameter and all organic material or other foreign material which interfere with the mat bearing completely on the soil or sod.
- B. Any small stones or clods which prevent contact of the mats with the soil shall be pressed in the soil with a small lawn-type roller or by other effective means. The mat shall have its lateral edge so impressed in the soil as to permit runoff water to flow over it.
- C. The matting strips shall be rolled on or laid in direction of flow. Spread mat evenly, smoothly, in a natural position without stretching and with all parts bearing on soil, and place blanket with netting on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. Make overlaps with the upgrade section on top.
- D. Bury upgrade end of each strip of fabric or blanket at least 6 inches in a vertical slot cut in the soil and press soil firmly against the embedded fabric or blanket.
- E. Anchor mats in place with vertically driven staples, driven until their tops are flush with the soil. Space staples at 3-foot centers along mat edges and stagger space at 3-foot centers through the center. Place staples at 10-inch centers at end or junction slots.
- F. Reseed areas damaged or destroyed during erosion mat placing operations as specified for original seeding.
- G. Dispose of surplus excavated materials and all stones, clods, or other foreign material removed in the preparation of the seeded soil or sodded surface before placing mat.
- H. Following mat placement, uniformly apply water to the area to moisten seedbed to 2-inch depth and in a manner to avoid erosion.
- I. Maintain erosion mat and make satisfactory repairs of damage from erosion, traffic, fires or other causes until work acceptance.

3.03 GEOTEXTILE FABRIC

- A. Before placing fabric, grade area smooth and remove stones, organic matter, or other foreign material which would interfere with fabric being completely in contact with soil.
- B. Place fabric loosely and lay parallel to direction of water movement. Pinning or stapling is acceptable to hold geotextile in place. Overlap or sew together separate pieces of fabric. Overlap joints a minimum 24 inches in the flow direction. After placement, do not expose fabric more than 48 hours before covering.
- C. Cover damaged areas with a patch of fabric using a 3-foot overlap in all directions.

3.04 SILT FENCE INSTALLATION

- A. Erect silt fence before starting construction operations which might cause sedimentation or siltation at site of proposed silt fence.

- B. Construct silt fence in an arc or horseshoe shape with ends pointing up slope. Construct silt fence to the dimensions and details shown on Drawings. Remove silt fences after slopes and ditches have been stabilized and turf developed to the extent that future erosion is unlikely. Dispose of materials remaining after removal.
- C. Inspect all silt fences immediately after each rainfall and at least daily. Correct deficiencies immediately. Where construction activity changes the earth contour and drainage runoff, make a daily review so that silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences.
- D. Remove and dispose of sediment deposits. Sediment deposits remaining in place after the silt fence is no longer required shall be dressed to conform with the existing grade and the area topsoiled, fertilized, and seeded as required.
- E. OWNER and ENGINEER may require installation of additional silt fence not shown on the Drawings.

3.05 DITCH CHECKS

- A. Ditch checks shall be installed in accordance with the IDOT Bureau Local Roads and Streets Manual Section 41-3.03(b)
- B. Spacing and Placement shall be in accordance with this Section.
- C. Specifications shall be in accordance with Section 280 of the IDOT Standard Specifications.
- D. Locations shall be as shown on drawings.
- E. Additional locations may be required as determined in the field.

3.06 CONCRETE WASHOUT

- A. Maintaining washout facilities shall include removing and disposing of hardened concrete and/or slurry and retuning the facilities to a functional condition.
- B. Temporary concrete washout facilities are to be inspected during the weekly erosion and sediment control inspection, after a storm event of 1/2-inch or greater and at the end of any day when concrete has been poured on the construction site. The inspection is to verify that there are no leaks, no spills and that the facilities capacity has not yet been compromised.
- C. Any overflowing of the washout facilities onto the ground must be cleaned up and removed within 24 hours of discovery.
- D. If a rain or snow event is forecasted, a non-collapsing, non-water collecting cover shall be placed over the washout facility and secured to prevent accumulation and overflow of precipitation.
- E. Contents of each concrete washout facility are not to exceed 75% of its designed capacity. If the contents reach 75% capacity, discontinue pouring concrete into the facility until it has been cleaned out.

- F. Allow slurry to evaporate or remove from the site in a safe manner (i.e., vacuum truck). All hardened material can then be removed and disposed of properly.
- G. If a lined basin is used, immediately replace the liner if it becomes damaged.
- H. Remove temporary concrete washout facilities when they are no longer needed and restore the disturbed areas to their original condition.

3.07 STABILIZED CONSTRUCTION ENTRANCE

- A. Stabilized construction entrance shall be installed in accordance with the standard detail and the IDOT Bureau of Local Roads and Streets Manual Section 41-3.06(a).
- B. Stabilized entrance/exit shall be checked on a regular basis as it may require periodic top dressing.
- C. Any run-off must be routed through a sediment trapping measure.

3.08 FIELD QUALITY CONTROL

- A. Inspect erosion control devices at least once every seven (7) calendar days and within 24 hours of the end of a storm event that is 1/2-inch or greater or equivalent snowfall. Make necessary repairs so that erosion and sediment controls are in good working order.
- B. Maintenance of erosion control systems is incidental to the contract unit prices.

3.09 CLEANING

- A. Section 01 77 00—Execution and Closeout Requirements: Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.10 PROTECTION

- A. Section 01 77 00—Execution and Closeout Requirements: Requirements for protecting finished Work.

END OF SECTION

SECTION 31 32 19

GEOTEXTILES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Geotextiles for areas below structures, at perforated drain pipe trenches, pressure relief valves, below base course, and below riprap.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Geotextile below riprap shall be Mirafi 180N, or equal.
- B. Geotextile below base course shall be Mirafi 600X, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Geotextile shall be installed in accordance with manufacturer's recommendations.
- B. Geotextile shall be lapped a minimum of 24 inches.

- C. If extensive areas of unstable subgrade are encountered on street areas, ENGINEER may request the furnishing and installation of construction fabric to obtain the necessary subgrade support for the roadway structure. Vibratory compaction shall not be used in the compaction of base course in areas where construction fabrics are used.
- D. CONTRACTOR shall protect the construction fabric from exposure to the sun until installation. Construction fabric shall be covered with stone or soil immediately upon placement.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Furnishing and placing riprap.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Stone for riprap shall be durable quarry stone of approved quality. It shall be sound, hard, dense, resistant to the action of air and water, and free from seams, cracks, or other structural defects.
- B. Stone for riprap shall be in accordance with Standard Specifications, Section 1005.01 Gradation 4, Class A.

PART 3-EXECUTION

3.01 PREPARATION

- A. The bed for the riprap shall be properly trimmed and shaped before geotextile and stone is placed. Bed shall be minimum 6 inches thick.
- B. Geotextile shall be placed below riprap. See Section 31 32 19-Geotextiles.

3.02 INSTALLATION

- A. Riprap shall be provided in areas as designated on the Drawings.
- B. Stone placed above the water line shall be placed by hand. It shall be laid with close, broken joints and shall be firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with ends in contact.
- C. The riprap shall be thoroughly compacted as construction progresses, and the finished surface shall present an even, tight surface.
- D. The large stone shall be placed in the lower courses. Interstices between stones shall be chinked with spalls firmly rammed into place.
- E. Unless otherwise shown or specified, riprap shall be at least 18 inches in thickness, measured perpendicular to the slope.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Aggregate base course for roads and parking areas.
 - 2. Gravel roads.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall repair all roads, shoulders, and gravel areas damaged in accordance with this section. All paved areas shall also be repaired in accordance with Section 32 11 26—Hot Mix Asphalt Paving.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.03 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

1.04 SUBMITTALS

- A. Submit sieve analysis for proposed materials in accordance with Section 01 33 00—Submittals.

1.05 DRAINAGE DURING CONSTRUCTION

- A. CONTRACTOR shall comply with the provisions of Article 280 of the Standard Specifications.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 AGGREGATES

- A. Aggregate for base course shall consist of crushed stone and shall meet the requirements of Article 351 of the Standard Specifications. The material furnished shall be uniformly graded and shall conform to ASTM C33.
- B. Base course shall be uniformly graded and shall conform to the requirements of No. CA6.
- C. Material for top layer of shoulders shall meet the requirements of No. CA4.

PART 3-EXECUTION

3.01 PREPARATION

- A. The subgrade shall be graded and rolled to provide uniform density and shall comply with the profile and cross sections contained in the Drawings. All street subgrade in cut areas and all areas to receive fill shall be proof-rolled in the presence of OWNER or ENGINEER with a heavily loaded triaxle dump truck or similar equipment prior to the placement of any fill materials or base course. The subgrade shall be prepared in accordance with Article 301 of the Standard Specifications.

3.02 CONSTRUCTION

- A. Base course grade shall be set to allow placement of thickness of asphaltic pavement shown or specified.
- B. Depth of base course shall be provided according to the standard cross sections or details provided on the Drawings.
- C. Depth of base course shall be the existing depth or 12 inches, whichever is greater.
- D. Base course shall be placed directly on subgrade areas or on top of salvaged asphalt millings unless otherwise indicated on the Drawings.
- E. Each layer of base course shall be wetted and rolled to provide maximum compaction in accordance with Article 351.05 of the Standard Specifications.
- F. The finished base course shall be fine graded in preparation for paving.
- G. After final grading, CONTRACTOR shall maintain the base course until asphaltic paving work has been completed.

- H. All gravel surfaces damaged during construction shall be replaced. The depth of aggregate shall match existing or 12 inches, whichever is greater.

END OF SECTION

SECTION 32 11 26

HOT MIX ASPHALT PAVING

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes Hot Mix Asphalt (HMA) paving, prime coat, and casting adjustments.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. CONTRACTOR is cautioned that existing private and public roads and shoulders may not hold up to typical construction traffic or activities. CONTRACTOR shall replace all roads, shoulders, and paved areas damaged during the project in accordance with this section. Gravel shoulders, gravel roads, and parking areas shall be repaired in accordance with Section 32 11 23—Aggregate Base Course.

1.02 MEASUREMENT AND PAYMENT

- A. Payment: Payment for HMA paving shall be considered incidental to the project and included in the Lump Sum Bid.

1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.04 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, and parking lots.

1.05 SUBMITTALS

- A. Prior to the commencement of paving, mix designs and aggregate sieve analysis shall be submitted to ENGINEER for approval in accordance with Section 01 33 00—Submittals.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 HMA PAVEMENT

- A. HMA surface course shall be Mix "D," N50, with a mix type of IL 9.5 mm and percent air voids of 4% at 50 gyrations. HMA binder course shall be IL 19.0 mm, N50, with percent air voids of 4% at 50 gyrations. HMA binder shall have a PG binder grade of PG 64-28. HMA surface course shall have a PG binder grade of SBS-PG-76-28.
- B. Aggregate shall conform to the requirements of Article 406.02 of the Standard Specifications.
- C. Where existing pavement is replaced, minimum pavement thickness shall be 4 inches or existing thickness, whichever is greater. Lower layer shall be 2 1/4 inches minimum. Upper layer shall be 1 3/4 inches minimum.
- D. Materials for prime coat shall conform to the requirements of Article 406.02.
- E. Pavement markings shall conform to Section 780 for white markings, except without the reflective additive.

PART 3–EXECUTION

3.01 ALLOWABLE REMOVAL OF PAVEMENT

- A. CONTRACTOR shall remove asphalt pavement and road surface as a part of the general excavation. The width of pavement removed shall be the minimum possible and acceptable for convenient and safe installation of structures, utilities, and appurtenances.
- B. All asphalt pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation. Should the cut edge be damaged, a new cut shall be made in neat, straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement.

3.02 CASTING ADJUSTMENTS

- A. All new and existing manhole castings and valve boxes within the paving limits of the street, which require adjustment, shall be adjusted to match the finished asphaltic surface. Adjustments shall not be made greater than 48 hours prior to the anticipated time of paving. Adjustments shall be performed as called for in Section 33 00 10–Buried Piping and Appurtenances. CONTRACTOR shall furnish Class 1 barricades with flashers on all adjusted castings until paving has been completed. Tops of castings and valve boxes shall be oiled or protected by other methods to prevent sealing of lids and filling of lift holes during

paving. Upon completion of paving operations, CONTRACTOR shall check all castings and valve boxes to see that the lids are clean and operational. Manhole casting adjustment shall be included in the cost of other items of work, and no further compensation will be made. Valve box adjustment shall be considered an incidental item of work.

3.03 BITUMINOUS MATERIALS (TACK COAT AND PRIME COAT)

- A. All work shall be in accordance with the Standard Specifications, Article 406.05.
- B. If hot mix asphalt surface course is applied to an existing street or is not applied the same day as binder course, the existing street or binder surface shall be tack coated prior to surface paving. Prior to placement of tack coat, the streets shall be thoroughly cleaned and broomed according to Section 358 of the Standard Specifications. Tack coat shall be applied at a rate of 0.05 pounds per square foot.
- C. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement.
- D. Aggregate bases shall have a layer of prime coat applied prior to paving the binder course. The prime coat shall be applied at the rate of 0.25 pounds per square foot.

3.04 JOINTS

- A. Joints between old and new pavements or between successive day's work shall be constructed and treated to provide a thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. These joints shall be treated with prime coat material applied with a hose and spray nozzle attachment to fully coat the joint surface.
- B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the surface course shall at no time be placed immediately over similar joints in the binder course beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the binder course and the location of similar joints in the surface course above.
- C. All costs for furnishing and applying prime coat to butt joints as specified above shall be considered incidental.

3.05 FINISHING ROADWAY

- A. The finished base course shall be fine-graded in preparation for HMA paving. Base course ramps at all existing pavement shall be removed to provide a full depth butt joint. Base course around manhole castings and valve boxes shall be hand-trimmed and compacted with a vibratory plate compactor.
- B. This item shall include all of the following preparatory and finishing items and any other incidental items of work required for construction. Asphaltic ramps around manholes on existing binder course to receive surface course shall be removed. Asphaltic ramps shall be installed on all manholes and at all butt joints in areas to receive binder course only.

- C. Finishing roadway shall be considered incidental to HMA paving.
- D. Paint all markings as shown on Drawings with lines not less than 4 inches wide.

3.06 TESTING HOT MIX ASPHALT

- A. ENGINEER may require samples of HMA pavement for testing. CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area. Samples for sieve analysis and asphalt content will be taken by ENGINEER prior to placement.

3.07 HOT MIX ASPHALT PAVING

- A. HMA paving work shall include the construction of plant-mixed hot mix asphalt pavement in the areas shown on the Drawings. All work shall be performed in accordance with Section 406 of the Standard Specifications.
- B. Prior to commencement of paving operations, CONTRACTOR shall examine the finished road bed. CONTRACTOR shall notify ENGINEER of any areas of suspected instability.
- C. The pavement structure for streets, roadway, and parking lot construction shall be determined from the standard cross sections provided on the Drawings.

END OF SECTION

SECTION 32 16 13

CONCRETE CURB AND GUTTER, SIDEWALKS, AND DRIVEWAY APRONS

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes concrete curb and gutter, sidewalks, and driveway aprons as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 MEASUREMENT AND PAYMENT

- A. All costs of the Work shall be included in the Lump Sum Bid.

1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.
- B. AASHTO M148 Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

1.04 QUALITY ASSURANCE

- A. Unless otherwise specified, all curb and gutter, sidewalks, and driveway apron construction shall meet the requirements of the Standard Specifications.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 CONCRETE

- A. All concrete shall conform to Section 1020 of the Standard Specifications, Class SI air entrained.

2.02 CURING COMPOUND

- A. Liquid curing compounds shall conform to the requirements of the Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete, AASHTO Designation M148, Type 2, White Pigmented.

PART 3-EXECUTION

3.01 BASE PREPARATION-CURB AND GUTTER

- A. The base course beneath the curb and gutter shall be trimmed or filled as necessary to provide a full depth of curb and gutter. Prior to placement of concrete, the base shall be thoroughly compacted and moistened.

3.02 BASE PREPARATION-SIDEWALKS AND DRIVEWAYS

- A. The subgrade shall be thoroughly compacted and finished to a trim, firm surface. All soft or unsuitable material shall be removed and replaced with suitable material.
- B. A minimum 4-inch-thick layer of base course shall be placed under all sidewalks. This material shall be thoroughly moistened and compacted before the concrete is placed.

3.03 FORMS

- A. Forms shall be of metal and of sufficient strength to resist distortion or displacement. Metal forms shall be used to construct a curb and gutter cross section. Forms shall be full depth of the required work. Facing boards, if used, shall be built so as to obtain the cross section called for on the Drawings. Forms shall be securely staked and held firmly to line and grade. Forms shall be cleaned thoroughly and oiled before reuse.
- B. All curved curb and gutter shall form smooth curves and shall not be a series of chords. Radius forms shall be used for all curved curb and gutter where the radius of curvature is 100 linear feet or less.

3.04 PLACING AND FINISHING CONCRETE

- A. Unless otherwise specified, concrete shall be placed in accordance with the Standard Specifications.
- B. Concrete shall be thoroughly tamped to remove all voids. The exposed surfaces of the curb and gutter shall be thoroughly troweled and finished with a brush at right angles to the line of the curb and gutter. The back edge of the curb, the edge of the gutter adjacent to the pavements, and edges adjacent to expansion joints shall be rounded with a 1/4-inch-radius edger. Honeycombed areas along the back of the curb shall be pointed with mortar.

- C. Before final finishing of curb and gutter, a 10-foot straight edge shall be used to check the surface. Any areas showing a variation of more than 1/4 inch from the straight edge shall be corrected. Final finishing shall be delayed a sufficient time so that excess water and grout will not be brought to the surface.
- D. Concrete for sidewalk shall be placed to a minimum thickness of 5 inches, except at driveways and alleys, which shall have a minimum thickness equal to that of the driveway. Driveways shall have a minimum thickness of 8 inches. The concrete shall be thoroughly spaded and tamped to remove all voids. The surface of the driveway or sidewalk shall be thoroughly troweled and finished with a brush at right angles to the driveways or sidewalk line.

3.05 MACHINE FORMED CURB AND GUTTER

- A. CONTRACTOR may elect to use a machine for placing, forming, and consolidating concrete curb and gutter. If a machine is used, the resulting curb and gutter shall be of such a quality as to equal or exceed that produced by the method described above.

3.06 JOINTING—CURB AND GUTTER

- A. A 3/4-inch expansion joint filler shall be placed through the curb and gutter at the radius points of all intersection curbs. This expansion joint filler shall extend through the entire thickness of concrete and shall be perpendicular to the surface and at right angles to the line of the curb and gutter.
- B. At intervals of not more than 10 feet, a contraction joint shall be tooled to a depth of one-fifth of the total concrete thickness with a 1/4-inch-radius jointer. The contraction joint shall be at right angles to the line of the curb and gutter.
- C. If machine-formed curb and gutter is provided by CONTRACTOR, CONTRACTOR shall create a plane of weakness at all joints that is sufficient to cause contraction cracking at the joints.
- D. CONTRACTOR may saw contraction joints. The depth of cut shall be a minimum of one-fifth of the total concrete thickness. Sawing shall be done as soon as practicable after the concrete has set sufficiently to preclude raveling during the sawing and before any shrinkage cracking takes place in the concrete. If this method results in random cracking, CONTRACTOR will be required to tool the contraction joints as specified above.
- E. The use of steel separator plates will not be allowed.
- F. Jointing shall be included in the price bid for curb and gutter.

3.07 JOINTING—SIDEWALKS AND DRIVEWAYS

- A. Concrete sidewalk shall be cut into rectangular blocks approximately 5 feet long. The cut must extend at least one-fifth of the total thickness of concrete. The edges of the sidewalk along forms and joints shall be rounded with an edging tool of 1/4-inch radius. All joints shall be at right angles to the centerline of the sidewalk.

- B. Concrete driveways shall be jointed in approximately square sections. The depth of the joint and the finishing of the edges shall be the same as for concrete sidewalk.

3.08 EXPANSION JOINTS

- A. A 1-inch-thick expansion joint filler shall be placed between curb ramps and back of curb.
- B. A 3/4-inch-thick expansion joint shall be placed at all sidewalk corners, between sidewalks and buildings, and between back of curb and sidewalk.

3.09 SLOPE

- A. Sidewalk cross slope shall be 1/4 inch per foot unless otherwise noted in the Drawings or requested by ENGINEER.

3.10 CURB RAMP

- A. Curb ramps shall be constructed in accordance with Standard 424001-07/424006-01/424016-01/424021-02.

3.11 INLET CASTING ADJUSTMENT

- A. Inlet casting shall be adjusted to grade as required for the installation of the new curb and gutter. Inlet casting backs shall be adjusted for a depressed flow line at all inlets in the low points (0.72 feet); all other inlet shall be adjusted for a normal flow line (0.50 feet).

3.12 CURING

- A. As soon after finishing operations as the free water has disappeared, the concrete surface shall be sealed by spraying on it a uniform coating of curing material in such a manner as to provide a continuous water impermeable film on the entire concrete surface.
- B. The material shall be applied to form a uniform coverage at the rate of not less than one-half gallon per 100 square feet of surface area.
- C. Within 30 minutes after the forms have been removed, the edges of the concrete shall be coated with the curing compound applied at the same rate as on the finished surface.

3.13 PROTECTION OF CONCRETE

- A. CONTRACTOR shall erect and maintain suitable barricades to protect the new concrete. Where it is necessary to provide for pedestrian traffic, CONTRACTOR shall, at their own cost, construct adequate crossings. Crossing construction shall be such that no load is transmitted to the new concrete.
- B. Any part of the work damaged or vandalized prior to final acceptance shall be repaired or replaced at the expense of CONTRACTOR in a manner satisfactory to ENGINEER.
- C. Pedestrian traffic shall not be permitted over new concrete prior to 72 hours after application of curing material. Vehicular traffic shall not be permitted over newly placed concrete within 7 days after completion when temperatures are 70°F or higher, 10 days when temperatures

are not lower than 60°F and up to a maximum of 21 days when the temperatures are generally lower than 60°F.

3.14 CONCRETE TESTING

- A. Concrete shall be tested in accordance with Section 03 30 00—Cast-In-Place Concrete.

END OF SECTION

SECTION 32 17 23.13

PAVEMENT MARKINGS

PART 1–GENERAL

1.01 SUMMARY

- A. This section describes furnishing and installing pavement markings conforming to the State of Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Section 780 and as shown on the Drawings.

1.02 MEASUREMENT AND PAYMENT

- A. The cost of this shall be included in the Lump Sum Bid.

1.03 REFERENCES

- A. State of Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Section 780.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 PAVEMENT MARKINGS

- A. Provide thermoplastic pavement markings in accordance with State of Illinois Department of Transportation Standard Specifications for Road and Bridge Construction.

PART 3-EXECUTION

3.01 PAVEMENT MARKINGS

- A. Place markings in accordance with Section 780 of the Standard Specifications.
- B. Stop bars shall be 18 inches solid white. Parking stall markings shall be 4-inch solid yellow line.
- C. Markings shall be placed at locations noted within 1-inch tolerance.

END OF SECTION

SECTION 32 31 11

FENCE GATE OPERATOR

PART 1—GENERAL

1.01 SUMMARY

- A. Furnish and install a fence gate operator system as described herein and shown on the Drawings. System shall include all necessary control boards, power supplies, loop detectors, connectors and accessories for a complete and operational system. System shall be fully compatible with the gates specified in Section 32 31 13—Chain Link Fence.
- B. Related Sections and Divisions: Applicable Provisions of Division 01 shall govern Work in this section.

1.02 REFERENCES

- A. ASTM F2200—Standard Specification for Automated Vehicular Gate Construction.
- B. UL 325—Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.03 QUALITY ASSURANCE

- A. Installation shall comply with all applicable codes.
- B. All equipment shall be new, in current production, and the standard products of a manufacturer of vehicular gate operator equipment.
- C. Manufacturer shall demonstrate features, functions, and operating characteristics.
- D. System shall be installed by a factory authorized CONTRACTOR with technicians trained in this system.

1.04 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01 33 00—Submittals.
- B. Submittals shall include an equipment list, datasheet(s), system description, block diagrams on equipment to be furnished, manufacturer's instructions, and electrical wiring diagrams for installation. Wiring diagrams shall be project-specific and comprehensive including device labels, point-to-point interconnections within control panels, and all interconnections between panels and remote devices. Drawings shall show all field wiring and communication interfaces along with project-specific wire/cable numbering that can be used by Division 26 for labeling field-installed wiring.
- C. Submittals shall include all data necessary to evaluate design, quality, and configuration of proposed equipment and system(s).

1.05 WARRANTY

- A. Gate operator shall be provided with a minimum 5-year warranty.

1.06 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
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PART 2—PRODUCTS

2.01 MANUFACTURER

- A. The Drawings and Specifications were prepared based on DoorKing, Inc. CONTRACTOR shall include in the Bid, and shall be responsible for, the cost of any changes to accommodate other equipment, including, but not limited to, structural and electrical work. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

2.02 FENCE GATE OPERATOR

- A. The fence gate operator shall use a microprocessor based solid-state control board that controls the functions of the fence gate operator. Operator shall be rated for continuous duty for use in commercial and industrial applications. Operator shall include the following features/functions as a minimum:
 - 1. Auto-close on/off selection with adjustable auto-close timer.
 - 2. Fail-secure on/off selection.
 - 3. Equipped with ports for plug-in loop detectors.
 - 4. Dry contacts rated for 1A at 120 VAC each to indicate gate is in the fully closed and fully open positions.
- B. A primary reduction system shall use an adjustable clutch and power transfer shall be provided by a single cog belt drive train.
- C. Fence gate operator shall use magnetic sensing to set open and close limit adjustments. Mechanical type limit switches will not be allowed.

- D. Fence gate operator shall automatically set both open and close limit adjustments upon power up and activation in the open direction. Operator shall automatically sense gate coasting.
- E. A pulling medium shall provide a positive mechanical connection to the gate system. Friction driven rail-type pulling mediums will not be allowed. A positive dead bolt shall activate only when the gate is forced open. Chain shall be minimum No. 40 nickel plated. Provide chain tray for gates longer than 20 feet.
- F. Primary and secondary entrapment detection shall be utilized to prevent persons from becoming entrapped in the gate system. Entrapment detection sensors shall automatically cause the gate operator to stop and reverse if an obstruction is sensed during the open or close cycle.
- G. Fence gate operator shall be capable of being mounted at the front, center, or rear of the gate system, shall be designed for either left- or right-hand mountings, and shall be designed for pad or post mounting.
- H. Fence gate operator frame shall be minimum 12 gauge G90 galvanized steel and shall be painted charcoal gray.
- I. Fence gate operator shall be capable of moving a 1,500-pound maximum gate weight and a 45-foot maximum gate length, and operate using 115 VAC, single-phase, with approximately 10-in/sec gate speed. Fence gate operator shall have two 115 VAC convenience outlets available for accessory transformer power and shall have a built-in lockable on/off switch and reset switch.
- J. Fence gate operator shall include gate control board with the following features/functions:
 - 1. Connections for optional system that tracks gate operations.
 - 2. Allows a stop or stop and reverse function (settable) from the access control system.
 - 3. Two ports for connection of plug-in vehicular loop detectors.
 - 4. One set of dry normally-open/normally-closed auxiliary contacts shall be available for external use.
 - 5. Separate inputs for external contact and noncontact entrapment protection devices.
 - 6. Functions shall be user programmable by DIP switches located on the control board. Provide NEMA 4X enclosure for control boards.
- K. Fence gate operation shall be monitored through optional gate tracker boards with the following features/functions:
 - 1. Provides power and inputs for 26-bit Wiegand devices.
 - 2. Records operator cycles, input errors, loop detector errors, obstruction hits, forced entry attempts, and power up events. Records shall be time and date stamped.
 - 3. Installed in a lockable, weather resistant cabinet, sized as required. Cabinet shall be factory pre-wired.
 - 4. Gate tracker boards shall be DoorKing, Inc., part number 2351-080, or equal.
- L. Vehicle loop detectors shall consist of plug-in modules that connect to the gate operation control board, loop lead-in cables, and underground loop wire. Fence gate operator shall include vehicle loop detectors with the following features/functions:
 - 1. Diagnostic LEDs for monitoring operation of the physical loop system and terminal strips for connection of loop lead-in cables.

2. Loop lead-in cable shall be shielded twisted pair installed in accordance with manufacturer's recommendations.
 3. Underground loop shall be made from a continuous loop wire without splices, coiled for number of turns recommended by manufacturer. Underground loop wire shall be 18 AWG cross linked XLPE-insulated wire installed in accordance with manufacturer's recommendations.
 4. Single or dual channel loop detectors as required to provide reverse and exit loops as shown on the Drawings.
 5. Loop detectors shall be DoorKing, Inc., part numbers 9410 (single channel) and 9409 (dual channel), or equal.
- M. Fence gate operation shall be fail-safe.
- N. Provide heater kit by DoorKing, part number 1601-154, or equal.
- O. Provide a keyed two-position selector switch to enable/disable gate operation. Keyed switch shall be DoorKing, part number 1206, or equal.
- P. Fence gate operator system shall be manufactured by DoorKing, Inc., model 9150, or equal.

2.03 GATE CONTROL ACCESSORIES

- A. Entrapment Protection Devices:
1. Include noncontact, electronic obstruction sensors and contact sensors as required to meet UL 325 safety standards. Sensing devices shall be monitored by the fence gate operator.
 2. Sensing edges by MillerEdge, part number MGS20, or equal.
 3. Photoeye by EMX, part number IRB-MON, or equal. Photoeye shall include powder coated steel protective hood, part number IRB-SH-SET, and water-tight strain relief, part number IRB-SP.
- B. Provide convenience open drive system to open the gate one time if the primary (AC) power fails.
- C. Access Control System Accessories: Gooseneck mounting stand shall be dual height, 42 inches tall to lower mounting plate, 72 inches tall to upper mounting plate. Dual height mounting stand shall be DoorKing, part number 1200-049, or equal. Provide weatherproof housing and mounting plate, as required, for all access control devices on the mounting stand.
- D. Provide a fire department lock box to override the access control system and allow emergency personnel access to the site. Lock box shall be DoorKing, part number 1401, or equal.
- E. Provide an informational sign on the gate notifying the driver of OWNER's contact information to gain entry. Sign shall be high impact polystyrene or fiberglass, minimum 36 inches wide by 24 inches high, with white background and black lettering. Text shall be determined by OWNER. Provide stainless steel mounting hardware as needed.

PART 3–EXECUTION

3.01 GATE CONTROLS

- A. The west and east entrance gates (G-01-01 and G-01-02) shall be controlled using the associated card reader, dry contact from the SCADA System, fire department lock box, exit loop, and entrapment detection devices as follows:
 - 1. If a valid access code from the card reader is received by the access control system through the access control system, if the exit loop is activated, if a request to open signal is received from the fire department lock box or if a request to open is received from the SCADA System, the gate shall open. The gate shall remain open until the entrapment safety loops on both sides of the gate detect that the vehicle has cleared the gate closure area and the gate close timer (0 to 90 seconds) has timed out.
 - 2. The gate operator audible alarm shall annunciate for 5 seconds prior to the gate opening and during gate travel.
 - 3. The gate operator shall be equipped with a photoeye and sensing edge to detect obstructions. If the photoeye or sensing edge detect an obstruction in the gate closure path, an audible alarm shall sound, the gate shall open, and the gate shall remain open for an adjustable timer (0 to 90 seconds) before trying to close again. If an obstruction is still present, the gate shall cycle through the timer again and continue this close-attempt sequence until the gate can fully close.
 - 4. Coordinate control functionality of the fire department lock box with the local fire department.
- B. Card reader devices shall be provided by the OWNER.

3.02 INSTALLATION

- A. Controls intended for user activation must be located at least 10 feet away from any moving part of the gate and where the user is prevented from reaching over, under, around, or through the gate to operate the controls.
- B. Physical gate stops shall be installed to stop the gate in the open and closed positions before installation of the fence gate operator.
- C. Provide all devices required to regulation UL 325 Class III entrapment protection even if these devices are not specifically identified on the Drawings.
- D. Fence gate operator and gate control system shall in accordance with manufacturer's recommendations and be installed by a qualified technician.
- E. CONTRACTOR shall provide all conduits, junction boxes, pull boxes, and other enclosures as required. Furnish and install all wiring for fence gate operator and all gate control system appurtenances in accordance with manufacturer's recommendations. Conduit protruding from poured concrete or soil shall be PVC coated rigid in accordance with Section 26 05 33–Conduit. Junction and pull boxes exposed to weather shall be stainless steel. All flexible conduit shall be liquid-tight in accordance with Section 26 05 33–Conduit.
- F. It is understood that this work shall include initial tests and adjustments necessary to establish and modify performance of the fence gate operator and gate control system as required to provide adequate site security.

- G. Gate operator shall be installed on a concrete pad in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCE

PART 1–GENERAL

1.01 SUMMARY

- A. Work includes providing all PVC-coated steel chain link fencing and gates complete, as shown on the drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A121–Zinc-Coated (Galvanized) Steel Barbed Wire.
- B. ASTM A121–Metallic Coated Steel Barbed Wire.
- C. ASTM A392–Zinc-Coated Steel Chain-Link Fence Fabric.
- D. ASTM A428–Weight of Coating on Aluminum-Coated Iron or Steel Articles.
- E. ASTM A491–Aluminum-Coated Steel Chain Link Fence Fabric.
- F. ASTM A1011–Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- G. ASTM F567–Installation of Chain-Link Fence.
- H. ASTM F626–Fence Fittings.
- I. ASTM F900–Industrial and Commercial Swing Gates.
- J. ASTM F1043–Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
- K. Chain Link Fence Manufacturers’ Institute (CLFMI)–Product Manual.

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product’s value to be included in the BABA de minimis log. Refer to Section 01 41 00–Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 POSTS, RAILS, AND BRACES

A. Construction:

1. All posts and rails shall be either tubular pipe conforming to ASTM F1043 Group 1A, Schedule 40 with a Type A zinc coating, or Group 1C cold-formed and welded pipe with a Type B zinc coating. Provide black PVC coating over all posts, arms rails, wires, supports, and appurtenances.
2. Post sizes shall be in accordance with the following:

LINE POSTS (MAXIMUM 10 FEET SPACING)

Height and Fence Type	Post Type	O.D. (IN.)	Weight (PLF)
6 feet or less	Group 1A	1.90	2.72
Up to 8 feet	Group 1A	2.375	3.65
Up to 10 feet with no wind screen or hardware cloth or privacy inserts	Group 1A	2.875	5.79
Up to 10 feet with wind screen, hardware cloth or privacy inserts	Group 1A	4.0	9.10

CORNER AND BRACE POSTS

Height and Fence Type	Post Type	O.D. (IN.)	Weight (PLF)
7 feet or less	Group 1A	2.375	3.65
8 feet or 10 feet without wind screen, hardware cloth or privacy inserts	Group 1A	2.875	5.79
10 feet with wind screen, hardware cloth or privacy inserts	Group 1A	4.0	9.10

3. Gate posts shall conform to manufacturer's specifications for various width gates. Minimum sizes shall be as follows:

GATE POSTS

Leaf Width	Post Type	O.D. (IN.)	Weight (PLF)
6 feet or less	Group 1A	2.875	5.79
7 feet to 13 feet	Group 1A	4.0	9.10
14 feet to 18 feet	Group 1A	6.625	18.97

4. Terminal posts shall be braced with the same material as top rail and trussed to line posts with 3/8-inch-diameter rods and tightened. One brace assembly shall be provided with each end or gate post and two assemblies with each corner or pull post.
5. Rails shall be 1 5/8 inch OD Group 1A 2.27 pound per foot or Group 1C 1.84 pounds per foot pipe.

B. Line Posts: Line posts may not be driven posts.

C. Required Arms, Rails, and Tension Wires: Provide rampart arm, top rail, intermediate rail, and bottom rail bottom tension wire.

2.02 FABRIC

A. Construction:

1. Fabric to be No. 9 gauge steel aluminum-coated steel wire woven in a 2-inch mesh; top selvage to have barbed finish, bottom selvage to be knuckled.
2. Fabric height shall be 6 feet, unless otherwise noted on the Drawings.
3. The designated height of the fence shall be the fabric height.
4. Fasteners:
 - a. Fasteners shall be PVC-coated steel wire clips and tie wires in accordance with ASTM A-641 Class III or aluminum coat in conformance with fence fabric specifications.
 - b. Provide fasteners for posts, top and intermediate rails, bottom rails, top tension wires, and braces of 9 gauge steel or 0.179-inch-diameter aluminum tie wires.
 - c. Provide fasteners for bottom tension wire of not smaller than 12 gauge, or 0.149-inch-diameter aluminum tie wires.
5. All fabric, fasteners, and appurtenances shall have black PVC coating.

2.03 GATES

A. General:

1. Provide additional horizontal and vertical members as necessary to provide proper gate operation and attachment to fabric and hardware.
2. Provide diagonal braces made of crossed adjustable length 3/8-inch-diameter truss rods on nonwelded gate frames and on welded frames where corner rigidity is not sufficient to prevent sag.
3. Gate frames shall be covered with the same fabric as the fence.
4. Weld or assemble gate frames with malleable or pressed steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges. Attach to frame at 15 inches o.c. all sides. Provide caps for all gate frame work ends.
5. All gates, manddoors, and appurtenances shall have black PVC coating.

B. Gate Hardware:

1. Provide heavy-duty hinges of malleable iron, pressed or forged steel, nonlift-off type, adjusted to permit 180-degree gate opening. Provide two hinges for each leaf.
2. Provide heavy-duty forked-type or plunger bar-type latches for all single-leaf gates. Provide center stop and keeper for all double-leaf gates. Provide spring latch for all sliding gates. Provide padlock eye as an integral part of all latches.
3. Provide heavy-duty track, ball bearing hanger sheaves framing and supports, guides, stays stops, and bracing necessary for sliding gates.
4. All gate hardware shall have black PVC coating.

2.04 ACCESSORIES

- A. General: All accessories, except tie wires and barbed wire, shall be galvanized to comply with ASTM F626. All accessories shall also have black PVC coating.
- B. Barbed Wire:
 - 1. Provide three strands of barbed wire at top of fence.
 - 2. Barbed wire shall be 2-strand, 12 1/2 gauge wire with 14 gauge, 4-point round barbs spaced approximately 5-inch o.c.
 - 3. Finish shall be galvanized to meet ASTM A 121, Class 3 or aluminized to meet ASTM A 585, Class 2.
- C. Barbed Wire Supporting Arms:
 - 1. Arms shall be heavy pressed steel complete with provisions for anchorage to tubular end, corner, and pull posts attaching three rows of barbed wire to each arm.
 - 2. Arms not required on roll formed terminal posts.
 - 3. Single arms shall be integral with a post top weather cap.
 - 4. Intermediate arms shall have hole for passage of top rail.
 - 5. Arms shall be capable of withstanding, without failure, 250 pounds of downward pull at outermost end of arm.
- D. Post Tops:
 - 1. Material shall be pressed steel or malleable iron.
 - 2. Top shall be weathertight.
 - 3. Top shall permit passage of top rail.
- E. Stretcher Bars:
 - 1. Stretcher bars required for tubular end, corner, pull, or gate posts.
 - 2. Bars shall be one-piece lengths equal to full height of fabric with minimum cross section of 3/16 inch by 3/4 inch.
 - 3. Provide one stretcher bar for each gate and end post and two stretcher bars for each corner and pull post.
- F. Stretcher Bar Bands:
 - 1. Material shall be heavy pressed steel.
 - 2. Spacing shall be 15 inches maximum o.c. to secure stretcher bar to tubular end, corner, pull, and gate post.
- G. Ground Rods: Provide a 1/2-inch-diameter 6-foot-long copper clad rod to provide a ground. Provide one for each 1,000 feet of fence and one for each separated fence section.

2.05 CONCRETE

- A. Concrete shall be Type A or A-FA, as specified in Section 03 30 00—Cast-In-Place Concrete.

PART 3—EXECUTION

3.01 SITE WORK

- A. Prior to fence construction, remove and dispose of all trees, brush, logs, stumps, and other debris for a width of at least 12 inches each side of the proposed fence alignment.

3.02 CONCRETE FOOTINGS

- A. Excavate holes for footings to neat dimensions in firm ground so that the post will be centered. Remove rock or other obstructions encountered to the required depth. Use forms in unstable soil, and allow them to remain in place for at least 24 hours after concrete is poured. Backfill, after forms are removed, with suitable material thoroughly compacted in place in layers to prevent settlement.
- B. Footings shall be 4 feet deep and 18-inch minimum diameter. The bottom of the post shall be 3 inches above the bottom of the hole. Corner, gate, and end post bases shall be 24-inch minimum diameter. Gate posts larger than 4 inches o.d. shall have a base with a minimum diameter of 18 inches. Concrete bases shall be domed at the post and have a smooth troweled finish. Concrete footings shall cure for seven days before placing tension wires.

3.03 POSTS AND BRACES

- A. Set posts in a vertical position at the required location and alignment. Set tops at the required elevation to provide a smooth profile at the top rail or tension wire without abrupt changes and in conformity with the general contour.
- B. Place an end post at each end of each run of fence. Place a corner post whenever a break of 30 degrees or more occurs in the horizontal alignment. Set an intersection post in line with an intersecting chain link fence and brace it to the adjacent posts of the intersecting fence.
- C. Place an intermediate-braced post where the vertical alignment changes by more than 5 degrees, or a change in fence grade of more than 9% occurs.
- D. Place an intermediate braced post at 660-foot intervals for fence with a top rail and at 1,000-foot intervals for fence with a top tension wire on all long runs of fence. Set an intermediate brace post at the approximate midpoint when runs of fence are less than 1,320 feet but more than 660 feet for fence with top rail, or less than 2,000 feet but more than 1,000 feet for fence with top tension wire.
- E. Where driven posts are specified, all end, corner, gate, and brace posts must be set in concrete. Driven posts shall be driven a minimum of 32 inches into undisturbed soil.

3.04 POST BRACING ASSEMBLY

- A. Post bracing assemblies consist of one or more brace rails and a 3/8-inch truss rod as hereafter specified. Provide brace rails the same size as the top rail. Provide truss rods with an adjustable take-up adapter.
- B. Install a single bracing assembly at each gate and end post location.
- C. Install a double bracing assembly at each corner post and all intermediate braced posts.
- D. Provide the bracing assembly with one horizontal brace rail and one diagonal truss rod on all fences which have a top rail. Locate the horizontal brace rail in accordance with the manufacturer's specifications.

- E. Provide the bracing assembly with one horizontal brace rail and one diagonal brace rail and one diagonal truss rod on all fences which do not have a top rail. Locate the horizontal rail in accordance with the manufacturer's specifications.

3.05 STRETCHER BARS

- A. Provide one stretcher bar for each gate and end post and two for each corner and pull post, except roll form posts with integral loops. Attach to posts with heavy-duty pressed steel or malleable iron bands spaced at 15 inches o.c.

3.06 GROUND RODS

- A. Connect at least three fence wires to the ground rod by clamping, bolting, or brazing. Ground rod shall be installed on line with fence.

3.07 FABRIC

- A. Install, stretch, and anchor tension wires to each end, corner, gate, and brace post and properly attach to each line post before the fabric is placed. Pass top tension wire (when required) through the post top rail opening. Install top, intermediate, and bottom rails at proper locations.
- B. Hang fabric on the inside playing/secure side of all installations at running tracks, baseball diamonds and tennis courts.
- C. Attach the end of the fabric to the end, corner, gate, or brace posts (except roll form posts with integral loops) by means of a stretcher bar threaded through the end loops of the fabric and stretched to remove all slack with proper stretching equipment. Secure the stretched fabric to posts, rails, and tension wires with specified fabric fasteners. Install fabric fasteners on all posts at not greater than 14 inches o.c. and on rails and bottom tension wires at not more than 24 inches o.c. Where a top tension wire is installed, fasten to the fabric at not more than 18 inches o.c.
- D. Repeat stretching operations at approximately every 100 feet for each run of fence.
- E. Make splices in fabric by interweaving a wire picket through each end loop of each piece of fabric. Each splice shall be subject to ENGINEER's review.

3.08 GRADE CLEARANCE

- A. For fences around the playground, provide a clearance of 1 inch.
- B. For security fence installations, install the fence with 1/2 inch clearance.

3.09 GATES

- A. Install gates plumb and level and adjust for smooth operation as intended without binding or hanging up.

3.10 BARBED WIRE

- A. Install barbed wire properly fastened to the rampart arms.

3.11 CLEANUP

- A. After chain link fence construction is completed, clean up all storage and work areas. Replace or repair, as required, all landscape features damaged or disturbed under this Contract.

END OF SECTION

SECTION 32 92 00

RESTORATION

PART 1-GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Placement of topsoil.
 - 2. Seeding.
 - 3. Fertilizer.
 - 4. Mulching.
 - 5. Maintenance.
- B. All areas disturbed by Work shall be restored. Backslopes adjacent to the sidewalk shall be seeded to the slope intercept. Borrow sites and disposal sites will not require seeding, but they shall be graded smooth.
- C. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- D. Payment: Payment for restoration shall be at the Lump Sum Price Bid. Costs for topsoiling, seeding, fertilizer, mulching, and maintenance of restored areas shall be included in the lump sum price bid. One percent of the total Contract price shall be retained following project completion until a uniform 2-inch growth of vegetation is established over all restored areas.

1.02 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications.

1.03 QUALITY ASSURANCE

- A. All work shall be in accordance with Standard Specifications, unless noted otherwise.

PART 2-PRODUCTS

2.01 TOPSOIL

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, stones greater than 3/4 inch in size, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.
- B. Topsoil from the site may be used if it meets the above requirements.

2.02 SEED

- A. Seed mixture shall be Class 2 per Article 250.07.

2.03 FERTILIZER

- A. Fertilizer shall be as specified in Article 250.

PART 3—EXECUTION

3.01 TOPSOIL

- A. Placing topsoil shall be in accordance with Article 211 of the Standard Specifications. Topsoil shall be placed to a uniform depth of 6 inches in place. Topsoil placement shall be incidental to sodding or seed, fertilizer, and mulching.

3.02 SEEDING

- A. Seeding shall be performed in accordance with Article 250 of the Standard Specifications.
- B. Seed shall be applied at the rates specified in Article 250 of the Standard Specifications.

3.03 FERTILIZER

- A. Fertilizer shall be applied per Article 250 of the Standard Specifications.

3.04 MULCHING

- A. All areas receiving seed shall be mulched.
- B. Mulching shall be performed in accordance with Method 2, Procedure 1 of Article 251 of the Standard Specifications.

3.05 MAINTENANCE

- A. Seeding/sodding shall proceed concurrently with construction. Seeding/sodding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.
- B. Mow sod at regular intervals to maintain at a maximum height of 2 1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- C. Immediately remove clippings after mowing.
- D. Water to prevent seed/sod and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which fail to show adequate catch. Bare spots shall not exceed 5 square feet in area and not exceed 3% of the total seeded areas.

- H. Immediately replace sod in areas which show bare spots or deterioration.
- I. Protect seeded areas with warning signs during maintenance period.
- J. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding or resodding if damage occurs prior to acceptance of work.

END OF SECTION

SECTION 33 00 10

BURIED PIPING AND APPURTENANCES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All underground piping, valves, and appurtenances of every description.
 - 2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
 - 3. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 4. Underground piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section. CONTRACTOR shall comply with the American Iron and Steel (AIS) requirements of the Consolidated Appropriations Act of 2014 as presented in Section 01 41 00—Regulatory Requirements, Paragraph 1.08.
- C. Measurement and Payment: Payment for all work, including materials, equipment, and miscellaneous items necessary to complete the installation, will be included in the Lump Sum Bid.

1.02 REFERENCED SPECIFICATIONS

- A. Standard Specifications for Water and Sewer Construction in Illinois, current edition, referred to herein as SSWSC.
- B. Illinois Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition, including all issued supplemental specifications, referred to herein as SSRBC.
- C. Engineering Design Criteria for the City of Rockford, Illinois.
- D. Water Distribution System Design and Specifications for the City of Rockford, Illinois.
- E. City of Rockford Water Distribution System Design and Specification Detail Drawings. Hard copies of the Standard Details are available at City Hall and at the following address: <https://rockfordil.gov/309/Design-Construction>

1.03 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.

- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved “or-equal” in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved “or-equal” request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2–PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials in contact with water to be used for potable water supplies shall be National Sanitation Foundation (NSF)-approved.
- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
 - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Materials provided shall be suitable for the conditions in which they are being installed and used. CONTRACTOR shall review installation requirements of the Contract with material suppliers and incorporate any additional installation requirements necessary to meet the required use within the price bid for the Work.
- D. All pipe and materials used in performance of the Work shall be clearly marked as to strength, class, or grade. Pipe and materials not so marked shall be subject to rejection.
- E. When requested by ENGINEER, material suppliers shall furnish certificates of compliance indicating that all tests required by various Standards have been conducted and that the test results comply with the Standards.
- F. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by ENGINEER.

2.02 MANHOLES AND UNDERGROUND UTILITY STRUCTURES

- A. Unless otherwise specified, all manholes shall be reinforced concrete precast manholes. Reinforced concrete manhole base sections, riser sections, cones, and flat slabs shall conform to the requirements of ASTM C478. Solid precast manhole bottoms shall be provided. Manholes shall be provided with minimum diameters as necessary.
- B. Manhole top sections shall be precast reinforced eccentric cones unless precast reinforced flat slabs are necessary because of shallow depth. Flat slabs shall have opening offset unless otherwise required or shown. Flat slabs shall be designed for HS20 loadings.

- C. Plastic Manhole Chimney Adjusting Rings:
1. Manhole adjusting rings shall be injection molded-recycled HDPE as manufactured by Ladtech, Inc., or expanded polypropylene as manufactured by Cretex Specialty Products.
 2. CONTRACTOR shall supply ring materials, adhesive, labor, and equipment to permanently install the rings in strict accordance to manufacturer's recommendations. Manhole casting rims within roadways shall be set 1/4 inch to 1/2 inch below finished pavement grade. Ring inside diameter shall be 24-inch nominal, or larger to match frame.
 3. CONTRACTOR shall have all ring sizes available when rebuilding tops of manholes, including tapered sections to allow for seamless adjusting of frame elevations on flat and sloped surfaces.
 4. Concrete adjusting rings shall not be used for manhole adjustments. Substitute plastic adjusting rings for concrete rings.
- D. Precast Reinforced Concrete Manholes and Catch Basins (for non-water main):
1. Lengths of manhole riser (barrel) shall be furnished in such combinations as to conveniently make up the depth of the manhole. A maximum of two handling holes per length of riser will be permitted.
 2. The interior bottom of storm sewer manholes shall be constructed of concrete benches which shall be precast or poured in place in the field. Benches shall extend to the top of each pipe to a maximum height of 42 inches. Flow lines shall be made smooth with uniform curves to promote flow through the manhole.
 3. All joints between manhole pipe sections and top shall be tongue and groove conforming to ASTM C443. Manhole joints shall be sealed with circular O ring or preformed flexible joint sealant that shall be Ram-nek, Kent-Seal, Mas-stik, or equal.
 4. Manhole connections for storm sewer mains and leads may be made with cast-in-place concrete during completion of manhole interior.
 5. Manholes shall be furnished of minimum diameters. Manholes shall be furnished large enough to provide a minimum distance, between adjacent pipe, measured tangentially along the inside face of the manhole, equal to one half the outside diameter of the intersecting sewer pipe. In any event, manholes shall be furnished in the diameter necessary to accommodate intersecting sewer pipe and the pipe to manhole connection as proposed for use.
 6. Precast reinforced concrete manhole risers and tops shall be tested in accordance with ASTM C497. Precast reinforced concrete manhole risers and tops meeting the strength requirements will be considered acceptable and shall be stamped with an appropriate monogram. When requested, copies of test reports shall be submitted to ENGINEER before the manhole sections are installed in the Project. Final acceptance will be made after field inspection upon delivery to the jobsite.
 7. Precast reinforced concrete manhole sections shall be subject to rejection for failure to conform to any of the requirements of the Standard Specifications. In addition, individual sections of manhole risers and tops may be rejected because of any of the following reasons:
 - a. Fracture or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
 - b. Defects that indicate imperfect proportioning, mixing, and molding.
 - c. Surface defects indicating honey combed or open texture.
 - d. Damaged ends, where such damage would prevent making a satisfactory joint.
 - e. Manhole steps out of line, or not properly spaced.
 - f. Noticeable infiltration into manhole.

- g. Variation in diameter of the manhole section of more than 1% from the nominal diameter.
 - h. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more regardless of position in the section wall.
- E. Each precast reinforced concrete manhole riser and top section shall be clearly marked with the name or trademark of the manufacturer and the date of manufacture. This marking shall be indented into the manhole section or shall be painted thereon with waterproof paint.
- F. Manhole Catch Basin and Inlet Castings (for non-water main):
 - 1. All manhole and inlet castings shall be gray iron and meet the requirements of ASTM A48. Unless otherwise shown on the Drawings, standard manhole castings shall be Neenah R-1550-A with machined frame, Type B solid lid, concealed pick holes and self-sealing gaskets, East Jordan Iron Works, or equal. Floodproof castings shall be Neenah R-1916-C with machined frame, type B solid lid, concealed pick holes and self-sealing gaskets, East Jordan Iron Works, or equal.
 - 2. Catch basin and inlet castings shall be Neenah R-1550-A with Type D open grate, East Jordan Iron Works, or equal.
 - 3. Catch Basin and Inlet castings for locations with curb and gutter shall be Neenah R-3067 with type L grates on slopes and type R grates at low points, East Jordan Iron Works, or equal. For driveway areas, inlet castings shall be Neenah R-3290 with Type C grates, East Jordan Iron Works, or equal.
 - 4. Interior mud basin castings shall be Neenah R-6118 with grey iron Class 35 frame and grating for heavy duty use, East Jordan Iron Works, or equal.
- G. Mortar: Mortar shall meet the requirements of ASTM C270. Mortar shall be one part Portland cement and 2 1/4 parts washed mortar sand.
- H. Preformed Flexible Joint Sealant: Preformed flexible joint sealant shall be EZ Stik, Kent Seal, Ram Nek, or equal, meeting the requirements of ASTM C990.
- I. O-Rings: O-rings shall meet the requirements of ASTM C443.
- J. Storm Sewer Inlets: All inlets shall meet the requirements of ASTM C913. Construction shall conform to Drawing 01-975-41A. Inlets shall be constructed of precast concrete.
- K. Masonry:
 - 1. Concrete block shall meet the requirements of ASTM C139.
 - 2. The face size of stretcher units shall be 7 5/8 inches by 15 5/8 inches. Variations in the face size shall be within the limits permitted by the above standards. Special shapes and sizes shall be furnished and installed as necessary.
 - 3. Sewer brick shall conform to ASTM C32. All sewer brick shall be Grade SS and manhole brick shall be Grade MS. Sewer brick shall be installed as shown on the Drawings furnished by ENGINEER and as required in the construction of sewer appurtenances.
- L. New Water Manholes:
 - 1. Manholes shall be provided for all exterior water valves.
 - 2. General: All provisions the City of Rockford Standard Detail: Manhole Type A (DTL MH/2009), enclosed in these specifications, except those contrary to provisions delineated herein or on the Drawings shall apply to manholes.

3. Unless otherwise specified or shown on the Drawings for special manholes, all manholes shall be reinforced concrete precast manholes. Reinforced concrete manhole base sections, riser sections, cones, and flat slabs shall conform to the requirements of ASTM C478. Solid precast manhole bottoms shall be provided except where shown on the Drawings.
4. Manhole top sections shall be precast reinforced eccentric cones unless precast reinforced flat slabs are specifically required or shown on the Drawings. Flat slabs shall have opening offset unless otherwise required or shown. Flat slabs shall be designed for HS20 loadings.
5. Manhole Chimney Adjusting Rings:
 - a. Provide concrete manhole adjusting rings.
 - b. Precast concrete adjusting rings for standard manholes shall have an inside diameter of 26 inches, be not less than 2 inches nor more than 6 inches high, and shall have a wall thickness of 6 inches unless otherwise specified. The rings shall contain a minimum of one No. 2 reinforcing rod centered within the ring. The joints between rings and between rings and castings shall be sealed with preformed flexible joint sealant as specified herein.
6. Manhole Castings: Frames for valve manholes shall be Neenah R 6065 with Type B lid, R 5900 F with Type C lid with two concealed pickholes equipped with self sealing gaskets, or equal.
7. Mortar: Mortar shall meet the requirements of ASTM C270. Mortar shall be one part Portland cement and 2 1/4 parts washed mortar sand.
8. Preformed Flexible Joint Sealant: Preformed flexible joint sealant shall be EZ Stik, Kent Seal, Ram Nek, or equal, meeting the requirements of ASTM C990.
9. O Rings: O rings shall meet the requirements of ASTM C443.

2.03 BURIED PIPING

A. Ductile Iron Piping and Fittings:

1. Unless otherwise shown or specified, all underground piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51 with mechanical joints or push-on joints. Unless otherwise shown or specified, all piping shall be minimum Special Thickness Class 52 up to 12-inch and 51 for pipes larger than 12-inch with a water hammer allowance of 100 psi. Additional pipe wall thickness shall be furnished as required by AWWA C150 for buried piping with the depth of cover as shown on the Drawings when using laying condition 4 of AWWA C600 or the Class C Bedding Detail.
2. Each pipe and fitting shall have the weight, class or nominal thickness, country where cast, casting period, manufacturer's mark, the year in which the pipe was produced, and the letters DI or DUCTILE cast or stamped thereon. Improper or incomplete marking will be cause for rejection of the pipe or fitting.
3. CONTRACTOR shall furnish certification data representing each class of pipe or fitting furnished. The certification report shall clearly state that all pipe and fittings furnished meet the appropriate AWWA specification. Ductile iron pipe shall consist of pipe centrifugally cast in metal or sand-lined molds. Pipe wall shall be homogeneous from inside to outside and shall be completely free of laminations, blisters, or other imperfections. Defects may be removed at the factory only.
4. Except as otherwise specified, underground pipe shall have mechanical joints or push-on joints conforming to AWWA C110 and C111, as well as AWWA C153 (compact), with vulcanized styrene butadiene rubber gaskets conforming to AWWA C111. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Bolts on mechanical

- joints shall be ASTM A242 high-strength low-alloy steel, conforming to AWWA C111 and ANSI A21.11. Certificate to that effect shall be provided.
5. For ductile iron pipe systems requiring pressure testing, restrained joints shall be provided in accordance with Part 3–Execution. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100 SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by Ford Meter Box Co., Inc., or equal, restraint. Push-on joints for ductile iron piping shall be restrained with MEGALUG® Series 1700 or 1100 HD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1450 by Ford Meter Box Co., Inc., Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, or equal.
 - a. Pipe restraint fittings shall be provided as follows:
 - (1) For ductile iron pipe with ductile iron mechanical joints MEGALUG® Series 1100 or 1100SD by EBAA Iron Sales, Inc.; Series D SLDE or SSLD by Sigma; Series 3000 or 3000S by Star Pipe Products; or equal.
 - (2) For ductile iron pipe with ductile iron push on joints MEGALUG® Series 1100HD or 1700 by EBAA Iron Sales, Inc; Series SLDEH or SSLDH by Sigma; Series 3100P or 3100S by Star Pipe Products; Flex Ring or Lok Ring by American Cast Iron Pipe Company; TR Flex by U.S. Pipe Company; or equal.
 - b. Gland body, wedges, and wedge actuating components shall be ductile iron conforming to ASTM A536 Grade 65 45 12. Bolts and tie rods shall be high strength low alloy steel conforming to AWWA C111.
 - c. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe to provide joint restraint are not acceptable.
 6. Joint restraint is not required for gravity sewers and drains.
 7. Underground pipe shall have mechanical joint ductile iron fittings conforming to AWWA C110 and C111 or AWWA C153 compact fittings with a minimum rated working pressure of 250 psi. Gaskets for fittings shall be as specified for underground piping.
 8. All ductile iron fittings shall be American Cast Iron Pipe, Tyler Union, U.S. Pipe, or equal.
 9. Unless otherwise specified, all exterior ductile iron piping and fittings shall be cement-mortar lined and asphaltic-coated inside. Cement-mortar lining shall be in accordance with AWWA C104. Unless otherwise specified, underground piping and fittings shall be shop primed or asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
 10. For potable water systems, the outside pipe coating shall comply with AWWA C151. Lining and coatings shall be suitable with potable water systems. The asphaltic coating shall be applied over the cement lining on the inside of the pipe and directly on the outside of the pipe. The coatings shall be smooth and impervious to water without any tendency to scale off.
 11. All buried ductile iron piping and appurtenances shall be polyethylene encased in accordance with AWWA C105. Polyethylene encasement shall be Class C (carbon black) and shall be minimum 8 mil thickness. Tape for securing the film shall be a thermoplastic material with a pressure sensitive adhesive face capable of bonding to metal, asphaltic coating, and polyethylene. Tape shall have a minimum thickness of 8 mils and a minimum width of 1 inch. The polyethylene film envelope shall be as free as is commercially possible of gels, streaks, pinholes, particles of foreign matter, and undispersed raw materials. There shall be no other visible defect, such as holes, tears, blisters, or thinning out at folds.
 12. Tapping and Bonding: In cases where corporation stops are to be tapped into mains, pipe wall thickness shall be furnished as specified in AWWA C151 to provide four threads or pipe saddles shall be furnished as approved by manufacturer.

13. Cutting in Tees: Cutting-in tees shall be of ductile or cast iron with the same rated working pressure of the pipe in which they are installed but no less than 150 psi.
 14. Exterior Joints, Fittings, and Gaskets: Joints, fittings, and gaskets shall have the same rated working pressure of the pipe in which they are installed but no less than a minimum rated working pressure of 150 psi.
- B. Stainless steel pipe penetrating into the reservoir and within the reservoir shall be SS316L as specified in Section 33 16 13—Wire-Wound Prestressed Concrete Water Storage Tank.
- C. Reinforced Concrete Pipe:
1. Reinforced concrete pipe for storm sewer shall meet the requirements of ASTM C76 for circular pipe. All pipes shall have a smooth interior wall. Strength and class of the pipe shall conform to the Drawings and as specified herein. All reinforced concrete pipe used in the work shall be of adequate strength to support the trench loads applied. Unless otherwise shown or specified, all reinforced concrete pipe shall be Class III minimum and shall have a minimum “B” wall construction. All reinforcing cages shall be circular for circular pipe. All reinforcing cages shall be elliptical for elliptical pipe. Reinforcing cage shall extend to the full width into the bell end of the pipe and to within 1 inch of the spigot end of the pipe.
 2. Standard and special fittings shall be of approved manufacturer and shall conform to requirements of the trade and these specifications. All fittings shall be of a strength at least equal to that of the sewer main and shall be jointed with the same type of joint as used in the sewer main.
 3. Not more than one lift hole per length of pipe shall be used in storm sewer.
 4. Reinforced concrete pipe and fittings shall be provided with joints and gaskets that meet ASTM C1628 for sanitary sewer pipe and ASTM C443 for storm sewer pipe. Joints for circular storm sewer shall be sealed with rubber gaskets having a continuous O-ring cross section, Tylox Superseal, or equal. All pipe shall be specifically built to fit the gasket used. Provide precast concrete endwalls on all storm sewers.
 5. Nonstandard pipe lengths may be used at manholes and structures as necessary to allow them to be located at the locations identified on the Drawings. Reinforced concrete bends, tees, and reducers shall be manufactured to provide for the required transitions as shown on the Drawings. Sufficient additional reinforcement shall be added at the spring lines and top and bottom of the pipe to prevent shearing after installation. Repairs to complete fabricated pipe fittings shall be such that the completed unit shall have the same strength as that of the remainder of the pipe barrel and the concrete used to complete the section shall not spall or separate.
 6. Concrete apron endwalls for concrete pipe sewers shall be manufactured with reinforcement and concrete conforming to the pertinent requirements for minimum Class II, Wall B, reinforced concrete pipe as specified in ASTM C76. Joint ties shall be installed at the last two downstream joints on any pipe run ending in an apron endwall that is constructed with reinforced concrete pipe of any type or size.
 7. Acceptance of reinforced concrete pipe shall be on the basis of plant load-bearing tests, material tests, and inspection of manufactured pipe for visual defects and imperfections.
 8. Cement used in the manufacture of reinforced concrete pipe shall meet the requirements of ASTM C150, Standard Specification for Portland Cement for Type II cement.
 9. A three-edge bearing test shall be conducted by the manufacturer according to ASTM C497 as proof of design by determining the ultimate load capacity of the pipe. One segment of pipe from each pipe class must pass the three-edge bearing test such

that the load required to produce the ultimate load exceeds the load rating of the pipe. The test results shall be maintained in a log and provided to OWNER. Manufacturer shall also maintain concrete cylinder testing data and quality control records to verify that pipe meets the required ASTM standards.

10. An alkalinity test shall be conducted on the concrete mixture used for each type and class of reinforced concrete pipe used in the Project. The alkalinity test shall be conducted according to ASTM C497 and the alkalinity of all concrete mixtures shall be equal to or greater than 0.2 grams of CaCO₃ equivalent reactivity per gram of concrete. The manufacturer shall complete the alkalinity tests.
11. The costs of the tests shall be incidental to the pipe cost. CONTRACTOR shall include all such costs in the price bid for the Work. CONTRACTOR shall submit a signed, dated, and certified copy of the test data to OWNER (in a format acceptable to OWNER) for review prior to delivering any pipe to the Project site. No additional compensation will be made to CONTRACTOR for the required testing.
12. The pipe leakage shall not exceed 150 gallons/day/inch inside diameter/mile of pipe. The manufacturer shall provide a written and signed statement indicating the pipe meets this criterion.
13. CONTRACTOR shall provide written certification that pipe meets the standards herein.

D. Solid Wall PVC:

1. Polyvinyl chloride (PVC) pipe shall meet the requirements of ASTM D3034 for pipe sizes 4 inches through 15 inches and ASTM F679 for pipe sizes 18 inches through 60 inches.
2. PVC material for ASTM D3034 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with minimum modulus of elasticity of 400,000 psi. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412. Pipe shall have a maximum standard dimension ratio (SDR) of 35.
3. PVC material for ASTM F679 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with a minimum modulus of elasticity of 500,000 psi. Pipe stiffness shall be a minimum 115 psi when tested in accordance with ASTM D2412.
4. Pipe and fittings shall be the product of one manufacturer, and the manufacturer shall have experience records substantiating acceptable performance of the pipe and fittings to be furnished. The minimum wall thickness of fittings shall be the same as the pipe to which it connects.
5. Acceptance of piping and fittings shall be subject to tests conducted in accordance with ASTM D3034 and/or ASTM F679.
6. Fittings such as saddles, elbows, tees, wyes, and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe.
7. Joints shall be of the elastomeric type for pipes 4 inches or larger and elastomeric or solvent cement for pipes less than 4 inches.
8. Elastomeric joints shall be a bell and spigot joint conforming to ASTM D3212 sealed by a rubber gasket conforming to ASTM F477 so that the assembly will remain watertight under all conditions of service, including the movements resulting from the expansion, contraction, settlement, and deformation of the pipe. Bells shall be formed integrally with the pipe and shall contain a factory-installed positively restrained gasket.
9. Solvent cement joints shall be assembled using solvent cement obtained from the pipe manufacturer, which conforms to the requirements of ASTM D2564.
10. The assembled joint shall pass the performance tests as required in ASTM D3212.

E. Miscellaneous Pipe:

1. Piping needed for repair or reconstruction of existing utilities and appurtenances shall be of the same type and strength as the existing. The type of jointing used in repair and reconstruction shall be reviewed by ENGINEER. Special fittings shall be furnished and installed as necessary for repair, reconstruction, or connection of existing facilities.
2. All special fittings on or for connection to utilities shall be specifically built for the type of gasket used. Special fittings shall have joints of the same type as the utility to which the connection is being made.

2.04 VALVES (VALVES FOR UNDERGROUND SERVICE ARE SPECIFIED IN DIVISION 40)

- A. Valves shall conform to Section 40 05 00–Piping and Appurtenances.

2.05 CONCRETE

- A. All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 03.

PART 3–EXECUTION

3.01 INSTALLATION

A. Underground Piping:

1. Utility lines shall be laid and installed to the lines and grades specified with valves, fittings, manholes, and other appurtenances at the specified locations; spigots centered in bells; and all manholes and riser pipes plumb. Water main shall be installed at the depth indicated. Gravity laterals shall maintain a minimum 6 feet of cover. Water main and other pressure mains shall be installed to within (plus or minus) 0.1 feet of designed grades. Storm sewer shall be installed to within (plus or minus) 0.03 feet of designed grades. Service lines shown on the Drawings are approximate. Staking shall be completed in conformance with Division 01 of the Standard Specifications.
2. Deviations Occasioned by Underground Facilities: Wherever significant obstructions not shown on the Drawings are encountered during the progress of the Work, CONTRACTOR shall proceed in accordance with the General Conditions to notify owners and protect the facilities. Existing items unnecessarily damaged during the performance of the Work shall be repaired and replaced at the expense of CONTRACTOR.
3. Prior to commencing pipe laying, CONTRACTOR shall notify ENGINEER of the intended date for starting Work. ENGINEER may request at CONTRACTOR's expense the removal and relaying of pipe which was installed prior to notification of ENGINEER.
 - a. Proper implements, tools, and facilities shall be provided and used by CONTRACTOR for the safe and convenient prosecution of the Work. All pipe, fittings, and appurtenances shall be carefully lowered into the trench piece by piece with a crane, rope, or other suitable tools or equipment, in such manner as to prevent damage to materials. Under no circumstance shall pipe be dropped or rolled into the trench.
 - b. Materials shall be as shown on the Drawings or as specified herein.

4. Material Inspection: CONTRACTOR shall inspect the pipe, fittings, and appurtenances for defects when delivered to the jobsite and prior to lowering into the trench. Defective material shall be removed from the jobsite. All material shall be clean and free of deleterious substances prior to use in the Work.
5. Except where noted or specified, all ductile iron underground piping shall be laid in accordance with AWWA C600 with the conditions that (a) blocking shall not be used to support pipe and (b) all bends and fittings shall be restrained as specified below, and pipe joints shall be restrained in all directions from all bends and fittings to the length as specified below.
6. Pipe Length:
 - a. The minimum length of pipe to be restrained shall be as shown in the following table.
 - b. This table assumes horizontal orientation of fittings, 150 psi test pressure plus a 100 psi water hammer allowance, ductile iron pipe, and a 3-foot bury. Lengths shall be adjusted for other conditions and fittings. For other fittings and for more specific requirements, see the Drawings:

REQUIRED LENGTH OF RESTRAINED PIPE BEYOND FITTING IN FEET

Fitting	Minimum Length—Ft
90 Degree Bend (≤ 6 inches)	36
90 Degree Bend (8 inches to 10 inches)	54
90 Degree Bend (12 inches to 14 inches)	72
90 Degree Bend (16 inches)	84
45 Degree Bend (≤ 8 inches)	18
45 Degree Bend (10 inches to 16 inches)	36
22 1/2 Degree Bend ≤ 16 inches	18
11 1/4 Degree Bend ≤ 16 inches	9
Fire Hydrant Leads	All Joints
Tees (≤ 4 inches)*	18 (Along Branch)
Tees (6 inches to 8 inches)*	36 (Along Branch)
Tees (10 inches to 12 inches)*	54 (Along Branch)
Tees (14 inches to 16 inches)*	72 (Along Branch)

*Restrained run length on tees assumed 18 feet on each side of fitting.

7. Water main shall be installed in accordance with AWWA C600 for iron pipe. All plugs, caps, tees, hydrants, bends, and other fittings for water mains shall be provided with restrained joints.
8. Plumbing system shall be installed and tested in accordance with local and state plumbing code requirements and applicable portions of State of Illinois Plumbing Code. Where requirements conflict, the stricter standard shall apply.
9. CONTRACTOR shall lay all gravity pipe to the line and grade shown on the Drawings with bell ends uphill wherever possible. If not possible, CONTRACTOR shall lay pipe to the line and grade shown on the Drawings with bell ends in the direction of laying. Water piping and chemical solution piping shall have a minimum of 6 1/2 feet of cover. Unless shown otherwise, drainage piping shall clear floor slabs or footings by a minimum of 6 inches.
10. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used. Pipe must be kept clean of mortar, cement, clay, sand, or other material. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.

11. At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. Acceptable plugs include Foreman Nite Caps by APS, mechanical joint cap or plug, bladder plug, or test plug. All foreign material shall be removed from the pipe prior to acceptance.
12. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
13. General Excavation:
 - a. Pipe Laying:
 - (1) All pipe shall be laid accurately to the line and grade as designated. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be joined or of the factory made jointing material shall be clean and dry. Lubricants, primers, adhesives, and other joint material shall be used and installed as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined, and adjusted in such a workmanlike manner as to obtain the degree of watertightness specified. Pertinent specifications from the joint and pipe manufacturer which outline procedures to be followed in making the joint shall be furnished to ENGINEER.
 - (2) Wyes, tees, and special fittings shall be installed as called for on the Drawings, or as requested by ENGINEER. Wyes, tees, and special fittings, shall, in general, be jointed with the same type of joint as used in the pipe.
 - (3) In joining two dissimilar types of pipe, manufactured adapters and fittings shall be used. Adapters and fittings shall be configured to maintain invert elevations at same level.
 - (4) Joint deflections shall not exceed the limits established by the pipe manufacturer for the pipe and joint being used.
 - (5) Joints that are damaged because of carelessness, improper handling, or failure to prevent imperfections in manufacture shall be subject to rejection and gaskets shall be subject to rejection whenever they show surface cracking, tears, or splice separation.
 - (6) At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. All foreign material shall be removed from the pipe prior to acceptance.
 - (7) After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with specified backfill material tamped around it except at the bells.
 - (8) Pipe shall be brought home by using a cross member and levers or jacks. It will not be permissible to push pipe home with motor powered excavation equipment.
 - (9) Water main shall be installed in accordance with AWWA C600 for iron pipe, AWWA C605 for PVC pipe, and AWWA M55 for HDPE pipe. All plugs, caps, tees, hydrants, bends, and other fittings for water mains shall be provided with restrained joints.
 - b. Sewer Service Branch and Lateral Installation:
 - (1) CONTRACTOR shall furnish and install sanitary sewer and storm sewer branches, laterals, and leads as shown on the Drawings or requested by ENGINEER. Under normal circumstances, service laterals will be installed within the right of way or easement to serve all existing buildings and all platted lots. In certain cases, only wye or tee branches will be installed to

vacant lots. Service laterals shall consist of a branch fitting at the main and extension of the specified lateral pipe to the end of lateral as called for and requested. All necessary fittings shall be furnished and installed to complete the installation. All necessary fittings shall be furnished and installed to complete installation of storm sewer leads.

- (2) Wye or tee branches: Wherever shown on the Drawings or requested by ENGINEER, wye or tee branches shall be provided for use in making sanitary sewer service and storm sewer inlet connections. Unless specified otherwise on the Drawings, wye or tee branches for sanitary sewer service lateral connections shall be 4-inch diameter. Wye or tee branches for storm sewer inlet connections shall be of the size called for on the Drawings, 12 inches minimum.
 - (3) Sanitary sewer service branches shall be turned so that the branch is at an angle of 30 degrees or 45 degrees from the horizontal.
 - (4) Sanitary Sewer Service Laterals: Under normal conditions and unless otherwise shown on the Drawings or requested by ENGINEER, all service laterals shall be Standard Laterals, Type 1.
 - (5) Installation and Testing Requirements: Except for those branches that are to be used on storm sewers or for extending sanitary sewer service laterals, wye and tee branches shall be closed with airtight stoppers blocked to withstand air test pressures.
 - (6) The ends of all laterals shall be plugged and blocked to resist air test pressures. All plugs shall be manufactured to fit the pipe used and shall be watertight.
 - (7) Unless otherwise provided for in the Drawings, each service lateral shall have a tracer wire installed from the main to the property line or the location of the connection to the existing service, whichever is greater or applicable. The tracer wire shall be 10-gauge solid copper with no splices. The wire shall be secured to the pipe with duct tape at a minimum of 3-foot intervals. The ends of the tracer wire shall be brought to the ground surface and stored in an access terminal box, DWS-Tracer Wire Access Box, or equal, at a location selected by OWNER. Eighteen inches of additional wire length shall be coiled at the location of the terminal box. CONTRACTOR shall confirm the method of installation is compatible with OWNER's means of detecting the location of the service lateral. Each tracer wire shall be tested by CONTRACTOR to confirm it accurately provides the location and depth of the sewer lateral.
 - (8) A complete and accurate tabulation of length, depth, and location of all branches, risers, and laterals shall be kept by CONTRACTOR on cards available from ENGINEER. Measurements shall be made from the nearest downstream manhole. Lateral installation to meet these Standard Specifications and field conditions are the responsibility of CONTRACTOR. Problems occurring because of failure to provide proper installation or proper records shall be corrected by CONTRACTOR at its expense.
 - (9) No installed lateral shall be backfilled until ENGINEER has been notified that the lateral is complete and reasonable time is allowed for observation of the Work.
- c. Water Service Lateral Installation:
- (1) Water service laterals requiring reconstruction and new service laterals shall be installed in accordance with AWWA C600. CONTRACTOR shall perform all excavation, backfill, and other Work necessary for a complete installation. The service tubing shall be continuous and shall be placed at a minimum

depth of 6 1/2 feet. Each service shall include a corporation stop at the main, copper service tubing, curb stop, curb box, couplings, and all other appurtenances necessary for a complete installation. Where existing services in the street are being reconstructed, the new service shall be connected to the existing service at the property line unless otherwise shown or specified. Taps in the main shall be at an angle of 45 degrees above the horizontal.

- (2) All curb boxes on new services shall be marked by placing a 4-foot long 2 by 4 adjacent to it. The 2 by 4 shall project 1 foot above existing ground and shall be painted blue. All services shall be extended to the street property line, unless otherwise shown or specified.
 - (3) All manholes shall be made watertight and shall show no visible signs of leakage at the time of final review and within the correction period. Any leakage shall be sealed from the exterior of the manhole.
- d. Manholes:
- (1) Manholes and Catch Basins shall be installed in accordance with the Drawings. Manholes shall be plumb with any steps aligned and openings located over steps. For sanitary sewers, openings shall be located over the bench and not the sewer flow line itself.
 - (2) All manholes shall be made watertight and shall show no visible signs of leakage at the time of final review and within the correction period. Any leakage shall be sealed from the exterior of the manhole.
- e. Storm Sewer Inlets:
- (1) Storm sewer inlets shall be installed in accordance with the Drawings. Inlets shall be set to the line and grade as furnished by ENGINEER. The outside end of the lift hole shall be covered with filter fabric to prevent the entrance of fines into the inlet.
 - (2) Inlets shall be connected to the storm sewer main either at manholes, at wye branches in the main, or to other inlets, all as shown on the Drawings. Minimum size of inlet lead pipe shall be 12 inches.
 - (3) Storm inlets shall be backfilled to undisturbed soil and at least 2 feet along connecting piping with bedding material.
- f. Masonry:
- (1) No masonry shall be laid when the temperature of the outside air is below 40°F unless all masonry materials are heated and protected against freezing.
 - (2) Only enough mortar shall be mixed that can be conveniently used before it reaches initial set. Retempering of mortar will not be permitted.
- g. Abandoning Utilities: Utilities to be abandoned shall, unless otherwise noted on the Drawings, be abandoned in place. Open ends of pipes shall be plugged with 12 inches of concrete. Manhole barrels, valve boxes and other such structures shall be removed in entirety and shall then be filled with backfill material compacted to that of the trench backfill. An approximate 9-inch-diameter opening shall be made in the bottom of the structure to allow for groundwater movement.
- h. Connections to and Modifications of Structures and Mains:
- (1) Unless otherwise noted on the Drawings, openings in existing structures to allow for connection of mains shall be core drilled, and the mains themselves shall be connected by use of watertight connections as specified in the Standard Specifications. Flow channels in the bottoms of existing structures shall be modified as necessary to provide smooth transition for incoming flow and/or orientation of mains. These modifications may include breaking out and reforming flow channels.

- (2) Where mains, new and existing, are to intersect, dog house manholes shall be provided to facilitate connection and to gain access to the intersecting mains. Manholes shall be provided at the manufacturing plant with arched openings in lower barrel section to span each of the intersecting mains. Reinforcing shall be cut and bent back. In the field, manhole shall be set on concrete blocks, with reinforcing provided for the bottom slab. Concrete shall be poured under and around the manhole to seal all openings, cover and adhere to the slab and bent reinforcement, and provide for benches or fillets in the manhole. Sanitary and storm sewer mains shall be kept intact until the bench or fillet is poured. Then the top of pipe to springline shall be removed to provide access.
14. Valve Boxes: The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.

3.02 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all televising, testing, cleaning, and disinfection in the price bid.
- B. Work shall be tested as specified in this section. Unless indicated in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. New piping shall be tested. Prior to conducting the pressure and leakage test, CONTRACTOR shall backfill the trench for its full depth. All bends and special connections to the main shall be adequately blocked and tied prior to the test. Any damage caused to the main or its appurtenances during performance of these tests shall be corrected by CONTRACTOR at its expense. Should underground piping fail test, CONTRACTOR shall be responsible for removal and replacement of backfill, and relay new pipe if necessary, to repair the defective pipe. Under no circumstances shall defects be sealed from the interior of the pipe, and only where specifically allowed by ENGINEER, shall defects be sealed from the exterior of the pipe. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint. Piping and appurtenances shall be watertight or airtight and free from visible leaks. Any leakage shall be sealed by methods acceptable to OWNER, from the exterior of the structure.
- D. Piping shall be flushed or blown out after installation prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Pressure Tests:
 1. Pressure tests shall be performed as required by AWWA C600 and AWWA C605, unless otherwise noted herein.
 2. When test medium for piping is water, all air shall be removed from piping by flushing, opening vents, loosening flanges, utilizing equipment vents and/or installation of corporations at high points in system. Test pumping equipment used shall be centrifugal pumps or other pumping equipment that will not place shock pressures on

the main. Power plunger pumps will not be permitted for use on closed pipe systems. Pumps shall be disconnected during test periods. Presence or absence of air will be determined during pressurization of the piping system.

3. The test pressure in all lines shall be held for two hours, during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests.
4. During performance of the hydrostatic pressure test, water main shall be subjected to a minimum pressure of at least 50% above normal working pressure with a minimum pressure 125 psi.
5. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
6. Where connections are made to existing mains, it shall be the responsibility of CONTRACTOR to provide the necessary hydrostatic tests on all new mains installed. This may necessitate, but is not limited to, the installation of temporary valves and restraint to isolate the new system from the existing system. All materials, Work, and equipment necessary for this Work shall be furnished by CONTRACTOR at its expense.
7. All testing of pipelines shall proceed concurrently with installation. CONTRACTOR is advised that it may be advantageous to conduct daily preliminary testing of its Work.
8. Water from disinfection testing shall not be discharged to a stream, creek, river, storm sewer tributary thereto, or to a navigable water without first neutralizing the chlorine residual in the water and complying with local, state, and federal laws thereto.
9. Gauges used for testing shall have increments as follows:
 - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - b. Tests requiring a pressure of greater than 10 psi by less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
PW	150	Water	"A" ⁽¹⁾

⁽¹⁾ Leakage allowance designation "A" shall mean not more than 0.002 gallons per hour per inch diameter per 100 feet of buried pipe for all piping except buried mechanical joint pipe. Buried mechanical and push-on joint pipe shall meet the leakage specifications of AWWA C600.

- F. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

3.03 DISINFECTION

- A. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.

- B. In accordance with the requirements of AWWA C651, at least one set of samples shall be collected from every new water main, plus one set from the end of the line and at least one set from each branch.
- C. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria in accordance with Option A of Section 5.1 of AWWA C651. Copies of test results shall be submitted to OWNER and ENGINEER.
- D. CONTRACTOR shall furnish all water and other materials, equipment, and labor necessary to disinfect all new water mains and all existing water mains disturbed by construction. CONTRACTOR shall notify the Health Department to observe disinfection test and shall coordinate and bear cost for necessary laboratory testing and shall provide safe bacteriological sample results to OWNER prior to placing the water main in service. Sampling and testing shall be scheduled to complete the Work within the Contract Times. Items of material for testing shall be furnished in the size and quantity necessary to properly complete the test. Interruption or delay of CONTRACTOR's Work progress caused by testing and sampling shall not be cause for extra payment under the Contract nor shall they be cause for extension of Contract Time.
- E. Water main shall be disinfected according to the Standard Specifications for Water and Sewer Main Construction in Illinois, which shall include initial flush and disinfection to 50 ppm with gaseous chlorine or other acceptable methods. Acceptable concentration after 24 hours shall be 25 ppm. Satisfactory disinfection shall be demonstrated in accordance with the requirements of 35 Ill. Adm. Code 652.203.

3.04 CLEANING

- A. All equipment and materials shall be clean before installation.
- B. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- C. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.
- D. All pipes and manholes shall be flushed until clean, and all debris and mud shall be removed.

3.05 DEMOLITION

- A. All exterior piping removals, including manholes and appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Where necessary, existing piping shall be exposed before installing new piping. Any changes in pipe location or elevation shall be reviewed by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal. Unless otherwise shown or specified, piping shown or specified to be abandoned

shall have each end plugged with concrete or nonshrink grout. Nonshrink grout shall be as specified in Division 03. Wherever excavations cross piping to be abandoned, piping shall be removed to the limits of the excavation and the ends shall be filled as specified above.

- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. Valves to be salvaged shall be turned over to OWNER as specified in Section 02 41 00–Demolition and as shown on the Drawings. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove the items listed below, including piping and appurtenances, as specified, and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

END OF SECTION

SECTION 33 16 13

WIRE-WOUND PRESTRESSED CONCRETE WATER STORAGE TANK

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Provide all materials, equipment, tools, and labor necessary for the designing, manufacturing, and construction of a 5,000,000-gallon wire-wound prestressed concrete water storage tank with foundation and appurtenances.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment Procedures:
 - 1. All excavation needed to accommodate Manufacturer's foundation design shall be included in the Lump Sum Bid. If excavation is required below design elevation, it shall be paid for in accordance with the provisions of Division 31.
 - 2. All concrete tests shall be performed by the Project Geotechnical Engineer and paid by OWNER. CONTRACTOR is responsible for coordinating testing.

1.02 REFERENCES (LATEST EDITIONS OF EACH REFERENCE AT THE TIME OF BIDDING SHALL APPLY)

- A. ACI 301—Specifications for Structural Concrete for Buildings.
- B. ACI 305—Hot Weather Concreting.
- C. ACI 306—Cold Weather Concreting.
- D. ACI 309R—Guide for Consolidation of Concrete.
- E. ACI 318—Building Code Requirements for Reinforced Concrete.
- F. ACI 350—Code Requirements for Environmental Engineering Concrete Structures and Commentary.
- G. ACI 350.3—Seismic Design of Liquid Containing Concrete Structures and Commentary.
- H. ACI 372R—Design and Construction of Circular Wire- and Strand Wrapped Prestressed Concrete Structures.
- I. ACI 506R—Guide to Shotcrete.
- J. ASCE Standard 7 Minimum Design Loads for Buildings and Other Structures.
- K. ASTM B117—Practice for Operating Salt Spray (FOG) Apparatus.
- L. ASTM D2247—Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.

- M. ASTM D3363—Standard Test Method for Film Hardness by Pencil Test.
- N. ASTM D4060—Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- O. ASTM D4214—Standard Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
- P. ASTM D4417—Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
- Q. ASTM D4541—Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- R. ASTM D4585—Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- S. ASTM D5064—Standard Practice for Conducting a Patch Test for Assessing Coating Compatibility.
- T. ASTM D7091—Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
- U. ASTM A123/A123M—Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- V. ASTM A185—Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- W. ASTM A416—Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
- X. ASTM A421/A421M—Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete.
- Y. ASTM A475—Standard Specification for Zinc-Coated Steel Wire Strand.
- Z. ASTM A615/A615M—Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- AA. ASTM A653/A653M—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- BB. ASTM A706/A706M—Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
- CC. ASTM A821—Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks.

- DD. ASTM A1008/A1008M—Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- EE. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- FF. ASTM C33—Standard Specification for Concrete Aggregates.
- GG. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- HH. ASTM C231—Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- II. ASTM C618, Type F—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- JJ. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 Ft.-lbf/ft³) 600 KN-M/M³.
- KK. ASTM C920—Specification for Elastomeric Joint Sealants.
- LL. ASTM D1056—Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
- MM. ASTM C1116/C1116M—Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
- NN. ASTM D1556—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- OO. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 Ft.-lbf/ft³) 2700 KN-M/M³.
- PP. ASTM D2000—Classification System for Rubber Products in Automotive Applications.
- QQ. AWWA C652—Standard for Disinfection of Water Storage Facilities.
- RR. AWWA D110—Wire and Strand Wound, Circular, Prestressed Concrete Water Tanks.
- SS. FAA—Federal Aviation Administration Circular 70/7460—IH, Obstruction Marking and Lighting.
- TT. NAPF—National Association of Pipe Fabricators 500-03—Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
- UU. NSF-61—Drinking Water Components.
- VV. NSF-600.
- WW. SSPC—Society for Protective Coatings—Steel Structures Painting Manual.

XX. TID-7024, Dynamic Pressure on Fluid Containers of Nuclear Reactors and Earthquakes.

YY. US Army Corps of Engineers Specification CRD-C-572, Specification for PVC Waterstop.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements: The following information is in accordance with AWWA D110, is made part of this specification, and refers to wire wound prestressed concrete tanks unless noted otherwise:
1. Horizontal prestressing shall be continuous. Discontinuous prestressing tendons or strands will not be allowed.
 2. Capacity and Dimensions
 - a. Capacity: 5,000,000 gallons.
 - b. Tank Dimensions: Inside Diameter = 156 feet, Height to Overflow = 35 feet.
 3. Location of Site/Access to Site: See Drawings.
 4. Nearest Community: Rockford, IL.
 5. Time of Completion: See Bid.
 6. Electric Power and Water Availability:
 - a. Refer to Division 26. 120 V permanent power is readily available at site for construction. Permanent service shall be provided by CONTRACTOR. Any temporary power shall be provided by CONTRACTOR, as necessary.
 - b. Temporary water is available adjacent to the site through the nearest fire hydrant as shown on the drawings. Coordinate with OWNER for temporary water supply meter and backflow preventer.
 7. Compressed Air: Not available at site.
 8. Piping Connections:
 - a. Pipe Materials: Pipe material shall be as specified in Section 33 00 10–Buried Piping and Appurtenances and Section 40 05 00–Piping and Appurtenances and where noted on the Drawings.
 - (1) All buried piping shall be ductile iron and all above grade piping within the reservoir shall be 316 stainless steel as specified.
 - (2) Drain pipe and overflow pipe shall be 316L stainless steel material within the tank.
 - (3) Water main to tank shall be ductile iron as specified in Section 33 00 10–Buried Piping and Appurtenances and Section 40 05 00–Piping and Appurtenances and shown in the Drawings. Flange gaskets are specified in Section 40 05 00–Piping and Appurtenances.
 - b. Pipe Connections: 16-inch-diameter ductile iron fill pipe and 30-inch-diameter ductile iron suction pipe by CONTRACTOR.
 - c. Earth Cover Over Piping: 78-inch minimum.
 9. Design Loads: Design of the tank wall, roof and floor shall be in accordance with AWWA D-110 Section 3.
 - a. Dead Load: Shall be the estimated weight of all permanent imposed loads. Unit weight of concrete 150 pounds per cubic foot; steel 490 pounds per cubic foot.
 - b. Live Load: shall be the weight of all the liquid when the reservoir is filled to overflowing. Unit weight of liquid 62.4 pounds per cubic foot.
 - c. Seismic Data: Seismic Zone as required by ASCE 7.
 - d. Backfill: See site plan.
 - e. Snow Loading: 30 psf.
 - f. Wind Load: Shall be as required by ASCE 7.

10. The Tank Contractor shall design the composite concrete wall with steel diaphragm and closure steel slot plate in combination with vertical mild steel reinforcement based on the following design criteria and requirements:
 - a. The prestressed tank wall shall be considered as a cylindrical shell with partial edge restraint.
 - b. The prestressed tank wall shall be reinforced vertically by deformed steel reinforcing bars. The steel diaphragm can be taken as effective vertical reinforcing.
 - c. The prestressed tank wall shall be of precast construction. The minimum core wall thickness shall be 4 inches. The core wall is that area of the wall interior to all circumferential prestressing. Shotcrete or cast-in-place concrete core walls are not permitted.
 - d. For wire wound tanks, a stress plate shall be required at all above grade locations where prestress wires are displaced 24 inches or greater. The stress plate shall be designed to transfer stress across the opening.
 - e. No reduction in ring compression or tension in the wall will be taken due to restraint at the bottom.
 - f. The long-term prestressing losses caused by shrinkage, creep, and relaxation in the prestressed reinforcement of the tank walls shall not be assumed less than 25,000 psi.
 - g. Lateral soil pressures shall not be considered in resisting seismically generated shear forces between the wall footing and the wall.
11. Floor Slab:
 - a. The floor slab shall be designed as a membrane floor not less than 4 inches thick. Construction joints will only be allowed as shown on the shop drawings and as approved by ENGINEER. Construction joints shall incorporate a horizontal 6-inch PVC waterstop.
 - b. Wall footings may be constructed above or below floor grade. If required, the floor shall have thickened regions to facilitate transitions from under slab concrete pipe encasements into the floor, appurtenance loadings and temporary bracing requirements.
 - c. Minimum cross sectional area ratio of floor reinforcement to concrete shall be in accordance with the following paragraph:
 - (1) For tanks with diameters less than 100 feet, provide 0.5%.
 - (2) For tanks with diameters 100 to 150 feet, provide 0.6%.
 - (3) For tanks with diameters greater than 150 feet, provide 0.8%
 - (4) For tanks with diameters larger than 100 feet, when shrinkage reducing admixtures are utilized, provide 0.5%.
 - d. Polypropylene or cellulose fibers may be used at the Tank Contractor's discretion.
12. The dome roof shall have a rise to span ratio within the range of 1:8 to 1:14. The dome shall be fixed to the tank wall. Columns or interior supports will not be allowed. Dome design shall be based on elastic spherical shell analysis. The dome roof shall be of precast or cast-in-place construction. The precast dome shall have continuous reinforcement at circumferential slots and radial reinforcement throughout the precast dome panels and lapped within the circumferential slots. The cast-in-place dome roof shall have continuous reinforcement in both the radial and circumferential direction. The dome thickness shall be no less than 3 inches or as recommended by AWWA (whichever is greater). The minimum cross sectional area ratio of dome reinforcement to concrete shall be 0.25 % in both the circumferential and radial directions. In the dome edge region two layers of non-prestressed reinforcing shall be provided in the meridional direction.

13. Sub drainage and Overflow Collection:
 - a. Perimeter and under floor drainage provisions as deemed necessary by CONTRACTOR.
 - b. Drainage: Provisions as deemed necessary by CONTRACTOR to promote drainage away from tank.
14. Location of vents, hatches, manways, safety devices, handrails, and ladders to be provided:
 - a. Venting: Freeze proof minimum 24-inch-diameter fail safe vent required with a stainless steel or Fiberglass No. 24 mesh screen to meet IEPA requirements. Screen shall be fail safe designed to operate if screen frosts over. Screens shall be reinforced with steel frames designed to lift off the bearing surfaces in the event the screens frost over and either positive or negative tank pressure is experienced. Screen blowout provisions during frost conditions shall not be provided. Vent shall be weather protected type. Entrance of rain or snow shall be prevented by overhanging or overlapping protective cap to below the vent side openings. Vent shall have capacity to meet anticipated filling and draining rates. See detail on Drawings for additional information.
 - b. A 48-inch square roof hatch with lockable, hinged 2-inch overlapping cover and curb frame. The hatch shall have a lift handle, padlock tab, padlock and a cover hold open mechanism. All hardware shall be 316 stainless steel. Locate hatch on the roof as shown on drawings.
 - c. Two circular 30-inch-diameter Type 316L stainless steel side wall manways with a hinged cover. A Type 316L stainless steel grab bar and a 316L stainless steel ladder shall be installed within the tank at one of the two manway locations, as shown on the Drawings. Locate access manways as shown on the Drawings.
 - d. Restrain Safety Cable Requirements: By CONTRACTOR per manufacturer's specifications.
 - e. Ladders:
 - (1) Ladders shall comply with OSHA standards.
 - (2) Ladders shall have an OSHA-approved Stainless Steel fall prevention device (if required) consisting of a sliding, locking mechanism and safety belt.
 - (3) The interior ladder shall extend from the floor to the roof hatch.
 - (4) The exterior ladder shall be provided to extend from 12 feet above the final grade to the tank roof.
 - (5) Safety cage required for exterior ladder with intrusion plate.
 - f. Safety Climb Equipment: Provide a safety climb device on the exterior and interior ladder. Interior wet safety climb equipment shall be 316 stainless steel with stainless steel cable and hardware. Cable system fall protection system shall be supplied by the same company and shall be equal to DBI/SALA LAD-SAF Flexible Cable Ladder System. Exterior safety climb equipment may be galvanized. Cable systems shall extend 3 feet above each platform and hatches shall be designed to not interfere with the equipment. System supplied shall conform to OSHA standards.
 - g. Roof Anchors: One roof anchor shall be installed with one being placed at the opening. Roof anchor shall have a support capacity of 5,000 pounds.
 - h. Guardrails: A roof guardrail will be required around the ladder and manways. A cable-up fall resistance safety system shall be provided from the guardrail to the failsafe vent. The handrail shall include an access point for the exterior ladder and the dome as shown on Drawings.
15. The 5-MG total reservoir capacity may include the unusable volume between the floor and 4.6 feet AFF. Air vortices are anticipated at maximum booster station pumping at a water level below 4.6 feet AFF.

16. Overflow: Minimum 16-inch-diameter 316 stainless steel pipe with a weir box designed for 5,000 gpm flow. An inverted siphon will not be acceptable as an overflow device. Overflow to terminate in a 90° elbow 18 inches above a concrete splash pad with a Tideflex valve. Provide stainless steel No. 24 mesh screen on outlet.
 - a. Internal Freeboard: Additional sloshing freeboard as deemed appropriate by CONTRACTOR.
 - b. Overflow Pipe: See Drawings for overflow pipe arrangement.
 - c. Concrete Splash Pad: CONTRACTOR shall provide a splash pad as shown on the Drawings.
 17. Filling Rates: 2,200 gpm maximum.
 18. Emptying Rates: 7,200 gpm maximum.
 19. Seismic Joint Types: See Specifications.
 20. Stresses and Reinforcement Requirements: By CONTRACTOR.
 21. Coefficient of Friction Requirements: By CONTRACTOR.
 22. Subsurface Investigation and Report: See soils report(s) included in the appendix.
 23. Soil Investigation Allowable Soil Bearing Pressure. See soils report.
 24. Seismic Effects of Backfill: By tank manufacturer.
 25. Finish Grade Relative to Tank Foundation: Partially buried per drawings.
 26. Tank Appurtenances:
 - a. Water level monitoring: See Division 26 specifications.
 - b. Reservoir Mixing System: See Division 46 specifications.
 - c. Transducer: See Division 26 specifications.
 27. Foundation Design Requirements: Foundation design by tank manufacturer.
 28. Written Report: This is required. CONTRACTOR shall also certify that the tank and foundation has been designed and constructed in accordance with AWWA D110 and these Specifications.
- B. Regulating Requirements: The materials, design, fabrication, and erection of the tank and its foundation shall conform to the current:
1. AWWA D110– Wire- and Strand-Wound, Circular, Concrete Water Tanks, of latest revision. The tank shall be designed in accordance with the requirements of ANSI/AWWA D110 using core wall Type III: Precast Concrete with a Steel Diaphragm, ACI 350, ACI 350.3, ASCE 7 and IBC.
 2. NSF International Standards for Protective Materials. All coatings shall be NSF Standard 61 and 600 approved when they are in contact with potable water.
 3. All paints shall conform to OSHA requirements for allowable exposure to lead, chromate, and other substances regulated as hazardous by the EPA.
 4. Storage tank and appurtenances shall meet all code requirements of IEPA.
 5. The design of the storage tank and foundation shall conform to the requirements of the 2015 International Building Code for seismic conditions and design loads.
 6. City of Rockford Building Ordinance to the 2015 IBC.
 7. Federal Aviation Administration (FAA).

1.04 SUBMITTALS

- A. Submit shop drawings and Operation & Maintenance Manuals in accordance with provisions of Section 01 33 00–Submittals.
- B. Submit manufacturer's shop drawings and calcs stamped and signed by a registered structural engineer in the State of Illinois.

- C. CONTRACTOR shall provide two copies of the foundation design calculations to ENGINEER along with the shop drawings. Foundation design calculations and shop drawings shall be stamped by a registered structural engineer in the State of Illinois. These design calculations are not shop drawings. They will be retained for OWNER's files.

1.05 QUALITY ASSURANCE

- A. CONTRACTOR shall have a minimum of 5 years of experience of the tank fabrication and erection with a minimum of ten prestressed wire wound tanks with a minimum capacity of 3,000,000 gallons.

1.06 WARRANTY

- A. Standard One Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

1.07 SITE CONDITIONS

- A. Soil borings were made, and the soils report is included in the appendix of these Specifications.
- B. All backfill, compaction, and testing shall be in accordance with Division 31. Refer to Section 31 23 00—Excavation, Fill, Backfill, and Grading for specific requirements.

1.08 FAA DETERMINATION

- A. The height and location of the tank does not exceed the requirements to submit an application to the FAA as outlined in the FAA application form. An FAA determination is not required for this tank.

1.09 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L. 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. The Drawings were prepared based on DN Tanks of Grand Prairie Texas. This listed equipment is part of the Base Bid as indicated on the Bid pages and will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.

2.02 CONCRETE

- A. Concrete shall conform to ACI 301.
- B. Cement shall be Portland cement Type I or Type II.
- C. Admixtures, other than air-entraining, superplasticizers, shrinkage reducing and water reducing admixtures will not be permitted unless approved by ENGINEER.
- D. Concrete for tank wall and dome construction shall have a minimum compressive strength of 4,000 psi at 28 days and a maximum water to cementitious ratio of 0.42. All precast wall and dome concrete shall be air-entrained.
- E. Concrete for the tank floor, footings, pipe encasement, and all other work shall have a minimum compressive strength of 4,000 psi at twenty-eight days, shall not be air-entrained and have a maximum water to cementitious ratio of 0.42. The coarse and fine aggregate shall meet the requirements of ASTM C33. Coarse aggregate shall be No. 467 with 100% passing the 1 1/2-inch sieve. Superplasticizers, water-reducing, and shrinkage reducing (if applicable) admixtures shall be incorporated into the floor concrete. If fibers are used, they shall be virgin poly-propylene or cellulose fibers, Microfiber by Grace, Fibermesh 150 by Propex, UltraFiber 500 by Buckeye, or equal. Fiber lengths shall be a maximum of 3/4 inch. The amount of fibers added to the concrete mix shall conform to the Manufacturer's recommendations.
- F. Proportioning for concrete shall be in accordance with ACI 301.
- G. All concrete shall have a maximum water-soluble chloride ion concentration of 0.06% by weight of cementitious material.

2.03 SHOTCRETE

- A. Shotcrete shall conform to ACI Standard 506, except as modified herein.
- B. The wet mix process shall be used for shotcreting.
- C. Shotcrete used for covering prestressed wire or strand shall consist of not more than three parts sand to one part Portland cement by weight. Additional coats of shotcrete shall consist of not more than four parts sand to one part Portland cement by weight. Polypropylene fibers shall be included in the shotcrete used for the finish cover coat. Fibers shall be Fibercast 500 by Propex, Fibermesh or equal. Fibers shall be virgin polypropylene and comply with ASTM C-1116 performance level I. Fiber length shall be 1/4 inch. The amount of the fibers added to the shotcrete used for the finish cover coat shall conform to the Manufacturer's recommendations. Fly ash may be incorporated into the finish cover coat. Fly ash shall

conform to ASTM C618, Type F. Shotcrete shall have a minimum strength of 4,500 psi at twenty-eight days and have a maximum water to cementitious ratio of 0.42.

- D. Rebound material shall not be reused in any form for shotcrete.
- E. If used by the Tank Contractor, the total volumetric air content of the shotcrete before placement shall not exceed 7% ($\pm 1\%$) as determined by ASTM C-173 or ASTM C-231.
- F. Fine Aggregates:
 - 1. The fineness modulus shall be between 2.7 and 3.0. A well-graded coarse sand shall be used for all shotcrete applications.
 - 2. The gradation for the fine aggregates shall adhere to the "Grading No. 1" requirements listed in "Table 1.1–Grading Limits for Combined Aggregates" of ACI 506.
- G. All shotcrete shall have a maximum water soluble chloride ion concentration of 0.06% by weight of cementitious material.

2.04 MORTAR FILL AND NON-SHRINK GROUT

- A. Mortar fill and non-shrink grout shall have a minimum compressive strength of 4,000 psi at 28 days, have a maximum water to cementitious ratio of 0.42 and meet all requirements for concrete contained in this specification.
- B. Portland cement grout will not be accepted.

2.05 REINFORCING STEEL

- A. Reinforcing steel shall be new billet steel Grade 60, as shown on the Drawings, meeting the requirements of ASTM A615. Welded wire fabric and weldable reinforcing steel shall conform to ASTM A185 and ASTM A706, respectively.
- B. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants, which reduce bond.
- C. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips. Rebar chair supports may be either steel with plastic tips, turned up legs or plastic.
- D. Continuous reinforcing is required through floor and cast-in-place dome construction joints, where applicable.

2.06 BASE RESTRAINT CABLES

- A. Where required by design, the tank designer shall use base restraint cables to resist earthquake and/or wind loads. Base restraint cables shall be hot-dipped galvanized seven-wire strand and shall be manufactured in accordance with ASTM A416 prior to galvanizing, and ASTM A475 after galvanizing. Only seven-wire strand will be allowed.
- B. Hot-dipped galvanized seven-wire strand shall have an MUS after galvanization of 21.36 kips and a min. yield at 1% extension of 15.60 ksi. 0.50-inch-diameter strand shall have an MUS after galvanization of 38.25 kips and a minimum yield at 1% extension of 28.00 ksi. 0.60-inch-diameter strand shall have an MUS after galvanization of 54.20 kips and

a min. yield at 1% extension of 40.70 ksi. All strands shall have a minimum of weight of zinc coating of 0.85 oz/sq-ft.

- C. Neoprene sleeves for base restraint cables shall be closed-cell conforming to ASTM D1056, Type 2, Class A, and Grade 3. The sleeves shall have a compression deflection limited to 25% at 9 to 13 psi, hardness of 60 to 80 durometer, a minimum tensile strength of 175 psi, a minimum elongation of 180%, and a maximum compressive set of 35%.

2.07 STEEL DIAPHRAGM

- A. The steel diaphragm shall meet the requirement of ASTM A1008 and shall be a minimum thickness of 0.017-inch. It shall be vertically ribbed with reentrant angles. The back of the channels shall be wider than the front, providing a mechanical keyway anchorage with the concrete and shotcrete encasement.
- B. The steel diaphragm shall extend to within 1 inch of the full height of the wall panel with no horizontal joints. Vertical joints within a wall panel shall be roll seamed or otherwise fastened in a fashion that results in a firm mechanical lock. Joints between wall panels that are not roll seamed shall be edge sealed with polysulfide or polyurethane sealant.
- C. No punctures will be permitted in the diaphragm except those required for pipe sleeves, temporary construction openings, or special appurtenances. ENGINEER shall approve details of the openings. All openings shall be completely edge sealed with polysulfide or polyurethane sealant.
- D. Diaphragm steel may be considered as contributing to the vertical reinforcement of the wall.
- E. Steel closure plates shall be used at wall slots between precast wall panels on the exterior face to create a continuous steel diaphragm.

2.08 CIRCUMFERENTIAL PRESTRESSING STEEL

- A. Steel for prestressing shall either be cold drawn, high carbon wire or galvanized seven wire strand.
- B. The wire shall meet the requirements of ASTM A821 and have a minimum ultimate tensile strength of 210,000 psi.
- C. Splices for horizontal prestressed reinforcement shall be ferrous material compatible with the reinforcement and shall develop the full strength of the wire or strand. Wire or strand splice and anchorage accessories shall not nick or otherwise damage the prestressing.

2.09 ELASTOMERIC MATERIALS

- A. A 9-inch minimum waterstop with centerbulb shall be polyvinyl chloride meeting the requirements of the Corps of Engineers Specification CRD-C 572. Splices shall be made in accordance with the Manufacturer's recommendations subject to the approval of the Engineer. Waterstop shall be manufactured by Greenstreak Plastic Products Company, Inc., or equal.

- B. Bearing pads shall be natural rubber or neoprene.
 - 1. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer and the physical properties shall comply with ASTM D2000 Line Call-Out M 4 AA 414 A1 3.
 - 2. Neoprene bearing pads shall have a hardness of 40 to 50 durometer, a minimum tensile strength of 1,500 psi, a minimum elongation of 500%, and a maximum compressive set of 50%. Pads shall meet the requirements of ASTM D2000 Line Call-Out M 2 BC 410 A1 4 B14 or M 2 BC 414 A14 C12 F17 for 40 durometer material.
- C. Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D1056, Type 2, Class A, and Grade 1 or 3. Compression deflection limited to 25% at 2 to 5 psi.
- D. Polysulfide or polyurethane sealant will be a two or three component elastomeric compound meeting the requirements of ASTM C920. Sealants shall have permanent characteristics of bond to metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air cured sealants shall not be used.

2.10 EXTERIOR COATINGS

- A. A decorative coating shall be applied to the exterior dome surface using one coat of a cementitious based damp-proofing product such as "Tamoseal" or equal, and one coat of a non-cementitious, high build, 100% acrylic resin polymer such as "Tammscoat Smooth" textured protective coating, "Tnemec Envirocrete 156" or equal. A decorative coating shall be applied to the above grade exterior wall surfaces using two coats of a non-cementitious, high build, 100% acrylic resin polymer such as "Tammscoat Smooth" textured protective coating, "Tnemec Envirocrete 156" or equal.

2.11 APPURTENANCES

- A. The Tank Contractor shall provide and install all appurtenances as shown on the drawings. Tank Appurtenances are detailed in Paragraph 1.03. Appurtenances shall include the following:
 - 1. Suction and Fill Piping.
 - 2. Overflow Piping and Weir.
 - 3. Concrete Splash Pad.
 - 4. Roof Hatch.
 - 5. Roof Ventilator (Fail Safe Vent).
 - 6. Interior Ladder:
 - a. Ladder rungs to be solid bars and knurled.
 - b. Ladders shall be 316L stainless steel on interior.
 - c. Ladders shall have minimum 2-inch-wide side rails and minimum spacing between side rails of 16 inches. Vertical rung spacing shall be 12 inches.
 - 7. Exterior Ladder:
 - a. Ladder rungs to be solid bars and fluted.
 - b. Ladders shall be of 316L stainless steel construction or 6061-T6 aluminum construction on exterior.
 - c. Ladders shall have minimum 2-inch-wide side rails and minimum spacing between side rails of 16 inches. Vertical rung spacing shall be 12 inches.
 - 8. Access Manway with Self-Sealing Gasket.

9. Guardrails:
 - a. Guardrail shall be manufactured with 316L stainless steel or 6061-T6 aluminum construction and a swing gate at each access point. Fasteners and hardware shall be 316L stainless steel.
 - b. Horizontal Rails and Posts to be 1 1/2-inch sch 80 pipe.
10. Transducer: As specified in Division 26.
11. Floats: As specified in Division 26.
12. Mixing System: As specified in Divisions 26 and 46.
13. Other equipment as specified and shown on the Drawings.

B. Use 316L stainless steel wedge anchors all connections to concrete, unless noted otherwise.

2.12 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer's recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.

2.13 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service.

PART 3—EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.
- B. A minimum of one trip and one day on site shall be provided for startup and training services.

3.02 CONSTRUCTION

- A. CONTRACTOR is responsible for all clearing and grubbing within the "area of site" as shown on the Drawings and as specified. All construction activities with respect to the elevated tank shall be contained within the area of site.
- B. The tank foundation shall be backfilled and compacted to 4 inches below final grade by CONTRACTOR. All backfill, compaction, and testing shall be in accordance with Section 31 23 00—Excavation, Fill, Backfill, and Grading. Backfill material around the tank shall be placed in uniform layers and compacted as specified for the material and site conditions. Asymmetrical backfill placement, except as may be required by the design and site conditions, shall be avoided.
- C. CONTRACTOR shall topsoil, final grade, and seed the entire "area of the site" and all other areas disturbed by CONTRACTOR. See Section 32 92 00—Restoration.

- D. All trees, shrubs and other vegetation in the tank area and temporary work areas designated for construction shall be removed by CONTRACTOR as described in Section 31 10 00–Clearing and Grubbing.
- E. All surface improvements and underground utilities to remain in place that are disturbed by CONTRACTOR shall be restored to their original condition under this Contract except those indicated to be abandoned in Section 02 41 00–Demolition or as shown on the Drawings. Replacement methods shall be approved by OWNER of such improvements and underground utilities.

3.03 FLOOR

- A. The floor and wall footings shall be constructed to the dimensions shown on the Approved Shop Drawings. This includes all floor piping penetrates as shown on the Drawings.
- B. Prior to placement of the floor reinforcing, a 6 mil polyethylene moisture barrier shall be placed over the leveling base material. Joints in the polyethylene shall be overlapped a minimum of 6 inches.
- C. Prior to placement of the floor concrete, all piping that penetrates the floor shall be set and encased in concrete.
- D. The vertical waterstop shall be placed and supported so that the bottom of the center bulb is at the elevation of the top of the footing. The waterstop shall be supported without puncturing any portion of the waterstop other than pre-manufactured holes, grommets or hog rings for tying at 12 inches o.c. The waterstop shall be spliced using a thermostatically controlled sealing iron and each splice shall be successfully spark tested prior to encasement in concrete.
- E. Floors over 20,000 sq. ft. in surface area, at the option of the Tank Contractor, may have one or more construction joints. Such construction joints shall be approved by ENGINEER prior to placement and shall include a continuous waterstop and reinforcement through the joint.
- F. The floor shall be cured by applying one coat of curing compound, curing blankets and/or flooding with water, and shall remain saturated for a minimum of seven days.

3.04 PRECAST WALL PANEL CONSTRUCTION AND ERECTION

- A. The precast wall panel shall be constructed with a continuous waterproof steel diaphragm embedded in the exterior of the precast panel. Horizontal joints in the diaphragm will not be allowed.
- B. No holes for form ties, nails, or other punctures will be permitted in the wall.
- C. Temporary wall openings may be provided for access and removal of construction materials from the tank interior subject to the approval of ENGINEER.
- D. Wall beds shall be constructed to provide finished panels with the proper curvature of the tank.
- E. Polyethylene sheeting shall be placed between successive pours to provide a high moisture environment and a long slow cure for the concrete.

- F. The erecting crane and lifting equipment shall be capable of lifting and placing the precast panels to their proper location without causing damage to the panel.
- G. The precast panels shall be erected to the correct vertical and circumferential alignment. The edges of adjoining panels shall not vary inwardly or outwardly by more than 3/8 inch and shall be placed to the tank radius within +3/8-inch.
- H. Joints between precast wall panels shall be bridged with a 10-gauge steel plate edge sealed with polysulfide or polyurethane and filled with mortar as shown on the drawings. No through-wall ties will be permitted.

3.05 PRECAST DOME PANEL CONSTRUCTION AND ERECTION

- A. Dome panel casting beds shall be constructed to provide finished dome panels with the proper dome curvature.
- B. Polyethylene sheeting shall be placed between successive pours to provide a high moisture environment and a long slow cure for the concrete.
- C. The erecting crane and lifting equipment shall be capable of lifting and placing the precast dome panels to their proper location without causing damage to the dome panel.
- D. The precast dome panels shall be erected to the correct radial and circumferential alignment as indicated in the Approved Shop Drawings. Adjacent dome panel offsets shall be constructed to a tolerance of $\pm 3/8$ -inch.

3.06 CAST-IN-PLACE DOME CONSTRUCTION

- A. In lieu of a Precast Dome Panel construction, CONTRACTOR may use a cast-in-place system meeting the following requirements.
- B. The dome shall be constructed to the dimensions and curvature provided on the Approved Shop Drawings.
- C. Dome roof decking shall not vary from level, or the curvature shown, more than 1/4-inch in 10 feet or 1/2-inch maximum in 20 feet or more.
- D. The dome shall be constructed to the thickness shown on the Approved Shop Drawings. Screed rails shall be provided for proper curvature and reinforcing cover.
- E. A curing compound which is compatible with the decorative coating systems shall be applied to the dome in accordance with the Manufacturer's recommendations. Water curing may be used in conjunction with the curing compound.

3.07 CONCRETE

- A. The concrete specified in this section is for the tank only. The concrete requirements of all other Work at the site shall meet the requirements of Division 03.
- B. All concrete shall be conveyed, placed, finished, and cured as required by pertinent ACI standards.

C. Weather Limitations:

1. Unless specifically authorized in writing by ENGINEER, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit and when the concrete is likely to be subjected to freezing temperatures before initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected in accordance with ACI 306. The temperature of the concrete shall be maintained in accordance with the requirements of ACI 301 and ACI 306. All methods and equipment for heating and for protecting concrete in place shall be subject to the approval of ENGINEER.
2. During hot weather, concreting shall be in accordance with the requirements of ACI 305.
3. Placement of concrete during periods of low humidity (below 50%) shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. In any event, surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing, or flooded with water, or shall be water cured continuously from the time the concrete has taken initial set. Curing compounds may be used in conjunction with water curing, provided they are compatible with coatings that may later be applied, or they are degradable.

D. Finishes: The tank shall be given the following finishes:

1. The floor slab shall receive a bull float finish or Fresno finish. The top of the wall footing, exterior to the waterstop, shall receive a steel trowel or magnesium trowel finish.
2. The interior of the precast wall panels shall receive a light broom finish.
3. The exterior of the dome shall receive a light broom finish. The interior of the dome shall receive a form finish.
4. Exterior shotcrete shall receive a natural gun / nozzle finish.

E. Curing: Concrete shall be cured using water methods, sealing materials, or curing compounds. Curing compounds shall not be used on surfaces to which decorative coatings, mortar, or shotcrete is to be applied. Curing compounds used within the tank shall be suitable for use with potable water.

F. Testing:

1. For concrete placed in precast panels or wall slots, a set of three cylinders shall be made for each truck load of concrete placed. For concrete placed in the floor, dome ring, or dome slots, two sets of five cylinders for the first 50 cubic yards, and one set of five cylinders for every 100 cubic yards thereafter placed in the same day. Two cylinders shall be tested at seven days, two at twenty-eight days, and one held as a spare.
2. Slump, air content and temperature testing shall be performed on each truck where cylinders are taken.
3. All concrete testing shall be in accordance with ASTM C31 and C39. Concrete tests including strength shall meet the requirements calculated and designed by structural engineer.

3.08 SHOTCRETING

A. Weather Limitations:

1. Shotcrete shall not be placed in freezing weather without provisions for protection against freezing. Shotcrete placement can start without special protection when the temperature is 35°F and rising and shall be suspended when the temperature is 40°F and falling. The surface to which the shotcrete is applied shall be free from frost. Cold weather shotcreting shall be in accordance with ACI 506, ACI 301 and ACI 306.

2. Hot weather shotcreting shall be in accordance with the requirements of ACI 506, ACI 301 and ACI 305.
- B. Coating of Steel Diaphragm:
1. The steel diaphragm shall be covered with a layer of shotcrete at least 1/2 inch thick prior to prestressing.
 2. Total minimum coating over the steel diaphragm shall be 1 1/2 inches including diaphragm cover, wire or strand cover, and finish cover coat.
- C. Coating Over Prestressing Wire or Strand:
1. Each prestress wire or strand shall be individually encased in shotcrete. Shotcrete thickness shall be sufficient to provide a clear cover over the wire and strand of at least 1/4 inch and 3/8 inch, respectively.
 2. Finish cover coat shotcrete shall be applied as soon as practical after the last application of wire or strand coat.
 3. The minimum final shotcrete cover over the outermost prestressing wire or strand layer shall be 1 inch.
- D. Placement of Shotcrete:
1. Shotcrete shall be applied by an ACI 506 certified nozzleman.
 2. Manually applied shotcrete shall be applied with the nozzle held at a small upward angle not exceeding five degrees and constantly moving during application in a smooth motion with the nozzle pointing in a radial direction toward the center of the tank. The nozzle distance from the prestressing shall be such that shotcrete does not build up or cover the front face of the wire or strand until the spaces behind and between the prestressing elements are filled.
 3. Unless applied by an automated shotcrete process, total cover coat thickness shall be controlled by shooting guide wires. Vertical wires shall be installed under tension and spaced no more than two feet apart to establish uniform and correct coating thickness. Monofilament line (100 lb. test) or 18- or 20-gauge high tensile strength steel wire shall be used. Guide wires shall be removed after placement of the cover coat.
 4. Shotcrete applied by an automated shotcrete process shall be applied using the wet mix only. Nozzles shall be kept mounted on power driven machinery enabling the nozzle to travel parallel to the surface to be sprayed at a uniform linear or bi-directional speed. The nozzle shall be kept at a uniform constant distance from the surface, providing a right angle spray of the material to the surface. The high velocity impact shall be developed pneumatically by injecting compressed air at the nozzle.
- E. Curing:
1. Shotcrete shall be cured using water curing methods, sealing materials or curing compounds at the option of the Tank Contractor. Curing compounds shall not be used on surfaces to which decorative coatings, mortar or shotcrete is to be applied. Curing compounds used within the tank wall shall be suitable for use with potable water. Intermediate layers of shotcrete shall be kept damp by water curing or other means no sooner than twelve hours after the shotcrete has been applied.
 2. Water curing is not required should additional shotcrete be applied on the entire wall surface within the following twelve hours.
 3. Indiscriminate use of continuous water cure for intermediate layers shall be avoided.
 4. Complete shotcrete surfaces, which do not receive any additional coatings, may be water cured for a period of at least seven days by encapsulating the shotcrete inside of plastic sheeting.

F. Testing:

1. Testing of shotcrete shall be in accordance with ACI 506, except as specified herein. One test panel shall be made for each of the following operations: core wall, wire or strand cover, and cover coat. Test panels shall be made from the shotcrete as it is being placed, and shall, as nearly as possible, represent the material being applied. The method of making a test sample shall be as follows: A frame of wire fabric (1 foot square, 3 inches in depth) shall be secured to a plywood panel and hung or placed in the location where shotcrete is being placed. This form shall be filled in layers simultaneously with the nearby application. After twenty-four hours, the fabric and plywood backup shall be removed and the sample slab placed in a safe location at the site.
2. The sample slab shall be moist cured in a manner identical with the regular surface application. The sample slab shall be sent to the testing laboratory. Nine 3-inch cubes shall be cut from the sample slab and subjected to compression tests in accordance with current ASTM Standards. Three cubes shall be tested at the age of seven days, three shall be tested at the age of 28 days, and three shall be retained as spares.
3. At the Tank Contractor's option testing of shotcrete applied with an automated process shall be in accordance with ACI 301 and conform to Paragraph 3.07.E, "Concrete" of these specifications in lieu of that indicated in Paragraph 3.09.F.

3.09 CIRCUMFERENTIAL PRESTRESSING

- A. Prestressing shall be performed utilizing continuous wire or strand. Prestressing wire/strand will be placed on the wall with a machine capable of consistently producing a stress in the wire/strand within a range of minus 7% to plus 7% of the stress required by the design. No circumferential movement of the prestressing along the tank wall will be permitted during or after stressing. Stressing may be accomplished by drawing the wire through a die or by another process that results in uninterrupted elongation, to provide uniform stress throughout its length and over the periphery of the tank.
- B. Each coil of prestressing shall be temporarily anchored at sufficient intervals to minimize the loss of prestress in case a wire/strand breaks during wrapping.
- C. Minimum clear space between prestressing wires is 5/16 inch or 1.5 wire diameters, whichever is greater. Minimum clear distance between prestressing strands is 3/8 inch or 1.5 strand diameters, whichever is greater. Any wires or strands not meeting the spacing requirements shall be respaced. Prestressing shall be placed no closer than 2 inches from the top of the wall, edges of openings, or inserts, nor closer than 3 inches from the base of walls or floors where radial movement may occur.
- D. The band of prestressing normally required over the height of an opening shall be displaced into circumferential bands immediately above and below the opening to maintain the required prestressing force. Bundling of the prestressing steel shall be prohibited.
- E. For wire wound tanks, a stress plate shall be used at all permanent wall penetrations above grade that results in displacement of wire/strand equal to or greater than 24 inches in height. The stress plate shall accommodate a portion of the prestressing normally required for the height of the opening. The remaining prestressing normally required shall be displaced into circumferential bands immediately above and below the penetration. The effect of banded prestressing shall be taken into account in the design.
- F. Ends of individual coils shall be joined by suitable steel splicing devices capable of developing the full strength of the prestressing wire/strand.

- G. The Tank Contractor shall furnish a calibrated stress recording device, which can be recalibrated, to be used in determining wire/strand stress levels on the wall during and after the prestressing process. At least one stress reading per vertical foot or one stress reading for every roll of prestressing, whichever is greater, shall be taken immediately after the wire or strand has been applied on the wall. Readings shall be recorded and shall refer to the applicable height and layer of the prestressing for which the stress is being taken. The Tank Contractor shall keep a written record of stress readings. All stress readings shall be made on straight lengths of wire/strand. If applied stresses fall below the design stress in the steel, additional wire or strand will be provided to bring the force on the core wall up to the required design force. If the stress in the steel is more than 7% over the required design stress, the wrapping operation should be discontinued, and satisfactory adjustment made to the stressing equipment before proceeding.
- H. When a mechanical stressing system is utilized a continuous electronically (or substantial equivalent) monitored permanent recording of the applied force shall be made during the entire circumferential prestressing application. All such recordings shall be based on a continuous sensing of the applied force on the wire/strand between the tensioning system and the wall when, and as, the strand is being wrapped and laid on the wall.

3.10 DECORATIVE COATINGS

- A. All exposed exterior dome surfaces shall be given a two-coat finish consisting of one coat of damp-proofing product such as "Tamoseal with AKKRO-7T" or equal, and one coat of "Tammscoat Smooth" or equal. If required in the Drawings, all exterior exposed wall surfaces shall be given a two-coat finish of a non-cementitious 100% acrylic such as "Tammscoat Smooth," Tnemec Envirocrete 156 or equal. Work shall be performed by workmen skilled in the application of these types of products. The Manufacturer's application instructions shall be submitted to ENGINEER for approval. The Tank Contractor shall confer with the Manufacturer's representatives regarding application techniques and shall follow the Manufacturer's instructions implicitly.
- B. The concrete surface to be coated shall be clean, free of all laitance, dirt, grease, or other foreign materials. All defective surfaces shall be filled and/or repaired. Application shall be in full accordance with the Manufacturer's instructions or as amended by ENGINEER.
- C. OWNER shall select the color.

3.11 APPURTENANCES

- A. Install all railing in accordance with approved shop drawings and manufacturer's instructions providing a complete installation.
 - 1. Install components plumb and level, accurately fitted, and free from distortion or defects.
 - 2. Clean all components as recommended by railing manufacturer.
- B. Safety Climb Equipment:
 - 1. Install equipment on all ladders and roof as specified and in accordance with manufacturer's instructions.
 - 2. Install safety climb cables per manufacturers requirements.
 - 3. Install all identifications and labels provided with the equipment.

- C. Electrical Accessories: All electrical accessories shall be provided as shown on the Drawings and specified in Division 26.
- D. The manway shall be cast into the wall, and the exterior manway ring shall be bolted on after tank prestressing is complete, prior to final covercoat placement.
- E. Exterior Ladder:
 - 1. All welds to be 3/16 inch minimum.
 - 2. All steel in contact with concrete must be coated with a heavy bitumastic coating, epoxy paint, or shimmed used PVC.
 - 3. Where 316L stainless steel bolts are in contact with dissimilar metals, use insulating sleeves and phenolic washers to electrically isolate the bolts.
 - 4. Where 316L stainless steel bolt are placed in the wall exterior, drill and place after wrapping and before final shotcreting.
- F. Roof Hatch:
 - 1. All steel in contact with concrete must be coated with a heavy bitumastic coating, epoxy paint, or shimmed used PVC.
 - 2. Where 316L stainless steel bolts are in contact with dissimilar metals, use insulating sleeves and phenolic washers to electrically isolate the bolts.

3.12 WATERTIGHTNESS TEST

- A. Upon completion, the tank shall be tested to determine watertightness. The tank shall be filled with potable water to the maximum level. Water will be furnished to the tank by OWNER. The test shall consist of measuring the liquid level over the next twenty-four hours to determine if any change has occurred. If a change is observed and exceeds the maximum allowance, the test shall be extended to a total of five days. If at the end of five days the average daily change has not exceeded the maximum allowance, the test shall be considered satisfactory. CONTRACTOR shall monitor settlement during the initial filling and watertightness test by measuring elevations at a minimum of 4 points around the perimeter of the tank immediately before, at day 2, and after watertightness test. CONTRACTOR should refer to geotechnical report regarding additional settlement monitoring recommendations and requirements.
- B. The liquid volume loss for a period of twenty-four hours shall not exceed 1/20th of 1% of the tank capacity, $0.0005 \times \text{tank volume}$. If the liquid volume loss exceeds this amount, it shall be considered excessive, and the tank shall be repaired and retested.
- C. Damp spots will not be permitted at any location on the tank wall. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. No leakage that includes visible flow through the wall-floor joint shall be permitted. Damp spots on the footing are permissible.
- D. Damp spots or standing water on the footing may occur upon tank filling and are permissible within the allowable volume loss. Measurable flow in this area is not permissible and shall be corrected.
- E. Water for the initial watertightness test shall be furnished to the tank by OWNER. Water for any subsequent tests which are required will be at the expense of CONTRACTOR.

3.13 CLEANING AND DISINFECTION

- A. CONTRACTOR shall sterilize tank to provide tank surface which is free from bacteria. The sterilization procedure shall conform to Chlorination Method 3 as described in AWWA C652 and shall be performed in conformance with the paint manufacturer's recommended cure times.
- B. In general, the tank shall be filled to 5% capacity and chlorine added to achieve an initial solution of 50 mg/L available chlorine. This solution shall be held for at least 6 hours. The tank shall then be hydrotested per manufacturer's recommendations and as specified.
- C. Water used for disinfection shall be flushed from tank and disposed of using a chlorine-reducing agent as provided for in AWWA C652 Appendix B. Tank shall then be refilled from the distribution system.
- D. OWNER will take water samples for bacterial analysis. Two safe samples will be required to be obtained for conformance with sterilization procedure.
- E. The interior of the fill pipe shall also be flushed and disinfected. Fill pipe shall be flushed extensively prior to filling and sterilizing. CONTRACTOR shall select the method and submit it to ENGINEER for review.
- F. OWNER will provide, at no charge, water to sterilize, fill, and test the tank once. Water will be provided from proposed connection point to distribution system or from the nearest distribution system hydrant to the tank. Means of transporting the water from the hydrant to the tank shall be provided by CONTRACTOR as required. It is the intent that the new site water main will be installed prior to testing and that water will be available at the site when testing and sterilizing is required. If bacteriological testing fails and the tank needs to be drained and refilled, CONTRACTOR shall purchase the water from OWNER.
- G. CONTRACTOR shall, at no additional cost to OWNER, repeat the disinfection process, following a positive (failing) bacteriological sample, and shall do so as many times as needed in order to confirm adequate disinfection as measured by a negative (passing) bacteriological sample.

END OF SECTION

SECTION 33 52 16

FUEL GAS DISTRIBUTION UTILITIES

PART 1—GENERAL

1.01 SUMMARY

- A. This section contains specifications for all fuel utility distribution systems for this project.
Work included:
 - 1. Natural gas service.
 - 2. Natural gas—aboveground.
 - 3. Buried natural gas piping.
 - 4. Vents and relief valves.
 - 5. Unions and flanges.

1.02 CODES AND STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 - 1. International Fuel Gas Code and applicable standard(s).
 - 2. NFPA 54—National Fuel Gas Code (Current Edition).
 - 3. Polyethylene gas distribution piping shall be installed in accordance with CFR 49, Part 192, Subpart G (mains), Subpart H (service lines), applicable codes and regulations, and ASTM D2774.

1.03 WELDER QUALIFICATIONS

- A. Before any polyethylene fusion welding is performed, CONTRACTOR to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- B. OWNER reserves the right to test the work of any welder employed on the project, at CONTRACTOR's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

1.04 NATURAL GAS SERVICE

- A. All charges for the gas service as shown on the Drawings, including the connection from the main in the street or other location to the gas meter, shall be paid by CONTRACTOR, including setting of gas meter(s) and all work performed by the gas company.
- B. The Utility Company is Nicor Gas. The natural gas utility provider contact information obtained during design is Scott Briner. CONTRACTOR is responsible to verify this information as well as installing and coordinating all aspects of the natural gas service.

- C. The secondary service pressure after the utility provided meter will be 1.5 psig, 780,000 BTU minimum, for the site, space, generator (standby power) and process heating.
- D. The tertiary service pressure and demand supplied to individual buildings shall be as shown on the Drawings.
- E. An allowance of \$15,000 shall be included by CONTRACTOR in the Lump Sum Bid for the scope of work provided by the Utility. Coordinate the natural gas service with the Utility. This allowance shall be adjusted by change order (up or down), based on the actual cost of the natural gas service from the Utility to CONTRACTOR.

1.05 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2—PRODUCTS

2.01 NATURAL GAS—ABOVEGROUND

- A. See Section 23 11 23—Facility Fuel Gas Piping for specifications.

2.02 BURIED NATURAL GAS PIPING

- A. Manufacturers: Performance Pipe, a division of Chevron Phillips Chemical Company LP, JM Eagle, or equal.
- B. Buried natural gas pipe tubing, fittings, and joints shall be PE 2708 (PE 2406) polyethylene, SDR-11 or less, ASTM D2513 and D3350 pipe and fittings. Provide butt-weld fittings conforming to ASTM D3261 or socket-type fittings conforming to ASTM D2683.
- C. Polyethylene pipe tubing, fitting, and joint materials shall be compatible and by same manufacturer. Fabricated fittings shall not be used. Match fittings to service rating of pipe.
- D. Provide an anodeless riser connection between buried plastic gas service piping and metallic riser in accordance with the local codes. Provide a metallic riser consisting of HDPE fused coating on steel pipe for connection to aboveground building distribution piping. Underground horizontal metallic portion of riser shall be at least 24 inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting

design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser. Provide Elster, George Fischer Central Plastics, or equal.

- E. Gas Transition Fittings: Provide manufactured steel transition fittings approved for joining steel and polyethylene pipe, conforming to AGA XR0603 requirements for transition fittings. Transition fittings shall be manufactured by Continental, Elster, George Fischer Central Plastics, or equal.
- F. Underground installation of piping shall conform with ASTM D2774.
- G. Provide tracer wire as specified.

2.03 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

2.04 UNIONS AND FLANGES

- A. See Section 23 11 23—Facility Fuel Gas Piping for aboveground system specifications.
- B. Do not use flanges for underground gas or oil systems. Use fittings that are solvent-welded or fusion-bonded joints only.

PART 3—EXECUTION

3.01 INSTALLATION

- A. Gas piping shall be installed in accordance with state, local, and utility codes and the National Fuel Gas Code, NFPA No. 54. All natural gas piping shall be tested in accordance with all state, local, and utility codes pertaining to natural gas service or service requirements. CONTRACTOR shall arrange for natural gas service and shall coordinate service size and location and shall furnish and install all shutoff valves and pressure reduction as required.
- B. CONTRACTOR shall excavate and lay all pipe to the line and grade shown on the Drawings. Grade stakes will be required for all lines.
- C. Where piping is laid in native soil, the width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used. If the maximum trench width is exceeded for any reason other than as otherwise specified, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense, unless CONTRACTOR can demonstrate that the pipe to be used is compatible with the resulting load applied.
- D. Thermoplastic pressure piping may be bedded in compacted sand. CONTRACTOR shall perform all necessary excavation and shall provide all required materials to provide this bedding. Bedding material shall conform to the requirements of ASTM C33. The material shall be hard, tough, and durable and shall meet the following gradation requirements.

PERCENTAGE BY WEIGHT PASSING

	Bedding Sand
1 inch	---
3/4 inch	---
1/2 inch	---
3/8 inch	100
No. 4	95 to 100
No. 8	80 to 100
No. 30	25 to 60
No. 100	5 to 20
Passing No. 200	2 to 10

- E. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
- F. When piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
- G. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.
- H. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be sand. Cover material for PVC pressure or other thermoplastic piping may be sand.
- I. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously. Cover material shall be placed over the top of the pipe to the height as shown on Drawing 01-975-43A for Class "B" (minimum 12 inches) or Class "C" (minimum 6 inches) Bedding. This backfill shall be placed by hand in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. If bedding material conforming to any of the above three crushed stone or crushed gravel gradations is used as cover material, it need not be tamped. The remaining 6 inches to make up the required 1 foot of select cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.
- J. All cover material shall be placed in maximum 6-inch layers and compacted by hand tamping. Compaction shall be equivalent to that described under "Compacted Fill and Backfill" as specified in Section 31 23 00–Excavation, Fill, Backfill, and Grading.
- K. Except as otherwise specified, all backfill above 1 foot above the pipe shall be "Compacted Fill and Backfill" as specified in Section 31 23 00–Excavation, Fill, Backfill, and Grading.

- L. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
- M. Install an electrically conductive 10 gauge copper wire with yellow insulation with buried natural gas piping. The tracer wire shall be installed at a distance of 4 inches to 6 inches adjacent to the pipe. The wire and all of its connections shall be insulated to prevent corrosion.
- N. Do not install natural gas piping in same trench with other utilities. Minimum horizontal clearance between gas pipe and parallel utility pipe shall be 2 feet. Natural gas pipe shall not be installed through catch basins, vaults, manholes or similar underground structures.
- O. Natural gas entrances into buildings shall be above grade.
- P. Protection Against Shear and Bending Loads: In accordance with ASTM D2774, natural gas connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle, or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.
- Q. Butt, socket, and saddle fusion joints in polyethylene natural gas piping shall be made using procedures that have been qualified and approved by the Operator in accordance with Title 49, CFR, and Part 192.283.
- R. In accordance with CFR. 49, part 192, Section 192.285, the Operator shall review that all persons making heat fusion joints have been qualified to make joints in accordance with the Operator's Approved Qualified Fusion Procedures. The Operator shall maintain records of qualified personnel, and shall certify that qualification training was received not more than 12 months before commencing construction. CONTRACTOR shall review that all persons making heat fusion joints are qualified in accordance with this section.
- S. Butt fusion of unlike wall thickness: Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple or by mechanical means or electrofusion.
- T. Polyethylene natural gas pipe and fittings may be joined together or to other materials by transition fittings, fully restrained mechanical couplings, or electrofusion. These devices shall be designed for joining polyethylene to another material and shall be approved by ENGINEER for use in natural gas distribution system.
- U. When mechanical OD compression couplings are used, polyethylene natural gas pipe shall be reinforced with a stiffener in the pipe bore. Stiffeners shall be properly sized for the diameter and wall thickness of polyethylene pipe being joined. For service pipe connections, the stiffener length shall match the pipe end penetration depth into the coupling.

V. General Excavation:

1. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract unless otherwise noted. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
2. Work shall conform to other sections of Division 31, except where modified by this section.
3. Pipe shall be placed only on dry foundations. No extra payment will be made to CONTRACTOR for dewatering.
4. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, the removal of pavement, filling, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling. All above work shall be included in the Lump Sum Bid.
5. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown. The bottom of the excavation shall be leveled off, all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced in accordance with Section 31 23 00–Excavation, Fill, Backfill, and Grading. Payment will also be in accordance with Section 31 23 00–Excavation, Fill, Backfill, and Grading.
6. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
7. Excavated native material that is unsuitable or not required for filling shall be removed from the site. Materials to be used for fill and suitable for this purpose shall be deposited where required except that no fill shall be placed where trenches for sewers, water lines, or other services will be located until after the trench work is completed.
8. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.
9. Any water, drainage, gas, sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance with the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.

W. Gas lines shall not be installed under buildings, structures, or in crawl spaces.

X. A Schedule 40 steel sleeve shall be installed on all natural gas risers passing through asphalt or concrete slabs. Allow at least 1 inch of radial clearance between sleeve and riser. Void shall be filled with pea gravel.

Y. Natural gas piping shall be buried a minimum depth of 36 inches, unless noted otherwise.

- Z. Do not route piping through sub-grade utility vaults.
- AA. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.
- BB. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow to dirt leg that is to be located in building for accessibility. When installing mains and branches, cap gas-tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- CC. Do not install gas pipe below a building or its foundation or in a ventilation air plenum.
- DD. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least 5 feet above grade.
- EE. All joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings.
- FF. Install shut off valves as shown on Drawings. Provide valve box and valve operator per NFPA and AGA standards.
- GG. Blow compressed air into gas piping system as a part of commissioning system, before placing into service, to clean piping until target cloth is clean and free of debris.
- HH. Use for all underground metallic piping or underground metallic gas conduit.
- II. Remove all dirt and other foreign material from exterior of pipe. Apply primer as recommended by the manufacturer. Use a spiral wrap process for applying tape to the pipe. Repair any breaks in the tape coating caused by the installation process.
- JJ. Concealed or underground unions or flanges are not acceptable.

3.02 FIELD QUALITY CONTROL

- A. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.
- C. Conduct pressure test with test medium of air unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. Do not backfill pipe until it has been successfully tested.

- E. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.
- F. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

System	Pressure	Medium	Duration
Natural gas	100 psig	Air	24 hr

- G. On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

END OF SECTION

SECTION 40 05 00

PIPING AND APPURTENANCES

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. All piping, valves, and appurtenances of every description except for pipe as specified in Division 33.
 - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
 - 3. Piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section. CONTRACTOR shall comply with the American Iron and Steel (AIS) requirements of the Consolidated Appropriations Act of 2014 as presented in Section 01 41 00—Regulatory Requirements, 1.08.

1.02 SUBMITTALS

- A. Applicable provisions of Section 01 33 00—Submittals cover requirements for shop drawings and Operation and Maintenance Manuals.
- B. General arrangement drawings, including support system of 3 inches or larger interior and 3 inches or larger exterior (aboveground) ductile iron, stainless steel piping shall be submitted to ENGINEER for approval. Shop drawings for all interior and aboveground exterior piping shall be two-line drawings drawn to scale. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, supports, and valves and appurtenances. Plug valve orientation, including operator and plug orientation, shall be shown on Drawings.
- C. Grooved joint couplings and fittings shall be referred to on arrangement drawings and product submittals, and be identified by the manufacturer's listed model or series designation.

1.01 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national

de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MATERIALS OF CONSTRUCTION

- A. Materials of Construction: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. Products used in potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372.
- B. Size and Type:
 - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
 - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER. All grooved joint couplings and fittings shall be of the same manufacturer.

2.02 PIPE AND PIPE FITTINGS

- A. Stainless Steel Piping:
 - 1. Stainless steel piping shall be ASTM A312, Grade TP 316L Schedule 10 stainless steel pipe.
 - 2. Fittings shall be ASTM A142 3000-pound socket weld.
 - 3. Flanges shall be ASTM A142 Class 150, raised face, slip on 125-230AA with circular lay.

2.03 VALVES

- A. Gate Valves:
 - 1. Shutoff valves in ductile iron potable and non-potable water lines 4-inch diameter and larger shall be AWWA C515, ductile iron, resilient seat, nonrising stem, 150 psi working pressure with O-ring packing box, Kennedy, American, American AVK, or equal.
 - 2. Underground valves shall have extended stem, cast iron telescopic valve box, and key.
 - 3. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated (prime and finish coats) as specified in Division 09. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be

furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

2.04 PIPING APPURTENANCES AND MISCELLANEOUS MATERIALS

- A. General: Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.
- B. Restrained Flanged Coupling Adapters: Restrained flanged coupling adapters shall be furnished and installed as shown on the Drawings. Restrained flanged coupling adapters shall be of ductile iron construction, complete with EPDM sealing gasket, and gripping wedges and torque limiting actuating screws. Restrained flanged coupling adapters shall be Series 2100 MEGAFLANGE by EBAA Iron, or equal.
- C. Pipe Coupling: Pipe couplings identified on the Drawings shall be Dresser Type 38, Smith Blair 411, or equal, steel coupling. CONTRACTOR shall provide tie ears and tension ties where necessary to restrain pipe.
- D. Tension Ties: All tension ties and rod ties shall be provided to resist a minimum 150 psi pressure in the pipe line. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary. Rods shall be provided with nuts and washers on both sides of tie ears. All nuts, washers, and rods shall be Type 304 stainless steel. Rods shall be Type 304 stainless steel at a minimum. Tie rods shall be equally spaced around pipe. The following table lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

Pipe Size (inches)	150 psi Pressure		250 psi Pressure	
	Minimum Number	Minimum Size (inches)	Minimum Number	Minimum Size (inches)
4-10	4	5/8	4	5/8
12	4	5/8	4	3/4
14	4	3/4	4	7/8
16	4	3/4	4	1
18	4	7/8	4	1 1/8
20	4	1	4	1 1/4
24	4	1 1/8	4	1 1/2
30	4	1 3/8	7	1 3/8
36	8	1 1/4	8	1 1/2

PART 3-EXECUTION

3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

3.02 INSTALLATION

A. Interior or Exposed Piping:

1. Provide pipe supports for all piping. Pipe support spacing and type shall, at a minimum, conform to manufacturer's recommendations unless more restrictive requirements are specified or shown on the Drawings. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile. Strap hangers, tin clips, or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the Drawings, using base fittings and concrete pads to 6 inches above the floor, Anvil 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on centers. Type 316L stainless steel supports and fasteners shall be used in submerged locations, tanks, or as indicated. Piping shall be adequately supported and braced to resist thrust at bends, rubber expansion joints, and joints. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, and sleeves in the forms before concrete is poured where needed or shown on the Drawings.
2. All piping shall be adequately supported and braced to resist thrust at bends and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
3. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8 inch is anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.
4. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
5. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Piping to be submerged shall be coated primed with Tnemec Series 94 and coated with Tnemec Series 22, or equal.

6. The following maximum spacings shall be provided for supports:

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

Nominal Pipe or Tube Size	Copper Tubing		Ductile Iron (See Note 1) ft	PVC/CPVC Pipe (See Note 2) ft
	Water Service ft	Vapor or Air Service ft		
1/4	5	5		
3/8	5	6		Continuous
1/2	5	6		Continuous
3/4	5	7		Continuous
1	6	8		4
1 1/4	7	9		4
1 1/2	8	10		4
2	8	10		4
2 1/2	9	10		4
3	10	10		4
4	10	10	10	4
5	10	10	10	4
6	10	10	10	9
8	10	10	10	9
10	10	10	10	10
12	10	10	10	10
14			10	10
16			10	10
18			10	10
20			10	
24			10	
30			10	

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult local plumbing code and manufacturer's recommendations as required. Minimum spacing requirements shall govern.

7. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
8. Provide saddles or shields under or around piping between hanger and supports for all insulated piping to prevent crushing of insulation.
9. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work. Care shall be taken in laying out piping so that there is no interference with the proper

location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.

10. Piping shall not interfere with headroom or clear floor space. Unless otherwise shown, piping shall run exposed in buildings, except in finished areas. Unless otherwise shown, small water piping in finished areas shall be concealed in interior walls, above suspended ceilings, or under floors where possible. Water piping shall not be installed in exterior walls, unless otherwise shown or noted on the Drawings. Joints shall not be used under floor slabs. Unless otherwise shown, piping under floor slabs shall clear floor slabs or footings by a minimum of 6 inches. Pipes under floors shall have a minimum of 6 inches of sand cover. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
11. Except for flanged piping, an ample number of standard weight ground joint unions and a shutoff valve shall be provided in all pipelines and at all equipment. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.
12. Valves shall be located on all branches of water supply lines where shown on the Drawings. Position valves to facilitate access and operation.
13. The appropriate number, size, and lengths of spool pieces and flange fillers needed for plumbing and leveling any existing piping shall be included in the price bid.
14. All stainless steel piping shall be protected from dust and debris deposits on the inside of the pipe during storage and installation. Protection shall be by plastic film or coated paper banded over the pipe ends to be removed just prior to installation. Any foreign matter shall be removed from the pipe interior at the time of installation.
15. The locations and elevations of existing piping are approximate. Any changes in the pipe location or elevation shall be reviewed by ENGINEER.
16. CONTRACTOR shall submit shop drawings showing new pipe routing and existing pipe removal. CONTRACTOR shall be responsible for final pipe routing and shall route new piping as required to minimize conflicts. Piping shown on the Drawings is approximate only. Not all existing piping, conduit, equipment, etc., are shown on the Drawings. CONTRACTOR shall field-verify locations. CONTRACTOR shall reroute existing piping, conduit, etc., as indicated or as required to install new piping or equipment. CONTRACTOR shall remove and relocate existing pipe supports as required to install new piping. CONTRACTOR shall provide all piping, fittings, flange fillers, and other appurtenances as required to provide functional system at no additional cost to OWNER.

- B. Cleaning and Disinfection: All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.

3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price Bid.
- B. Work shall be tested as specified in this section. Unless indicated by ENGINEER in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.

- C. New piping shall be tested. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint or before caulking of any gaps at flanges of ductile iron piping. Piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. Piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Gauges used for testing shall have increments as follows:
 - 1. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
 - 2. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
 - 3. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
- F. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests.

Fluid Abbreviation or Name	Minimum Test Pressure in psi	Test Medium	Leakage Allowance Designation
PW	150	Water	"A" ⁽¹⁾

⁽¹⁾ Leakage allowance Designation "A" shall mean zero leakage.

3.04 DEMOLITION

- A. All interior piping removals, including appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Any change in pipe location or elevation shall be reviewed by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove the following, including piping and appurtenances, as specified and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

3.05 CLEANING AND DISINFECTION

- A. All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the system before it is put on line.
- B. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Lump Sum Bid. Copies of test results shall be submitted to OWNER and ENGINEER.
- C. Potable water piping shall be disinfected according to the *Standard Specifications for Water and Sewer Main Construction* in Illinois, which shall include initial flush and disinfection to 50 ppm with gaseous chlorine or other acceptable methods. Acceptable concentration after 24 hours shall be 25 ppm.
- D. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- E. All surplus material, tools, and equipment shall be removed and the premises shall be left free of everything of the kind.

END OF SECTION

SECTION 46 41 23

SUBMERSIBLE MIXING SYSTEM

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. This section includes furnishing, installing, and placing into successful operation one submersible mixing system including electrical improvements.
 - 2. The mixing system and appurtenances shall be furnished by IXOM Watercare.
 - 3. The necessary electrical improvements shall be performed by a certified electrician. Mixing system will be monitored by a current switch as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section. CONTRACTOR shall comply with the American Iron and Steel (AIS) requirements of the Consolidated Appropriations Act of 2014 as presented in Section 01 41 00—Regulatory Requirements, Paragraph 1.08.

1.02 REFERENCES

- A. NSF / ANSI Standard 61.

1.03 QUALITY ASSURANCE

- A. Continuous Operation Equipment. The mixer shall operate continuously, all day and all night, using 120 VAC as the power source.

1.01 BUILD AMERICA, BUY AMERICA REQUIREMENTS

- A. CONTRACTOR shall comply with the Build America, Buy America (BABA) requirements of Title IX of the Infrastructure Investment and Jobs Act of 2021 (P.L 117-58). CONTRACTOR shall submit, with each shop drawing, step certification that regulated iron, steel, manufactured products, and construction materials meet BABA requirements; or submit with each shop drawing a letter stating the BABA regulated product and the product's value to be included in the BABA de minimis log. Refer to Section 01 41 00—Regulatory Requirements for BABA requirements.
- B. The named item of equipment or material in the specifications establishes the type, function, appearance, and quality required, but may not meet the requirements of BABA. CONTRACTOR shall meet BABA requirements for the named item of equipment or material, with an approved "or-equal" in accordance with GC-7.05; or include on the BABA national de minimis waiver if the waiver conditions are met. An approved "or-equal" request to meet BABA requirements shall not result in any change in Contract Price or Contract Times.

PART 2-PRODUCTS

2.01 MANUFACTURERS

- A. Specified Equipment. The mixer shall be manufactured by IXOM Watercare of Dickinson, North Dakota.

2.02 MIXER-GENERAL REQUIREMENTS

- A. Provide one Gridbee model GS-12-120V portable tank mixer.
- B. Complete Mix: The manufacturer guarantees that the subject tank will be completely mixed by the mixer. In continuous operation of the mixer: At least once per 24 hours all water temperatures within the tank shall converge to within 1.0°C.
- C. Continuous Operation With 120 VAC Power Supply: The mixer shall operate continuously during day and night.
- D. Stainless Steel Construction: The mixer shall be constructed primarily of Type 316 stainless steel metal for strength and superior corrosion resistance.
- E. Motor: The mixer shall be mechanically operated by a submersible motor that meets the following criteria:
 - 1. Direct drive, with no gearbox and no lubrication maintenance required.
 - 2. Designed for submersible operation.
 - 3. Designed for Continuous Operation without overheating or compromising motor life expectancy.
- F. Low Elevation Intake: The mixer shall be supplied with an intake capable of being positioned at the lowest elevation of the tank or reservoir floor. The intake level shall bring water into the mixer at horizontal layer within 6 inches (15 cm) of the tank.
- G. The complete mixing system shall be NSF/ANSI Standard 61 and NSF Annex G listed for safe contact with potable water.
- H. Maintenance Requirements. The mixer shall operate normally with the following maintenance features.
 - 1. No scheduled lubrication is required of any system components including motor.
 - 2. No spare parts shall be required to be kept on hand.

2.03 MIXER MOTOR CABLE

- A. Provide mixer motor cable, length as required, to reach from the mixer to the mixer junction box; CONTRACTOR shall coordinate. The mixer motor cable shall be suitable for submersible applications. This shall be indicated by a code or legend permanently printed on the cable. Cable size shall conform to NEC requirements. Provide a stainless steel Kellum grip for support of the mixer motor cable.

2.04 FINISHES

- A. It is the intent of these specifications that equipment, support and accessories be furnished factory shop-primed and finish-painted. Equipment and appurtenances shall be prepared in

accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by manufacturer and shall be suitable for describe if applicable (e.g., corrosive atmosphere, high temperature, outdoor operation). Touchup paint shall be provided by manufacturer.

2.05 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service.

PART 3–EXECUTION

3.01 GENERAL

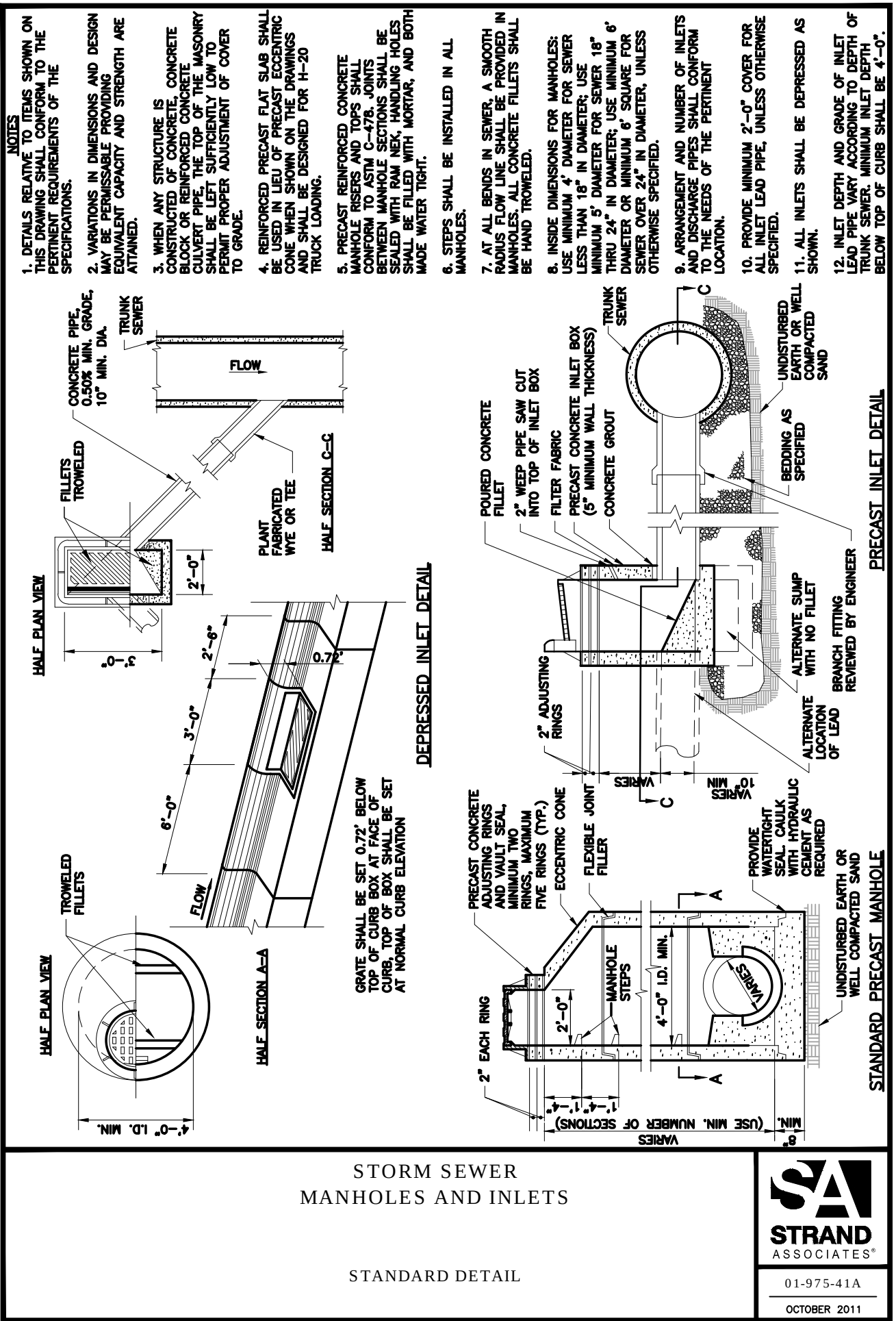
- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, startup, and operator training. Comply with additional requirements as specified below.

3.02 FACTORY INSTALLATION

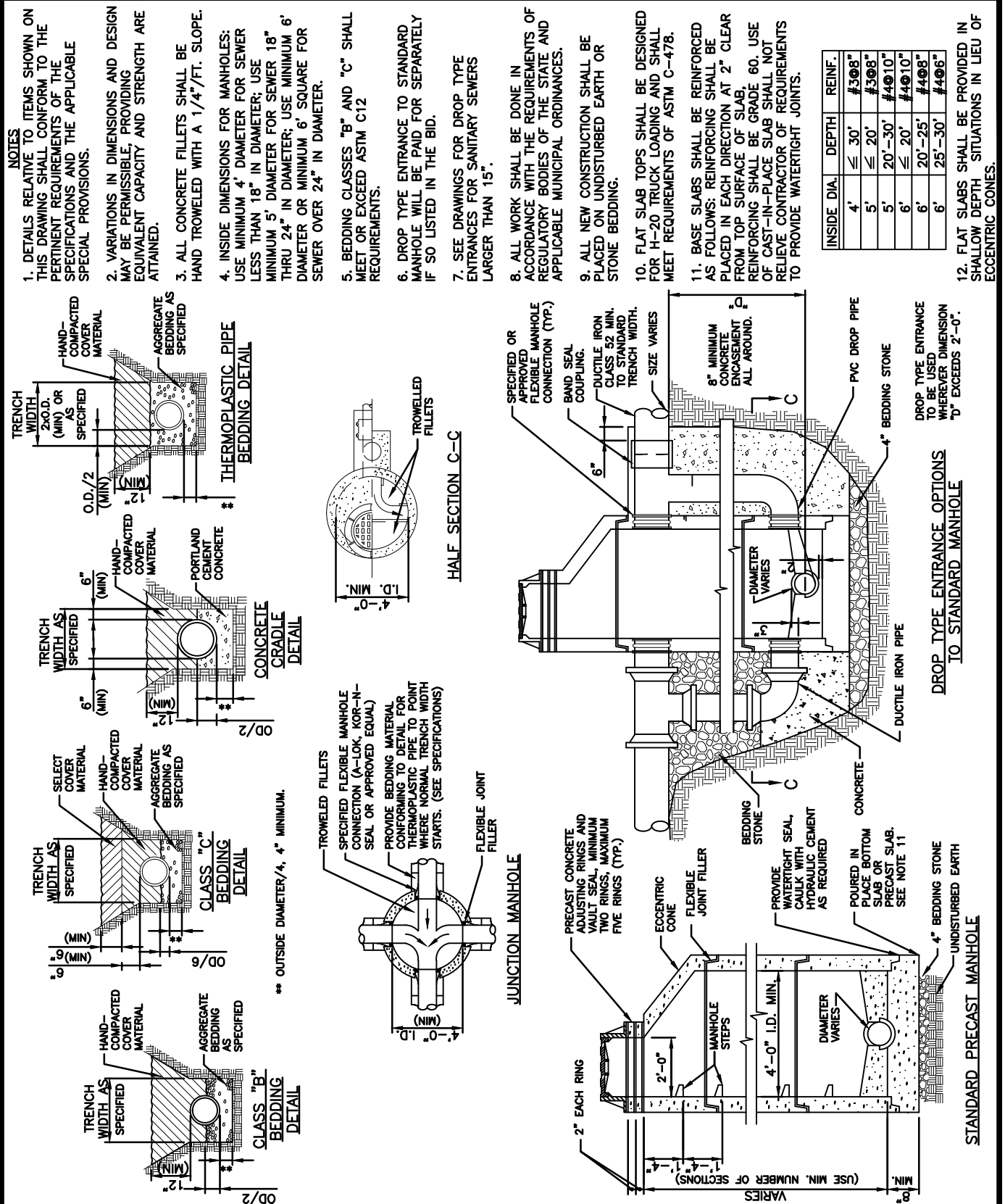
- A. The mixer manufacturer or supplier shall install the mixer from the junction box at the top of the tank and set the mixer to confirm proper machine spatial placement in the tank and proper intake depth setting.
- B. The field services shall be performed by manufacturer or mixer supplier employees experienced in the operation of this equipment.
- C. Within 30 days following installation, the manufacturer or supplier shall provide an installation report.

END OF SECTION

DRAWINGS



01-975-41A
OCTOBER 2011



SANITARY SEWER APPURTENANCES

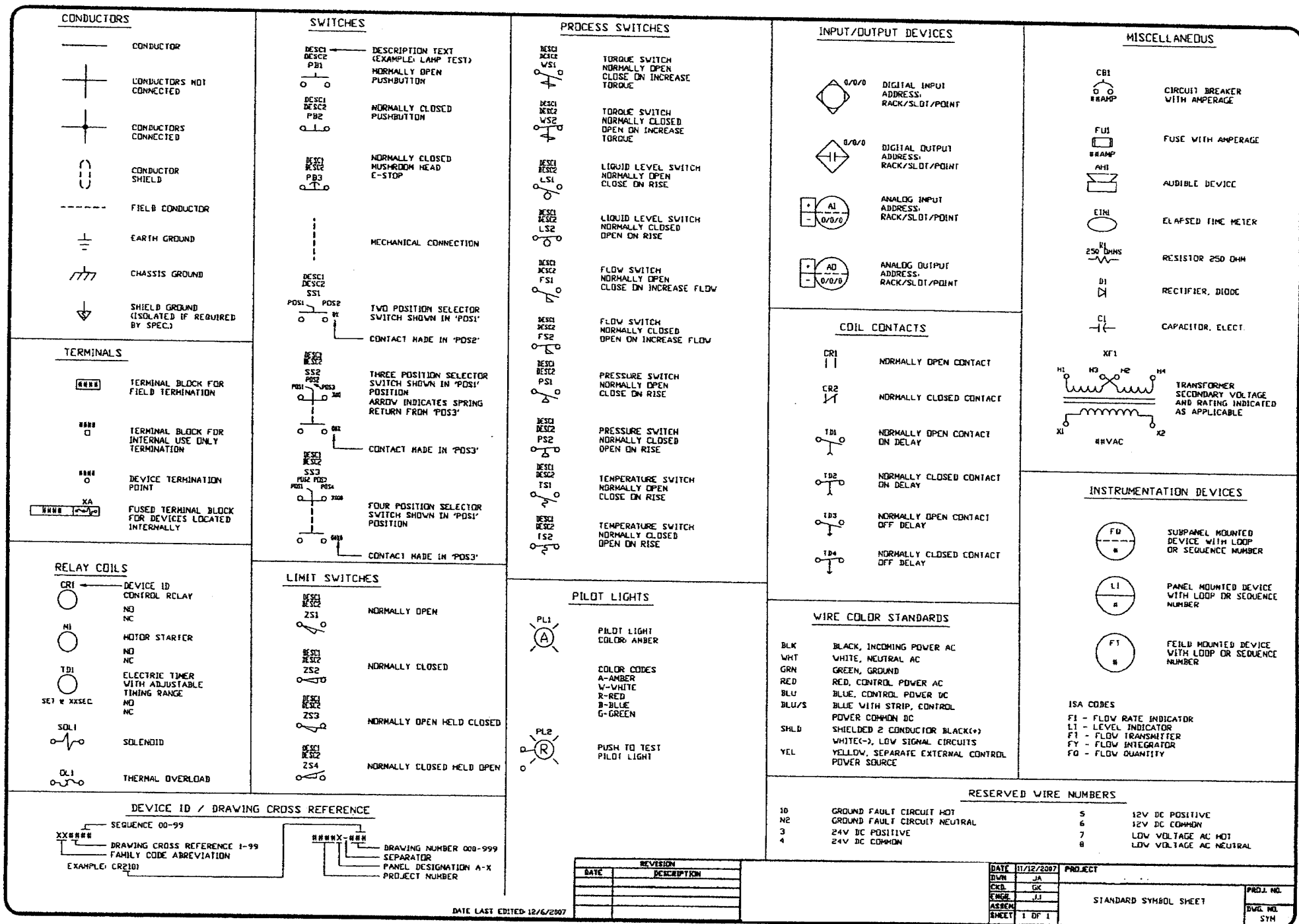
STANDARD DETAIL



01-975-43A

OCTOBER 2011

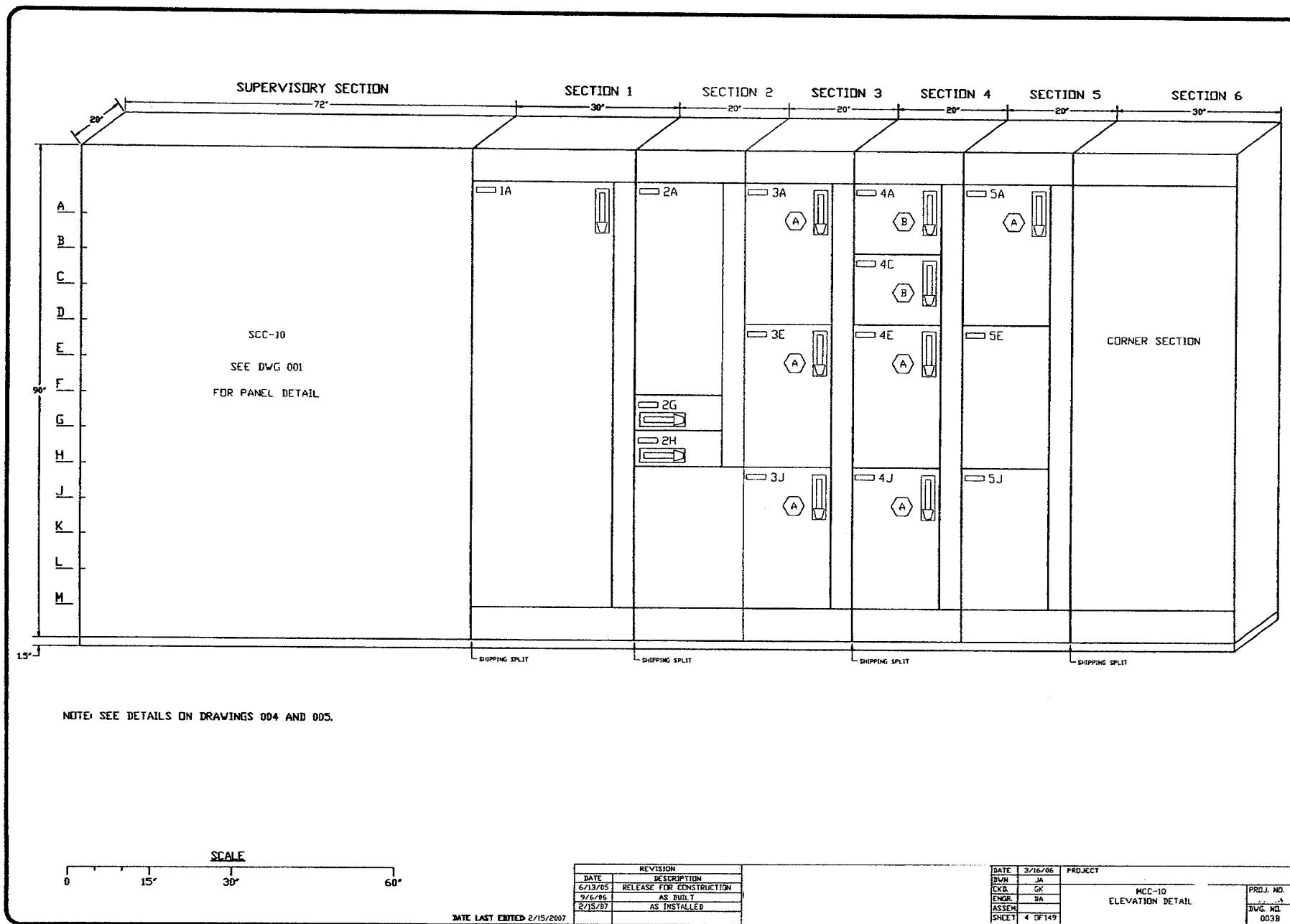
SAMPLE DRAWINGS



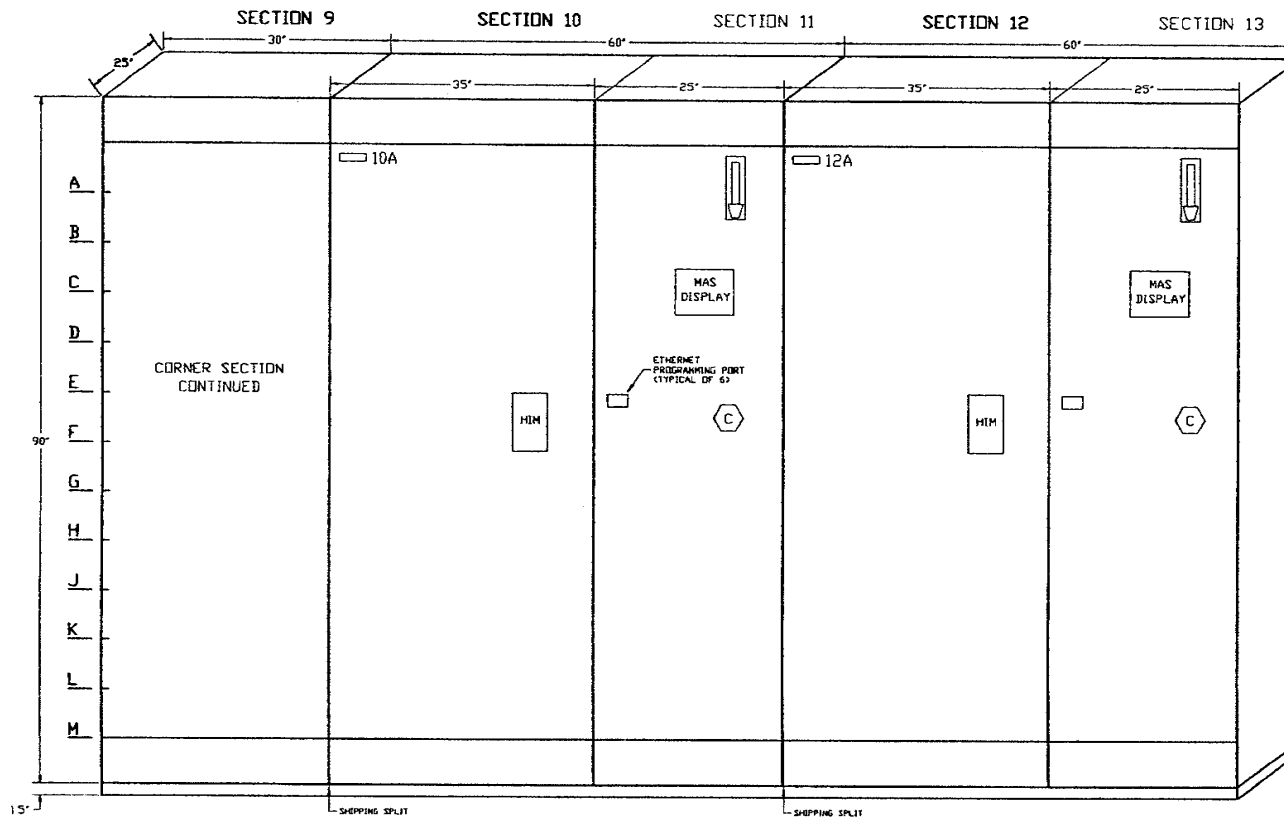
Standard Abbreviations

<u>Abbreviation</u>	<u>Description</u>	<u>Abbreviation</u>	<u>Description</u>
A	Air Compressed	OV	Overvoltage
AC	Air Condition	PB	Pushbutton
AD	Auto Dialer	PC	Pull Cord
AH	Alarm Horn	PC	Personal Computer
AL	Alarm Light	PFC	Power Factor Capacitor
AM	Amp Meter/Ammeter	PL	Pilot Light
ANN	Annunciator	PLC	Programmable Logic Controller
AR	Alternating Relay	PM	Power or Phase Monitor
AWG	American Wire Gauge	PN	Pneumatic
BA	Battery	PR	Pressure Regulator
BLU	Blue	PS	Pressure Switch
BRN	Brown	PS	Power Supply
CA	Cable	PSH	Pressure Switch High
CB	Circuit Breaker	PSL	Pressure Switch Low
CR	Control Relay	REC	Receptacle
CT	Current Transformer	SP	Surge Protector
DB	Distribution Block	SS	Selector Switch
DI	Diode	STP	Shielded Twisted Pair
DS	Disconnect Switch	SV	Solenoid Valve
EC	Electronic Control Device	TD	Time Delay Relay
ETM	Elapsed Time Meter	TG	Toggle Switch
EN	Enclosure	TS	Temperature Switch
FO	Fiber Optic	TSP	Twisted Shielded Pair
FS	Flow Switch	TT	Temperature Transmitter
FU	Fuse	UPS	Uninterruptible Power Supply
GFI	Ground Fault Interrupter	UTP	Unshielded Twisted Pair
GND	Ground	VA	Voltampere
GRN	Green	VFD	Variable
HTR	Heater	VM	Voltmeter
LA	Lightning Arrestor	WHT	White
LP	Lighting Panel	WS	Weight Switch
LR	Latching Relay	WT	Weight Transmitter
LS	Level Switch	XFMR	Transformer
MS	Motor Starter Contactor	SI	Signal Isolator
M	Motor	SS	Speed Switch
NP	Nameplate	ZS	Position Switch
OIT	Operator Interface Terminal		
OL or O/L	Overload		
ORG	Orange		

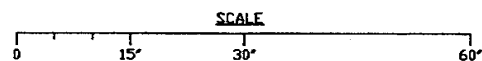
Sample List of
Abbreviations



Sample Exterior
Layout Drawing 909



NOTE: SEE DETAILS ON DRAWINGS 004 AND 005.
SECTIONS 10 THROUGH 13 ARE MOUNTED BACK-TO-BACK
WITH SECTIONS 14 THROUGH 17.



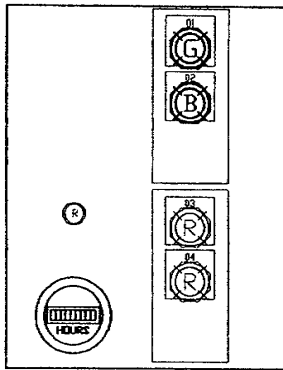
DATE LAST EDITED 2/15/2007

REVISION	
DATE	DESCRIPTION
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9/6/96	AS BUILT
2/15/07	AS INSTALLED

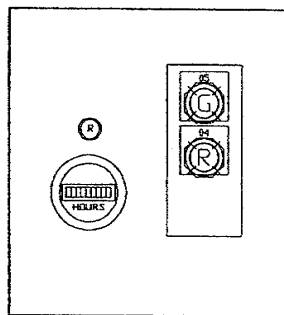
DATE	3/16/06	PROJECT	
CHKD.	JA		
ENGR.	GK	MCC-10	PROJ. NO.
ASSEN.	BA	ELEVATION DETAIL	
SHEET	6 OF 149		DWG. NO. 003D

Sample Exterior
Layout Drawing 18 of 909

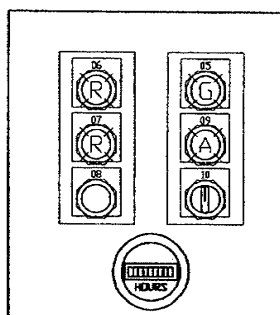
A DETAIL



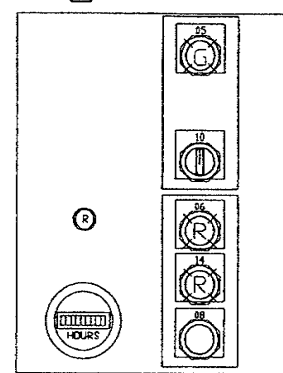
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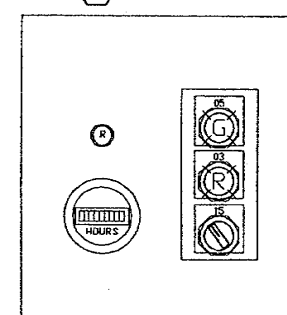
C DETAIL



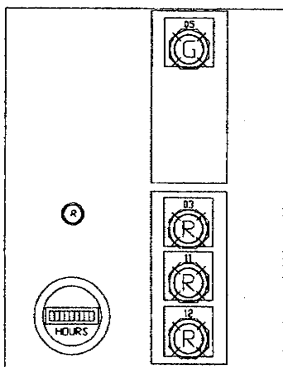
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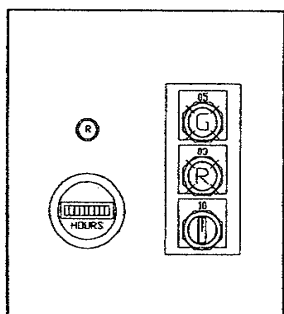
H DETAIL



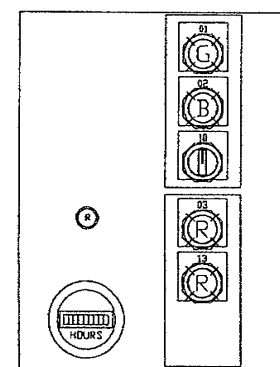
D DETAIL



E DETAIL

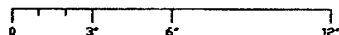


F DETAIL



LEGEND PLATE SCHEDULE					
TAG	DESC1	DESC2	DESC3	SIZE	REMARKS
01	FORWARD			1-13/16" SQ	
02	REVERSE			1-13/16" SQ	
03	OVERLOAD			1-13/16" SQ	
04	OVERCURRENT			1-13/16" SQ	
05	RUN			1-13/16" SQ	
06	VFD FAULT			1-13/16" SQ	
07	MOTOR/BEARING	HIGH TEMP		1-13/16" SQ	
08	RESET			1-13/16" SQ	
09	JBOX/MOTOR	MOISTURE		1-13/16" SQ	
10	HAND	AUTO	OFF	1-13/16" SQ	
11	ZERO SPEED	ALARM		1-13/16" SQ	
12	ESTOP	ACTIVATED		1-13/16" SQ	
13	INSPECTION	DOOR OPEN		1-13/16" SQ	
14	MOTOR	INVERTER		1-13/16" SQ	
15	OFF	ON		1-13/16" SQ	

SCALE

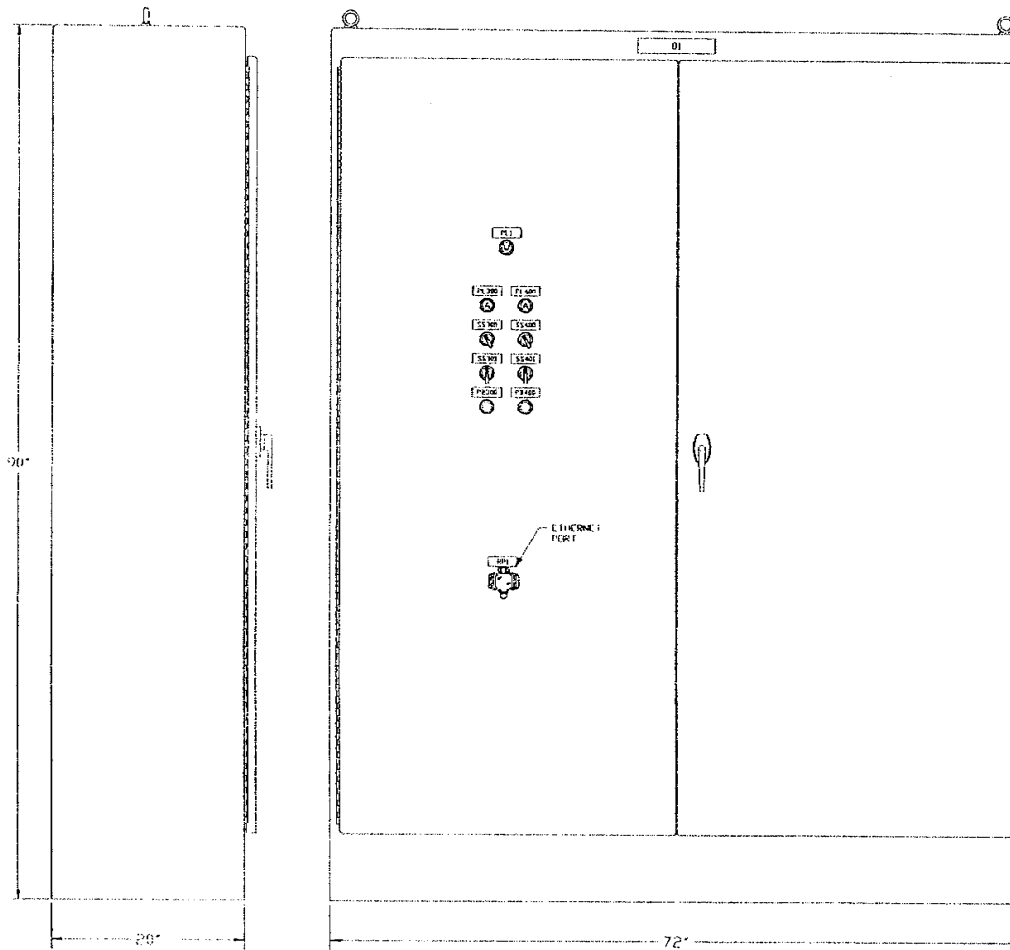


DATE LAST EDITED 2/15/2007

REVISION	
DATE	DESCRIPTION
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9/6/06	AS BUILT
2/15/07	AS INSTALLED

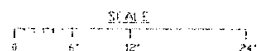
DATE	3/16/06	PROJECT
DWN	JA	
CKD	ER	
ENGR	BA	
ASSEM		
SHEET	11 OF 149	

Sample Exterior
Layout Drawing 19 of 909



SIDE VIEW

FRONT VIEW



DATE LAST EDITED: 2/15/2007

REVISION	
DATE	DESCRIPTION
6/13/05	RELEASE FOR CONSTRUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

NAMEPLATE SCHEDULE					
TAG	DESC1	DESC2	DESC3	SIZE	REMARKS
01	SCC-10			15x8	
PB300	RESET			1X3	
PB400	RESET			1X3	
PL1	POWER ON UPS			1X3	
PL300	INFLUENT	WET WELL NO1	BACKUP FLOATS ACTIVE	1X3	
PL400	INFLUENT	WET WELL NO2	BACKUP FLOATS ACTIVE	1X3	
SS300	BACKUP FLOATS	DN - AUTO		1X3	
SS301	LEAD PUMP	03 - AUTO - 05		1X3	
SS400	BACKUP FLOATS	DN - AUTO		1X3	
SS401	LEAD PUMP	04 - AUTO - 06		1X3	
RPI	ETHERNET	PROGRAMMING PORT		1X3	

NAMEPLATES ARE BLACK WITH WHITE LETTERS

NOTES

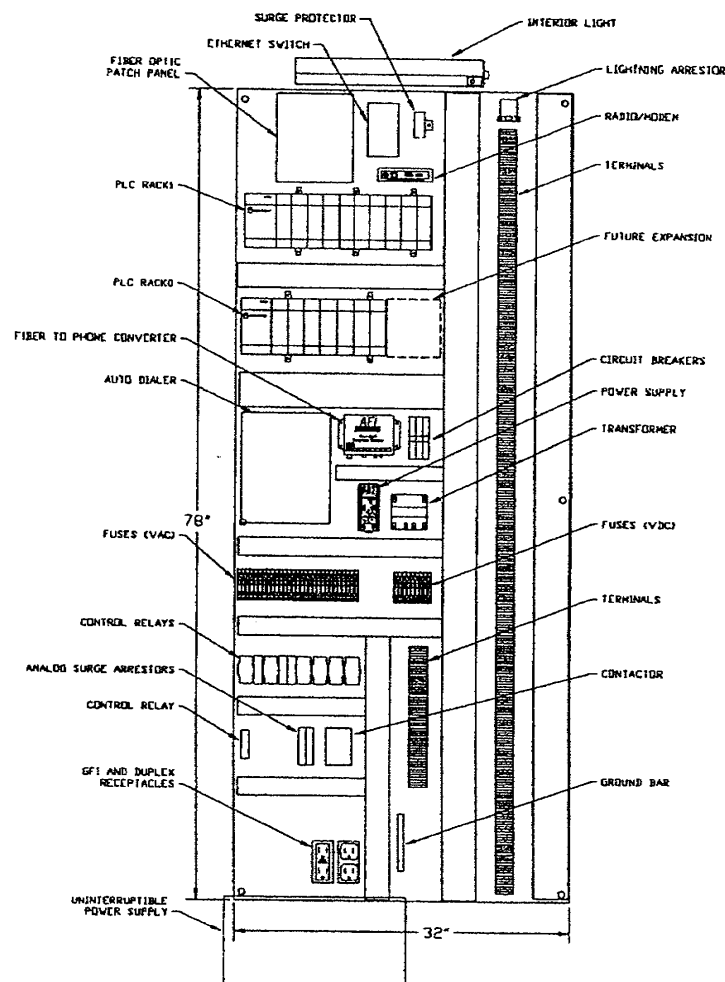
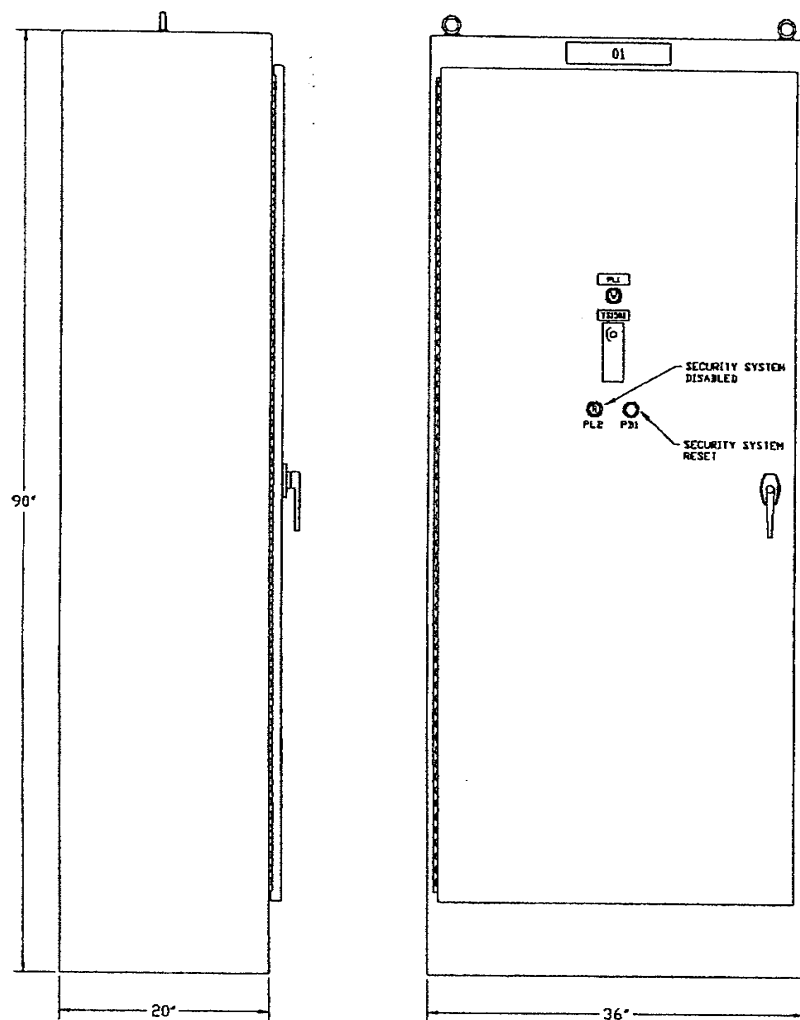
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- FINISH IS ANSI 61 GRAY
- UL# BF-3171536

DATE	3/16/06	PROJECT
DWN	JA	
CKD	GV	
ENGR	BA	
ASSEM		
SHEET	1 OF 149	

SCC-10
ENCLOSURE DETAIL

PROJ. NTL
BUG. NO.
001

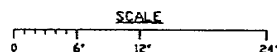
Sample Exterior Layout Drawing



PANEL LAYOUT

NOTES:

1. ENCLOSURE IS A NEMA TYPE 12 FREESTANDING HOFFMAN A903620FS, WITH INNER PANEL HOFFMAN A90P36F1.
2. FINISH IS ANSI 61 GRAY.
3. UL 508A



SUBMITTAL USE ONLY
NOT FOR
CONSTRUCTION
DATE LAST EDITED: 12/6/2007

REVISION	
DATE	DESCRIPTION

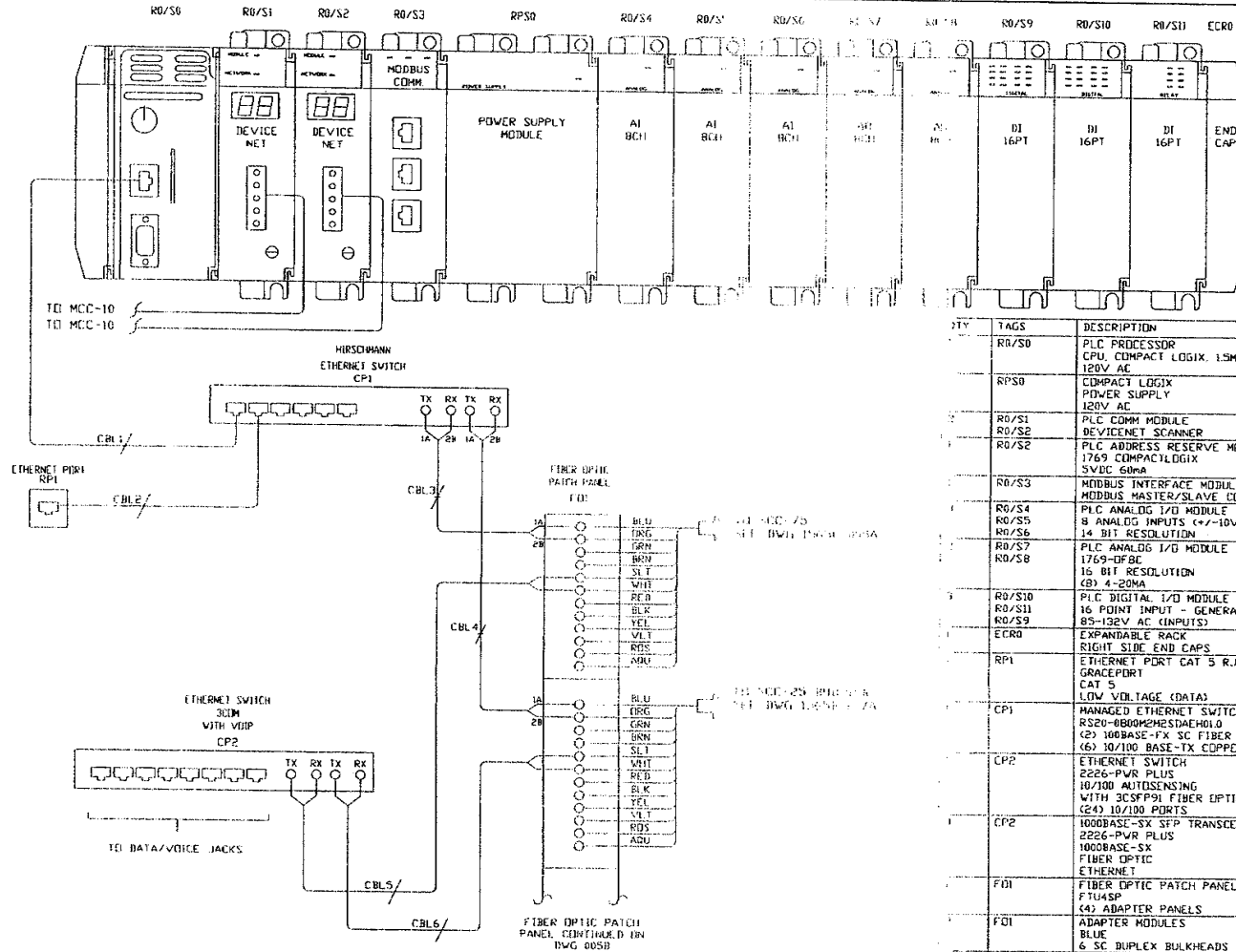
NAMEPLATE SCHEDULE					
TAG	LINE 1	LINE 2	LINE 3	SIZE	REMARKS
01	SCC-MAIN			2x10	
PL1	POWER ON UPS			1X3	
TS1580	LOW BUILDING TEMPERATURE			1X3	

NAMEPLATES ARE BLACK WITH WHITE LETTERS

DATE	11/12/2007	PROJECT	SCC-MAIN	PROJ. NO.
BY	JA		ENCLOSURE DETAIL	
CHKD.	GK			
ENGR.	JJ			
ASST.				
SHEET	1 OF 34			DWG. NO. 001

Sample Exterior and Interior Layout Drawing

COMPACT LOGIX I/O SCHEDULE



QTY	TAGS	DESCRIPTION	MFG	CATALOG
1	R0/S0	PLC PROCESSOR CPU, COMPACT LOGIX. 15MB MEMORY 120V AC	ALLEN BRADLEY	1769-L35E
1	RPS0	COMPACT LOGIX POWER SUPPLY 120V AC	ALLEN BRADLEY	1769-PA4
1	R0/S1	PLC COMM MODULE DEVICENET SCANNER	ALLEN BRADLEY	1769-SDN
1	R0/S2	PLC ADDRESS RESERVE MODULE 1769 COMPACT LOGIX 5VDC 60MA	ALLEN BRADLEY	1769-ARM
1	R0/S3	MODBUS INTERFACE MODULE MODBUS MASTER/SLAVE COMM. MODULE	PROSOFT	MV169-MCM
1	R0/S4	PLC ANALOG I/O MODULE 8 ANALOG INPUTS (+/-10VDC, +/-20mA) 14 BIT RESOLUTION	ALLEN BRADLEY	1769-IF8
1	R0/S5	PLC ANALOG I/O MODULE 16 BIT RESOLUTION CB 4-20MA	ALLEN BRADLEY	1769-DI8C
1	R0/S6	PLC DIGITAL I/O MODULE 16 POINT INPUT - GENERAL PURPOSE 85-120V AC (INPUTS)	ALLEN BRADLEY	1769-IA16
1	R0/S7	EXPANDABLE RACK RIGHT SIDE END CAPS	ALLEN BRADLEY	1769-CRRI
1	R0/S8	ETHERNET PORT CAT 5 RJ45 F/F BULKHEAD GRACEPORT CAT 5 10/100 VOLTAGE (DATA)	GRACE ENG PRODUCTS	P-R2-B3
1	R0/S9	MANAGED ETHERNET SWITCH / MEDIA CTR. / CTRER RS20-0800M2MSDAEH010 (2) 100BASE-TX SC FIBER OPTIC (6) 10/100 BASE-TX COPPER	HIRSCHMANN	943 434-003
1	R0/S10	ETHERNET SWITCH 2226-PWR PLUS 10/100 AUTOSENSING WITH 3CSFP91 FIBER OPTIC TRANSCEIVER (24) 10/100 PORTS	3COM	3C16498-US
1	R0/S11	1000BASE-SX SFP TRANSCEIVER 2226-PWR PLUS 1000BASE-SX FIBER OPTIC ETHERNET	3COM	3CSFP91
1	ECR0	FIBER OPTIC PATCH PANEL F104SP (4) ADAPTER PANELS	HUBBELL	F104SP
1	CP1	ADAPTER MODULES BLUE 6 SC. DUPLEX BULKHEADS	HUBBELL	FSPSC16
1	CP2	UTP PATCH CABLE PCXSE803 CAT 5E RJ45	HUBBELL	PCXSE803
1	CBL1	FIBER OPTIC PATCH CABLE 1 METER (1 PAIR) (2) FIBERS SC MM 62.5	HUBBELL	IFPCSCSC1MM
1	CBL2	FIBER OPTIC PATCH CABLE 2 METER (1 PAIR) (2) FIBERS SC-LC MM 62.5	HUBBELL	IFPCLCSC2MM

DATE	REVISION
11/16/2007	RELEASE FOR DISTRIBUTION
11/16/2007	REVISION 1
11/16/2007	REVISION 2

DATE LAST EDITED 11/16/2007

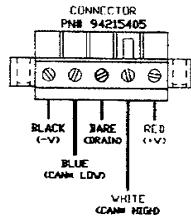
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11/16/2007	DA	SCC-10
11/16/2007	DA	PLC I/O SCHEDULE
11/16/2007	DA	PRJ NO.
11/16/2007	DA	DWG. NO.
11/16/2007	DA	800A

Sample Interconnection
Diagram

DEVICENET CONNECTOR DETAIL

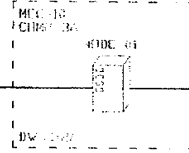
NOTES:

1. CAN+ = CONTROLLER AREA NETWORK

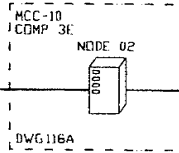


SEE DEVICENET
CONNECTION DETAIL

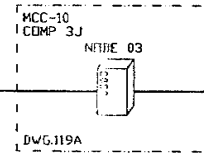
MECHANICAL FINE
SCREEN NO.1
MFS-10-01A



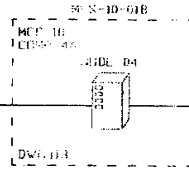
SCREENINGS WASH
PRESS NO.1 GRINDER
SWP-10-01A



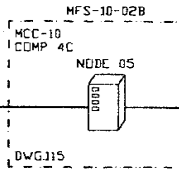
SCREENINGS WASH
PRESS NO.1 AUGER
SWP-10-01B



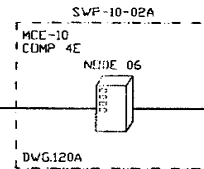
MECHANICAL FINE
SCREEN NO.2 BRUSH
MFS-10-01B



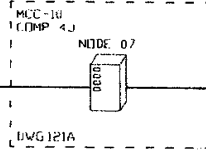
MECHANICAL FINE
SCREEN NO.2 BRUSH
MFS-10-02B



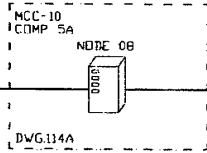
SCREENINGS WASH
PRESS NO.2 GRINDER
SWP-10-02A



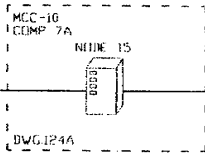
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PRESS NO.2 AUGER
SWP-10-02B



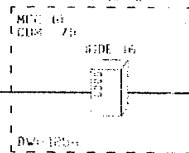
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SCREEN NO.2
MFS-10-02A



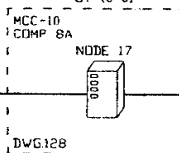
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CONVEYOR NO.1
SSC-10-01



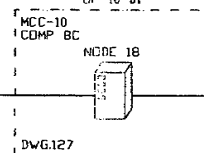
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CONVEYOR NO.2
SSC-10-02



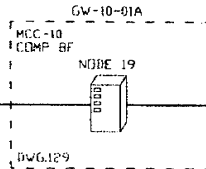
GRIT TRAP NO.1
GT-10-01



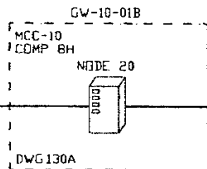
GRIT PUMP NO.1
GP-10-01



GRIT WASHER NO.1
AGITATOR
GW-10-01A



GRIT WASHER NO.1
AUGER
GW-10-01B



10
DWG.009R

* 120 OHM TERMINATING
RESISTOR REQUIRED

DATE LAST EDITED 7/16/2008

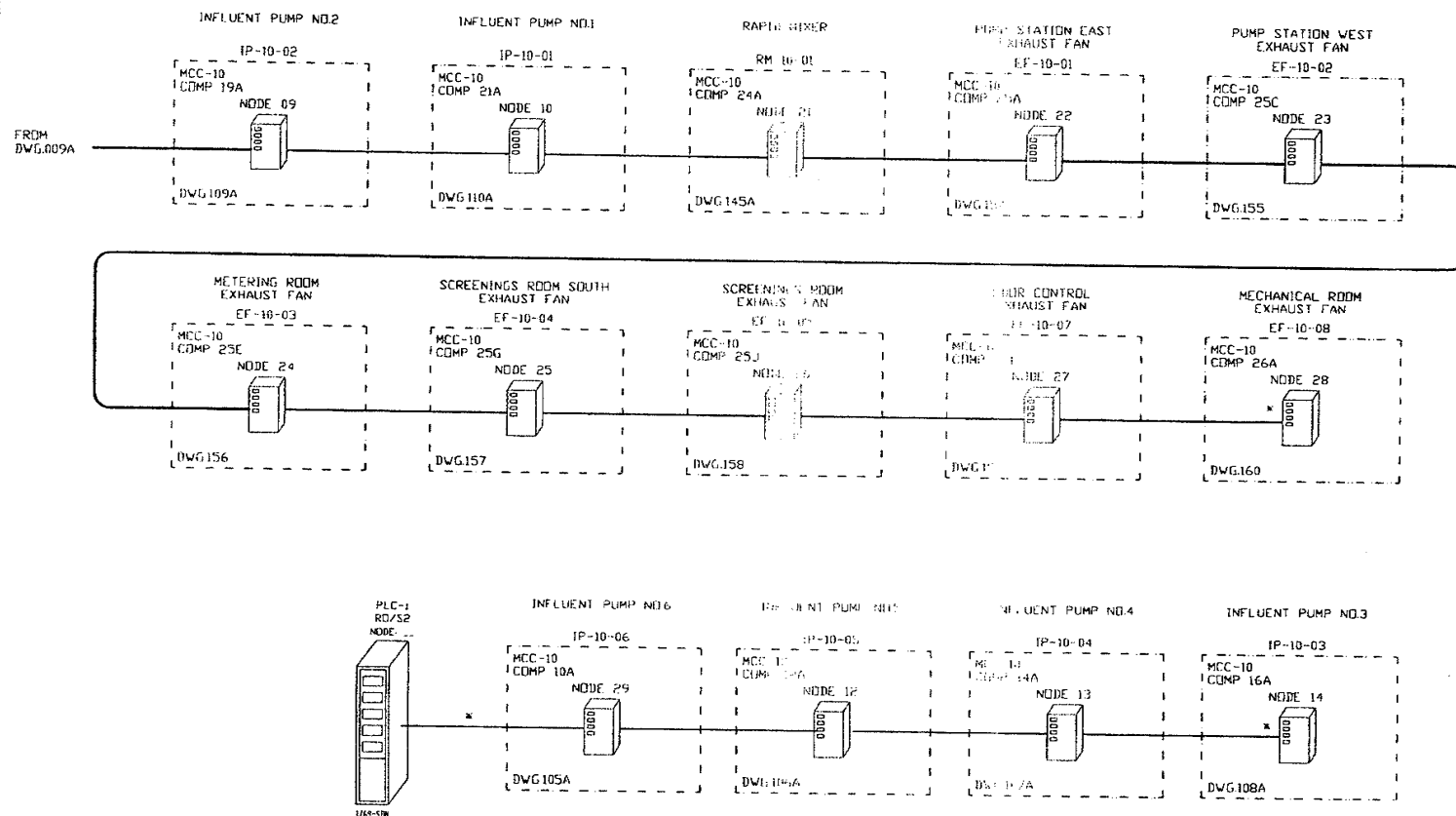
REVISION	
DATE	DESCRIPTION
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8/28/08	AS BUILT
8/28/08	AS INSTALLED

DATE	3/16/06	PROJECT	
DWN	JA		
CHK	GA		
ENGR	BA		
ASSEM			
SHEET	19 OF 149		

MCC-10
DEVICENET
NODE ADDRESSING

PROJ. NO.
DWG. NO.
009A

Sample Network Diagram



■ 120 OHM TERMINATING RESISTOR REQUIRED

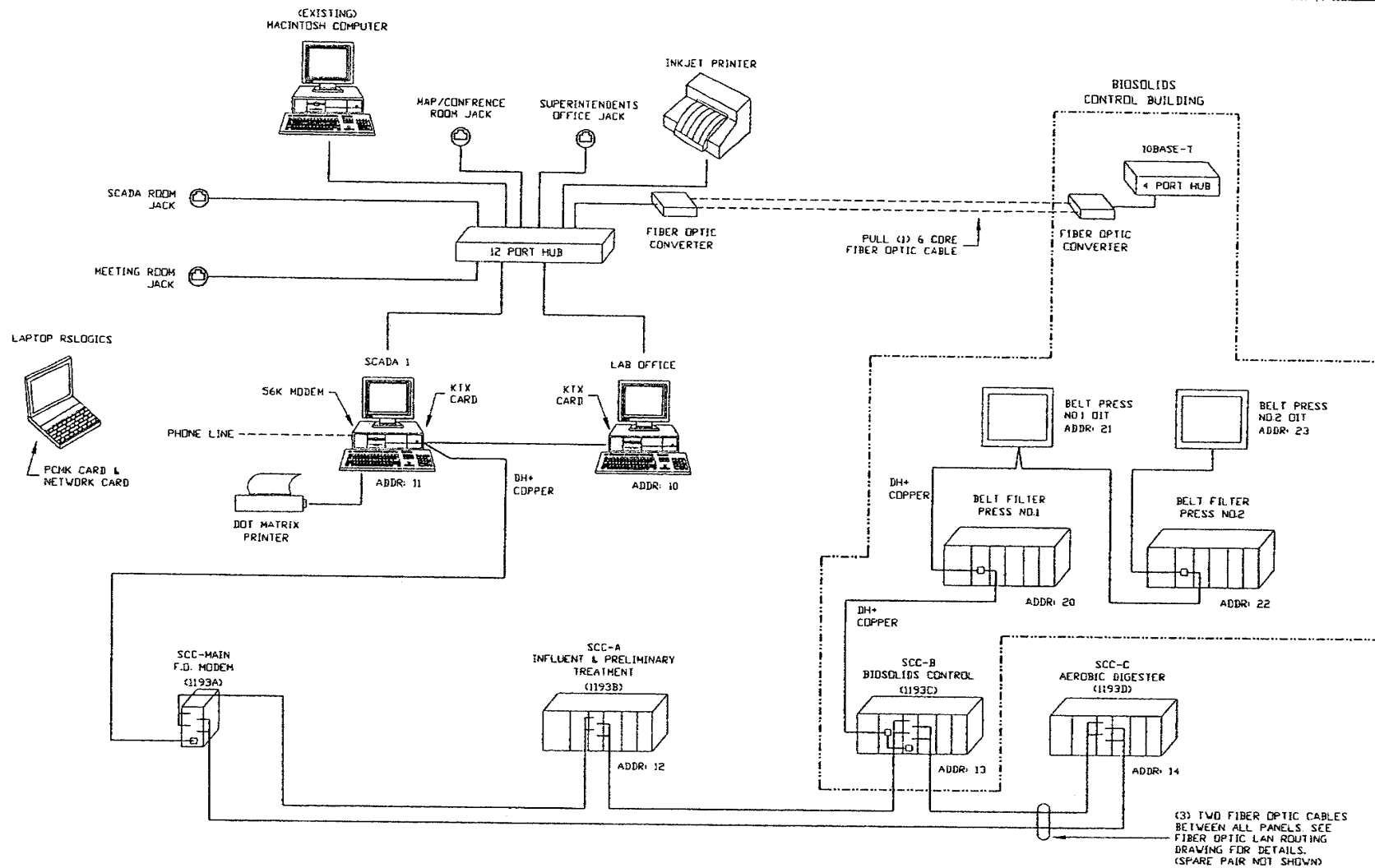
DATE LAST EDITED 7/16/2019

REVISION	
DATE	DESCRIPTION
02/24/03	RELEASE FOR CONSTRUCTION
03/04/03	AS BUILT
03/07/07	AS INSTALLED

DATE	BY	PROJECT
02/24/06	JA	MCC-10
03/04/06	JA	DEVICENET
03/04/06	JA	NODE ADDRESSING
03/07/07	JA	
03/07/07	JA	

PROJ. NO.
DWG. NO.
009B

Sample Network Diagram



DATE LAST EDITED 02/09/01

REVISION	
DATE	DESCRIPTION

DATE	3/12/01	PROJECT	
BY	JA		
CHKD	GR		
ENGR	PS		
ASSEM			
SHEET	OF		

SCADA SYSTEM LAYOUT

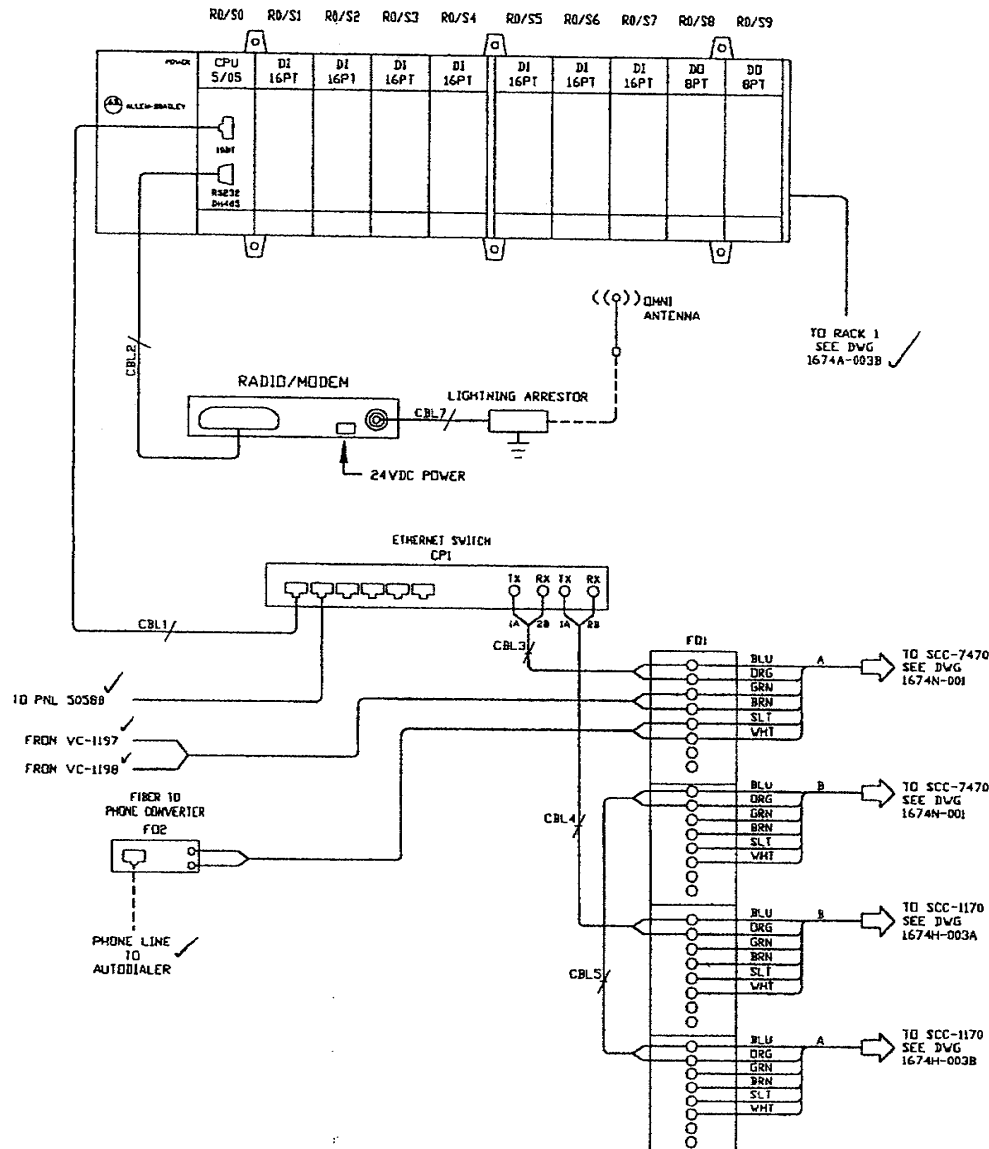
PROJ. NO.

DWG. NO.
001

720 of 909

Sample Network Diagram

SLC500 I/O SCHEDULE



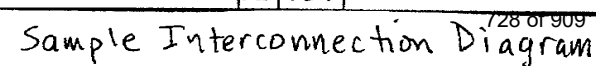
QTY	TAGS	DESCRIPTION	MFG	CATALOG
1	R0	PLC RACK 10 SLOT BASE RACK	ALLEN BRADLEY	1746-A10
1	RPS0	PLC POWER SUPPLY RACK POWER SUPPLY (5A @ 5VDC) 120/240V AC	ALLEN BRADLEY	1746-P2
1	R0/S0	PLC CPU WITH ETHERNET CPU 5/05 WITH 32K MEMORY	ALLEN BRADLEY	1747-L552
7	R0/S1 R0/S2 R0/S3 R0/S4 R0/S5 R0/S6 R0/S7	PLC DIGITAL I/O MODULE 16 POINT INPUT - GENERAL PURPOSE 85-132V AC	ALLEN BRADLEY	1746-IA16
2	R0/S8 R0/S9	PLC DIGITAL I/O MODULE 8 POINT RELAY CONTACT OUTPUT (ISOLATED) 3A @ 120V AC	ALLEN BRADLEY	1746-0X8
1	CP1	8 PORT ETHERNET HUB RS20-0800M2DAEH01.9 10/100 MBIT/S AUTOSENSING (2) SC DUPLEX FIBER OPTIC (6) RJ45 PORTS	HIRSCHMANN	943 434-021
1	F01	FIBER OPTIC PATCH PANEL, BLACK SVIC3-M	SIEMON COMPANY	SVIC3-M-01
4	F01	ST BULKHEAD CONNECTOR MODULE RIC-F-SCB-01	SIEMON COMPANY	RIC-F-SCB-01
1	F02	TELEPHONE LINE EXTENDER B6 SERIES 12VAC 500mA N/A N/A	AMERICAN FIBERTEK	MT-86CC
1	CBL1	UTP PATCH CABLE PCXSE CAT 5E RJ45	HUBBELL	PCX5CB03
1	CBL2	SERIAL COMMUNICATIONS CABLE 1001 3 FEET DB9F/DB9M STRAIGHT THROUGH	CABLE WHOLESALE	1001-03200
3	CBL3 CBL4 CBL5	FIBER OPTIC PATCH CABLE 1 METER (1 PAIR) (2) FIBERS SC MH 62.5 SC MH 62.5	HUBBELL	DFPCSCCCIMM
1	CBL7	ANTENNA CABLE RG142B/U RG142 - 3F1 LENGTH NMALE - TNC	TESSCO	448350

SUBMITTAL USE ONLY
NOT FOR
CONSTRUCTION
DATE LAST EDITED: 12/6/2007

DATE	REVISION
	DESCRIPTION

DATE	01/12/2007	PROJECT	
DWN	JA		
CHK	JK		
ENG	JJ		
ASST			
SHEET	3 OF 34		

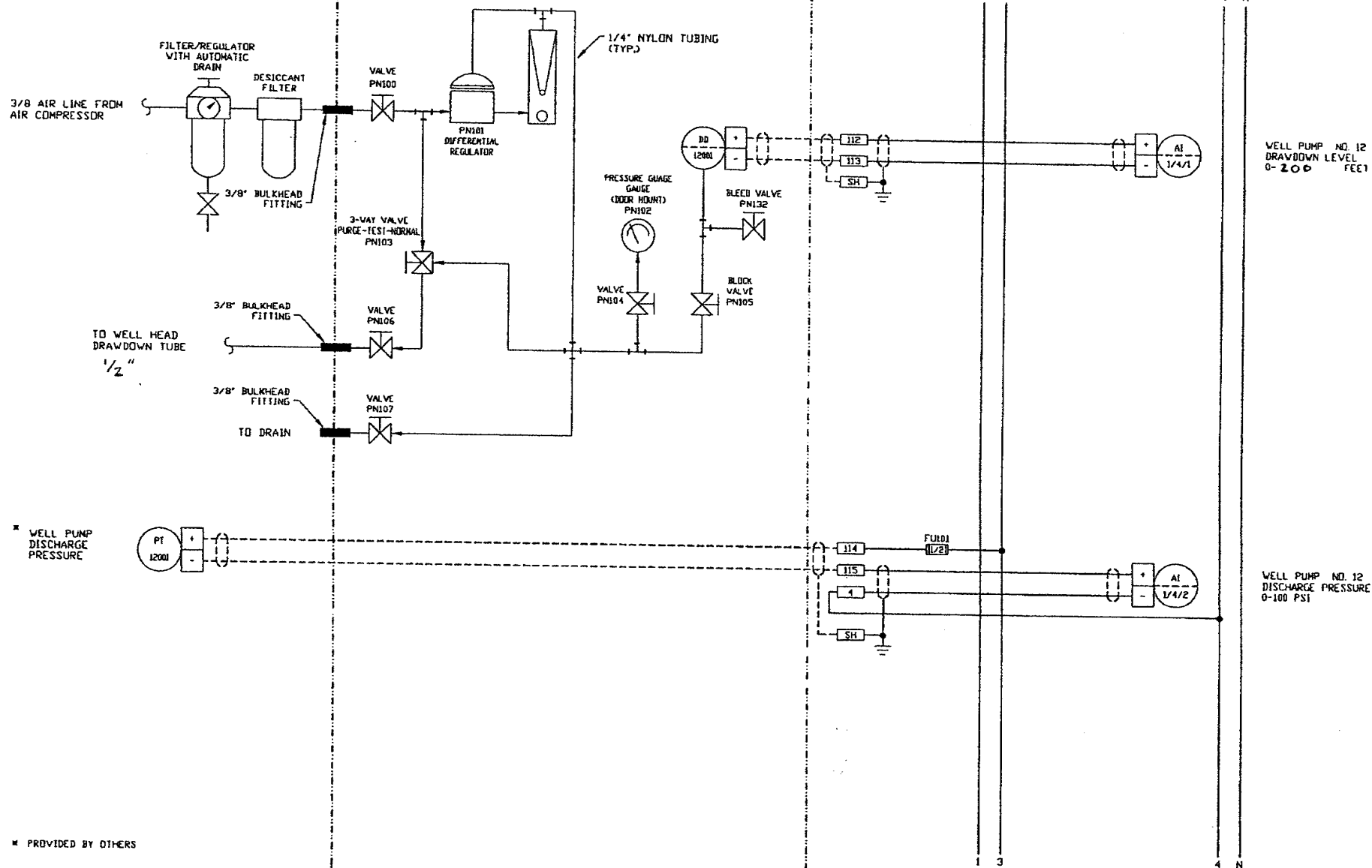
Sample Interconnection Diagram 727 of 909



FIELD OR AS NOTED

DRAWDOWN TRANSDUCER PANEL (1674A1-002)

SCC-MAIN



SUBMITTAL USE ONLY
NOT FOR
CONSTRUCTION
DATE LAST EDITED 12/10/2007

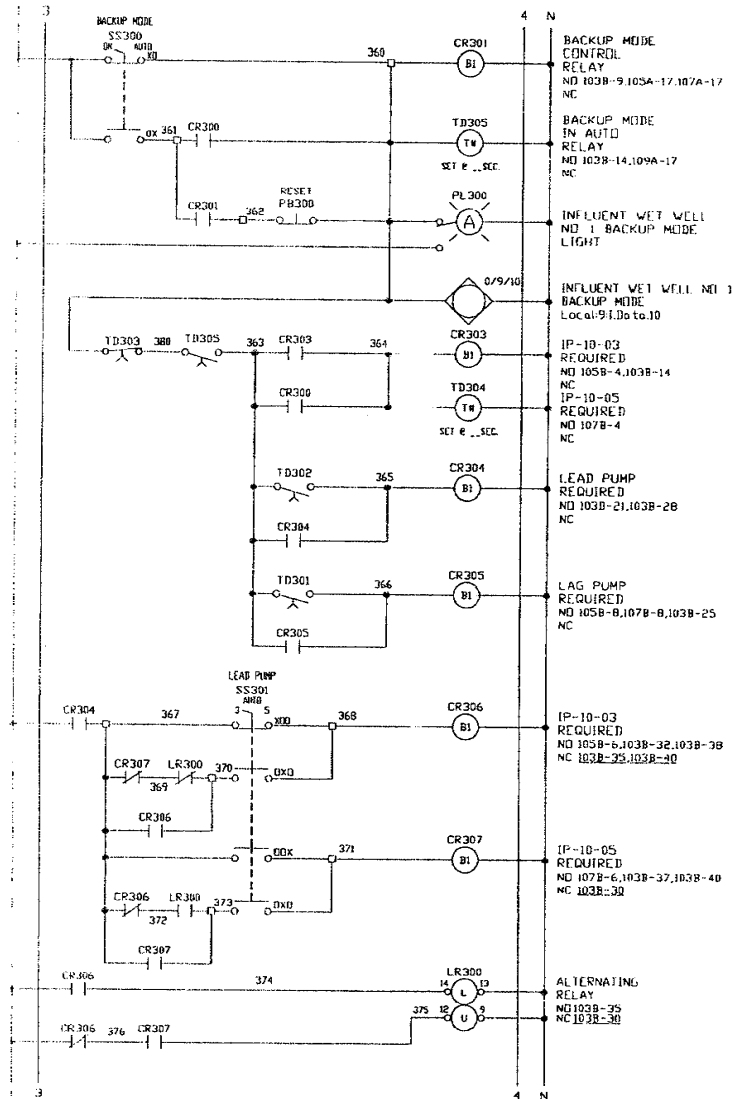
REVISION	
DATE	DESCRIPTION

DATE	11/12/2007	PROJECT
DWN	JA	SCC-MAIN WELL PUMP NO. 12
CKR	GR	
ENGR	JJ	
ALSTON		
SHEET	9 OF 34	PROJ. NO. DWG. NO. 101B

Sample Elementary schematic 29 of 909

FIELD OR AS NOTED

SCC-10

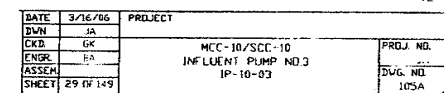


DATE	REVISION
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2/24/06	AS BUILT
2/14/07	AS INSTALLED

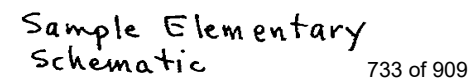
DATE LAST EDITED 2/15/2007

DATE	BY	PROJECT	PROJ. NO.
3/16/06	JA	SCC-10	
ENGR.	JA	INFLUENT WET WELL NO 1	
ASSER.	JA		
SHEET	1		

Sample Elementary
Schematic



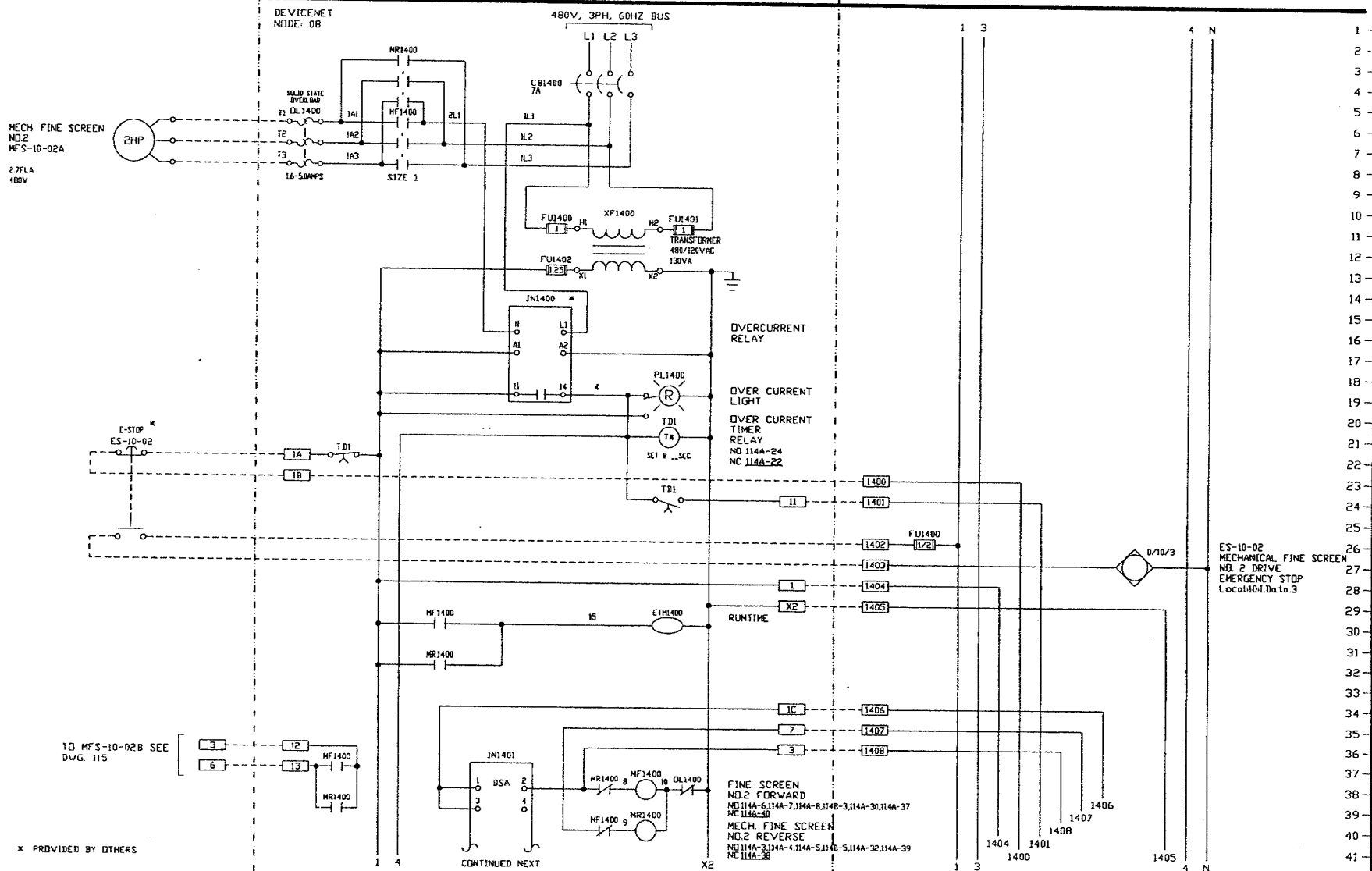
732 of 909



FIELD OR AS NOTED

MCC-10 COMP. 5A

SCC-10



DATE	REVISION
6/28/06	RELEASE FOR PRODUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE LAST EDITED 2/15/2007

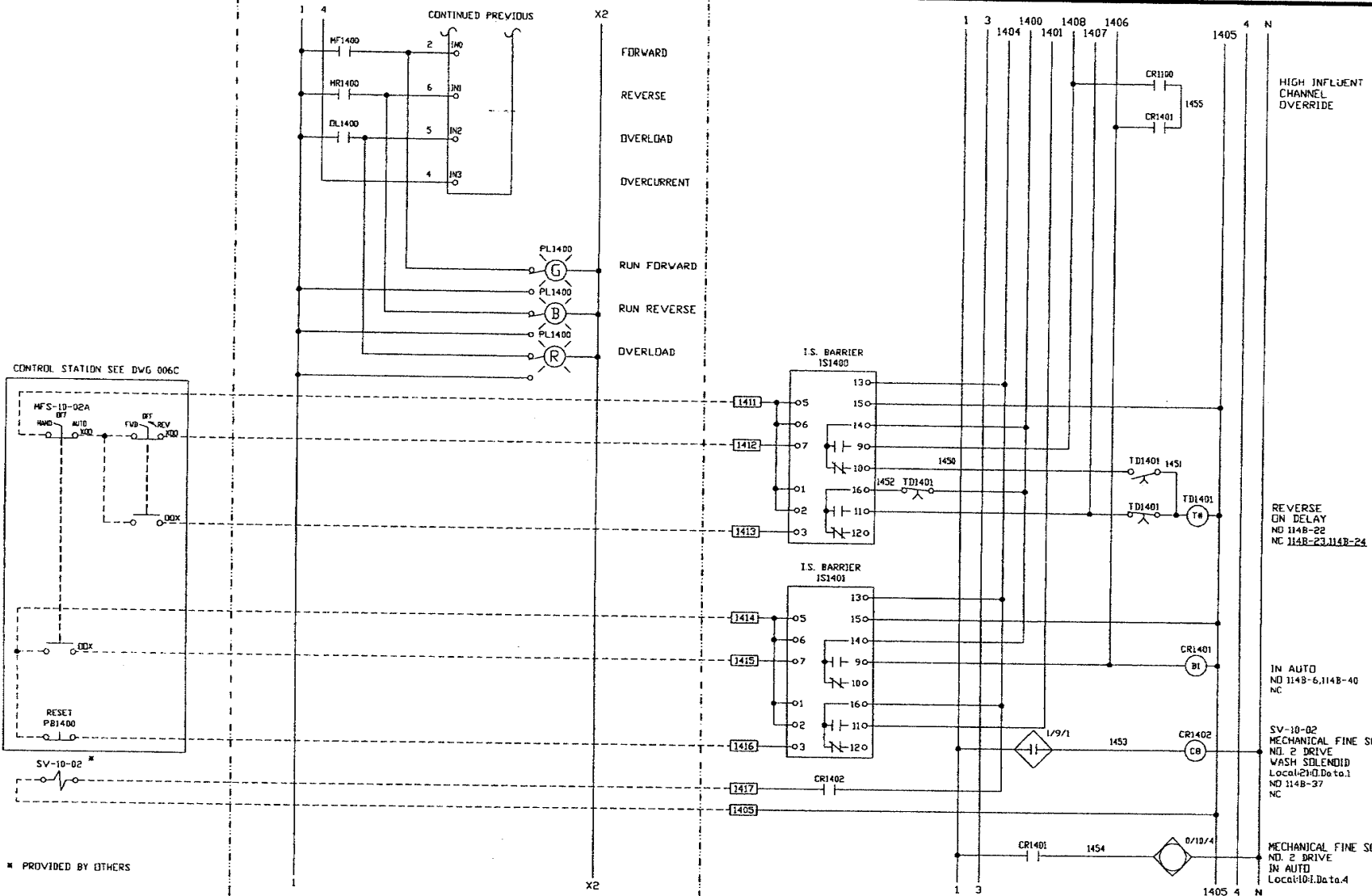
DATE	3/16/06	PROJECT
DWN	JA	
CKD	OK	
ENGR	BA	
ASSEM		
SHEET	46 OF 149	

MCC-10/SCC-10
MECHANICAL FINE SCREEN NO.2
MFS-10-02APROJ. NO.
BVG. NO.
114ASample Elementary
Schematic 35 of 909

FIELD DR AS NOTED

MCC-10 COMP. 5A

SCC-10



REVISION	
DATE	DESCRIPTION
6/28/06	RELEASE FOR PRODUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE LAST EDITED: 2/15/2007

DATE	3/16/06	PROJECT
DWN	JA	
CHKD	GR	
ENGR	BA	
ASSEM		
SHEET	47 OF 149	

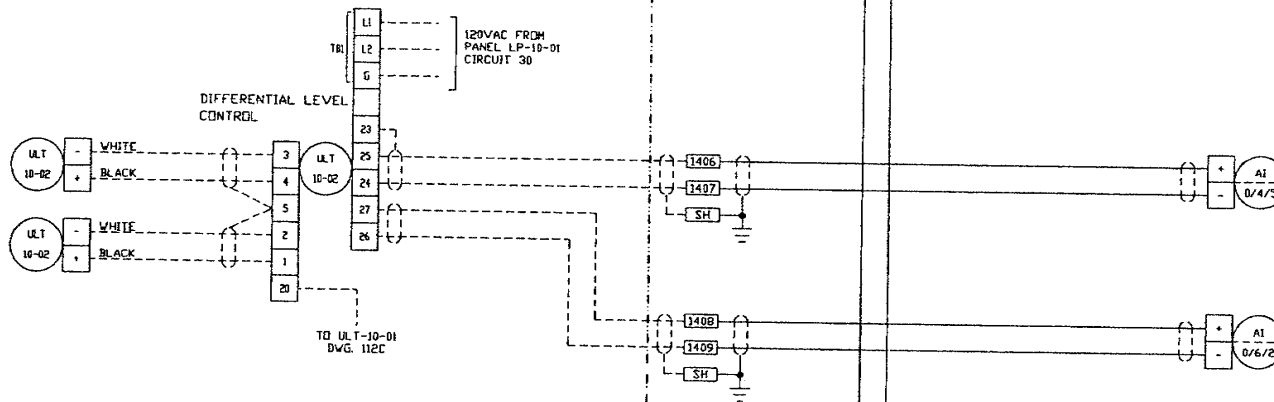
MCC-10/SCC-10
MECHANICAL FINE SCREEN NO.2
HFS-10-02A

PPBJ. NO.
DVE. NO.
114B

Sample Elementary
Schematic 736 of 909

FIELD OR AS NOTED

SCC-10

UPSTREAM
LEVEL TRANSDUCERDOWNSTREAM
LEVEL TRANSDUCER
 ULT-10-02
 MECHANICAL FINE SCREEN
 NO. 2 UPSTREAM LEVEL
 0-8.5 FEET
 Local4:1Ch5Data

 ULT-10-02
 MECHANICAL FINE SCREEN
 NO. 2 DOWNSTREAM LEVEL
 0-4.0 FEET
 Local6:1Ch2Data

ULT-10-01			
PARAMETER	INDEX	VALUE	DESCRIPTION
P001	1,2,3	1,1,4	OPERATION = DIFFERENTIAL
P002	6	1	MATERIAL = LIQUID
P003	1,2	2	MAX PROCESS SPEED = MEDIUM
P004	1,2	100	TRANSDUCER = XPS-10"
P005	6	4	UNITS = FEET
P006	1	6.435	EMPTY = 6.435
	2	6.179	EMPTY = 6.179
P007	1	4	SPAN = 4
	2	4	SPAN = 4
P202	1	1	4-20mA OUTPUT = UPSTREAM LEVEL
P202	2	2	4-20mA OUTPUT = DOWNSTREAM LEVEL

DATE LAST EDITED 7/16/2008

REVISION	
DATE	DESCRIPTION
6/28/06	RELEASE FOR PRODUCTION
9/6/06	AS BUILT
2/15/07	AS INSTALLED

DATE	3/16/06
DWN	JA
CHKD	DK
ENGR	BA
ASSEM	
SHEET	48 OF 149

PROJECT	
SCC-10	
MECHANICAL FINE SCREEN NO.2	
MFS-10-02A	

PROJ NO.	
DWG NO.	114C

 Sample Elementary
 Schematic 37 of 909

SUPPLEMENTAL GEOTECHNICAL ENGINEERING REPORT



October 28, 2024

Mr. Matt Baillargeon
City of Rockford
425 East State Street
Rockford, Illinois 61104

Re: **SUPPLEMENTAL** Geotechnical Engineering Report
Proposed Maintenance Garage Building
and Parking Lots
Water Utility Cedar Street Site
1141 Stanley Street
Rockford, Illinois 61102
GEOCON Project No. 23-G0529.2

Dear Mr. Baillargeon:

Pursuant to our proposal for geotechnical engineering services, we have completed a subsurface exploration and geotechnical analysis for the above referenced project. This electronic copy of the **SUPPLEMENTAL** Geotechnical Engineering Report includes our findings and recommendations for the proposed project referenced above. Please contact our office if you require hard copies of the report.

GEOCON Professional Services, LLC. (GEOCON) appreciates the opportunity to be of service during this phase of the project. If there are any questions or comments you may have regarding the contents of this report, or if we may be of any further service, please contact us at your convenience.

Sincerely,

GEOCON Professional Services, LLC.

A handwritten signature in black ink, appearing to read 'B. Filafusi'.

Brandon Filafusi, EIT
Project Engineer

A handwritten signature in black ink, appearing to read 'K. Rippy'.

Kenneth K. Rippy, PE
Senior Engineer





SUPPLEMENTAL Geotechnical Engineering Report

**Proposed Maintenance Garage Building
and Parking Lots
Water Utility Cedar Street Site
1141 Stanley Street
Rockford, Illinois 61102**

**Mr. Matt Baillargeon
City of Rockford
425 East State Street
Rockford, Illinois 61104**

**Prepared By:
GEOCON Professional Services, LLC.
22774 Citation Road, Unit A
Frankfort, Illinois 60423**

October 28, 2024

GEOCON Project No. 23-G0529.2

TABLE OF CONTENTS

	Page
INTRODUCTION	1
PREVIOUS BORINGS	1
PROJECT AND SITE DESCRIPTION	1
SUBSURFACE EXPLORATION	2
Drilling and Sampling Procedures	2
Laboratory Tests	2
SOIL CONDITIONS	3
GROUNDWATER CONDITIONS	3
ENGINEERING RECOMMENDATIONS	4
Site Preparation and Mass Grading	4
Controlled Compacted Fill	5
Maintenance Garage Foundations	5
Foundation Settlement	6
Seismic Considerations	6
Slabs-on-Grade	7
Pavement Recommendations	7
Administration Building Renovation Considerations	8
CONSTRUCTION CONSIDERATIONS	9
Groundwater Control	9
Excavations	9
GENERAL COMMENTS	9
 APPENDIX	
 Boring Location Diagram	
Soil Boring Logs (B-11 to B-15)	
General Notes	

SUPPLEMENTAL GEOTECHNICAL ENGINEERING REPORT
Proposed Maintenance Garage Building
and Parking Lots
Water Utility Cedar Street Site
1141 Stanley Street
Rockford, Illinois 61102

INTRODUCTION

This report presents the results of a subsurface exploration for the proposed 5MG water storage reservoir planned as part of the City of Rockford Well No. 45 Site Improvement project, located at 1141 Stanley Street, in Rockford, Illinois. The purpose of this report was to determine and evaluate the subsurface conditions existing at the subject site, and to establish related geotechnical parameters for foundation design and construction of the project.

PREVIOUS BORINGS

GEOCON performed a previous phase of subsurface exploration at this site in 2023 that focused on the proposed 5MG water reservoir that will be located in the western portion of this site. The Geotechnical Report was submitted under GEOCON Project No. 23-G0529, dated May 21, 2023. Borings B-1 to B-5 were located within the footprint of the new reservoir and borings B-6 to B-10 were performed within a new access drive that will connect the parking garage located on the eastern part of the site to the new reservoir and existing booster station. Please refer to the previous report for further information.

PROJECT AND SITE DESCRIPTION

The site is currently developed with an existing 5MG underground reservoir and associated facilities. It is understood that the existing reservoir will be demolished, and the site will be partially redeveloped. The existing approximately 200 feet by 200 feet by 18 feet tall concrete reservoir is buried approximately 10 feet below grade. After demolition, the area will be backfilled with structural fill in order to provide suitable subgrade support for the new building and new parking lots/drives. A new Maintenance Garage building and at-grade parking lots will be constructed in place of the existing reservoir that is scheduled for demolition. The new Maintenance Garage will occupy a footprint of approximately 50 feet wide by 100 feet long and will consist of a single story, slab on grade building supported by spread footings.

Building renovations are planned at the existing Administration Building located in the northeast part of the site. The FFE of a small portion of the north end of the building is relative El. 130.5 feet while the FFE of the remainder of the building is relative El. 127.0 feet. The interior of this portion of the building will be renovated which will include lowering the floor to match the FFE of the remainder of the building. The bottom of footing relative elevation in this portion of the building is El. 125.5 feet indicating the depth of footing after renovation will be reduced to about 18 inches. The exterior grade adjacent to the north and west faces of the building will be lowered to approximately match the new floor elevation. Additional insulation for a shallow frost protected foundation configuration will be provided.

In addition to the new access drives and parking lots, the playground and basketball court located north of the existing reservoir will be relocated to the northwest corner of the property. The Boring Location

Diagram located in the Appendix depicts a schematic of the existing conditions and proposed site improvements.

SUBSURFACE EXPLORATION

The supplemental subsurface investigation included performance of (5) borings, labeled B-11 to B-15, drilled at the approximate locations shown on the Boring Location Diagram, included in the Appendix. The borings were staked in the field by GEOCON and surface elevations were estimated by Google Earth. After completion of the borings, they were backfilled with soil cuttings and patched with like materials as encountered at the boring.

Drilling and Sampling Procedures

The soil borings were performed with an ATV-mounted drilling rig equipped with a rotary head. Conventional, continuous flight, hollow-stem augers were used to advance the borings with representative samples obtained in each boring employing split-barrel sampling techniques in accordance with ASTM Procedure D-1586. Soil samples were secured at 2.5-foot intervals to a depth of 15 feet, and 5-foot intervals thereafter, as indicated on the boring logs provided in Appendix.

The Standard Penetration Test (SPT) is defined as the number of blows required to advance a 2-inch O.D., split-barrel sampler a distance of one foot by a 140-pound hammer falling 30 inches, commonly described as the N-value. These sampler resistances provide a useful indication of the consistency or relative density of most soil deposits and are reported on the boring logs presented in the Appendix. Samples of cohesive soils obtained from the borings were tested with a calibrated hand penetrometer to aid in evaluating the soil strength characteristics. The results from this testing is tabulated on the boring logs.

Water level observations were made during drilling operations and upon completion of the borings. This data is noted on the boring logs and within the *Groundwater Conditions* section.

Laboratory Tests

Additional characteristics of the foundation materials were determined in the laboratory to provide data on which to classify and estimate the engineering properties of the subsurface soil deposits encountered in the borings. All samples were visually classified by the geotechnical engineer according to the Unified Soil Classification System (ASTM D-2488). An explanation of the symbols used in this system is included in the Appendix.

Representative samples were tested in the laboratory to determine the natural moisture content of the soils. All moisture contents are expressed as a percentage of the dry weight of soil. Representative samples of the cohesive soils encountered in the borings were tested in the laboratory with a calibrated RIMAC spring tester to determine the approximate unconfined compressive strength of the soil samples.

The laboratory testing program selected for this project is intended to assist with determination of soil classification as well as strength and deformation characteristics of the subsurface soil deposits that will provide foundation support for the proposed structures. All laboratory testing was performed in general accordance with the respective ASTM Methods, as applicable, and the results are included on

the boring logs and laboratory test reports included in the Appendix. Unless notified to the contrary, all samples will be disposed of after one month.

SOIL CONDITIONS

The types of foundation materials encountered at the test boring locations are described on the Soil Boring Logs. The lines delineating the changes in strata on the logs represent an approximate boundary between the various soil classifications. It must be recognized that the soil descriptions are considered representative for the specific test hole location, but the variations may occur between the sampling intervals and boring locations. A summary of the major soil profile components is described in the following paragraphs. A more detailed description and supporting data for each boring location can be found on the individual boring logs.

The surface at B-11 and B-13 to B-15 consisted of about 6 inches of topsoil whereas the surface was paved at B-12 and the pavement section consisted of 6 inches of HMA underlain by 8 inches of aggregate base. The subgrade below the surficial materials described above was highly variable from boring to boring. At borings B-11, B-13, and B-14 the upper profile consisted of interbedded layers of silty clay, lean clay and sand extending to a depth of about 6 feet below grade. The sand layers were generally described as loose with N-values ranging from 4 to 6 blows per foot. The silty clay or lean clay layers were described as very stiff to hard with unconfined compressive strengths ranging from 2.0 to 5.2 tsf and moisture contents ranging from 20.8 to 23.8 percent. The upper strata described above were underlain by a sand stratum extending to the boring termination depths, 15 to 25 feet below grade. The sand layer was described as loose to medium dense with N-values ranging from 4 to 27 blows per foot. At B-11 the sand was saturated with groundwater below a depth of 9 feet, which correlates to El. 726 feet. A layer of brown clayey silt was encountered at B-11 from a depth of 18.5 to 23.5 feet below grade. The clayey silt was described as loose with an N-value of 6 blows per foot.

The subgrade below the pavement section at B-12 consisted of brown sandy clay or sandy silt extending to a depth of 13.5 feet below grade. The sandy clay was described as very soft to stiff with unconfined compressive strengths ranging from 0.2 to 1.2 tsf and moisture contents ranging from 15.4 to 22.8 percent. The sandy silt layer encountered in B-12 at a depth of 6 feet below grade was saturated with groundwater. Below a depth of 13.5 feet the boring encountered sand and silt strata similar to the other borings described above. The subgrade below the topsoil at B-15 consisted of sandy silt fill underlain by silty clay and the boring encountered auger refusal on an apparent obstruction at a depth of 6 feet. Obstructions were encountered above a depth of 6 feet as evidenced by sampler refusal in both the 1 to 2.5 foot and 3.5 to 5 foot sample intervals. **Further investigation is recommended in this area of the site to determine the cause of sampler and auger refusal.**

GROUNDWATER CONDITIONS

Groundwater was encountered while drilling in the deeper borings B-11 and B-12 at depths of 6 to 9 feet below grade, as noted in the following table:

Table 1. Groundwater Depth While Drilling

Boring No.	While Drilling, ft.	Elevation, ft.
B-11	9	726
B-12	6	723

It should be noted that due to the relatively limited stabilization times under which the water level measurements were made, these observed groundwater level readings may not indicate the static water level for the site. In addition, groundwater levels fluctuate over time and are influenced by seasonal precipitation and varying permeability characteristics of the subsurface soils.

ENGINEERING RECOMMENDATIONS

Site Preparation and Mass Grading

The new Maintenance Garage and at-grade parking lots will be constructed in place of the existing reservoir that is scheduled for demolition. The existing approximately 200 feet by 200 feet by 18 feet tall concrete reservoir is buried approximately 10 feet below grade. After demolition, the area will be backfilled with compacted structural fill in order to provide suitable subgrade support for the new building and new parking lots/drives. Obstructions were encountered at B-15 above a depth of 6 feet as evidenced by sampler refusal in both the 1 to 2.5 foot and 3.5 to 5 foot sample intervals. **Further investigation/test pits should be performed in this area of the site to determine the cause of sampler and auger refusal and to provide recommendations for subgrade stabilization.**

All existing structures or other below ground objects should be demolished/removed completely from within new foundation influence zones of the new Maintenance Garage building and at least 2 feet below bottom of any new slabs or pavements. Below grade portions of these structures must be backfilled as described under Controlled Compacted Fill. In no case should demolition debris be used as controlled compacted fill.

After demolition, it is recommended that the exposed subgrade soil be recompacted and density tests performed to verify the subgrade meets the minimum density requirement of 95% of the material's Modified Dry Density (MDD) determined in accordance with ASTM D-1557. Areas that do not meet the minimum density requirement, or experience rutting or pumping due to equipment loading, should be improved by scarification, air drying and recompaction, or by subgrade improvement methods such as undercutting the softer soils and replacing with suitable compacted aggregate fill consisting of CA-1 capped with CA-6. After the subgrade soils meet the minimum density requirement and are firm and unyielding, deemed suitable for support of the slabs and pavements, low areas may then be raised to the planned subgrade elevation with suitable, properly compacted fill as described in the following section.

The existing subgrade soils will be susceptible to disturbance from precipitation, construction traffic, and vibrations. Care should be taken to avoid disturbance of the subgrade soil and construction traffic over prepared subgrades should be avoided. If the subgrade soils become disturbed during construction,

they should be scarified and recompactd or removed and replaced prior to placing new site grading fill or granular subbase material.

Mass grading and earthwork operations should be observed and evaluated by a representative of the geotechnical engineer.

Controlled Compacted Fill

It is recommended that fill materials used for structural support in the building areas consist of well-graded granular soils or lean clay, free of organic matter or other deleterious material. All structural fill should be placed on firm subgrades, and the fill should be placed in lifts and properly compacted. All newly placed fill should be placed in 9 inch or less loose lifts and compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557 (Modified Proctor) method of test. The fill should be placed within +/- 2 percent of the optimum moisture content value determined by laboratory Proctor testing.

Backfill placed in utility excavations or against foundation walls should consist of a granular material such IDOT CA-6 or CA-7 crushed limestone aggregate. Proper placement and compaction of backfill in these areas is considered essential in order to reduce the potential for distress of overlying pavements, floor slabs and footings. The placement of backfill against unsupported walls may induce movement, particularly where the backfill is placed on one side of the wall to a higher elevation than the backfill on the other side. Small, hand-operated compactors should be used in confined areas.

The site should be graded to promote runoff of surface water in order to minimize ponding of precipitation on the prepared subgrades, or in excavations. If the subgrade becomes saturated, or becomes deteriorated from repeated construction traffic, the affected material should be removed, and these materials should be disked and recompactd or undercut and replaced with suitable fill prior to further construction in those areas.

GEOCON recommends that the evaluation of the subgrade and selection of fill materials for various applications should be done in consultation with the geotechnical engineer, and placement of fill for structural applications be monitored and tested by a representative of the geotechnical engineer.

Maintenance Garage Foundations

Spread footings may be used to support the planned Maintenance Garage building provided the demolition and backfill of the existing reservoir are closely monitored and the backfill is placed under density control. Spread footings bearing on suitable structure backfill can be designed for a net allowable bearing pressure of 3,000 pounds per square foot (psf). The net allowable soil bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.

For the purposes of resisting lateral loads, the coefficient of friction can be taken as 0.45 where spread footings are supported by compacted granular material and the coefficient of friction should be reduced to 0.35 for spread footings supported on clay subgrade. Also note that passive resistance in the frost zone is typically neglected due to potential strength loss during freeze thaw cycles. The capacities

provided above are ultimate values, and it is recommended that an appropriate factor of safety be used to arrive at allowable values of lateral resistances.

Inspection and testing of the foundation subgrade soil should be performed by a representative of the geotechnical engineer to verify the type of material type and confirm that any soft or otherwise disturbed soil has been removed from the excavation. At a minimum, the foundation observation and testing program should include visual inspection of the foundation excavations prior to concrete placement, to verify native soils and confirm that any loose or otherwise disturbed soil has been removed from the excavation. The soil present below foundation grade should be probed with the Dynamic Cone Penetrometer (DCP) to verify the bearing soils have a minimum unconfined compressive strength of 1.5 tsf.

Unsuitable or lower strength bearing soils present within the influence zone of the foundation systems that do not meet the minimum DCP requirements described above should be removed and replaced with select granular material, consisting of IDOT CA-1 crushed limestone aggregate capped off with a minimum of 6 inches of CA-6 or equivalent. Fill materials placed below the foundations should extend a minimum of 6 inches beyond the edge of the footings for each foot of fill placed.

It is recommended that footings be placed at a minimum depth of 48 inches below the finished grade for frost protection purposes. All footings should be protected from the effects of frost if construction is carried out during winter months unless surface is covered. To avoid disproportionately small footing sizes, it is recommended that continuous footings have a minimum dimension of 18 inches and isolated footings have a minimum dimension of 30 inches. A one-third increase in allowable design bearing pressure could be used in designing footings for added temporary live loads such as those due to wind gusts or seismic activity.

Foundation Settlement

The results of the field and laboratory testing were used to estimate settlement of the proposed foundations. Correlations between physical soil index properties such as moisture content, Standard Penetration N-values, and compressibility parameters, were used in the analyses. It is our opinion that foundation settlement will be within tolerable limits (less than 1 inch) provided the recommended design and construction criteria are followed. It is recommended that the construction of foundations be monitored and tested by a representative of the geotechnical engineer.

Seismic Considerations

Based on data obtained from the borings, a Seismic Site Classification of "D" is applicable for this site in accordance with the 2021 Edition of the IBC. The following tables contain Site Coefficients and Seismic Design Parameters for the project:

Table 2. Values for Short Time Periods

Site Class	S_s	F_a	S_{MS}	S_{DS}
D	0.12g	1.6	0.193g	0.128g

S_s : The maximum considered earthquake ground motion for a short time period at the project area is 12.0% (0.12g) based on Figure 1613.2.1(2) from the IBC code.

F_a : The site coefficient for short time periods from Table 1613.2.3(1) from the IBC code.

S_{MS} : Maximum considered earthquake spectral response accelerations for short time periods.

S_{DS} : Five percent damped design spectral response accelerations for short time periods.

Table 3. Values for 1-Second Periods

Site Class	S_1	F_v	S_{M1}	S_{D1}
D	0.057g	2.4	0.136g	0.091g

S_1 : The maximum considered earthquake ground motion for a 1-second time period at the project area is 5.7% (0.057g) based on Figure 1613.2.1(4) from the IBC code.

F_v : The site coefficient for 1-second time periods from Table 1613.2.3(2) from the IBC code.

S_{M1} : Maximum considered earthquake spectral response accelerations for 1-second time periods.

S_{D1} : Five percent damped design spectral response accelerations for 1-second time periods.

Slabs-on-Grade

Floor slab subgrades should be prepared during mass grading in accordance with the recommendations presented in previous sections of this report. It is anticipated that some amount of time will pass between mass grading and final preparation of the floor slab subgrade, any areas that experience deterioration from weather or repeated construction traffic should be repaired by disk and recompaction, or by undercutting and replacement with CA-1 capped off with CA-6.

Beneath slab-on-grade areas, a minimum of 6 inches of aggregate is recommended to facilitate fine grading and provide a capillary cut-off. The floor slab subgrade and aggregate base materials should be placed and compacted to a minimum of 95 percent of the Modified Proctor test (ASTM D-1557) maximum dry density. Floor slabs can be designed using a vertical modulus of subgrade reaction of 100 pounds per cubic inch (pci).

Floor slabs should be isolated from walls and foundations to minimize the risk of cracking due to differential movements between the walls and the floor slab. Slabs should be at least nominally reinforced with steel welded wire mesh to help reduce cracking and maintain the structural integrity of the slab. Slab reinforcement, joint layout and concrete slab thickness design should be performed by a qualified structural engineer with consideration given to the expected loading and environment, drainage, and subgrade conditions.

Pavement Recommendations

Similar to the floor slab areas, it is anticipated that pavement subgrades will be prepared during mass grading in accordance with the recommendations presented in previous sections of this report. Any areas that experience deterioration over time from weather or repeated construction traffic should be repaired by disk and recompaction, or by undercutting and replacement with 3-inch crushed limestone aggregate.

Aggregate base may be placed after the subgrade has been properly compacted, fine graded and proof rolled. The proof rolling and backfilling operations should be inspected by a representative of GEOCON to assure sufficient remediation of unsuitable materials and proper placement of backfill in accordance with the recommendations in the previous, applicable sections of this report.

Based on experience with similar projects, recommended pavement sections are shown in Table 4:

TABLE 4. Recommended HMA Pavement Section

Pavement Material	Light Duty Drives & Parking Areas	Heavy Duty Drives & Parking Areas
	Thickness (inches)	
Hot Mix Asphalt Surface Course 9.5mm	2.0	2.0
Hot Mix Asphalt Binder Course 19.0mm	2.0	4.0
Aggregate Base IDOT CA-6	10.0	12.0
Total Pavement Section	14.0	18.0

Rigid pavements, such as Portland cement concrete pavements, should have a minimum of 6 inches of concrete over a minimum of 6 inches of compacted aggregate base consisting of IDOT CA-6. A maximum joint spacing of 12 to 15 feet is also recommended. The joints should be sealed after cutting to retard the downward migration of water and incompressibles; however, the sealing material should not be applied until the majority of the shrinkage cracking has occurred.

It is recommended that saw-cut joints, if used, be completed as soon as possible after the concrete has cured sufficiently to safely allow the placement of saw cutting equipment and personnel on the surface of the concrete. Prompt completion of saw-cut joints will greatly assist in channeling the propagation of shrinkage cracks that occur during initial curing of the concrete, thereby reducing the appearance of cracks in undesired areas.

Pavements should be sloped to promptly remove surface water. Ponding of water on pavement sections and saturation of pavement subgrades is a common cause of premature pavement deterioration. Routine maintenance consisting of repairing damaged areas is helpful in maintaining pavement life and serviceability. Pavement specifications should reference the Illinois Department of Transportation (IDOT) Standard Specifications.

Administration Building Renovation Considerations

The floor of a small portion of the existing Administration Building will be lowered about 3.5 feet to match the FFE of the remainder of the building and exterior surface grades will be similarly lowered. The burial depth of the footings in this area of the building will consequently be reduced, resulting in a lower allowable bearing pressure than originally available to support the footing. Additional transient loads will also be applied to the foundation bearing soils as a result of the increased in wind load on the wall faces due to the larger exposed surface. Accordingly, we recommend that any foundation subject to reduced bearing depth be underpinned to provide additional support.

The burial depth of the footings will not meet the requirements for frost protection therefore additional insulation for a shallow frost protected foundation configuration should be provided. The underpinning operation could consist of push piers attached to the side of the footing which could be accessed either inside or outside of the building, or helical piers, which due to access limitations are typically located on the exterior side of the footing. The excavation, underpinning and backfill operation should be completed in short segments so long sections of the footing are not exposed at the same time. Push piers and helical piers are generally considered design build foundation types where the specialty contractor retained to install the piers will determine the capacity and depth based on geotechnical parameters interpreted from the boring logs provided herein.

CONSTRUCTION CONSIDERATIONS

Groundwater Control

At the time of drilling, groundwater was measured at depths ranging from 6 to 18.5 feet below existing grade. Short term groundwater measurements obtained from bore holes at the time of drilling may not be indicative of long-term groundwater levels that may be encountered during construction.

The presence of groundwater or perched water entering excavations should be anticipated at this site. It is recommended that appropriate dewatering equipment be available to control any groundwater which may be encountered during excavation, and the construction should be completed under relatively dry conditions.

When designing site drainage patterns, site runoff should be diverted away from the foundations and directed towards on-site detention areas, or storm sewer systems. Such measures reduce the potential for softening and possible erosion of the foundation and pavement subgrade soils. It is especially important that water not be allowed to collect next to or within the foundation excavations.

Excavations

All excavations should comply with the requirements of OSHA 29CFR, Part 1926, Subpart P, "Excavations," regarding excavation and trench safety, as well as other applicable codes. This document states that excavation safety is the sole responsibility of the contractor and accordingly reference to this OSHA requirement should be included in the project specifications. Excavation slopes shall in no case be steeper than those specified by OSHA, and all excavations should be monitored by a competent person, as defined by the OSHA standard. Appropriate shoring or sloping techniques should be used to prevent cave-ins.

Excavations near existing foundations, pavements or utilities should be made with caution as disturbance within foundation influence zones that support adjacent structures could result in excessive settlement. If the proposed construction will extend into the influence zone of the existing foundations, a shoring or underpinning system may be required to protect or support the adjacent structures.

GENERAL COMMENTS

This geotechnical exploration and foundation analysis has been conducted to aid in the evaluation of the foundation conditions on the subject site. The recommendations presented herein are based on the available soil information obtained and the design information provided. Any changes in the soil

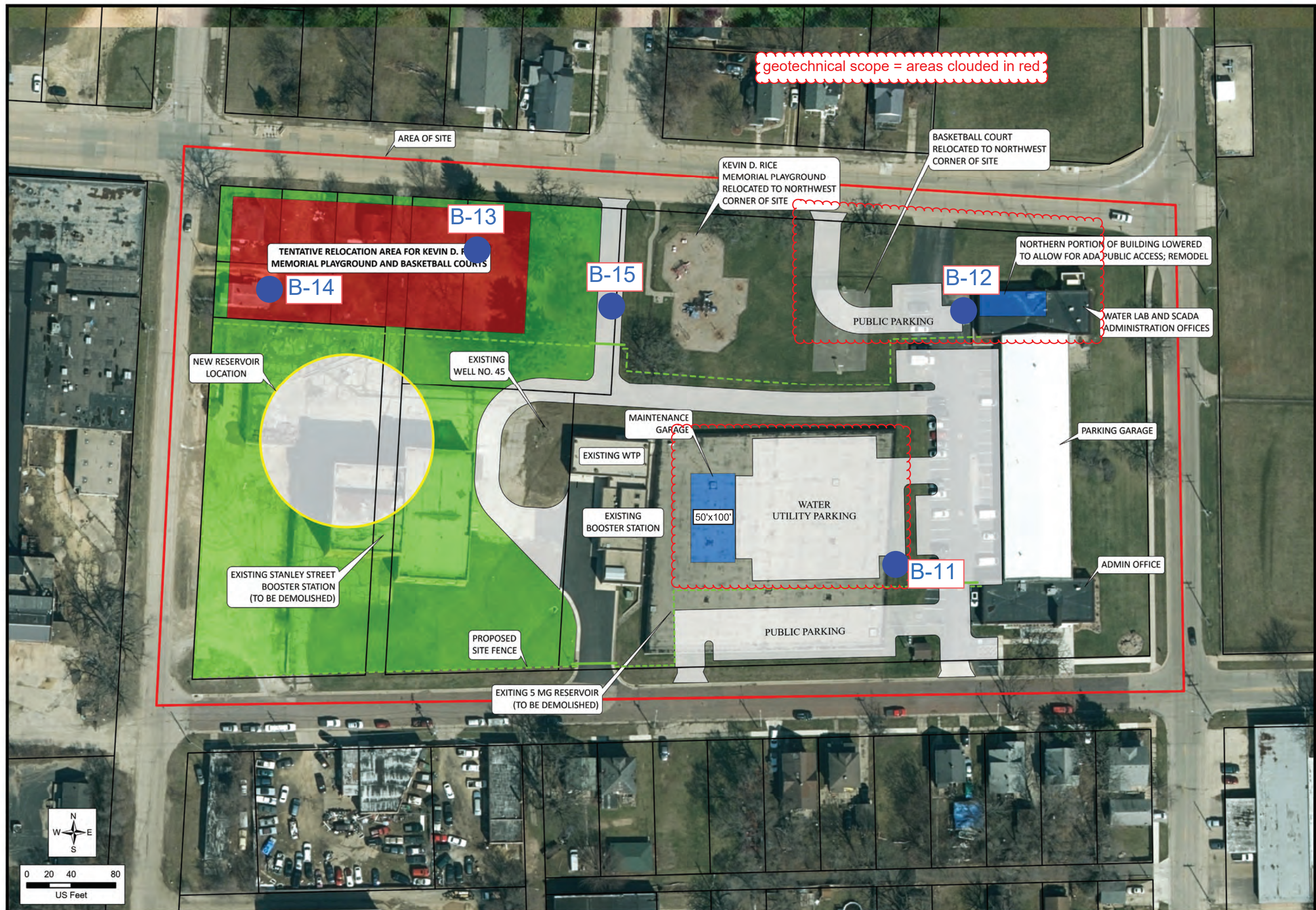
conditions encountered during construction, design, or building locations should be brought to the attention of the soils engineer to determine if modifications in the recommendations are required. The final design plans and specifications should also be reviewed by the soils engineer to determine that the recommendations presented herein have been interpreted and implemented as intended. It is recommended that the earthwork and foundation operations be monitored by the Geotechnical Engineer, to test and evaluate the bearing capacities, and the selection, placement and compaction of controlled fills.

This geotechnical study has been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations, and opinions contained herein have been promulgated in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations, expressed or implied, and no warranty or guarantee is included or intended in this report.

APPENDIX

Boring Location Diagram Soil Boring Logs (B-11 to B-15) General Notes





ALTERNATIVE 1 SITE LAYOUT
WATER UTILITY CEDAR STREET SITE
CITY OF ROCKFORD
WINNEBAGO COUNTY, ILLINOIS

**BORING NO. B-11**

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 9/30/24 LOGGED BY RJ/DJ DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	734.5		6" TOPSOIL											
			brown POORLY GRADED SAND	X SS 1	50	2-3-3 (6)			14.0					
	731.5		trace clay											
			loose											
5			brown LEAN CLAY	X SS 2	67	2-3-3 (6)	2.0	2.1	23.2					
			very stiff											
	729.0													
			brown POORLY GRADED SAND	X SS 3	78	1-3-5 (8)			9.7					
			loose											
10			moist in SS4	X SS 4	89	2-2-3 (5)			15.8					
			trace clay @ 11 FT	X SS 5	94	2-2-3 (5)			14.9					
	721.5													
15			brown SILTY SAND	X SS 6	100	3-5-8 (13)			12.2					
			medium dense											
	716.5													
20			brown CLAYEY SILT (saturated)	X SS 7	100	2-3-3 (6)			22.2					
			loose											
	711.5													
25			brown WELL GRADED SAND	X SS 8	100	4-8-9 (17)			18.4					
	710.0		medium dense, wet											

Bottom of borehole at 25.0 feet.

COMPLETION DEPTH 25 ft GROUND ELEVATION 735 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 9.00 ft / Elev 726.00 ft
▼ AT END OF DRILLING 18.50 ft / Elev 716.50 ft
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - OZ STD DATA TEMPLATE.GDT - 10/22/24 12:20 - K:\GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO. 45, ROCKFC



BORING NO. B-12

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 9/30/24 LOGGED BY RJ/DJ DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	728.5		6" ASPHALT											
	727.8		8" AGGREGATE BASE											
			brown SANDY CLAY stiff to medium stiff	X SS 1	56	2-2-3 (5)	1.0	1.1	15.4					
				X SS 2	83	1-1-1 (2)	0.5		22.8					
5														
	723.0													
	721.5		brown SANDY SILT (saturated) very loose	X SS 3	89	1-1-1 (2)			17.9					
			brown SANDY CLAY very soft to stiff											
				X SS 4	61	2-2-3 (5)	1.0	1.2	17.8					
				X SS 5	89	1-2-2 (4)	0.25		15.7					
	715.5													
			brown POORLY GRADED SAND loose	X SS 6	100	1-2-2 (4)			10.8					
15														
	710.5													
			brown and gray SILT medium dense, wet	X SS 7	100	5-6-10 (16)			22.3					
20														
	705.5													
	704.0		gray POORLY GRADED SAND trace gravel medium dense, wet	X SS 8	100	3-5-6 (11)			14.5					
25														

Bottom of borehole at 25.0 feet.

COMPLETION DEPTH 25 ft GROUND ELEVATION 729 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 6.00 ft / Elev 723.00 ft
▼ AT END OF DRILLING 18.50 ft / Elev 710.50 ft
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - OZ STD DATA TEMPLATE.GDT - 10/22/24 12:20 - K:\GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFC



BORING NO. B-13

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 9/30/24 LOGGED BY RJ/DJ DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	734.5		6" TOPSOIL											
			brown SILTY CLAY very stiff to hard	SS 1	61	2-3-2 (5)	2.5		15.7					
				SS 2	56	3-4-6 (10)	4.5+	5.2	20.8					
5														
	729.0		brown POORLY GRADED SAND loose to medium dense	SS 3	78	4-2-2 (4)			7.2					
				SS 4	67	2-2-2 (4)			6.1					
10														
				SS 5	67	8-10-14 (24)			2.6					
				SS 6	78	4-12-15 (27)			2.5					
15	720.0													

Bottom of borehole at 15.0 feet.

COMPLETION DEPTH 15 ft GROUND ELEVATION 735 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
AT TIME OF DRILLING --- None
AT END OF DRILLING --- Dry upon completion
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

**BORING NO. B-14**

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 9/30/24 LOGGED BY RJ/DJ DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	731.5		6" TOPSOIL											
			brown CLAYEY SAND loose	SS 1	78	1-2-2 (4)			7.2					
	728.5		brown SILTY CLAY trace sand very stiff	SS 2	61	2-2-2 (4)	2.0	2.0	23.8					
5	726.0		brown POORLY GRADED SAND trace gravel loose	SS 3	78	2-2-3 (5)			6.0					
				SS 4	61	1-2-2 (4)			5.3					
				SS 5	67	2-2-5 (7)			5.2					
				SS 6	56	1-2-4 (6)			4.6					
15	717.0													

Bottom of borehole at 15.0 feet.

COMPLETION DEPTH 15 ft GROUND ELEVATION 732 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
AT TIME OF DRILLING --- None
AT END OF DRILLING --- Dry upon completion
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

22774 Citation Rd., Unit A Frankfort, IL 60423 Phone 815-806-9986 Fax 815-464-8691

GPS STANDARD GEOTECH LOG - OZ STD DATA TEMPLATE.GDT - 10/22/24 12:20 - K:\GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFC



BORING NO. B-15

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 9/30/24 LOGGED BY RJ/DJ DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0.0			6" TOPSOIL											
	734.0		dark brown and black SANDY SILT FILL with gravel and organics very dense	SS 1	100	4-50/1"			9.4					
2.5														
	731.0		brown SILTY CLAY trace sand & gravel very stiff	SS 2	62	4-6-50/1"	3.25		13.9					
5.0														
	728.5		refusal encountered - possible cobble obstruction											
Refusal at 6.0 feet. Bottom of borehole at 6.0 feet.				SS 3		50/0"								

COMPLETION DEPTH 6 ft GROUND ELEVATION 734.5 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
AT TIME OF DRILLING --- None
AT END OF DRILLING --- Dry upon completion
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.



GENERAL NOTES

CLIENT City of Rockford

PROJECT NAME Well No. 45 Site Improvements

PROJECT NUMBER 23-G0529

PROJECT LOCATION 1141 Stanley St, Rockford, IL

SAMPLE IDENTIFICATION

Visual soil classifications are made in general accordance with the United Soil Classification System (USCS) on the basis of textural and particle size categorization, and various soil behavior characteristics. Visual classifications should be substantiated by appropriate laboratory testing when a more exact soil identification is required to satisfy specific project applications criteria.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487-98)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	$C_u \geq 4$ AND $1 \leq C_c \leq 3$	GW	WELL-GRADED GRAVEL	
			$C_u \geq 4$ AND/OR $1 \geq C_c \geq 3$	GP	POORLY-GRADED GRAVEL	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	$C_u \geq 6$ AND $1 \leq C_c \leq 3$	SW	WELL-GRADED SAND	
			$C_u \geq 6$ AND/OR $1 \geq C_c \geq 3$	SP	POORLY-GRADED SAND	
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR MH	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY	
			PI>4 AND PLOTS<"A" LINE	ML	SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY	
			PI PLOTS <"A" LINE	MH	ELASTIC SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT	

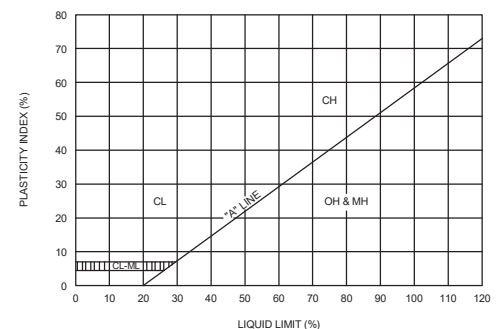
PROJECT LITHOLOGIC SYMBOLS (USCS)

	ASPHALT: Asphalt		CL-ML: USCS Low Plasticity Silty Clay		CLS: USCS Low Plasticity Sandy Clay
	FILL: Fill (made ground)		GPS: USCS Poorly-graded Sandy Gravel		GRAVEL FILL: Gravel Fill
	LIMESTONE: Limestone		ML: USCS Silt		MLS: USCS Sandy Silt
	SC: USCS Clayey Sand		SM: USCS Silty Sand		SP: USCS Poorly-graded Sand

PROJECT SAMPLE TYPES

- Rock Core (RC)
- Split Spoon (SS)

PLASTICITY CHART



SOIL RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

NON-COHESIVE SOILS		COHESIVE SOILS		
RELATIVE DENSITY	N-VALUE*	CONSISTENCY	N-VALUE*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 5	0.25 - 0.50
MEDIUM DENSE	10 - 30	MEDIUM STIFF	5 - 10	0.50 - 1.0
DENSE	30 - 50	STIFF	10 - 14	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	14 - 32	2.0 - 4.0
		HARD	OVER 32	OVER 4.0

* N-VALUE: NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

ABBREVIATIONS

SS	- SPLIT-SPOON SAMPLE	LL	- LIQUID LIMIT (%)
ST	- SHELBY TUBE SAMPLE	PL	- PLASTIC LIMIT (%)
AU	- AUGER SAMPLE	PI	- PLASTIC INDEX (%)
MC	- MOISTURE CONTENT (%)	NP	- NON PLASTIC
-200	- PERCENT PASSING NO. 200 SIEVE	DD	- DRY DENSITY (PCF)
Qp	- POCKET PENETROMETER (TSF)	DCP	- DYNAMIC CONE PENETROMETER
Qu	- UNCONFINED STRENGTH (TSF)	IBV	- IMMEDIATE BEARING VALUE

GEOTECHNICAL ENGINEERING REPORT



May 31, 2023

Mr. Matt Baillargeon
City of Rockford
425 East State Street
Rockford, Illinois 61104

Re: Geotechnical Engineering Report
5M Gallon Water Storage Reservoir
Well No. 45 Reservoir Replacement and Site Modifications
1141 Stanley Street
Rockford, Illinois 61102
GEOCON Project No. 23-G0529

Dear Mr. Baillargeon:

Pursuant to our proposal for geotechnical engineering services, we have completed a subsurface exploration and geotechnical analysis for the above referenced project. This electronic copy of the Geotechnical Engineering Report includes our findings and recommendations for the proposed project referenced above. Please contact our office if you require hard copies of the report.

GEOCON Professional Services, LLC. (GEOCON) appreciates the opportunity to be of service during this phase of the project. If there are any questions or comments you may have regarding the contents of this report, or if we may be of any further service, please contact us at your convenience.

Sincerely,

GEOCON Professional Services, LLC.

A handwritten signature in black ink, appearing to read "B. Filafusi".

Brandon Filafusi, EIT
Project Engineer

A handwritten signature in black ink, appearing to read "K. Rippey".

Kenneth K. Rippey, PE
Senior Geotechnical Engineer





Geotechnical Engineering Report

**5M Gallon Water Storage Reservoir
Well No. 45 Reservoir Replacement and Site Modifications
1141 Stanley Street
Rockford, Illinois 61102**

**Mr. Matt Baillargeon
City of Rockford
425 East State Street
Rockford, Illinois 61104**

**Prepared By:
GEOCON Professional Services, LLC.
22774 Citation Road, Unit A
Frankfort, Illinois 60423**

May 31, 2023

GEOCON Project No. 23-G0529

TABLE OF CONTENTS

	Page
INTRODUCTION	1
NEED FOR ADDITIONAL BORINGS	1
PROJECT AND SITE DESCRIPTION	1
SUBSURFACE EXPLORATION	2
Drilling and Sampling Procedures	2
Laboratory Tests	3
SOIL CONDITIONS	3
GROUNDWATER CONDITIONS	4
ENGINEERING RECOMMENDATIONS	5
Tank Foundations	5
Deep Foundation Alternatives	6
Seismic Considerations	7
Demolition	8
Controlled Compacted Fill	8
CONSTRUCTION CONSIDERATIONS	9
Groundwater Control	9
Excavations	9
GENERAL COMMENTS	10
APPENDIX I	
Site Vicinity Map	
Boring Location Diagram	
Soil Boring Logs	
General Notes	
Seismic Design Map	
APPENDIX II	
Pile Bearing vs. Estimated Length	

GEOTECHNICAL ENGINEERING REPORT
5M Gallon Water Storage Reservoir
Well No. 45 Reservoir Replacement and Site Modifications
1141 Stanley Street
Rockford, Illinois 61102

INTRODUCTION

This report presents the results of a subsurface exploration for the proposed 5MG water storage reservoir planned as part of the City of Rockford Well No. 45 Site Improvement project, located at 1141 Stanley Street, in Rockford, Illinois. The purpose of this report was to determine and evaluate the subsurface conditions existing at the subject site, and to establish related geotechnical parameters for foundation design and construction of the project.

NEED FOR ADDITIONAL BORINGS

Borings B-1 to B-5 were performed within the footprint of the proposed 5MG water storage reservoir. B-1, located in the center of the tank, was extended into bedrock encountered at a depth of 67 feet below grade. Borings B-2 to B-5 were located around the perimeter of the tank and these borings were terminated within Stratum 3 (as described below) at a depth of 30 feet below grade. Depending on the type of foundation selected for support of the reservoir structure, additional borings may be warranted to verify the thickness of Stratum 3 and the depth to Stratum 4 or bedrock.

PROJECT AND SITE DESCRIPTION

The site is currently developed with an existing 5MG underground reservoir and associated facilities. It is understood that the existing reservoir and booster station will be demolished, and the site will be partially redeveloped as shown on the Boring Location Diagram provided in Appendix I.

The proposed tank will consist of a 5M gallon water storage tank with a diameter of 156 feet and 30-foot-high walls. It is anticipated that a membrane-type floor of cast-in-place concrete will be used for this project. It has been assumed that the superstructure of the tank will consist of precast, post-tensioned concrete panels with a steel diaphragm and shotcrete cover, which will comprise the walls of the tank, and a precast concrete, dome shaped roof. Structure loads were not provided. Based on available information, the total load including tank and contents will be 44,600 kips and the diameter of the foundation slab will be 160 feet. We estimate the liquid head will be 2,200 psf and the wall load associated with the walls and roof of the structure will be 5 kips per foot. It was assumed this line load does not include transient loading that would not contribute to settlement. The floor of the structure is indicated to be a 2-foot-thick slab consisting of reinforced concrete. Based on Google Earth, existing grades in the area where the tank will be constructed are relatively flat at or near El. 733 to El. 736 feet. The finished floor elevation of tank will be approximately 5 feet below grade at El. 729 feet.

Piping for the new reservoir will consist of three buried lines of varying sizes. The three buried lines are the suction line connecting to the east side of the existing water treatment plant (WTP), the fill line connecting to the existing buried water main on the east side of the WTP, and the drain line that will

discharge to the southwest of the new reservoir. The invert of the proposed pipes were unknown at the time of this report.

A new parking lot will be constructed in place of the existing reservoir that is scheduled for demolition. The existing approximately 200 feet by 200 feet by 18 feet deep (buried approximately 10 feet below grade) concrete reservoir will be demolished and backfilled.

The location of the reservoir is currently covered by poor quality asphalt and a portion of the existing Stanley Street Booster Station that are both scheduled to be demolished. The area is to be properly demolished, subsequent cleanup and approval of the resulting excavation prior to regrading with engineered backfill (see demolition section) before construction of the reservoir begins. The material used to backfill should be taken into consideration provided that the new reservoir excavation will extend into backfilled areas. The extent of the poor-quality asphalt to be removed is located above portions of the proposed piping as well. In addition, the existing reservoir is to be demolished, excavation cleaned and approved prior to regrading with engineered backfill (see demolition section) before construction of the parking lot in this location begins.

The Boring Location Diagram located in Appendix I depicts a schematic of the existing conditions and proposed site improvements.

SUBSURFACE EXPLORATION

A total of ten (10) borings were advanced for the project at the approximate locations shown on the Boring Location Diagram, included in Appendix I. Five (5) borings were located in the footprint of the water storage tank and were extended to depths ranging from 30 to 71 feet below grade. Borings B-6 to B-8 were located in the footprint of the pump station, east of the tank, and were extended to predetermined boring termination depths of 25 feet below grade. Borings B-9 and B-10 were located in the new drive connecting the east and west portions of the new development.

The borings were staked in the field by GEOCON and surface elevations were estimated by Google Earth. After completion of the borings, the holes were left open for 24-hours to collect delayed ground water level readings, then backfilled with soil cuttings and patched with like materials as encountered at the boring.

Drilling and Sampling Procedures

The soil borings were performed with a truck-mounted drilling rig equipped with a rotary head. Conventional, continuous flight, hollow-stem augers were used to advance the borings with representative samples obtained in each boring employing split-barrel sampling techniques in accordance with ASTM Procedure D-1586. Soil samples were secured at 2.5-foot intervals to a depth of 20 feet, and 5-foot intervals thereafter, as indicated on the boring logs provided in Appendix I.

The Standard Penetration Test (SPT) is defined as the number of blows required to advance a 2-inch O.D., split-barrel sampler a distance of one foot by a 140-pound hammer falling 30 inches, commonly described as the N-value. These sampler resistances provide a useful indication of the consistency or relative density of most soil deposits and are reported on the boring logs presented in the Appendix. Samples of cohesive soils obtained from the borings were tested with a calibrated hand penetrometer

to aid in evaluating the soil strength characteristics. The results from this testing is tabulated on the boring logs.

Water level observations were made during drilling operations. This data is noted on the boring logs. A groundwater level monitoring well was installed at B-5. The well was set at a depth of 30 feet with the lower 20 feet being well screen and the upper 10 feet solid well riser. Delayed groundwater level measurements obtained from the well are provided below.

Laboratory Tests

Additional characteristics of the foundation materials were determined in the laboratory to provide data on which to classify and estimate the engineering properties of the subsurface soil deposits encountered in the borings. All samples were visually classified by the geotechnical engineer according to the Unified Soil Classification System (ASTM D-2488). An explanation of the symbols used in this system is included in the Appendix.

Representative samples were tested in the laboratory to determine the natural moisture content of the soils. All moisture contents are expressed as a percentage of the dry weight of soil. Representative samples of the cohesive soils encountered in the borings were tested in the laboratory with a calibrated RIMAC spring tester to determine the approximate unconfined compressive strength of the soil samples.

The laboratory testing program selected for this project is intended to assist with determination of soil classification as well as strength and deformation characteristics of the subsurface soil deposits that will provide foundation support for the proposed structures. All laboratory testing was performed in general accordance with the respective ASTM Methods, as applicable, and the results are included on the boring logs and laboratory test reports included in the Appendix. Unless notified to the contrary, all samples will be disposed of after one month.

SOIL CONDITIONS

The types of foundation materials encountered at the test boring locations are described on the Soil Boring Logs. The lines delineating the changes in strata on the logs represent an approximate boundary between the various soil classifications. It must be recognized that the soil descriptions are considered representative for the specific test hole location, but the variations may occur between the sampling intervals and boring locations. A summary of the major soil profile components is described in the following paragraphs. A more detailed description and supporting data for each boring location can be found on the individual boring logs.

The subsurface profile at this site consists of 4 generalized soil strata followed by poor quality limestone bedrock. The upper stratum, **Stratum 1**, extended to approximately El. 724.5 to 729 feet and consisted of predominantly fill or natural sandy clay to clayey sand with low strength characteristics. This material is not considered suitable for support of foundations or slabs associated with the tank or pump station.

A brown poorly graded fine sand stratum, **Stratum 2**, was encountered below the upper stratum and extended to an average elevation of El. 713 feet. Considering the sample data for all borings, the sand stratum has boring to boring average N value ranging from 8 to 12 blows per foot of sampler penetration, indicating the native sand can be described as loose to medium dense. Samples of the sand

were saturated with groundwater below a depth of about 23 feet, which corresponds to El. 713 to 716 feet.

Stratum 3 consisted of interbedded layers of sand, silt, and clay extending to a depth of 48 feet below grade at B-1, which correlates to El. 687 feet. The sand and silt layers were described as loose to medium dense with N-values ranging from 6 to 23 blows per foot and samples of the silt had moisture contents ranging from 17.4 to 26.9 percent. The silty clay layers within Stratum 3 were encountered at B-1 from 33 to 43 feet below grade and B-3 from 23 to 28 feet below grade. The silty clay was described as stiff with unconfined compressive strengths ranging from 1.0 to 2.0 tsf and moisture contents ranging from 17.1 to 21.3 percent.

B-1 was the only boring that extended into **Stratum 4** which consisted of very dense sand or hard clay extending to El. 668 feet where limestone bedrock was encountered. The very dense sand layers had N values ranging from 42 blows per foot to 50 blows per 5 inches of sampler penetration. The silty clay encountered below a depth of 63 feet had an unconfined compressive strength of 4.5+ tsf and a moisture content of 19.3 percent.

At B-1, weathered limestone bedrock was encountered below the hard clay and the boring was terminated at a depth of 71 feet below grade, which correlates to El. 664 feet. A 2.5-foot core run indicated the limestone was very poor quality with core recovery of 58 percent and an RQD of 15 percent.

GROUNDWATER CONDITIONS

Groundwater was encountered while drilling in all borings except B-7, B-9, and B-10, at depths ranging from 7 to 23.5 feet below grade, as noted in the following table:

Table 1: Groundwater Depth While Drilling

Boring No.	While Drilling, ft.	Elevation, ft.
B-1	7	728
B-2	16	718
B-3	23.5	709.5
B-4	23.5	711.5
B-5	20	716
B-6	23.5	713.5
B-8	17	716

A temporary groundwater level monitoring well was installed at B-5. Data from groundwater level measurements indicated the groundwater level dropped approximately 3 feet to El. 713 feet.

It should be noted that due to the relatively limited stabilization times under which the water level measurements were made, these observed groundwater level readings may not indicate the static water level for the site. In addition, groundwater levels fluctuate over time and are influenced by seasonal precipitation and varying permeability characteristics of the subsurface soils.

ENGINEERING RECOMMENDATIONS

Tank Foundations

Based on the soil conditions encountered during the subsurface investigation, conventional spread foundations consisting of a base slab with a thickened edge, may be suitable for support of the at-grade water storage tank, provided the estimated settlement indicated below is within tolerable limits for the structure. The average pressure on the subgrade below the floor of the tank is estimated to be about 2.5 ksf. Stratum 1 as described previously is not suitable for support of the estimated soil pressure, therefore, we recommend removal of the stratum and replacement of the unsuitable material with compacted CA-6 crushed limestone aggregate. The excavation to remove the unsuitable soil must extend laterally beyond the perimeter of the foundation for a minimum distance equal to the thickness of the backfill below the base slab. Fill placement and compaction recommendations provided in the Controlled Compacted Fill section of this report should be followed during backfilling operations.

If a base slab foundation is used to support the tank, it is estimated the tank foundation will be supported at or about El. 727 feet upon the CA-6 backfill, and the floor load will be distributed through the compacted backfill to the medium dense sand stratum encountered at or about El. 726 feet. During and after removal of the unsuitable fill and soft clay, we recommend inspection and testing of the subgrade be performed by a representative of the geotechnical engineer. The subgrade should be inspected and tested to verify material type and confirm that any loose or otherwise disturbed soil has been removed from the undercut excavation. Dynamic cone penetrometer (DCP) testing should be performed before backfill placement, and minimum results should correspond to an N value of 12 blows per foot.

Settlement of the sand stratum encountered directly below the tank floor was estimated using the semiempirical statistical method developed by Burland and Burbidge (1985), an average foundation load of 2.5 ksf applied at El. 727 feet, and assuming the compacted aggregate backfill extended at least to El. 726 feet. Based on the analyses, it is our opinion that foundation settlement at the center of the tank would be on the order of 3 to 4 inches and differential settlement between the center and edge will be on the order of 1 ½ to 2 inches. We recommend that settlement be closely monitored during initial loading of the tank.

To reduce settlement, foundations in conjunction with ground improvement methods may be considered for structure support. In this regard, the existing fill materials and underlying natural sand soil may be improved/reinforced with rammed aggregate piers or grout columns. The piers are constructed by making 24 to 36-inch diameter holes through the more compressible layers, and in this case into Stratum 3, and backfilling the piers with thin lifts of compacted aggregate or grout. Compaction densifies the aggregate and increases the lateral stress in the soil matrix. This system will serve to reduce settlements and increase bearing capacity by replacing the existing fill and a portion of native soils with a stiffer composite soil matrix.

Preliminary estimates indicate that aggregate or grout column improved ground should be capable of supporting the applied loads with adequate FS against bearing failure and settlements within tolerable limits. Specialty contractors with experience in the design and installation of aggregate or grout columns should be consulted in regard to these matters. Upon request, GEOCON would be pleased to contact ground improvement firms or assist with obtaining budget figures for performance of ground improvement at this site.

Deep Foundation Alternatives

At the discretion of the design build tank contractor, due to concern with excessive settlement, driven piles or Auger-cast piles may be preferred by the design build contractor and would provide suitable foundation support for the tank.

Driven Steel H-Pile Foundations - Driven steel H-pile foundations can be used to support the proposed reservoir. The driving refusal criteria may be determined by wave equation analysis with driving energies set at a level not to exceed the yield strength of the steel. Steel H-pile foundation driven to refusal on or near the surface of bedrock, can be designed for an allowable load of 280 and 300 tons possible for HP 14 x 102 lb. and HP 14 x 117 lb. piles, respectively, for 50 ksi steel at allowable stress equal to $0.35 f_y$. The load capacities of driven piles should be confirmed by wave equation load prediction analysis in combination with dynamic pile analyzer studies of test piles. Where loads do not justify such high capacities, lighter steel piles could be used such as HP12 X 53 lb. piles. Such piles could be driven to appropriate driving resistance (determined by wave equation analysis) into Stratum 4 below 50 feet and can be designed for an allowable load of 50 tons (see Appendix II).

Where driven piles are utilized, the elevations of the tops of each of the piles should be checked after driving and again after driving of adjacent piles. All piles which indicate heaving after driving of adjacent piles should be redriven to appropriate resistance.

A typical spacing for driven piles is usually recommended as 2.5 to 3 times the pile diameter center to center. This type of criteria is normally based on reasonable out of plumb tolerance and disturbance factors for friction or end bearing piles in soil. However, since these piles will be end bearing on rock, concerns for soil disturbance do not apply. For this situation, the center to center spacing of piles can be reduced to 2.5 times the pile width for H-piles.

The maximum design allowable uplift load is 40 tons for static conditions. Higher uplift capacities are possible if proven by the load test. The allowable load on piles for compression and tension may be increased by 33% for short-term transient loads, such as wind. However, the maximum allowable load, including short-term transient loads, should not exceed 50% of the yield stress of the pile.

Auger-Cast Pile Foundations - As an alternative to driven H piles, the proposed development could also be supported on auger-cast piles. Auger-cast piles are installed by continuous flight augering into the overburden soil utilizing a hollow-stem auger, typically of 14-inch diameter or larger. Upon reaching the required depth, grout is pumped through the center of the auger as the auger is turned and withdrawn, resulting in a continuous column of cement grout.

Reinforcement of auger-cast piles is achieved by immersing a vertical reinforcement bar and or cage into the center of each pile, while the grout is still fluid.

There are a number of risks associated with the installation of auger-cast piles since little of the operation can be seen. It is important that a continuous flow of grout be provided to the auger, and during the auger extraction, rotation and grout pumping not be interrupted. Interruption of any of these activities can cause discontinuities in the pile. We recommend that auger-cast piles be installed by a contractor having a minimum of five (5) years of experience in the installation of these types of foundations. Also, we recommend that the actual grout volume placed in each pile be compared with the theoretical grout volume, given the pile diameter and length. A grout overage of 15 to 30 percent or more is likely for properly constructed auger-cast piles.

14-inch auger-cast piles extended into the very dense sand and gravel at 50 feet are likely to develop load carrying capacities on the order of 50 to 60 tons per pile for properly constructed piles.

Settlement of a pile foundation is expected to be less than ½ inch. A pile load test is recommended to confirm or improve the pile design.

For perimeter grade beams which are utilized to connect pile caps, it is recommended that these grade beams be extended a minimum of 3.5 feet below finished exterior grade for frost cover protection, and where grade beams are constructed in unheated areas, that they be extended to a minimum of 4 feet below finished grade. Since the uppermost portion of the fill appears to be well compacted, it may be possible to construct grade beams bank-to-bank, rather than placing and removing forms and the associated backfill. Where this is undertaken, it is recommended that the excavations be made, reinforcing placed and concrete placed all within one (1) work shift.

Seismic Considerations

Based on the data obtained from the borings, a Seismic Site Classification of "D" is applicable for this site in accordance with the 2015 Edition of the IBC. The following tables contain Site Coefficients and Seismic Design Parameters for the project:

Table 2. Values for Short Time Periods

Site Class	S _s	F _a	S _{MS}	S _{DS}
D	0.12g	1.6	0.193g	0.128g

S_s: The maximum considered earthquake ground motion for a short time period at the project area is 12% (0.12g) based on Figure 1613.5(1) from the IBC code.

F_a: The site coefficient for short time periods from Table 1613.5.3(1) from the IBC code.

S_{MS}: Maximum considered earthquake spectral response accelerations for short time periods.

S_{DS}: Five percent damped design spectral response accelerations for short time periods.

Table 3. Values for 1-Second Periods

Site Class	S_1	F_v	S_{M1}	S_{D1}
D	0.057g	2.4	0.136g	0.091g

S_1 : The maximum considered earthquake ground motion for a 1-second time period at the project area is 5.7% (0.057g) based on Figure 1613.5(2) from the IBC code.

F_v : The site coefficient for 1-second time periods from Table 1613.5.3(2) from the IBC code.

S_{MS} : Maximum considered earthquake spectral response accelerations for 1-second time periods.

S_{DS} : Five percent damped design spectral response accelerations for 1-second time periods.

Demolition

All existing structures or other below ground objects encountered should be removed completely from within new foundation influence zones and at least 2.0 feet below bottom of any new slabs or pavements, and if existing basements are encountered, they must be backfilled as described under Controlled Compacted Fill. In no case should demolition debris be used as controlled compacted fill.

Demolition and protection of buried and at-grade structures and features will be required. Surface features requiring removal include areas of grass and topsoil, as well as pavements, walkways, and stairs. These at-grade features will be replaced in kind or to meet the needs of the area surrounding the new 5M gallon water storage reservoir.

Protection of existing piping to remain will be critical during installation of new piping. Impacts to existing piping will include loading from construction activities, direct and indirect excavation, new connections, and plugging of piping to be removed or abandoned in place. All protection of existing utilities will be the responsibility of the Contractor.

The Contractor will be required to consider earth retention systems and dewatering methods for construction excavations adjacent to critical infrastructure required to remain in place and operable during construction.

Controlled Compacted Fill

The subgrade should be evaluated at the time of construction by a qualified representative of the geotechnical engineer to verify the subgrade is suitable for support of the structure and/or backfill. The existing subgrade soils will be susceptible to disturbance from precipitation, construction traffic and vibrations. Care should be taken to avoid disturbance of the subgrade soil and construction traffic over prepared subgrades should be avoided. If the subgrade soils become disturbed during construction, they should be scarified and recompacted or removed and replaced prior to placing new site grading fill or granular subbase material.

It is recommended that fill materials used for structural support consist of imported well graded crushed limestone aggregate material meeting the gradation requirements for IDOT CA-6. All structural fill should be placed on approved subgrades, and the fill should be placed in lifts and properly compacted.

All newly placed fill should be placed in 9 inch or less loose lifts and compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557 (Modified Proctor) method of test. The fill should be placed within +/- 2 percent of the optimum moisture content value determined by laboratory Modified Proctor testing.

Backfill placed in utility excavations or against foundation walls should consist of a well-graded granular material. Proper placement and compaction of backfill in these areas is considered essential in order to reduce the potential for distress of overlying pavements and floor slabs. The placement of backfill against unsupported walls may induce movement, particularly where the backfill is placed on one side of the wall to a higher elevation than the backfill on the other side. Small, hand-operated compactors should be used in confined areas.

The site should be graded to promote runoff of surface water in order to minimize ponding of precipitation on the prepared subgrades, or in excavations. If the subgrade becomes saturated, or becomes deteriorated from repeated construction traffic, the affected material should be removed and these materials should be disked and recompactd or undercut and replaced with suitable fill prior to further construction in those areas.

GEOCON recommends that the evaluation of the subgrade and selection of fill materials for various applications should be done in consultation with the Geotechnical Engineer, and placement of fill for structural applications be monitored and tested by a representative of the Geotechnical Engineer.

CONSTRUCTION CONSIDERATIONS

Groundwater Control

The presence of groundwater or perched water entering excavations should be anticipated at this site. It is recommended that appropriate dewatering equipment be available to control any groundwater which may be encountered during excavation, and the construction should be completed under relatively dry conditions. When designing site drainage patterns, site runoff should be diverted away from the foundations and directed towards on-site detention areas, or storm sewer systems. Such measures reduce the potential for softening and possible erosion of the foundation and pavement subgrade soils. It is especially important that water not be allowed to collect next to or within the foundation excavations.

Excavations

All excavations should comply with the requirements of OSHA 29CFR, Part 1926, Subpart P, "Excavations," regarding excavation and trench safety, as well as other applicable codes. This document states that excavation safety is the sole responsibility of the contractor and accordingly reference to this OSHA requirement should be included in the project specifications. Excavation slopes shall in no case be steeper than those specified by OSHA, and all excavations should be monitored by a competent person, as defined by the OSHA standard. Appropriate shoring or sloping techniques should be used to prevent cave-ins.

Excavations near existing foundations should be made with caution as disturbance within foundation influence zones that support adjacent structures could result in excessive settlement. If the proposed

construction will extend into the influence zone of the existing foundations, a shoring or underpinning system may be required to protect or support the adjacent structures.

GENERAL COMMENTS

This geotechnical exploration and foundation analysis has been conducted to aid in the evaluation of the foundation conditions on the subject site. The recommendations presented herein are based on the available soil information obtained and the design information provided. Any changes in the soil conditions encountered during construction, design, or building locations should be brought to the attention of the soils engineer to determine if modifications in the recommendations are required. The final design plans and specifications should also be reviewed by the soils engineer to determine that the recommendations presented herein have been interpreted and implemented as intended. It is recommended that the earthwork and foundation operations be monitored by the Geotechnical Engineer, to test and evaluate the bearing capacities, and the selection, placement and compaction of controlled fills.

This geotechnical study has been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations, and opinions contained herein have been promulgated in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations, expressed or implied, and no warranty or guarantee is included or intended in this report.

APPENDIX I

**Site Vicinity Map
Boring Location Diagram
Soil Boring Logs
General Notes
Seismic Design Map**



APPENDIX II

Pile Bearing vs. Estimated Length





APPENDIX I



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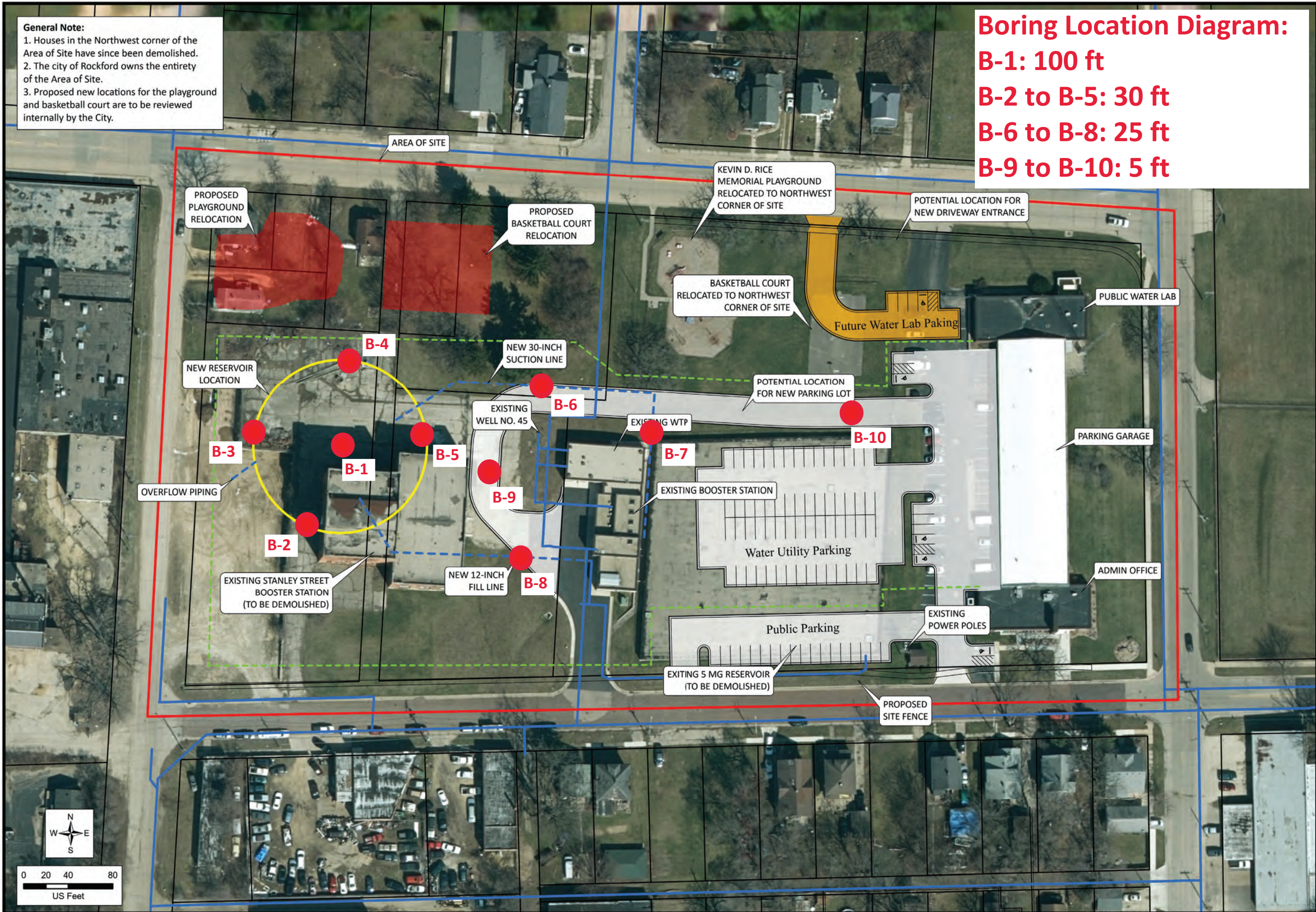
SITE VICINITY MAP
5M Gallon Water Storage Reservoir
1141 Stanley Street
Rockford, IL 611102

PROJECT NUMBER:
23-G0529

DATE: May 2023

General Note:
1. Houses in the Northwest corner of the Area of Site have since been demolished.
2. The city of Rockford owns the entirety of the Area of Site.
3. Proposed new locations for the playground and basketball court are to be reviewed internally by the City.

Boring Location Diagram:
B-1: 100 ft
B-2 to B-5: 30 ft
B-6 to B-8: 25 ft
B-9 to B-10: 5 ft



PROPOSED RESERVOIR LOCATION

**WELL 45 RESERVOIR REPLACEMENT
CITY OF ROCKFORD
WINNEBAGO COUNTY, ILLINOIS**



FIGURE 4.04-1
778 of 1009

**BORING NO. B-1**

PAGE 1 OF 3

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/10/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	734.8		3" ASPHALT											
	734.0		9" AGGREGATE BASE											
			black SAND and brown CLAY (FILL) with gravel loose	SS 1	78	4-4-5 (9)			15.1					
	731.5		brown SANDY CLAY medium stiff, moist	SS 2	89	2-1-2 (3)	0.75		19.6					
	728.5		▽ brown CLAYEY SAND loose, very moist to wet	SS 3	89	2-2-2 (4)			17.1					
	726.0		brown POORLY GRADED SAND with gravel loose to medium dense, very moist to wet	SS 4	89	3-5-5 (10)			12.9					
				SS 5	89	3-3-4 (7)			18.1					
				SS 6	33	2-2-3 (5)			17.6					
				SS 7	56	5-5-6 (11)			14.2					
				SS 8	89	4-7-10 (17)			17.9					
	713.0		brown SILT medium dense, wet	SS 9	100	7-8-10 (18)			21.8					
25														

COMPLETION DEPTH 71 ft GROUND ELEVATION 735 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 7.00 ft / Elev 728.00 ft
AT END OF DRILLING --- Switched to rotary
AFTER DRILLING --- Borehole closed

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.



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												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
25			brown SILT medium dense, wet (continued)											
	707.0													
30			gray CLAYEY SILT medium dense, wet	X SS 10	100	3-4-6 (10)			26.9					
	702.0													
35			gray SILTY CLAY very stiff	X SS 11	100	3-5-7 (12)	2.0		20.9					
40				X SS 12	89	5-7-12 (19)	2.0		17.1					
	692.0													
45			gray SILTY SAND medium dense, wet	X SS 13	89	5-11-12 (23)			18.0					
	687.0													
50			gray SANDY GRAVEL very dense, wet	X SS 14	55	13-50/5"			12.2					
	682.0													
55			gray POORLY GRADED SAND dense, wet	X SS 15	100	17-19-23 (42)			21.4					

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												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
	677.0		gray POORLY GRADED SAND dense, wet (continued)											
60			gray SANDY SILT very dense, wet	X SS 16	100	19-25-34 (59)			18.2					
	672.0													
65			gray SILTY CLAY hard	X SS 17	89	17-12-8 (20)	4.5+		19.3					
	668.0													
	666.5		WEATHERED LIMESTONE											
70			LIMESTONE	RC 1	58 (15)									
	664.0													

Refusal at 68.5 feet.
Bottom of borehole at 71.0 feet.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

**BORING NO. B-2**

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/11/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	733.8		3" ASPHALT											
	733.0		9" AGGREGATE BASE	X SS 1	89	3-3-4 (7)	2.0	2.2	12.1					
			brown SANDY CLAY medium stiff to very stiff											
5				X SS 2	89	1-1-2 (3)	0.5	0.6	15.3					
	728.0													
			brown POORLY GRADED SAND trace gravel loose to medium dense, moist	X SS 3	89	1-2-3 (5)			11.0					
10			trace black staining in SS4	X SS 4	67	1-2-2 (4)			13.1					
				X SS 5	89	2-3-4 (7)			7.1					
15				X SS 6	89	3-3-4 (7)			10.4					
			▼ wet at 16 ft	X SS 7	89	3-4-6 (10)			17.1					
20				X SS 8	89	3-3-5 (8)			20.2					
	711.0													
25			brown SANDY SILT medium dense, very moist to wet	X SS 9	100	4-7-9 (16)			21.6					
	706.0													
30	704.0		gray CLAYEY SILT medium dense, wet	X SS 10	100	3-5-5 (10)			26.0					

Bottom of borehole at 30.0 feet.

COMPLETION DEPTH 30 ft GROUND ELEVATION 734 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 16.00 ft / Elev 718.00 ft
▼ AT END OF DRILLING 16.00 ft / Elev 718.00 ft
AFTER DRILLING --- Borehole closed

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

**BORING NO. B-3**

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/9/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	732.8		3" ASPHALT											
	732.0		9" AGGREGATE BASE											
	731.0		dark brown CLAY (FILL) very stiff	X SS 1	89	4-5-5 (10)	2.25	2.4	13.6					
			brown CLAYEY SAND loose	X SS 2	67	2-2-2 (4)			12.4					
5														
	726.5		brown SANDY CLAY stiff	X SS 3	89	2-2-4 (6)	1.25		22.8					
	724.5		trace black staining at 7.5 ft											
10			brown POORLY GRADED SAND with gravel medium dense	X SS 4	100	3-7-10 (17)			3.7					
				X SS 5	89	8-8-10 (18)			4.3					
				X SS 6	89	6-8-8 (16)			3.6					
15				X SS 7	100	4-6-6 (12)			3.3					
				X SS 8	100	4-5-8 (13)			4.5					
20														
	710.0		brown SILTY CLAY stiff, moist	X SS 9	100	3-5-7 (12)	1.0		21.3					
25														
	705.0		gray CLAYEY SILT loose, wet	X SS 10	100	3-4-5 (9)			25.4					
30	703.0													

Bottom of borehole at 30.0 feet.

COMPLETION DEPTH 30 ft GROUND ELEVATION 733 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 23.50 ft / Elev 709.50 ft
▼ AT END OF DRILLING 23.50 ft / Elev 709.50 ft
AFTER DRILLING --- None

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.



CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/11/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	734.8		3" ASPHALT											
	734.0		9" AGGREGATE BASE	X SS 1	89	3-3-4 (7)	1.5	1.8	18.5					
			brown SANDY CLAY medium stiff to stiff											
5			trace silt in SS2	X SS 2	100	2-2-3 (5)	1.0	1.0	22.7					
				X SS 3	100	1-2-1 (3)	0.5	0.6	15.5					
	726.5													
10			brown POORLY GRADED SAND with gravel loose to medium dense	X SS 4	100	3-4-4 (8)			3.9					
				X SS 5	100	3-4-7 (11)			7.4					
15				X SS 6	100	4-6-9 (15)			5.3					
				X SS 7	100	5-5-8 (13)			5.1					
20				X SS 8	100	5-7-10 (17)			5.7					
	712.0													
25			brown CLAYEY SILT medium dense, moist	X SS 9	100	6-7-8 (15)			22.5					
	707.0													
30	705.0		gray CLAYEY SILT medium dense, wet	X SS 10	100	3-4-6 (10)			20.9					

Bottom of borehole at 30.0 feet.

COMPLETION DEPTH 30 ft GROUND ELEVATION 735 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 23.50 ft / Elev 711.50 ft
▼ AT END OF DRILLING 23.50 ft / Elev 711.50 ft
AFTER DRILLING --- Borehole closed

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.



CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/11/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	735.8		3" ASPHALT											
	735.0		9" AGGREGATE BASE	X SS 1	89	3-4-6 (10)			11.7					
	732.5		brown CLAYEY SAND medium dense											
5			brown SANDY CLAY stiff	X SS 2	100	2-2-3 (5)	1.25	1.3	18.9					
	729.0			X SS 3	100	2-3-5 (8)	1.5	1.5	23.8					
			brown POORLY GRADED SAND with gravel medium dense											
10				X SS 4	89	2-4-6 (10)			6.2					
				X SS 5	89	6-7-7 (14)			5.2					
15				X SS 6	89	4-5-6 (11)			6.5					
				X SS 7	89	5-8-10 (18)			5.6					
20				X SS 8	89	3-4-6 (10)			4.0					
	713.0													
25			brown CLAYEY SAND with gravel medium dense, wet	X SS 9	89	4-5-5 (10)			21.4					
	708.0													
30	706.0		gray CLAYEY SILT loose, wet	X SS 10	89	3-2-3 (5)			23.8					

Bottom of borehole at 30.0 feet.

COMPLETION DEPTH 30 ft GROUND ELEVATION 736 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 20.00 ft / Elev 716.00 ft
▼ AT END OF DRILLING 20.00 ft / Elev 716.00 ft
▼ AFTER DRILLING 23.00 ft / Elev 713.00 ft

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Well set at El. 706 ft with 20 ft screen to El. 726 ft.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

**BORING NO. B-6**

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/11/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	736.0		12" TOPSOIL											
			brown POORLY GRADED SAND medium dense	X SS 1	89	4-6-10 (16)			7.7					
	733.5													
5			brown SANDY CLAY very stiff	X SS 2	89	3-3-4 (7)	2.0		23.8					
	731.0													
			brown POORLY GRADED SAND with gravel very loose to medium dense	X SS 3	100	4-3-3 (6)			5.4					
10				X SS 4	78	1-1-2 (3)			3.1					
				X SS 5	78	1-1-1 (2)			3.4					
15				X SS 6	56	7-8-9 (17)			7.8					
				X SS 7	78	5-6-10 (16)			3.8					
20				X SS 8	78	6-8-12 (20)			3.1					
	714.0													
			brown SILT medium dense, wet	X SS 9	89	5-8-9 (17)			22.6					
25	712.0													

Bottom of borehole at 25.0 feet.

COMPLETION DEPTH 25 ft GROUND ELEVATION 737 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 23.50 ft / Elev 713.50 ft
▼ AT END OF DRILLING 23.50 ft / Elev 713.50 ft
AFTER DRILLING --- Borehole closed

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

**BORING NO. B-7**

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/11/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	738.0		12" TOPSOIL											
			dark brown SAND and GRAVEL (FILL) loose to medium dense	X SS 1	89	3-4-4 (8)			10.6					
5				X SS 2	56	4-6-7 (13)			8.1					
	733.0													
			brown SANDY GRAVEL (FILL) loose	X SS 3	33	3-2-2 (4)			5.2					
	730.5													
10			dark brown SAND and GRAVEL (FILL) with topsoil loose	X SS 4	33	2-2-2 (4)			14.6					
	728.0													
			brown POORLY GRADED SAND with gravel medium dense	X SS 5	100	8-10-10 (20)			2.9					
15				X SS 6	100	6-8-12 (20)			3.1					
				X SS 7	100	6-7-10 (17)			4.1					
20				X SS 8	100	4-8-9 (17)			4.4					
	716.0													
25	714.0		brown SILTY SAND medium dense, moist	X SS 9	100	4-5-5 (10)			17.4					

Bottom of borehole at 25.0 feet.

COMPLETION DEPTH 25 ft GROUND ELEVATION 739 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
AT TIME OF DRILLING --- None
AT END OF DRILLING --- Dry upon completion
AFTER DRILLING --- None

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.



CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/11/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	732.0		12" TOPSOIL											
			brown POORLY GRADED SAND with gravel medium dense	X SS 1	67	5-9-12 (21)			7.7					
5				X SS 2	67	5-6-6 (12)			3.5					
				X SS 3	89	4-5-5 (10)			4.1					
10				X SS 4	89	3-4-6 (10)			3.1					
				X SS 5	89	4-7-8 (15)			3.4					
15				X SS 6	89	3-5-6 (11)			5.8					
	717.0		brown SANDY SILT medium dense, moist	X SS 7	89	4-9-10 (19)			20.6					
	714.5		brown SILT loose, moist	X SS 8	89	3-3-4 (7)			21.1					
20														
	710.0		brown SANDY SILT medium dense, wet	X SS 9	100	5-8-8 (16)			19.0					
25	708.0													

Bottom of borehole at 25.0 feet.

COMPLETION DEPTH 25 ft GROUND ELEVATION 733 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 17.00 ft / Elev 716.00 ft
▼ AT END OF DRILLING 17.00 ft / Elev 716.00 ft
AFTER DRILLING --- Borehole closed

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

**BORING NO. B-9**

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/11/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0.0														
	734.8		3" ASPHALT											
			9" AGGREGATE BASE											
	734.0													
			black and dark brown SANDY CLAY (FILL) stiff	SS 1	89	3-3-3 (6)	1.25		15.3					
2.5														
	731.5													
			brown POORLY GRADED SAND with gravel loose	SS 2	89	2-2-2 (4)			4.6					
5.0	730.0													

Bottom of borehole at 5.0 feet.

COMPLETION DEPTH 5 ft GROUND ELEVATION 735 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
AT TIME OF DRILLING --- None
AT END OF DRILLING --- Dry upon completion
AFTER DRILLING --- None

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - OZ STD DATA TEMPLATE.GDT - 5/18/23 15:10 - K:\GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFORD



BORING NO. B-10

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 5/9/23 LOGGED BY TZ/NW DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0.0			12" TOPSOIL											
	738.0													
			brown CLAYEY SAND loose	SS 1	78	2-2-3 (5)			11.2					
2.5														
	735.5													
			brown POORLY GRADED SAND with gravel loose	SS 2	89	3-3-6 (9)			12.8					
5.0	734.0													

Bottom of borehole at 5.0 feet.

COMPLETION DEPTH 5 ft GROUND ELEVATION 739 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
AT TIME OF DRILLING --- None
AT END OF DRILLING --- Dry upon completion
AFTER DRILLING --- None

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - GPS STD DATA TEMPLATE.GDT - 2/25/25 15:51 - K12 GEOTECHNICAL2023123-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, ILLDRILLER AND LAB23-G0529 WELL NO 45, ROCKFORD



BORING NO. 25-B16

PAGE 1 OF 1

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 2/12/25 LOGGED BY MW/RK DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	732.7		4" TOPSOIL black and brown SANDY CLAY (FILL) very stiff	SS 1	33	4-4-5 (9)	3.25		22.7					
				SS 2	22	3-4-4 (8)	3.25		20.8					
5														
	727.0													
			brown POORLY GRADED SAND trace gravel loose to medium dense	SS 3	22	3-4-4 (8)			15.6					
				SS 4	33	4-6-8 (14)			5.1					
10				SS 5	44	6-6-8 (14)			4.2					
				SS 6	44	9-8-8 (16)			4.0					
15	718.0													

Bottom of borehole at 15.0 feet.

COMPLETION DEPTH 15 ft GROUND ELEVATION 733 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
AT TIME OF DRILLING --- None
AT END OF DRILLING --- Dry upon completion
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - GPS STD DATA TEMPLATE.GDT - 2/25/25 15:51 - K:\2 GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFORD



BORING NO. 25-B2

PAGE 1 OF 2

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 2/11/25 LOGGED BY MW/RK DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	733.8		3" ASPHALT											
	733.0		9" AGGREGATE BASE											
			brown SANDY CLAY soft to stiff	X SS 1	22	9-16-10 (26)	0.75		13.3					
5				X SS 2	67	2-2-2 (4)	0.25	0.4	17.0					
				X SS 3	44	2-1-2 (3)	0.5		16.5					
10				X SS 4	78	1-1-2 (3)	0.5	0.6	17.1					
				X SS 5	67	2-3-4 (7)	1.0	1.0	19.2					
15	721.0		brown POORLY GRADED SAND trace gravel very loose to medium dense	X SS 6	44	3-5-5 (10)			8.6					
			▼ wet at 18 ft	X SS 7	56	2-2-2 (4)			23.0					
25				X SS 8	78	6-10-5 (15)			23.2					
				X SS 9	56	3-3-4 (7)			22.1					
30	705.5		gray SILT medium dense, wet											

COMPLETION DEPTH 58.92 ft GROUND ELEVATION 734 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 18.00 ft / Elev 716.00 ft
▼ AT END OF DRILLING 18.00 ft / Elev 716.00 ft
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - GPS STD DATA TEMPLATE.GDT - 2/25/25 15:51 - K:\2 GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFORD

**BORING NO. 25-B2**

PAGE 2 OF 2

CLIENT City of Rockford **PROJECT NAME** Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 **PROJECT LOCATION** 1141 Stanley St, Rockford, IL
DATE COMPLETED 2/11/25 **LOGGED BY** MW/RK **DRILLING METHOD** 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
30			gray SILT medium dense, wet (<i>continued</i>)											
	700.5													
35			gray SANDY CLAY stiff	X SS 10	33	7-13-12 (25)	1.5		9.4					
	695.5													
40			gray SILTY CLAY with sand very stiff	X SS 11	83	19-21-19 (40)	2.0		15.3					
45				X SS 12	94	22-19-19 (38)	2.0		15.6					
	685.5													
50			brown POORLY GRADED SAND very dense, wet	X SS 13	63	16-26- 50/4"			11.1					
55				X SS 14	67	18-28-33 (61)			15.0					
	675.5													
	675.1		WEATHERED LIMESTONE	X SS 15	0	50/5"								
Refusal at 58.9 feet. Bottom of borehole at 58.9 feet.														

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - GPS STD DATA TEMPLATE.GDT - 2/25/25 15:51 - K:\2 GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFORD



BORING NO. 25-B3

PAGE 1 OF 2

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 2/12/25 LOGGED BY MW/RK DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	732.8		3" ASPHALT											
	732.0		9" AGGREGATE BASE											
			dark brown and brown CLAY (FILL) medium stiff	X SS 1	56	5-5-5 (10)	1.0	0.9	10.3					
5			brown CLAYEY SAND very loose	X SS 2	33	2-2-1 (3)			7.6					
	727.0													
			brown with black SANDY CLAY soft, moist	X SS 3	44	1-1-1 (2)	0.25		21.6					
	724.5													
10			brown POORLY GRADED SAND medium dense to dense	X SS 4	44	3-3-9 (12)			6.6					
				X SS 5	44	10-15-21 (36)			3.1					
				X SS 6	44	17-17-12 (29)			10.9					
15				X SS 7	44	7-8-9 (17)			2.6					
				X SS 8	44	5-7-6 (13)			32.2					
20														
	712.0													
			brown and gray SILT loose to medium dense, moist to wet	X SS 9	78	4-5-10 (15)			22.7					
				X SS 10	72	7-10-4 (14)			22.5					
25				X SS 11	83	2-2-2 (4)			22.7					
	705.0													
			gray SILT loose, wet	X SS 12	78	2-2-7 (9)			23.4					
30														

COMPLETION DEPTH 58.58 ft GROUND ELEVATION 733 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 18.00 ft / Elev 715.00 ft
▼ AT END OF DRILLING 18.00 ft / Elev 715.00 ft
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - GPS STD DATA TEMPLATE.GDT - 2/25/25 15:51 - K12 GEOTECHNICAL2023123-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, ILLDRILLER AND LAB23-G0529 WELL NO 45, ROCKFORD



BORING NO. 25-B3

PAGE 2 OF 2

CLIENT City of Rockford

PROJECT NAME Well No. 45 Site Improvements

PROJECT NUMBER 23-G0529

PROJECT LOCATION 1141 Stanley St, Rockford, IL

DATE COMPLETED 2/12/25

LOGGED BY MW/RK

DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
30														
	702.0													
			gray SANDY CLAY medium stiff, moist	X SS 13	78	4-6-7 (13)	0.5		14.9					
	699.5													
35			gray SILTY CLAY stiff to hard	X SS 14	89	3-5-9 (14)	2.0	2.2	20.5					
				X SS 15	89	3-3-4 (7)	1.0		22.3					
				X SS 16	44	3-3-5 (8)	1.0	1.1	20.4					
40				X SS 17	89	5-5-3 (8)	1.75		21.7					
				X SS 18	89	4-3-8 (11)	2.0		23.5					
45				X SS 19	78	2-4-6 (10)	2.25	2.4	14.4					
				X SS 20	89	5-3-4 (7)	2.0	1.8	19.6					
50				X SS 21	78	3-7-7 (14)	2.0	2.1	18.7					
				X SS 22	89	8-15-30 (45)	4.0	4.0	21.7					
55														
	677.0													
			WEATHERED LIMESTONE	SS 23	100	50/3"			15.0					
	674.4													
			Refusal at 58.6 feet. Bottom of borehole at 58.6 feet.	SS 24	0	50/1"								

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - GPS STD DATA TEMPLATE.GDT - 2/25/25 15:51 - K:\2 GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFORD



BORING NO. 25-B5

PAGE 1 OF 2

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
DATE COMPLETED 2/12/25 LOGGED BY MW/RK DRILLING METHOD 3.25 in. HSA

DEPTH (ft.)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
0														
	735.8		3" ASPHALT											
	735.0		9" AGGREGATE BASE											
			brown SANDY CLAY stiff	X SS 1	33	9-7-2 (9)	1.5		13.1					
5				X SS 2	44	2-2-3 (5)	1.75	1.8	21.4					
	730.0		brown POORLY GRADED SAND trace gravel very loose to medium dense	X SS 3	33	1-1-1 (2)			7.3					
10				X SS 4	33	1-1-1 (2)			5.2					
				X SS 5	44	2-2-2 (4)			13.4					
15				X SS 6	44	3-7-6 (13)			3.5					
20				X SS 7	22	6-7-8 (15)			3.3					
25			▼ wet at 24 ft	X SS 8	44	2-3-5 (8)			18.4					
	707.5		gray SILT medium dense, wet	X SS 9	56	4-6-7 (13)			26.0					
30														

COMPLETION DEPTH 60 ft GROUND ELEVATION 736 ft
CAVE DEPTH ft BACKFILL Soil Cuttings
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 24.00 ft / Elev 712.00 ft
▼ AT END OF DRILLING 24.00 ft / Elev 712.00 ft
AFTER DRILLING ---

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

GPS STANDARD GEOTECH LOG - GPS STD DATA TEMPLATE.GDT - 2/25/25 15:51 - K:\2 GEOTECHNICAL\2023\23-G0529 GEO WELL NO. 45 RESERVOIR REPLACEMENT AND SITE MODIFICATIONS, ROCKFORD, IL\DRILLER AND LAB\23-G0529 WELL NO 45, ROCKFORD, IL



BORING NO. 25-B5

PAGE 2 OF 2

CLIENT City of Rockford PROJECT NAME Well No. 45 Site Improvements
 PROJECT NUMBER 23-G0529 PROJECT LOCATION 1141 Stanley St, Rockford, IL
 DATE COMPLETED 2/12/25 LOGGED BY MW/RK DRILLING METHOD 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS		
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
30			gray SILT medium dense, wet (continued)											
	702.5													
35			gray SILTY CLAY stiff to very stiff	X SS 10	17	6-8-8 (16)	1.25		20.5					
40				X SS 11	89	6-6-10 (16)	2.25		18.0					
45				X SS 12	44	4-10-12 (22)	2.0		21.4					
50	687.5		gray POORLY GRADED SAND trace gravel medium dense to dense, wet	X SS 13	44	8-16-24 (40)			12.5					
55				X SS 14	22	4-5-15 (20)			13.1					
60	677.5 676.0		gray SILTY CLAY hard	X SS 15	78	6-7-12 (19)	4.5+	5.2	20.0					

Bottom of borehole at 60.0 feet.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.



ALTERNATIVE 1 SITE LAYOUT

**WATER UTILITY CEDAR STREET SITE
CITY OF ROCKFORD
WINNEBAGO COUNTY, ILLINOIS**



FIGURE 5.02-1
1110029



GENERAL NOTES

CLIENT City of Rockford

PROJECT NAME Well No. 45 Site Improvements

PROJECT NUMBER 23-G0529

PROJECT LOCATION 1141 Stanley St, Rockford, IL

SAMPLE IDENTIFICATION

Visual soil classifications are made in general accordance with the United Soil Classification System (USCS) on the basis of textural and particle size categorization, and various soil behavior characteristics. Visual classifications should be substantiated by appropriate laboratory testing when a more exact soil identification is required to satisfy specific project applications criteria.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487-98)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	$C_u \geq 4$ AND $1 \leq C_c \leq 3$	GW	WELL-GRADED GRAVEL	
			$C_u \geq 4$ AND/OR $1 \geq C_c \geq 3$	GP	POORLY-GRADED GRAVEL	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	$C_u \geq 6$ AND $1 \leq C_c \leq 3$	SW	WELL-GRADED SAND	
			$C_u \geq 6$ AND/OR $1 \geq C_c \geq 3$	SP	POORLY-GRADED SAND	
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR MH	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY	
			PI>4 AND PLOTS<"A" LINE	ML	SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY	
			PI PLOTS <"A" LINE	MH	ELASTIC SILT	
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT	

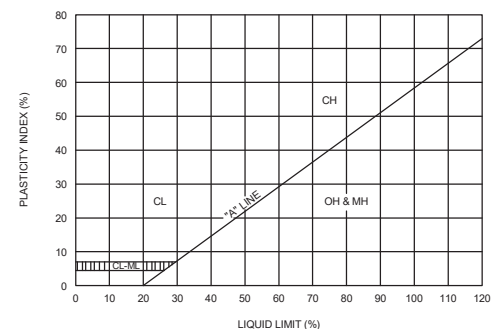
PROJECT LITHOLOGIC SYMBOLS (USCS)

	ASPHALT: Asphalt		CL-ML: USCS Low Plasticity Silty Clay		CLS: USCS Low Plasticity Sandy Clay
	FILL: Fill (made ground)		GPS: USCS Poorly-graded Sandy Gravel		GRAVEL FILL: Gravel Fill
	LIMESTONE: Limestone		ML: USCS Silt		MLS: USCS Sandy Silt
	SC: USCS Clayey Sand		SM: USCS Silty Sand		SP: USCS Poorly-graded Sand

PROJECT SAMPLE TYPES

	Rock Core (RC)
	Split Spoon (SS)

PLASTICITY CHART



SOIL RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

NON-COHESIVE SOILS		COHESIVE SOILS		
RELATIVE DENSITY	N-VALUE*	CONSISTENCY	N-VALUE*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 5	0.25 - 0.50
MEDIUM DENSE	10 - 30	MEDIUM STIFF	5 - 10	0.50 - 1.0
DENSE	30 - 50	STIFF	10 - 14	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	14 - 32	2.0 - 4.0
		HARD	OVER 32	OVER 4.0

* N-VALUE: NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

ABBREVIATIONS

SS	- SPLIT-SPOON SAMPLE	LL	- LIQUID LIMIT (%)
ST	- SHELBY TUBE SAMPLE	PL	- PLASTIC LIMIT (%)
AU	- AUGER SAMPLE	PI	- PLASTIC INDEX (%)
MC	- MOISTURE CONTENT (%)	NP	- NON PLASTIC
-200	- PERCENT PASSING NO. 200 SIEVE	DD	- DRY DENSITY (PCF)
Qp	- POCKET PENETROMETER (TSF)	DCP	- DYNAMIC CONE PENETROMETER
Qu	- UNCONFINED STRENGTH (TSF)	IBV	- IMMEDIATE BEARING VALUE



23-G0529 Well No. 45 Site Improvements

1141 Stanley St, Rockford, IL 61102, USA

Latitude, Longitude: 42.2706589, -89.108195



Date	5/29/2023, 10:24:09 AM
Design Code Reference Document	IBC-2015
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	0.12	MCE_R ground motion. (for 0.2 second period)
S_1	0.057	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.193	Site-modified spectral acceleration value
S_{M1}	0.136	Site-modified spectral acceleration value
S_{DS}	0.128	Numeric seismic design value at 0.2 second SA
S_{D1}	0.091	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.061	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.097	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
S_{sRT}	0.12	Probabilistic risk-targeted ground motion. (0.2 second)
S_{sUH}	0.133	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
S_{sD}	1.5	Factored deterministic acceleration value. (0.2 second)
S_{1RT}	0.057	Probabilistic risk-targeted ground motion. (1.0 second)
S_{1UH}	0.066	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S_{1D}	0.6	Factored deterministic acceleration value. (1.0 second)
$PGAd$	0.6	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.061	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration

Type	Value	Description
C_{RS}	0.906	Mapped value of the risk coefficient at short periods
C_{R1}	0.868	Mapped value of the risk coefficient at a period of 1 s
C_V		Vertical coefficient

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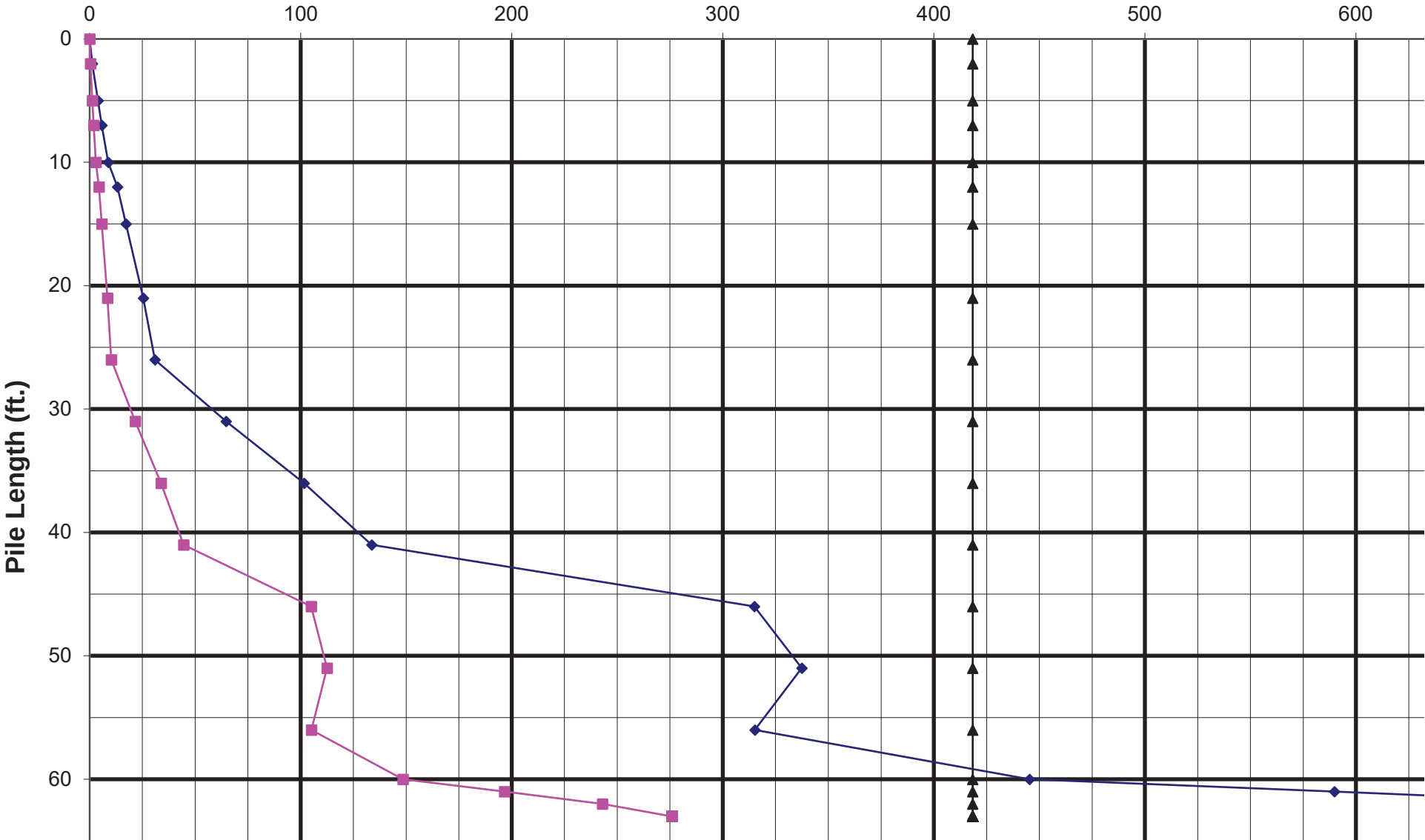
APPENDIX II

Pile Bearing vs. Estimated Length

HP 12x53 Pile

Bearing Resistance (kips)

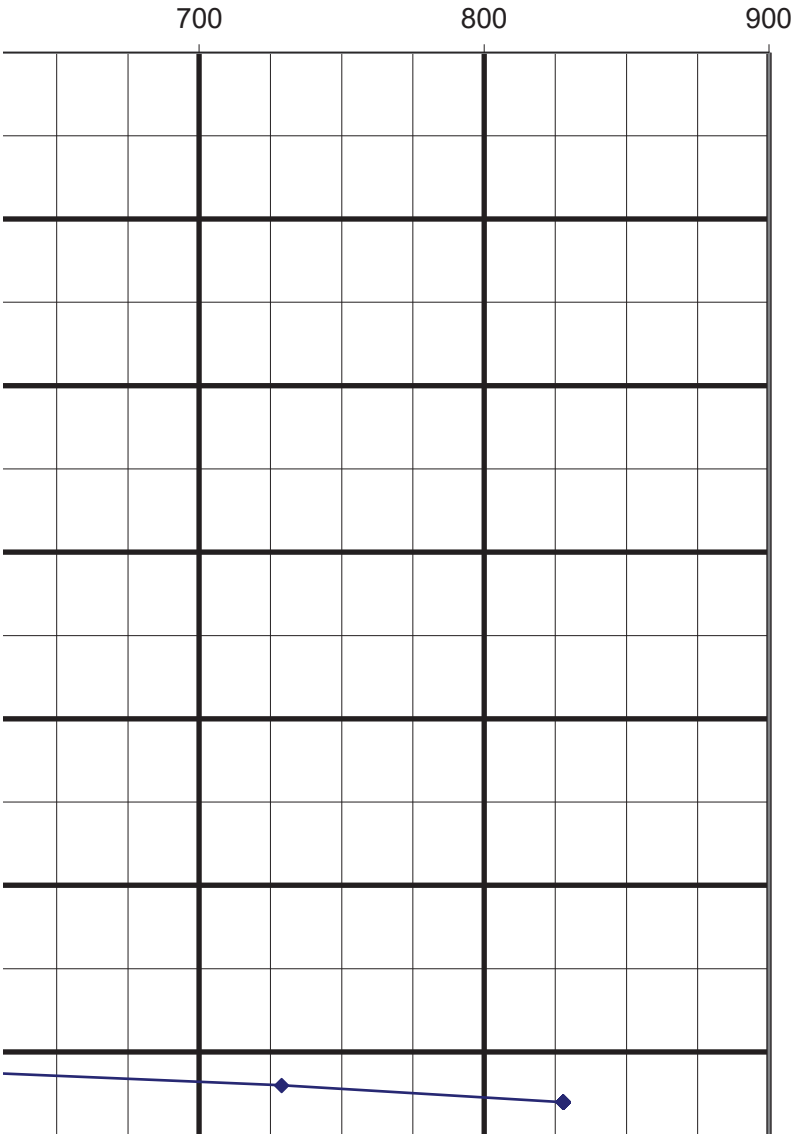
—◆— NOMINAL REQ'D BEARING —■—



70



— ALLOW. RESISTANCE AVAILABLE —▲— Maximum Bearing For Steel HP 12 X 53 Pile



ASBESTOS SAMPLING

10/25/24

City of Rockford
425 E State St
Rockford, IL 61104

Re: **Asbestos Sampling 1111 Cedar St.**

Dear City of Rockford,

On October 11, 2024, CMM Environmental conducted limited asbestos sampling at the above referenced location. During the inspection it was noted that the building may contain mercury switches (1), light fixtures containing ballast (166) and other contents (lab chemicals, maintenance chemicals, etc) that may be deemed hazardous materials throughout the building.

CMM's sampling of suspect asbestos containing materials were limited to the following:

- Pipe Wrap
- Ceiling Tile
- Plaster
- Caulk
- Baseboard Mastic
- HVAC Wrap
- Window Glazing
- HVAC Sealant
- Vibration Dampener
- Floor Tile
- Drywall

The sampling of suspect materials was limited to amounts determined to be efficient to identify their asbestos content.

Table 1 – Asbestos Containing Materials

Material Description	Material Location	Asbestos Type	Material Condition	Quantity
Metal Fire Door	Throughout	Assumed	Good	TBD
Pipe Wrap	Janitor Closet in Locker Room – Water Lab Side	10% Chrysotile	Good	15 lf observed (most likely there will be additional pipe wrap above drop ceiling throughout facility)

- All quantities are estimated and any contractor should field verify quantities prior to bidding on this work.

77 Illinois Administrative Code Chapter I Section 855.345 references sampling Miscellaneous Materials "...in a manner sufficient to determine whether material is asbestos containing materials (ACM) or not asbestos containing materials." CMM has determined this to be interpreted as the generally accepted industry standard protocol of "three (3) samples to make a negative result for asbestos and one (1) sample to make a positive result for asbestos," however sampling protocols are sometimes varied due to the limited amounts of suspect materials present.

A group letter or combination of letter and number was assigned to each Homogenous Material. This combination serves as a prefix to identify materials of similar composition, texture, color, and date of installation. Each sample was then assigned a sample number such as 01, 02, 03, etc.

All samples were identified on a signed and dated Chain-of-Custody document, which accompanied the samples to the laboratory.

To ensure both quality and objectivity, an independent laboratory was used. Laboratories are selected based on their current accreditations. The laboratory chosen participates in the National Voluntary Laboratory Accreditation Program (NVLAP) for quality control procedures (NVLAP Lab Code: 200399-0). As specified in 40 CFR Chapter I (1-1-87 edition) Part 763, Subpart F, Appendix A. Please feel free to contact the laboratory directly with any questions.

Suspected asbestos samples were analyzed using polarized light microscopy (PLM) / dispersion staining techniques in accordance with the EPA Method documents "US EPA 600/M4-82-020, 1982" & "US EPA 600/R-93/118, 1993". Detection limits for this type of analysis are approximately one percent (by volume).

FRIABLE ASBESTOS – material can be crumbled, pulverized, or reduced to powder by hand pressure; these materials must be removed prior to demolition activities and should be addressed during renovation activities that would disturb the material, such as thermal system insulation. The following friable asbestos containing materials were identified:

- Pipe Wrap

CATEGORY 1 NON-FRIABLE – material is pliable (not brittle), breaks by tearing rather than fracturing and does not easily release asbestos fibers upon breaking; these materials should be addressed during renovation activities that would disturb the material, but do not need removal prior to demolition activities (handled as demolition material at a certified landfill) if they are in good condition and not rendered friable during handling, transporting, and disposal. However, most asbestos containing building materials on concrete substrate are removed prior to demolition activities to reduce the overall cost due to landfill charges and the fact that concrete cannot be left on site or recycled with these materials in place. Category I Non-Friable materials include resilient floor coverings, asphalt roofing materials, gaskets, and packing. The following types of Category I Non-Friable asbestos were identified:

- None

CATEGORY II NON-FRIABLE – material is not pliable, breaks by fracturing rather than tearing, and does release some asbestos fibers upon breaking; these materials should be addressed during renovation activities that would disturb the material and are removed prior to demolition activities since they are normally rendered friable during demolition and/or handling, transporting and disposal. Category II Non-Friable materials include any non-friable asbestos containing material that is not in Category I (i.e. transite siding). The following types of Category II Non-Friable asbestos were identified:

- Metal Fire Doors throughout (assumed asbestos content)

NON ASBESTOS CONTAINING MATERIALS – The following materials were tested and found to contain *no* asbestos (or less than 1%):

- Ceiling Tile
- Plaster
- Caulk
- Baseboard Mastic
- HVAC Wrap
- Window Glazing
- HVAC Sealant
- Vibration Dampener
- Floor Tile
- Drywall

Recommendations / Directions / Instructions

If a material is analyzed, by any method, and is found to contain any amount of asbestos, personnel disturbing the material should at a minimum, wear personnel protection such as NIOSH approved respirators and full body protective clothing. It is further recommended that the building and its occupants be protected against the possible exposure of airborne asbestos fibers.

If the asbestos content is less than 10 percent as determined by a method other than point counting by polarized light microscopy (PLM), verify the asbestos content by point counting using PLM (USEPA Method 198.1). The owner/operator of the building may (1) elect to assume the amount to be greater than 1% and treat the material as asbestos-containing material or (2) require verification of the amount by point counting. If a result obtained by point count is different from a result obtained by visual estimation, the point count result shall be used. Point counting shall be conducted only by direction of the client at the client's expense. The client assumes and retains all responsibility and authority to conduct point counting at their expense.

Contractors should use caution and be advised and directed that during renovation or demolition of a structure that concealed materials may be discovered, therefore, should suspect materials not identified in this inspection become exposed or made aware, you should cease operations that may disturb, dislodge or disrupt the material until it is sampled and analyzed for its possible asbestos content.

Samples were collected at the request of our client in a manner that should identify suspect areas as being asbestos containing or not, however, sample collection strategies may not satisfy the appropriate structure's governing agency's rules or policies. The results in this report are intended for the sole use of our client for their personnel's safety and should not be considered as an asbestos inspection. Should the client intend to submit these sampling results to the structure's governing agency, then CMM will need to extend our services to include compliance with the governing agency's policies / rules at an additional expense.

CMM Environmental recommends the use of certified and licensed asbestos personnel for **all** planned disturbance of known and suspect asbestos containing products. In accordance with IDPH, IEPA, U.S.EPA and OSHA regulations asbestos containing materials must be removed by and disposed of by a certified/licensed asbestos abatement personnel/contractor.

Definitions

Asbestos Containing Products means, according to the U.S. EPA Method 600/R-93/116, Regulated Asbestos Containing Materials (RACM) are those materials found to contain greater than 1% asbestos per volume of bulk material sampled, by PLM. The term is not intended to include *de minimis* or inaccessible materials that do not present a risk of harm to public health and that generally would not be the subject of enforcement actions if brought to the attentions of appropriated regulatory agencies.

Asbestos Types are Chrysotile (white asbestos making up approximately 95% of all asbestos used in the United States), Amosite (brown asbestos making up approximately 5% of all asbestos used in the United States), Crocidolite (blue asbestos making up approximately less than 5% of all asbestos used in the United States), and rarely found in buildings are Anthophyllite, Tremolite & Actinolite.

Friable Asbestos Material means any material containing more than 1 percent asbestos as determined using the method specified in appendix E, subpart E, 40 CFR part 763 section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Homogeneous Material -- an area or group of Surfacing Materials, Thermal Systems Insulation, or Miscellaneous Materials that is uniform in color & texture and has the same installation date.

Polarized Light Microscopy (PLM) means an optical microscopy technique for analyzing bulk samples for asbestos in which the sample is illuminated with polarized light (light which vibrates in only one plane) to distinguish between different types of asbestos fibers by their shape and unique optical properties.

Transmission Electron Microscopy (TEM) means a method of microscopic analysis, which utilizes an electron beam that is focused onto a thin sample. As the beam penetrates (transmits) through the sample, the difference densities produces an image on a fluorescent screen from which samples can be identified and counted. Also used for analyzing air samples for asbestos.

Conclusion

The conclusions of this report are CMM's professional opinions, based solely upon visual site observations and interpretations of laboratory analyses, as described in this report. The opinions presented herein apply to the site conditions existing at the time of CMM's investigation and interpretation of current regulations pertaining to asbestos. Therefore, CMM's opinions and recommendations may not apply to future conditions that may exist at the site, which we have not had the opportunity to evaluate. It should be noted that conditions change and that materials constantly degrade. All applicable federal, state and local regulations should always be verified prior to any work that will disturb or dislodge materials confirmed, assumed or presumed to contain asbestos.

CMM's assessment was limited to observation, sampling and the analysis of suspect asbestos containing products in accessible portions of the area(s) covered by this survey. Materials in the building that are not considered building materials, are unusual or *de minimis*, or were inaccessible, due to common construction techniques, to the inspector were excluded from the inspection. As a result, additional asbestos containing building materials may be present in inaccessible areas (e.g. between walls, ceiling spaces enclosed by wallboard, interior of fire doors, below grade exterior piping and sealants, etc.) of the structure that were not observed during the survey.

This inspection report is designed to assist the client in the understanding of the regulations regarding asbestos, however, it should not be used as a substitution for obtaining and familiarizing yourself with, including the compliance of, all asbestos related regulations including, but not limited to, 40 CFR, Chapter 61, Subpart M (National Emission Standard for Asbestos) prior to the start of any renovation or demolition activity that will disturb or dislodge asbestos containing materials or suspect/assumed asbestos containing materials.

This report has been prepared for the exclusive use of the intended client, for the specific application to the defined property as addressed in this report. Any additional user of this report shall determine the suitability of the material contained herein for their intended use, and any such user assumes all risks and liability in connection therewith. No claim is made that these findings will remain applicable to future site activities and conditions. Interpretations by any such user from information contained in this report or the drawing of conclusions by any such user from information contained in this report shall be undertaken solely at the risk of said party.

At all times during the performance of the inspection, safety was a priority. Due to the emphasis on safety, there were no injuries, there was no building contamination, and there were no asbestos exposures to either CMM personnel or building occupants.

This report remains the sole property of CMM. The contents herein cannot be copied, scanned, duplicated, disclosed or distributed in whole or in part until complete and full payment has been received, or arraigned, for the complete services rendered, expenses incurred and/or, all legal, collection, and judgment fees afforded to CMM. either by contractual agreement or satisfactory judgments.

CMM. would like to thank you for the opportunity to be of service to you on this project. We hope that our performance has warranted the opportunity to work with you on future projects.

I hereby certify that all documents and work products prepared hereunder comply with all applicable laws and regulations, including, but not limited to, 105 ILCS 105, 225 ILCS 207 and 77 Ill. Adm. Code 855."

Signed,

A handwritten signature in dark ink, appearing to read 'Chris Manuel', with a stylized, flowing script.

Chris Manuel
President
Inspector # 100-20143

Appendix A (Lab Report)

**EMSL Analytical, Inc.**

4140 Lift Drive Hillside, IL 80182

Tel/Fax: (773) 313-0099 / (773) 313-0139

<http://www.EMSL.com> / chicagolab@emsl.com

EMSL Order: 262409787

Customer ID: CMMMA75

Customer PO:

Project ID: City of Rockford

Attention: Chris Manuel
CMM Environmental
415 N 3rd St
Rockford, IL 61107

Phone: (815) 218-3784

Fax:

Received Date: 10/21/2024 12:10 PM

Analysis Date: 10/23/2024

Collected Date: 10/11/2024

Project: 1111 CEDAR (City of Rockford)

**Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E
Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy**

Sample	Description	Appearance	Non-Asbestos		Asbestos % Type
			% Fibrous	% Non-Fibrous	
001 262409787-0001	HVAC SEALANT-LOFT	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
002 262409787-0002	HVAC SEALANT-LOFT	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
003 262409787-0003	HVAC SEALANT-LOFT	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
004 262409787-0004	WG-METAL WINDOWS-GARAGE E SIDE	Gray/Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
005 262409787-0005	WG-METAL WINDOWS-GARAGE E SIDE	Gray/Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
006 262409787-0006	WG-METAL WINDOWS-GARAGE E SIDE	Gray/Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
007 262409787-0007	HVAC WRAP-GARAGE	Beige Fibrous Homogeneous	98% Glass	2% Non-fibrous (Other)	None Detected
008 262409787-0008	HVAC WRAP-GARAGE	Beige Fibrous Homogeneous	98% Glass	2% Non-fibrous (Other)	None Detected
009 262409787-0009	HVAC WRAP-GARAGE	Beige Fibrous Homogeneous	98% Glass	2% Non-fibrous (Other)	None Detected
010 262409787-0010	DW-KITCHEN CLOSET FIELD SIDE	Brown/White Non-Fibrous Homogeneous	10% Cellulose 2% Glass	88% Non-fibrous (Other)	None Detected
011 262409787-0011	DW-KITCHEN CLOSET FIELD SIDE	Brown/White Non-Fibrous Homogeneous	10% Cellulose 2% Glass	88% Non-fibrous (Other)	None Detected
012 262409787-0012	DW-KITCHEN CLOSET FIELD SIDE	Brown/White Non-Fibrous Homogeneous	10% Cellulose 2% Glass	88% Non-fibrous (Other)	None Detected
013 262409787-0013	CT-WATER LAB	Brown/White Non-Fibrous Homogeneous	10% Cellulose 2% Glass	88% Non-fibrous (Other)	None Detected
014 262409787-0014	CT-WATER LAB	Brown/White Non-Fibrous Homogeneous	10% Cellulose 2% Glass	88% Non-fibrous (Other)	None Detected
015 262409787-0015	CT-WATER LAB	Brown/White Non-Fibrous Homogeneous	10% Cellulose 2% Glass	88% Non-fibrous (Other)	None Detected
016 262409787-0016	CAULK-KITCHEN WATER LAB	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 10/23/2024 16:08:35

**EMSL Analytical, Inc.**

4140 Litt Drive Hillside, IL 60182

Tel/Fax: (773) 313-0099 / (773) 313-0139

<http://www.EMSL.com> / chicagoab@emsl.com

EMSL Order: 262409787

Customer ID: CMMMA75

Customer PO:

Project ID: City of Rockford

**Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E
Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy**

Sample	Description	Appearance	Non-Asbestos		Asbestos % Type
			% Fibrous	% Non-Fibrous	
017 262409787-0017	CAULK-KITCHEN WATER LAB	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
018 262409787-0018	CAULK-KITCHEN WATER LAB	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
019 262409707-0019	UD- GARAGE	Black Non-Fibrous Homogeneous	10% Synthetic	90% Non-fibrous (Other)	None Detected
020 262409787-0020	UD- GARAGE	Black Non-Fibrous Homogeneous	10% Synthetic	90% Non-fibrous (Other)	None Detected
021 262409707-0021	UD- GARAGE	Black Non-Fibrous Homogeneous	10% Synthetic	90% Non-fibrous (Other)	None Detected
022 262409787-0022	PW-JANITOR CLOSET LOCKER ROOM WATER LAB	Brown Fibrous Homogeneous	80% Cellulose	10% Non-fibrous (Other)	10% Chrysotile
023 262409707-0023	PW-JANITOR CLOSET LOCKER ROOM WATER LAB				Positive Stop (Not Analyzed)
024 262409787-0024	PW-JANITOR CLOSET LOCKER ROOM WATER LAB				Positive Stop (Not Analyzed)
025 262409707-0025	CT-JANITOR CLOSET LOCKER ROOM WATER LAB	Brown Fibrous Homogeneous	96% Cellulose	2% Non-fibrous (Other)	None Detected
026 262409787-0026	CT-JANITOR CLOSET LOCKER ROOM WATER LAB	Brown Fibrous Homogeneous	98% Cellulose	2% Non-fibrous (Other)	None Detected
027 262409707-0027	CT-JANITOR CLOSET LOCKER ROOM WATER LAB	Brown Fibrous Homogeneous	96% Cellulose	2% Non-fibrous (Other)	None Detected
028 262409707-0028	CT-CLOSET WATER LAB	Gray/White Fibrous Homogeneous	30% Cellulose 30% Min. Wool	30% Perlite 10% Non-fibrous (Other)	None Detected
029 262409787-0029	CT-CLOSET WATER LAB	Gray/White Fibrous Homogeneous	30% Cellulose 30% Min. Wool	30% Perlite 10% Non-fibrous (Other)	None Detected
030 262409707-0030	CT-CLOSET WATER LAB	Gray/White Fibrous Homogeneous	30% Cellulose 30% Min. Wool	30% Perlite 10% Non-fibrous (Other)	None Detected
031 262409787-0031	PLASTER-LOCKER ROOM CEILING WATER LAB	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
032 262409707-0032	PLASTER-LOCKER ROOM CEILING WATER LAB	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
033 262409787-0033	PLASTER-LOCKER ROOM CEILING WATER LAB	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
034 262409707-0034	BASEBOARD MASTIC KITCHEN WATER LAB	Beige Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
035 262409787-0035	BASEBOARD MASTIC KITCHEN WATER LAB	Beige Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 10/23/2024 16:08:35

**EMSL Analytical, Inc.**

4140 Litt Drive Hillside, IL 60182

Tel/Fax: (773) 313-0099 / (773) 313-0139

<http://www.EMSL.com> / chicagoab@emsl.com

EMSL Order: 262409787

Customer ID: CMMA75

Customer PO:

Project ID: City of Rockford

**Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E
Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy**

Sample	Description	Appearance	Non-Asbestos		Asbestos
			% Fibrous	% Non-Fibrous	% Type
036	BASEBOARD	Beige		100% Non-fibrous (Other)	None Detected
262409787-0036	MASTIC KITCHEN WATER LAB	Non-Fibrous Homogeneous			
037	CT BATH WATER LAB	Gray/White Fibrous Homogeneous	30% Cellulose 30% Min. Wool	30% Perlite 10% Non-fibrous (Other)	None Detected
262409787-0037					
038	CT BATH WATER LAB	Gray/White Fibrous Homogeneous	30% Cellulose 30% Min. Wool	30% Perlite 10% Non-fibrous (Other)	None Detected
262409787-0038					
039	CT BATH WATER LAB	Gray/White Fibrous Homogeneous	30% Cellulose 30% Min. Wool	30% Perlite 10% Non-fibrous (Other)	None Detected
262409787-0039					
040	FT-KITCHEN FIELD SIDE	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
262409787-0040					
041	FT-KITCHEN FIELD SIDE	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
262409787-0041					
042	FT-KITCHEN FIELD SIDE	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
262409787-0042					
043-Wrap	HVAC WRAP-CLOSET WATER LAB	Brown/Black Fibrous Homogeneous	60% Cellulose	40% Non-fibrous (Other)	None Detected
262409787-0043					
043-Insulation	HVAC WRAP-CLOSET WATER LAB	Gray Non-Fibrous Homogeneous	98% Glass	2% Non-fibrous (Other)	None Detected
262409787-0043A					
044-Wrap	HVAC WRAP-CLOSET WATER LAB	Brown/Black Fibrous Homogeneous	60% Cellulose	40% Non-fibrous (Other)	None Detected
262409787-0044					
044-Insulation	HVAC WRAP-CLOSET WATER LAB	Gray Fibrous Homogeneous	98% Glass	2% Non-fibrous (Other)	None Detected
262409787-0044A					
045-Wrap	HVAC WRAP-CLOSET WATER LAB	Brown/Black Fibrous Homogeneous	60% Cellulose	40% Non-fibrous (Other)	None Detected
262409787-0045					
045-Insulation	HVAC WRAP-CLOSET WATER LAB	Gray Fibrous Homogeneous	98% Glass	2% Non-fibrous (Other)	None Detected
262409787-0045A					

Analyst(s)

Mazen Elkhatib (31)

Shamya Pugh (16)

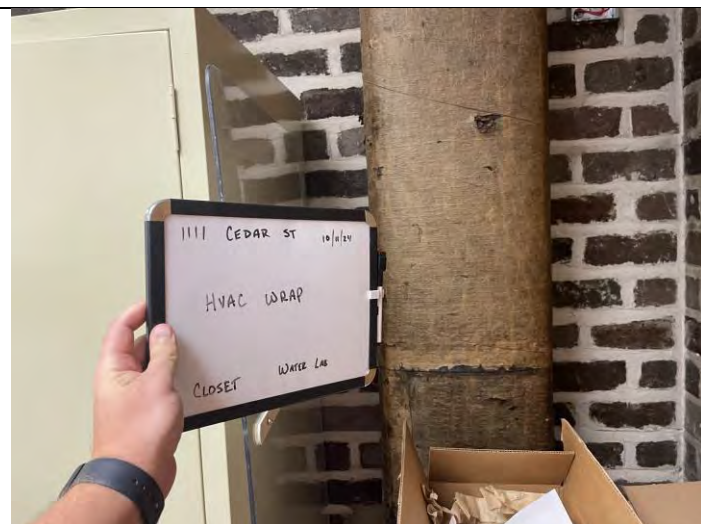
James Hahn, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and meet method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Hillside, IL NVLAP Lab Code 200369-0

Initial report from: 10/23/2024 16:08:36

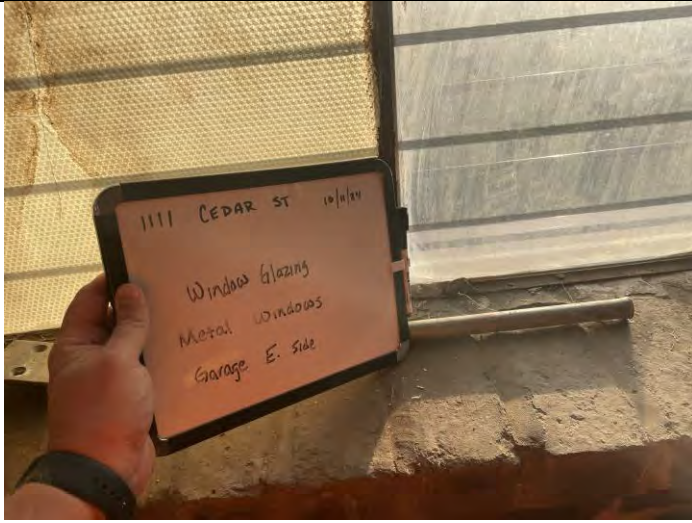
Appendix B (Pictures)



Date: 10/11/24
Location: Water Lab - Closet
Description: HVAC Wrap



Date: 10/11/24
Location: Water Lab
Description: Ceiling Tile



Date: 10/11/24

Location: Garage (East Side)

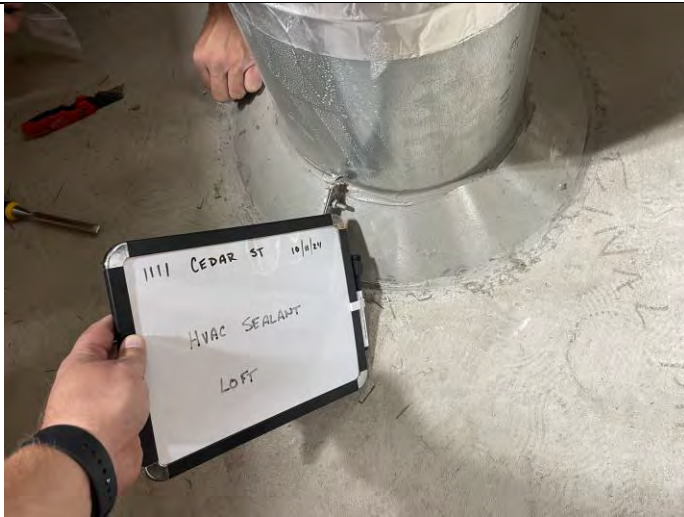
Description: Window Glazing on Metal Windows



Date: 10/11/24

Location: Garage

Description: Ceiling Tiles



Date: 10/11/24
Location: Loft in Garage
Description: HVAC Sealant



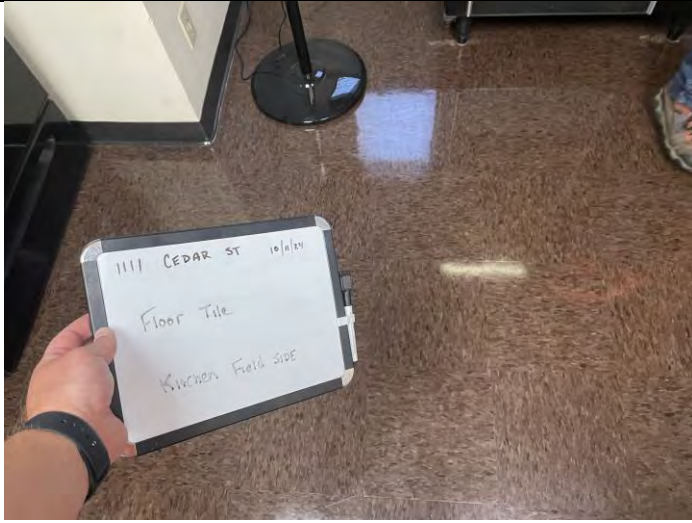
Date: 10/11/24
Location: Garage
Description: Vibration Dampener



Date: 10/11/24
Location: Garage
Description: HVAC Wrap



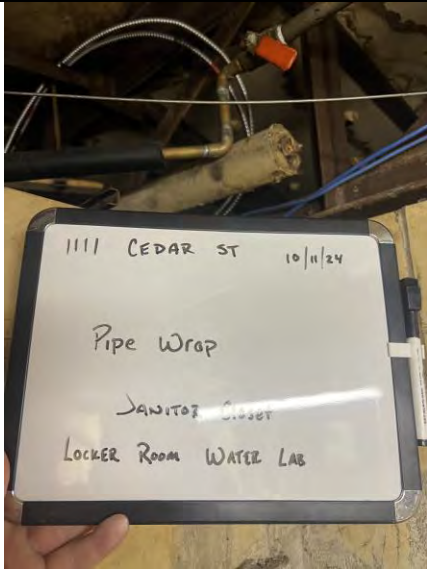
Date: 10/11/24
Location: Field Side
Description: Door to Garage



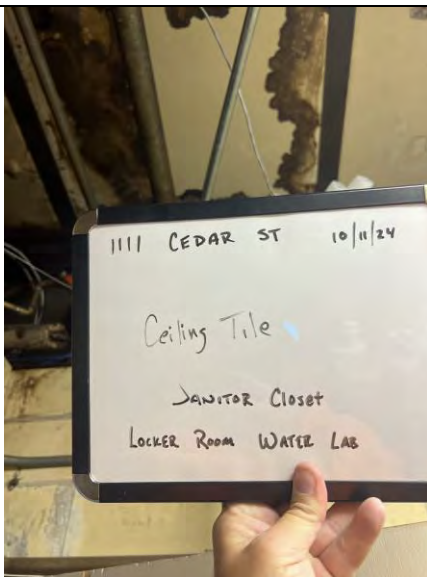
Date: 10/11/24
Location: Kitchen – Field Side
Description: Floor Tile



Date: 10/11/24
Location: Main Entry – Field Side
Description: Floor Tile



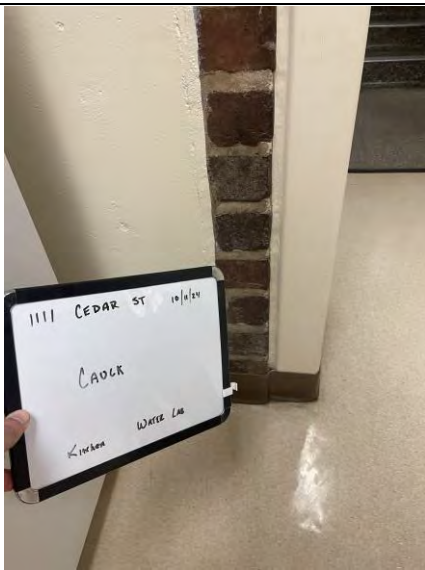
Date: 10/11/24
Location: Janitor Closet – Locker Room Water Lab
Description: Pipe Wrap



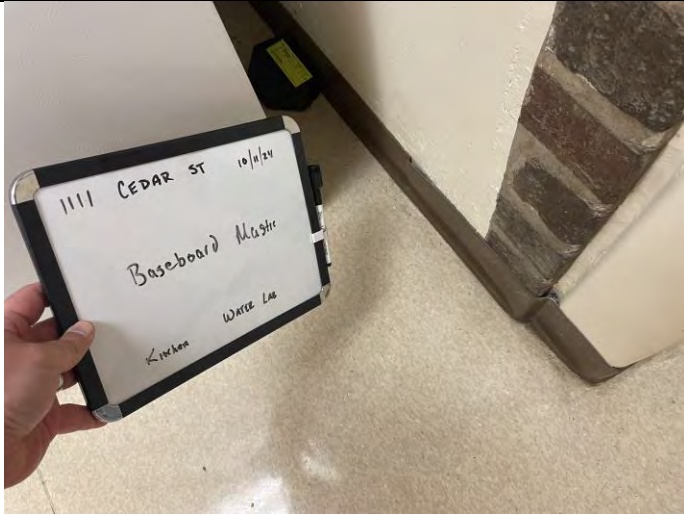
Date: 10/11/24
Location: Janitor Closet – Locker Room Water Lab
Description: Ceiling Tile



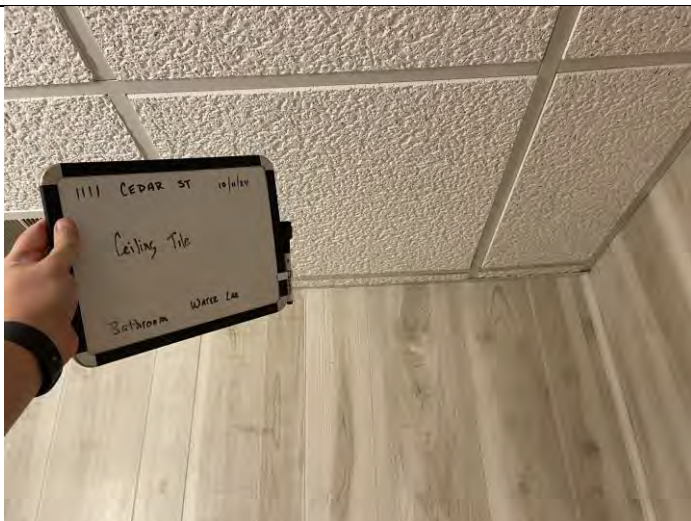
Date: 10/11/24
Location: Locker Room – Water Lab
Description: Plaster



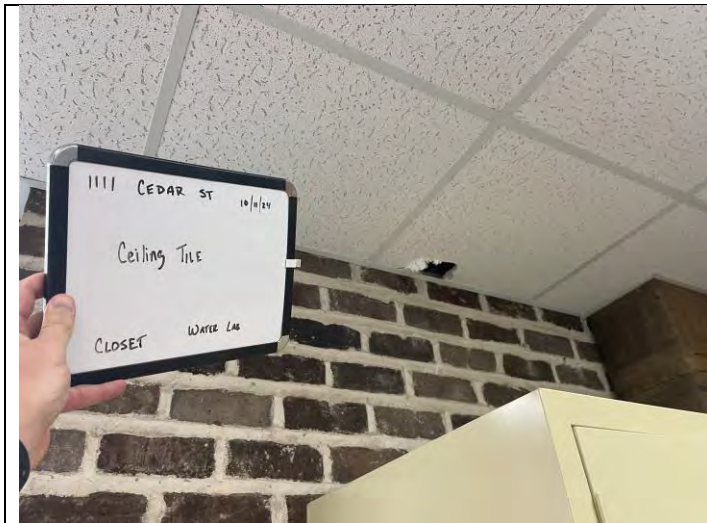
Date: 10/11/24
Location: Kitchen – Water Lab
Description: Caulk



Date: 10/11/24
Location: Kitchen – Water Lab
Description: Baseboard Mastic



Date: 10/11/24
Location: Bathroom – Water Lab
Description: Ceiling Tile



Date: 10/11/24
Location: Closet – Water Lab
Description: Ceiling Tile

Appendix C (Certifications)

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200399-0

EMSL Analytical Inc.
Hillside, IL

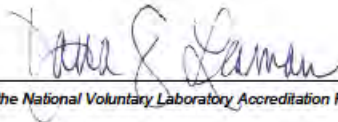
*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Asbestos Fiber Analysis

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2024-04-01 through 2025-03-31
Effective Dates




For the National Voluntary Laboratory Accreditation Program



**ASBESTOS
PROFESSIONAL
LICENSE**

ENDORSEMENTS

TC EXPIRES

INSPECTOR

1/12/2025

ID NUMBER

100 - 20143

ISSUED

3/15/2024

EXPIRES

05/15/2025

CHRISTOPHER M MANUEL

415 N 3RD STREET
ROCKFORD, IL 61107

Environmental Health



Alteration of this license shall result in legal action
This license issued under authority of the State of Illinois
Department of Public Health
This license is valid only when accompanied by a valid
training course certificate.



**ASBESTOS
PROFESSIONAL
LICENSE**

ENDORSEMENTS

TC EXPIRES

INSPECTOR

1/12/2025

ID NUMBER

100 - 20379

ISSUED

3/6/2024

EXPIRES

05/15/2025

ZACK W MCINTYRE

1615 WESTCHESTER DR
ROCKFORD, IL 61107

Environmental Health



Alteration of this license shall result in legal action
This license issued under authority of the State of Illinois
Department of Public Health
This license is valid only when accompanied by a valid
training course certificate.

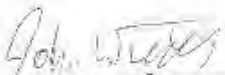


CERTIFICATION

This Certificate is given to

CMM ENVIRONMENTAL

*In recognition of being Certified as a Women Business Enterprise with the
City of Rockford*


John Wulich, Contract and Grant Compliance Officer


Thomas P. McNamara, Mayor of the City of Rockford

September 17, 2021

Expiration Date:

COMPREHENSIVE LEAD-BASED PAINT INSPECTION REPORT

COMPREHENSIVE LEAD-BASED PAINT INSPECTION REPORT



**1111 CEDAR STREET
ROCKFORD, ILLINOIS 61102**

Prepared For:



WATER DEPARTMENT

**1111 CEDAR STREET,
ROCKFORD, ILLINOIS 61102**

Inspector and Report Prepared By:



**200 PRAIRIE STREET, SUITE 203
ROCKFORD, ILLINOIS 61103**

James W. Sundberg

Illinois Department of Public Health Licensed Risk Assessment/Inspector 1743
Heuresis (Viken) XRF #2187

Signature *James W. Sundberg*

10/11/2024

Inspection and Report Date

Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102

INTRODUCTION

This is a Comprehensive Lead-Based Paint (LBP) Inspection Report of the Southwest HVAC room located at 1111 Cedar Street, Rockford, Illinois. This **WAS** a comprehensive inspection of the building. This inspection was conducted on October 11, 2024.

The building was built in late 1950-1960's. Painted, varnished, and shellacked throughout the exterior and interior rooms were inspected for lead based paint (LBP). This **WAS** a comprehensive LBP Inspection, as defined by the United States Department of Housing and Urban Development (HUD).

GOVERNING PROTOCOLS

Even though not applicable in this type of building, the protocol used for this inspection is based on the practices and procedures in the United States Department of Housing and Urban Development's (HUD) *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*, 2012 Revision (HUD Guidelines) including the 2012 Chapter 7 revisions, the United States Environmental Protection Agency's (USEPA) 40 CFR Part 745 (*Lead; Identification of Dangerous Levels of Lead; Final Rule; January 5, 2001*). HUD publishes the only known protocols for Lead Based Paint Inspections.

The HUD Guidelines and 40 CFR Part 745 set a regulatory level of 1.0 mg/cm² for lead in paint. This inspection was conducted using this level as the definition of Lead Based Paint (LBP). Any XRF result that is equal to or greater than 1.0 mg/cm² should be considered by State and Federal law to be **POSITIVE** for LBP.

INSPECTION METHODOLOGY

Areas identified by IEA's client were inspected for lead paint using X-Ray Fluorescence Analyzer (XRF) instrumentation. All suspect materials that were painted, varnished, shellacked, stained, or otherwise coated within IEA's scope of work were inspected.

XRF Operational Requirements

The following requirements were followed for all XRF testing performed during this inspection.

Interference

The PB200i XRF is not affected by spectral interference's. Flat surfaces were tested whenever possible. All measurements were reported on the raw data forms and are provided in the report.

XRF Measurement Requirements

The building was considered, in the judgement of the Lead Inspector, to be one testing building.

Identified areas by IEA's client were tested to identify the presence of lead in the surface coating. These areas included all accessible exterior and interior areas.

Safety Considerations

XRF instruments were only operated by individuals who have successfully completed the Manufacturer's Training requirements for the PB200i Lead Paint Analyzer. Care was taken not to expose occupants or workers to measurable amounts of radiation during the inspection process.

Instrument Selection

The instrument used to perform the inspection was the Heuresis Pb200i XRF lead based paint spectrum analyzers. The instruments are manufactured by Viken Technologies and has a HUD/EPA approved Performance Characteristic Sheet (PCS). The Pb200i PCS can be found in Appendix G.

The Pb200i method of measurement is based on spectrometric analysis of lead K-shell X-ray fluorescence within a controlled depth of measurement. The controlled depth concept restricts the penetration of the K-shell X-rays into the substrate so that the system cannot be misled by the presence of lead pipes or other objects located deep in a wall.

Instrument Calibration

There are two modes of measurements in the instruments, "PCS Mode" and "Calibration Mode". Calibration checks are taken using the "Calibration" mode of operation. This mode automatically adjusts the time of the reading depending on the age of the source. (The older the source, the longer the reading.) Three calibration checks are taken using a National Institute of Standards and Testing (NIST) 1.02 mg/cm² standard on a wood block. These checks are taken at the beginning of each day (or job), at least every four hours during the ongoing inspection, and at the end of each day (or job). Calibrations performed during this inspection indicate the XRF instruments were operating within the PCS specifications. Documentation of all calibration checks can be found throughout this report.

Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102

Substrate Correction

The inspection measurements are taken in the “PCS Mode.” In the “PCS Mode,” the analyzer seeks the shortest period of time to assure a definitive measurement with a 95% confidence. The Pb200i analyzer concludes a measurement once this level of confidence is achieved, typically between 2 and 4 seconds depending on the regulatory level, which is set in the machine before the inspection begins. The PCS indicates that **no substrate correction is required when the instrument is operated in the Quick mode.**

Inconclusive XRF Results

According to the PCS, the Pb200i does not have an inconclusive range on any of the six discussed substrates (brick, concrete, drywall, metal, plaster, and wood). An inconclusive result means that the amount of lead present in the paint film, is too near to the regulatory level to determine, with 95% confidence level, that the measured concentration of lead is above the regulatory level (**POSITIVE**) or below the regulatory level (**NEGATIVE**) for LBP. **Any reading at this level in the final report should be assumed as Positive for LBP.**

Quality Control Measurements and Samples

For XRF measurements, a minimum of 1% of the shots were repeated for quality control purposes. The repeat shots provide a measure of the precision of the XRF instrument. All of the repeated readings were within statistical limits of 95% probability of the original shot.

Document Review

No documentation review was conducted as part of this LBP inspection.

In the absence of construction history documentation, the lead paint inspector combined components of similar construction and painting histories together into homogeneous structures.

Documentation

XRF Scope Sheets were thoroughly completed, indicating the date of the inspection, name of inspector, the structure/unit/room name, sample location, and numerical XRF results of each testing combination. Copies of these sheets are located in the Inspector's file.

The results of the inspection are contained in a series of reports. The format of each report complies with the HUD Guidelines, Chapter 7, and contains information about testing location, testing combination, paint condition, result levels, and XRF operation mode.

Each report has its own unique job number. The job number is a time stamp of when that particular job was started, and which XRF instrument was used to perform the inspection. For this building, the job corresponds to the inspector and the rooms he inspected. One (1) inspectors and one (1) XRF conducted this inspection.

LEAD BASED PAINT REPORTS

At the completion of each job, a series of reports are generated that contain all of the required information from the inspection. The reports are included in the Appendix and are as follows:

Summary Report

This report indicates all the results that were at or above the regulatory level that was set in the instrument. In this inspection, the regulatory level was set at 1.0 mg/cm². The XRF Summary Report is included in Appendix A.

Detailed Report

The Detailed Report lists every reading taken in each room equivalent inspected. This report is generated per XRF job. The XRF Detailed Report is included in Appendix B.

Definitions

“Room Equivalent” as defined in HUD Chapter 7, may be a living room, a kitchen, a hallway, a bathroom, a stairway, etc. A closet is considered to be “Part” of a room, not a separate room equivalent.

“Component” is a structure such as a window casing, a door, or a wall etc. that is within a Room Equivalent. A window system, consists of two components; the window sill and the window apron. Each of these two components must be tested separately if they are present. The “Door System” consists for the components of the “Door Panel”, and the “Door Casing/Jamb System”. The door casing system consists of the door casing, header, and door jamb. The door panel and the door casing/jamb system must be tested separately.

“Substrate” is the material upon which the paint or other coating is applied to. There are six basic substrates. They are Brick, Concrete, Drywall, Metal, Plaster, and Wood.

“Testing Combination” is composed of a Room Equivalent, a Component, and a Substrate. Color is no longer considered part of a testing combination under HUD 1997 Revised Guidelines. However, where color may have been considered by the inspector to be of concern, that testing combination was tested.

Only one of each testing combination within a room equivalent was required to be tested. However, at least one test is required on each wall within each room equivalent. All testing combinations within each room equivalent were tested. All four walls within each room equivalent were tested (except as otherwise discussed earlier in this report).

Spatial Orientation

Each wall within a room equivalent is labeled “A”, “B”, “C”, or “D” in the reports and on the room diagrams. Throughout the all of the Inspection and Inspection Reports, the A wall is always facing to the North. Walls B, C, and D continue around the particular room in a clockwise motion. In this report, Wall B is to the East, Wall C is to the South, and Wall D is to the West.

FINDINGS

There was a total of 284 XRF readings taken throughout the areas identified by IEA's client to be inspected for Lead Based Paint in and around the Building. The Inspector took an additional 12 readings while calibrating their XRF.

Table I summarizes all components that were identified with lead at or above the regulatory level for lead. A detailed list of components that tested positive for lead in specific rooms can be found in the **Summary Report** (Appendix A) in this report.

TABLE I
GENERAL LBP COMPONENTS WITH QUANTITIES

LOCATION/ROOM	COMPONENT	SUBSTRATE	ROUGH QUANTITIES
Exterior Building	Bollards	Metal	250 ft ²
	Lintels, Older	Metal	500 ft ²
Interior Building	Lintels, Older	Metal	See Above
Interior Lab Men Locker Room	Walls and Window Sills	Glazed Tile	400 ft ²
Garage	Floor Stripes (Yellow and White)	Concrete	400 ft ²

APPLICABLE REGULATIONS

WORKER PROTECTION (OSHA)

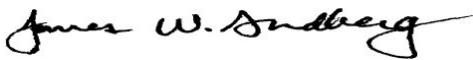
The United States Occupational Safety and Health Administration (OSHA) considers lead in paint to be any detectable level of lead concentration to be a concern during renovation and demolition activities, as indicated in the OSHA Lead in Construction Standard (29 CFR 1926.62). The purpose of the OSHA Lead in Construction Standard is to protect construction workers from exposure to lead dust and fumes. OSHA is primarily concerned with activities that disturb paints with detectable amounts of lead. Several painted surfaces at the property were determined to contain lead above the OSHA level of concern.

The most effective way to determine if lead dust will be a health concern during renovation is to conduct a Negative Initial Determination (NID) to determine if the amount of generated lead dust would exceed the Permissible Exposure Limit (PEL) for lead dust or fumes. In general, an NID is a measurement of a known, airborne contaminant (e.g., lead) over period of eight hours. If the amount of airborne lead in the area is less than the PEL (as calculated by a qualified laboratory) than non-abatement workers would be allowed to perform the work provided that:

- 1) the NID information is given to the contractor and s/he agrees to it;
- 2) the contractor does not deviate from the process that was measured during the NID; and
- 3) The NID has been performed within the previous 12 months.

CERTIFICATION

The inspection was conducted by an experienced lead paint inspector/risk assessor and is licensed as such by the Illinois Department of Public Health. The work performed complies with HUD sampling protocols, state, local and other specified regulatory requirements.



James W. Sundberg
Licensed Lead Risk Assessor Illinois 1743

Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102

APPENDICES

**Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102**

APPENDIX A

Summary Report

Summary Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 24
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
1 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
2 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
3 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
4 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
5 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
6 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
29	Positive	Off	Interior	Lab Men Locker	Wall		Glazed Tile	B	LC	Intact	2.2 mg/cm ²	Action Level (1.0)
30	Positive	Off	Interior	Lab Men Locker	Wall		Glazed Tile	D	LC	Intact	2.0 mg/cm ²	Action Level (1.0)
31	Positive	Off	Interior	Lab Men Locker	Window	Sill	Glazed Tile	D	Center	Intact	2.5 mg/cm ²	Action Level (1.0)
35	Positive	Off	Interior	Lab Men Locker	Lintel		Metal	D	Center	Intact	1.6 mg/cm ²	Action Level (1.0)
123	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	B	Center	Intact	2.3 mg/cm ²	Action Level (1.0)
124	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	D	Center	Intact	2.1 mg/cm ²	Action Level (1.0)

Summary Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 24
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
125	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	C	Center	Intact	2.3 mg/cm ²	Action Level (1.0)
126	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	A	Center	Intact	2.2 mg/cm ²	Action Level (1.0)
143	Positive	Off	Interior	South Loft	Lintel		Metal	C	Center	Intact	2.7 mg/cm ²	Action Level (1.0)
272	Positive	Off	Exterior	Building	Bollard		Metal	D	Left	Intact	3.3 mg/cm ²	Action Level (1.0)
273	Positive	Off	Exterior	Building	Bollard		Metal	D	Center	Intact	3.2 mg/cm ²	Action Level (1.0)
274	Positive	Off	Exterior	Building	Bollard		Metal	D	Right	Intact	2.3 mg/cm ²	Action Level (1.0)
291 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
292 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
293 (CAL)		Off	Calibration								0.9 mg/cm ²	Action Level (1.0)
294 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
295 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
296 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)

Summary Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024

Inspection Site: 1111 Cedar Street
Rockford, IL 61102

Action Level: 1.0 (mg/cm²)

Total Readings: 24

Unit Started: 10/11/2024 08:38:07

Unit Ended: 10/11/2024 11:17:43

----- END OF READINGS -----

**Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102**

APPENDIX B

Detailed Report

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
1 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
2 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
3 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
4 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
5 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
6 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
7	Negative	Off	Interior	Lab Conference	Ceiling		Plaster	D		Intact	0.3 mg/cm ²	Action Level (1.0)
8	Negative	Off	Interior	Lab Conference	Wall		Drywall	D	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
9	Negative	Off	Interior	Lab Conference	Wall		Drywall	C	LC	Intact	0.2 mg/cm ²	Action Level (1.0)
10	Negative	Off	Interior	Lab Conference	Wall		Plaster	A	UR	Intact	0.2 mg/cm ²	Action Level (1.0)
11	Negative	Off	Interior	Lab Conference	Door	Panel	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
12	Negative	Off	Interior	Lab Conference	Door	Jamb	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
13	Negative	Off	Interior	Lab Conference	Lintel		Metal	C	Left	Intact	0.2 mg/cm ²	Action Level (1.0)
14	Negative	Off	Interior	Lab Wellness	Lintel		Metal	A	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
15	Negative	Off	Interior	Lab Wellness	Ceiling		Plaster	A		Intact	0.2 mg/cm ²	Action Level (1.0)
16	Negative	Off	Interior	Lab Wellness	Wall		Drywall	B	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
17	Negative	Off	Interior	Lab Wellness	Door	Panel	Wood	B	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
18	Negative	Off	Interior	Lab Wellness	Door	Jamb	Wood	B	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
19	Negative	Off	Interior	Lab Wellness	Baseboard		Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
20	Negative	Off	Interior	Lab Conference	Baseboard		Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
21	Negative	Off	Interior	Lab Wellness	Door	Panel	Wood	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
22	Negative	Off	Interior	Lab Men Locker	Door	Panel	Wood	A	Center	Intact	0.2 mg/cm ²	Action Level (1.0)
23	Negative	Off	Interior	Lab Men Locker	Door	Panel	Wood	B	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
24	Negative	Off	Interior	Lab Men Locker	Door	Jamb	Wood	B	Left	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
25	Negative	Off	Interior	Lab Men Locker	Bench		Wood	C	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
26	Negative	Off	Interior	Lab Men Locker	Locker		Metal	C	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
27	Negative	Off	Interior	Lab Men Locker	Locker		Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
28	Negative	Off	Interior	Lab Men Locker	Divider Wall		Metal	C	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
29	Positive	Off	Interior	Lab Men Locker	Wall		Glazed Tile	B	LC	Intact	2.2 mg/cm ²	Action Level (1.0)
30	Positive	Off	Interior	Lab Men Locker	Wall		Glazed Tile	D	LC	Intact	2.0 mg/cm ²	Action Level (1.0)
31	Positive	Off	Interior	Lab Men Locker	Window	Sill	Glazed Tile	D	Center	Intact	2.5 mg/cm ²	Action Level (1.0)
32	Negative	Off	Interior	Lab Men Locker	Wall		Ceramic	C	LR	Intact	0.1 mg/cm ²	Action Level (1.0)
33	Negative	Off	Interior	Lab Men Locker	Wall		Drywall	C	UR	Intact	0.1 mg/cm ²	Action Level (1.0)
34	Negative	Off	Interior	Lab Men Locker	Pipe		Metal	C	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
35	Positive	Off	Interior	Lab Men Locker	Lintel		Metal	D	Center	Intact	1.6 mg/cm ²	Action Level (1.0)
36	Negative	Off	Interior	Lab Men Locker	Ceiling		Plaster	D		Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
37	Negative	Off	Interior	Lab Stairs	Ceiling		Plaster	A		Intact	0.1 mg/cm ²	Action Level (1.0)
38	Negative	Off	Interior	Lab Stairs	Wall		Drywall	A	UC	Intact	0.1 mg/cm ²	Action Level (1.0)
39	Negative	Off	Interior	Lab Stairs	Door	Panel	Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
40	Negative	Off	Interior	Lab Stairs	Door	Jamb	Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
41	Negative	Off	Interior	Lab Stairs	Railing		Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
42	Negative	Off	Interior	Lab Stairs	Electric	Panel	Metal	B	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
43	Negative	Off	Interior	Lab Stairs	Support	Column	Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
44	Negative	Off	Interior	Lab Stairs	Lintel		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
45	Negative	Off	Interior	Lab Kitchen	Lintel		Metal	A	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
46	Negative	Off	Interior	Lab Kitchen	Support	Column	Metal	A	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
47	Negative	Off	Interior	Lab Kitchen	Wall		Drywall	D	UL	Intact	0.0 mg/cm ²	Action Level (1.0)
48	Negative	Off	Interior	Lab Kitchen	Wall		Drywall	C	UR	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
49	Negative	Off	Interior	Lab Kitchen	Wall		Drywall	B	UL	Intact	0.1 mg/cm ²	Action Level (1.0)
50	Negative	Off	Interior	Lab Kitchen	Wall		Drywall	A	UR	Intact	0.0 mg/cm ²	Action Level (1.0)
51	Negative	Off	Interior	Lab Kitchen	Door	Jamb	Wood	B	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
52	Negative	Off	Interior	Lab Kitchen	Door	Panel	Metal	B	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
53	Negative	Off	Interior	Lab Kitchen	Door	Panel	Metal	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
54	Negative	Off	Interior	Lab Kitchen	Door	Casing	Metal	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
55	Negative	Off	Interior	Lab Kitchen	Lintel		Metal	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
56	Negative	Off	Interior	Lab West Entry	Window	Casing	Metal	B	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
57	Negative	Off	Interior	Lab West Entry	Door	Casing	Metal	B	Right	Intact	0.1 mg/cm ²	Action Level (1.0)
58	Negative	Off	Interior	Lab West Entry	Door	Panel	Metal	B	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
59	Negative	Off	Interior	Lab West Entry	Wall		Drywall	B	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
60	Negative	Off	Interior	Lab West Entry	Wall		Drywall	A	LC	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
61	Negative	Off	Interior	Lab West Entry	Wall		Concrete	D	UL	Intact	0.2 mg/cm ²	Action Level (1.0)
62	Negative	Off	Interior	Lab W Office	Wall		Concrete	D	LC	Intact	0.1 mg/cm ²	Action Level (1.0)
63	Negative	Off	Interior	Lab W Office	Wall		Concrete	A	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
64	Negative	Off	Interior	Lab W Office	Wall		Drywall	B	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
65	Negative	Off	Interior	Lab W Office	Wall		Drywall	C	UL	Intact	0.1 mg/cm ²	Action Level (1.0)
66	Negative	Off	Interior	Lab W Office	Window	Casing	Metal	D	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
67	Negative	Off	Interior	Lab W Office	Door	Jamb	Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
68	Negative	Off	Interior	Lab W Office	Door	Panel	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
69	Negative	Off	Interior	Lab W Office	Baseboard		Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
70	Negative	Off	Interior	Lab Control Rm	Door	Casing	Wood	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
71	Negative	Off	Interior	Lab Control Rm	Door	Panel	Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
72	Negative	Off	Interior	Lab Control Rm	Door	Panel	Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
73	Negative	Off	Interior	Lab Control Rm	Wall		Drywall	C	UL	Intact	0.0 mg/cm ²	Action Level (1.0)
74	Negative	Off	Interior	Lab Control Rm	Wall		Drywall	C	UL	Intact	0.0 mg/cm ²	Action Level (1.0)
75	Negative	Off	Interior	Lab Control Rm	Wall		Drywall	D	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
76	Negative	Off	Interior	Lab Control Rm	Wall		Drywall	B	UC	Intact	0.1 mg/cm ²	Action Level (1.0)
77	Negative	Off	Interior	Lab Control Rm	Wall		Drywall	A	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
78	Negative	Off	Interior	UPS Storage	Wall		Drywall	D	LL	Intact	0.1 mg/cm ²	Action Level (1.0)
79	Negative	Off	Interior	UPS Storage	Wall		Metal	C	LR	Intact	0.1 mg/cm ²	Action Level (1.0)
80	Negative	Off	Interior	UPS Storage	Wall		Drywall	B	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
81	Negative	Off	Interior	UPS Storage	Wall		Concrete	A	LL	Intact	0.3 mg/cm ²	Action Level (1.0)
82	Negative	Off	Interior	UPS Storage	Electric	Panel	Metal	A	Right	Intact	0.1 mg/cm ²	Action Level (1.0)
83	Negative	Off	Interior	UPS Storage	Door	Casing	Metal	C	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
84	Negative	Off	Interior	UPS Storage	Door	Panel	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
85	Negative	Off	Interior	Lab	Door	Panel	Wood	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
86	Negative	Off	Interior	Lab	Door	Jamb	Metal	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
87	Negative	Off	Interior	Lab	Cabinet		Metal	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
88	Negative	Off	Interior	Lab	Wall		Drywall	A	UC	Intact	0.1 mg/cm ²	Action Level (1.0)
89	Negative	Off	Interior	Lab	Wall		Drywall	B	UC	Intact	0.1 mg/cm ²	Action Level (1.0)
90	Negative	Off	Interior	Lab	Wall		Drywall	C	UL	Intact	0.0 mg/cm ²	Action Level (1.0)
91	Negative	Off	Interior	Lab	Wall		Drywall	D	UR	Intact	0.2 mg/cm ²	Action Level (1.0)
92	Negative	Off	Interior	Lab Cubicles	Wall		Drywall	D	LC	Intact	0.2 mg/cm ²	Action Level (1.0)
93	Negative	Off	Interior	Lab Cubicles	Wall		Drywall	C	LL	Intact	0.1 mg/cm ²	Action Level (1.0)
94	Negative	Off	Interior	Lab Cubicles	Wall		Drywall	B	LC	Intact	0.1 mg/cm ²	Action Level (1.0)
95	Negative	Off	Interior	Lab Cubicles	Wall		Drywall	A	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
96	Negative	Off	Interior	Lab Cubicles	Radiator	Cover	Metal	B	Center	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
97	Negative	Off	Interior	Lab Cubicles	Door	Panel	Metal	A	Right	Intact	0.1 mg/cm ²	Action Level (1.0)
98	Negative	Off	Interior	Lab Cubicles	Door	Casing	Metal	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
99	Negative	Off	Interior	Lab Cubicles	Door	Casing	Wood	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
100	Negative	Off	Interior	Lab Toilet	Door	Jamb	Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
101	Negative	Off	Interior	Lab Toilet	Door	Jamb	Wood	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
102	Negative	Off	Interior	Lab Toilet	Wall		Wood	A	LR	Intact	0.0 mg/cm ²	Action Level (1.0)
103	Negative	Off	Interior	Lab Toilet	Wall		Wood	B	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
104	Negative	Off	Interior	Lab Toilet	Wall		Wood	C	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
105	Negative	Off	Interior	Lab Toilet	Wall		Wood	D	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
106	Negative	Off	Interior	Lab Toilet	Baseboard		Wood	D	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
107	Negative	Off	Interior	Lab Toilet	Radiator	Cover	Metal	D	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
108	Negative	Off	Interior	Lab Toilet	Locker		Metal	D	Right	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
109	Negative	Off	Interior	Garage	Door	Panel	Metal	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
110	Negative	Off	Interior	Garage	Door	Casing	Metal	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
111	Negative	Off	Interior	Garage	Lintel		Metal	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
112	Negative	Off	Interior	Garage	Wall		Conc Block	A	UR	Intact	0.0 mg/cm ²	Action Level (1.0)
113	Negative	Off	Interior	Garage	Window	Sash	Metal	B	Left	Intact	0.3 mg/cm ²	Action Level (1.0)
114	Negative	Off	Interior	Garage	Window	Casing	Metal	B	Left	Intact	0.2 mg/cm ²	Action Level (1.0)
115	Negative	Off	Interior	Garage	Joist		Metal	B	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
116	Negative	Off	Interior	Garage	Joist		Metal	A	Right	Intact	0.1 mg/cm ²	Action Level (1.0)
117	Negative	Off	Interior	Garage	Joist		Metal	D	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
118	Negative	Off	Interior	Garage	Joist		Metal	C	Center	Intact	0.2 mg/cm ²	Action Level (1.0)
119	Negative	Off	Interior	Garage	Ceiling		Drywall	C		Intact	0.0 mg/cm ²	Action Level (1.0)
120	Negative	Off	Interior	Garage	Ceiling		Drywall	D		Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
121	Negative	Off	Interior	Garage	Ceiling		Drywall	A		Intact	0.0 mg/cm ²	Action Level (1.0)
122	Negative	Off	Interior	Garage	Ceiling		Drywall	B		Intact	0.0 mg/cm ²	Action Level (1.0)
123	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	B	Center	Intact	2.3 mg/cm ²	Action Level (1.0)
124	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	D	Center	Intact	2.1 mg/cm ²	Action Level (1.0)
125	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	C	Center	Intact	2.3 mg/cm ²	Action Level (1.0)
126	Positive	Off	Interior	Garage	Floor	Stripe	Concrete	A	Center	Intact	2.2 mg/cm ²	Action Level (1.0)
127	Negative	Off	Interior	Garage	Overhead	Door Panel	Fiberglass	D	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
128	Negative	Off	Interior	Garage	Overhead	Door Panel	Metal	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
129	Negative	Off	Interior	Garage	Overhead	Door Panel	Metal	D	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
130	Negative	Off	Interior	Garage	Door	Panel	Metal	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
131	Negative	Off	Interior	Garage	Door	Casing	Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
132	Negative	Off	Interior	Garage	Lintel		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
133	Negative	Off	Interior	Garage	Wall		Wood	C	LL	Intact	0.1 mg/cm ²	Action Level (1.0)
134	Negative	Off	Interior	Garage	Stair	Stringer	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
135	Negative	Off	Interior	Garage	Stair	Railing	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
136	Negative	Off	Interior	Garage	Stair	Tread	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
137	Negative	Off	Interior	South Loft	Joist		Metal	A	Center	Intact	0.2 mg/cm ²	Action Level (1.0)
138	Negative	Off	Interior	South Loft	Joist		Metal	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
139	Negative	Off	Interior	South Loft	Joist		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
140	Negative	Off	Interior	South Loft	Joist		Metal	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
141	Negative	Off	Interior	South Loft	Electric	Panel	Metal	C	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
142	Negative	Off	Interior	South Loft	Railing		Metal	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
143	Positive	Off	Interior	South Loft	Lintel		Metal	C	Center	Intact	2.7 mg/cm ²	Action Level (1.0)
144	Negative	Off	Interior	South Loft	Door	Panel	Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
145	Negative	Off	Interior	South Loft	Door	Casing	Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
146	Negative	Off	Interior	South Loft	Fan Guard		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
147	Negative	Off	Exterior	Roof	Gas Pipe		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
148	Negative	Off	Exterior	Roof	Door	Panel	Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
149	Negative	Off	Exterior	Roof	Door	Casing	Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
150	Negative	Off	Exterior	Roof	Lintel		Metal	C	Center	Intact	0.5 mg/cm ²	Action Level (1.0)
151	Negative	Off	Exterior	Roof	Electric	Panel	Metal	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
152	Negative	Off	Interior	Field Hallway	Door	Panel	Metal	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
153	Negative	Off	Interior	Field Hallway	Door	Casing	Metal	A	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
154	Negative	Off	Interior	Field Hallway	Wall		Conc Block	A	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
155	Negative	Off	Interior	Field Hallway	Wall		Conc Block	B	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
156	Negative	Off	Interior	Field Hallway	Wall		Drywall	D	LC	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
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 Unit Started: 10/11/2024 08:38:07
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
157	Negative	Off	Interior	Field Hallway	Window	Casing	Wood	D	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
158	Negative	Off	Interior	Field Hallway	Door	Panel	Wood	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
159	Negative	Off	Interior	Field Hallway	Door	Casing	Wood	C	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
160	Negative	Off	Interior	Field Hallway	Lintel		Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
161	Negative	Off	Interior	Field Break Rm	Wall		Drywall	A	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
162	Negative	Off	Interior	Field Break Rm	Wall		Drywall	B	LC	Intact	0.1 mg/cm ²	Action Level (1.0)
163	Negative	Off	Interior	Field Break Rm	Wall		Drywall	C	LC	Intact	0.1 mg/cm ²	Action Level (1.0)
164	Negative	Off	Interior	Field Break Rm	Wall		Drywall	D	LC	Intact	0.1 mg/cm ²	Action Level (1.0)
165	Negative	Off	Interior	Field Break Rm	Window	Sill	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
166	Negative	Off	Interior	Field Break Rm	Window	Casing	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
167	Negative	Off	Interior	Field Break Rm	Door	Panel	Wood	A	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
168	Negative	Off	Interior	Field Break Rm	Door	Jamb	Wood	A	Left	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
169	Negative	Off	Interior	Field Break Rm	Cabinet		Wood	C	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
170	Negative	Off	Interior	Field Break Rm	Ledge		Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
171	Negative	Off	Interior	Field Meter Rm	Cabinet		Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
172	Negative	Off	Interior	Field Meter Rm	Door	Jamb	Wood	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
173	Negative	Off	Interior	Field Meter Rm	Window	Casing	Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
174	Negative	Off	Interior	Field Meter Rm	Door	Panel	Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
175	Negative	Off	Interior	Field Meter Rm	Cabinet		Metal	B	Center	Intact	0.2 mg/cm ²	Action Level (1.0)
176	Negative	Off	Interior	Field Meter Rm	Floor		Concrete	B		Intact	0.3 mg/cm ²	Action Level (1.0)
177	Negative	Off	Interior	Field Meter Rm	Floor	Cover	Metal	B	Center	Intact	0.2 mg/cm ²	Action Level (1.0)
178	Negative	Off	Interior	Field Meter Rm	Wall		Drywall	C	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
179	Negative	Off	Interior	Field Meter Rm	Wall		Concrete	D	LC	Intact	0.1 mg/cm ²	Action Level (1.0)
180	Negative	Off	Interior	Field Meter Rm	Wall		Brick	D	UC	Intact	0.2 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
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 Unit Started: 10/11/2024 08:38:07
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
181	Negative	Off	Interior	Field Meter Rm	Window	Sill	Brick	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
182	Negative	Off	Interior	Field Meter Rm	Wall		Brick	C	LL	Intact	0.1 mg/cm ²	Action Level (1.0)
183	Negative	Off	Interior	Field Meter Rm	Wall		Brick	B	LR	Intact	0.2 mg/cm ²	Action Level (1.0)
184	Negative	Off	Interior	Field Meter Rm	Wall		Brick	A	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
185	Negative	Off	Interior	Field Reception	Wall		Concrete	C	LL	Intact	0.3 mg/cm ²	Action Level (1.0)
186	Negative	Off	Interior	Field Reception	Wall		Concrete	B	LC	Intact	0.2 mg/cm ²	Action Level (1.0)
187	Negative	Off	Interior	Field Reception	Wall		Drywall	B	UR	Intact	0.1 mg/cm ²	Action Level (1.0)
188	Negative	Off	Interior	Field Reception	Wall		Drywall	C	UL	Intact	0.2 mg/cm ²	Action Level (1.0)
189	Negative	Off	Interior	Field Reception	Window	Casing	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
190	Negative	Off	Interior	Field Reception	Door	Casing	Wood	D	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
191	Negative	Off	Interior	Field Reception	Door	Panel	Wood	D	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
192	Negative	Off	Interior	Field Reception	Chase		Wood	C	LR	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
193	Negative	Off	Interior	Field Cubicles	Lintel		Metal	A	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
194	Negative	Off	Interior	Field Cubicles	Door	Casing	Metal	C	Right	Intact	0.3 mg/cm ²	Action Level (1.0)
195	Negative	Off	Interior	Field Cubicles	Door	Panel	Wood	C	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
196	Negative	Off	Interior	Field Cubicles	Wall		Drywall	C	LR	Intact	0.1 mg/cm ²	Action Level (1.0)
197	Negative	Off	Interior	Field Cubicles	Wall		Drywall	D	LL	Intact	0.1 mg/cm ²	Action Level (1.0)
198	Negative	Off	Interior	Field Cubicles	Wall		Drywall	A	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
199	Negative	Off	Interior	Field Cubicles	Wall		Drywall	B	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
200	Negative	Off	Interior	Field Meeting Rm	Wall		Drywall	B	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
201	Negative	Off	Interior	Field Meeting Rm	Electric	Panel	Metal	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
202	Negative	Off	Interior	Field Entry	Lintel		Metal	A	Center	Intact	0.2 mg/cm ²	Action Level (1.0)
203	Negative	Off	Interior	Field Entry	Window	Sash	Wood	A	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
204	Negative	Off	Interior	Field Entry	Window	Casing	Wood	A	Left	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
205	Negative	Off	Interior	Field Entry	Baseboard		Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
206	Negative	Off	Interior	Field Entry	Door	Panel	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
207	Negative	Off	Interior	Field Entry	Door	Jamb	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
208	Negative	Off	Interior	Field Entry	Lintel		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
209	Negative	Off	Interior	Supt Office	Lintel		Metal	A	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
210	Negative	Off	Interior	Supt Office	Door	Panel	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
211	Negative	Off	Interior	Supt Office	Door	Casing	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
212	Negative	Off	Interior	Supt Office	Window	Casing	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
213	Negative	Off	Interior	Supt Office	Wall		Wood	C	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
214	Negative	Off	Interior	Field Conference	Wall		Wood	A	LR	Intact	0.0 mg/cm ²	Action Level (1.0)
215	Negative	Off	Interior	Field Conference	Door	Panel	Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
216	Negative	Off	Interior	Field Conference	Door	Casing	Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
217	Negative	Off	Interior	Field Conference	Window	Casing	Wood	D	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
218	Negative	Off	Interior	Field Conference	Lintel		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
219	Negative	Off	Interior	Field Conference	Lintel		Metal	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
220	Negative	Off	Interior	Field SW Hallway	Window	Casing	Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
221	Negative	Off	Interior	Field SW Hallway	Baseboard		Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
222	Negative	Off	Interior	Field SW Hallway	Door	Panel	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
223	Negative	Off	Interior	Field SW Hallway	Door	Jamb	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
224	Negative	Off	Interior	Field SW Hallway	Wall		Drywall	C	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
225	Negative	Off	Interior	Field SW Hallway	Wall		Drywall	D	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
226	Negative	Off	Interior	Field SW Hallway	Wall		Drywall	A	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
227	Negative	Off	Interior	Field SW Hallway	Wall		Drywall	B	LR	Intact	0.0 mg/cm ²	Action Level (1.0)
228	Negative	Off	Interior	Field SW Hallway	Door	Jamb	Metal	A	Left	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
229	Negative	Off	Interior	Field NW Office	Lintel		Metal	A	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
230	Negative	Off	Interior	Field NW Office	Window	Casing	Wood	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
231	Negative	Off	Interior	Field NW Office	Window	Casing	Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
232	Negative	Off	Interior	Field NW Office	Baseboard		Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
233	Negative	Off	Interior	Field NW Office	Door	Panel	Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
234	Negative	Off	Interior	Field NW Office	Door	Jamb	Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
235	Negative	Off	Interior	Field NW Office	Wall		Wood	C	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
236	Negative	Off	Interior	Field SW Office	Wall		Wood	A	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
237	Negative	Off	Interior	Field SW Office	Door	Panel	Wood	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
238	Negative	Off	Interior	Field SW Office	Door	Jamb	Wood	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
239	Negative	Off	Interior	Field SW Office	Window	Casing	Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
240	Negative	Off	Interior	Field SW Office	Wall		Wood	B	UR	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
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 Unit Started: 10/11/2024 08:38:07
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
241	Negative	Off	Interior	Field SW Office	Lintel		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
242	Negative	Off	Interior	Field W Locker	Door	Casing	Metal	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
243	Negative	Off	Interior	Field W Locker	Radiator	Cover	Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
244	Negative	Off	Interior	Field W Locker	Wall		Drywall	C	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
245	Negative	Off	Interior	Field W Locker	Wall		Drywall	D	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
246	Negative	Off	Interior	Field W Locker	Wall		Drywall	B	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
247	Negative	Off	Interior	Field W Locker	Wall		Drywall	A	UR	Intact	0.0 mg/cm ²	Action Level (1.0)
248	Negative	Off	Interior	Field W Locker	Door	Panel	Wood	A	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
249	Negative	Off	Interior	Field W Locker	Door	Panel	Wood	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
250	Negative	Off	Interior	Field W Toilet	Door	Jamb	Metal	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
251	Negative	Off	Interior	Field W Toilet	Divider	Wall	Metal	A	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
252	Negative	Off	Interior	Field W Toilet	Radiator	Cover	Metal	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
253	Negative	Off	Interior	Field W Toilet	Wall		Drywall	D	LL	Intact	0.1 mg/cm ²	Action Level (1.0)
254	Negative	Off	Interior	Field W Toilet	Wall		Drywall	C	UL	Intact	0.0 mg/cm ²	Action Level (1.0)
255	Negative	Off	Interior	Field W Toilet	Wall		Drywall	B	UL	Intact	0.1 mg/cm ²	Action Level (1.0)
256	Negative	Off	Interior	Field W Toilet	Wall		Drywall	A	UR	Intact	0.1 mg/cm ²	Action Level (1.0)
257	Negative	Off	Interior	Field Men Toilet	Wall		Drywall	A	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
258	Negative	Off	Interior	Field Men Toilet	Wall		Drywall	B	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
259	Negative	Off	Interior	Field Men Toilet	Wall		Drywall	C	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
260	Negative	Off	Interior	Field Men Toilet	Wall		Drywall	D	UC	Intact	0.0 mg/cm ²	Action Level (1.0)
261	Negative	Off	Interior	Field Men Toilet	Radiator	Cover	Metal	D	Center	Intact	0.2 mg/cm ²	Action Level (1.0)
262	Negative	Off	Interior	Field Men Toilet	Divider	Wall	Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
263	Negative	Off	Interior	Field Men Toilet	Door	Casing	Metal	B	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
264	Negative	Off	Interior	Field Men Toilet	Door	Panel	Wood	B	Left	Intact	0.0 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
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 Unit Started: 10/11/2024 08:38:07
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
265	Negative	Off	Interior	Field Men Locker	Door		Wood	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
266	Negative	Off	Interior	Field Men Locker	Door	Jamb	Metal	C	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
267	Negative	Off	Interior	Field Men Locker	Radiator	Cover	Metal	A	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
268	Negative	Off	Interior	Field Men Locker	Wall		Drywall	A	LC	Intact	0.0 mg/cm ²	Action Level (1.0)
269	Negative	Off	Interior	Field Men Locker	Wall		Drywall	B	LL	Intact	0.0 mg/cm ²	Action Level (1.0)
270	Negative	Off	Interior	Field Men Locker	Wall		Drywall	C	LC	Intact	0.1 mg/cm ²	Action Level (1.0)
271	Negative	Off	Interior	Field Men Locker	Wall		Drwyall	D	LR	Intact	0.3 mg/cm ²	Action Level (1.0)
272	Positive	Off	Exterior	Building	Bollard		Metal	D	Left	Intact	3.3 mg/cm ²	Action Level (1.0)
273	Positive	Off	Exterior	Building	Bollard		Metal	D	Center	Intact	3.2 mg/cm ²	Action Level (1.0)
274	Positive	Off	Exterior	Building	Bollard		Metal	D	Right	Intact	2.3 mg/cm ²	Action Level (1.0)
275	Negative	Off	Exterior	Building	Overhead	Door Panel	Metal	D	Right	Intact	0.1 mg/cm ²	Action Level (1.0)
276	Negative	Off	Exterior	Building	Overhead	Door Panel	Metal	D	Center	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
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Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
277	Negative	Off	Exterior	Building	Overhead	Door Panel	Metal	D	Left	Intact	0.1 mg/cm ²	Action Level (1.0)
278	Negative	Off	Exterior	Building	Gutter		Metal	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
279	Negative	Off	Exterior	Building	Downspout		Metal	D	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
280	Negative	Off	Exterior	Building	Overhead	Door Casing	Wood	D	Right	Intact	0.0 mg/cm ²	Action Level (1.0)
281	Negative	Off	Exterior	Building	Overhead	Door Casing	Wood	D	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
282	Negative	Off	Exterior	Building	Overhead	Door Casing	Wood	D	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
283	Negative	Off	Exterior	Building	Railing		Metal	C	Center	Intact	0.1 mg/cm ²	Action Level (1.0)
284	Negative	Off	Exterior	Building	Awning		Metal	C	Right	Intact	0.2 mg/cm ²	Action Level (1.0)
285	Negative	Off	Exterior	Building	Window	Guard	Metal	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
286	Negative	Off	Exterior	Building	Window	Sash	Metal	B	Center	Intact	0.0 mg/cm ²	Action Level (1.0)
287	Negative	Off	Exterior	Building	Window	Sash	Metal	B	Left	Intact	0.0 mg/cm ²	Action Level (1.0)
288	Negative	Off	Exterior	Building	Window	Sash	Metal	B	Right	Intact	0.1 mg/cm ²	Action Level (1.0)

Detailed Lead Based Paint Inspection

Inspection Date: 10/11/2024 - 10/11/2024
 Action Level: 1.0 (mg/cm²)
 Total Readings: 296
 Unit Started: 10/11/2024 08:38:07
 Unit Ended: 10/11/2024 11:17:43

Inspection Site: 1111 Cedar Street
 Rockford, IL 61102

Read #	Result	RTA Present	Room	-->RoomChoice	Structure	-->Member	Substrate	Wall	Location	Condition	Lead (mg/cm ²)	Mode
289	Negative	Off	Exterior	Building	Generator	Gate	Metal	B	Right	Intact	0.2 mg/cm ²	Action Level (1.0)
290	Negative	Off	Exterior	Building	Awning		Plaster	A	Right	Intact	0.1 mg/cm ²	Action Level (1.0)
291 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
292 (CAL)		Off	Calibration								1.0 mg/cm ²	Action Level (1.0)
293 (CAL)		Off	Calibration								0.9 mg/cm ²	Action Level (1.0)
294 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
295 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)
296 (CAL)		Off	Calibration								0.0 mg/cm ²	Action Level (1.0)

----- END OF READINGS -----

**Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102**

APPENDIX C

Inspector Licensing

Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102



Alteration of this license shall result in legal action
RISK ASSESSOR CERTIFICATE EXPIRES
3/7/2025

This license issued under authority of the State
of Illinois -Department of Public Health

This license is valid only when accompanied by
a valid training course certificate

If found return to 525 W Jefferson St Springfield, IL 62761

**Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102**

APPENDIX D

XRF Performance Characteristic Sheets

Performance Characteristic Sheet

EFFECTIVE DATE: December 1, 2015

MANUFACTURER AND MODEL:

Make: *Heuresis*
Models: *Model Pb200i*
Source: *⁵⁷Co, 5 mCi (nominal – new source)*

FIELD OPERATION GUIDANCE

OPERATING PARAMETERS:

Action Level mode

XRF CALIBRATION CHECK LIMITS:

0.8 to 1.2 mg/cm ² (inclusive)

SUBSTRATE CORRECTION:

Not applicable

INCONCLUSIVE RANGE OR THRESHOLD:

ACTION LEVEL MODE READING DESCRIPTION	SUBSTRATE	THRESHOLD (mg/cm ²)
Results not corrected for substrate bias on any substrate	Brick	1.0
	Concrete	1.0
	Drywall	1.0
	Metal	1.0
	Plaster	1.0
	Wood	1.0

BACKGROUND INFORMATION

EVALUATION DATA SOURCE AND DATE:

This sheet is supplemental information to be used in conjunction with Chapter 7 of the HUD *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing* ("HUD Guidelines"). Performance parameters shown on this sheet are calculated using test results on building components in the HUD archive. Testing was conducted on 146 test samples in November 2015, with two separate instruments running software version 2.1-2 in Action Level test mode. The actual source strength of each instrument on the day of testing was approximately 2.0 mCi; source ages were approximately one year.

OPERATING PARAMETERS

Performance parameters shown in this sheet are applicable only when properly operating the instrument using the manufacturer's instructions and procedures described in Chapter 7 of the HUD Guidelines.

XRF CALIBRATION CHECK:

The calibration of the XRF instrument should be checked using the paint film nearest 1.0 mg/cm² in the NIST Standard Reference Material (SRM) used (e.g., for NIST SRM 2579, use the 1.02 mg/cm² film).

If the average (rounded to 1 decimal place) of three readings is outside the acceptable calibration check range, follow the manufacturer's instructions to bring the instrument into control before XRF testing proceeds.

SUBSTRATE CORRECTION VALUE COMPUTATION:

Chapter 7 of the HUD Guidelines provides guidance on correcting XRF results for substrate bias. Supplemental guidance for using the paint film nearest 1.0 mg/cm² for substrate correction is provided:

XRF results are corrected for substrate bias by subtracting from each XRF result a correction value determined separately in each house for single-family housing or in each development for multifamily housing, for each substrate. The correction value is an average of XRF readings taken over the NIST SRM paint film nearest to 1.0 mg/cm² at test locations that have been scraped bare of their paint covering. Compute the correction values as follows:

Using the same XRF instrument, take three readings on a bare substrate area covered with the NIST SRM paint film nearest 1 mg/cm². Repeat this procedure by taking three more readings on a second bare substrate area of the same substrate covered with the NIST SRM.

Compute the correction value for each substrate type where XRF readings indicate substrate correction is needed by computing the average of all six readings as shown below.

For each substrate type (the 1.02 mg/cm² NIST SRM is shown in this example; use the actual lead loading of the NIST SRM used for substrate correction):

$$\text{Correction value} = (1\text{st} + 2\text{nd} + 3\text{rd} + 4\text{th} + 5\text{th} + 6\text{th Reading})/6 - 1.02 \text{ mg/cm}^2$$

Repeat this procedure for each substrate requiring substrate correction in the house or housing development.

EVALUATING THE QUALITY OF XRF TESTING:

Randomly select ten testing combinations for retesting from each house or from two randomly selected units in multifamily housing.

Conduct XRF re-testing at the ten testing combinations selected for retesting.

Determine if the XRF testing in the units or house passed or failed the test by applying the steps below. Compute the Retest Tolerance Limit by the following steps:

Determine XRF results for the original and retest XRF readings. Do not correct the original or retest results for substrate bias. In single-family and multi-family housing, a result is defined as a single reading. Therefore, there will be ten original and ten retest XRF results for each house or for the two selected units.

Calculate the average of the original XRF result and the retest XRF result for each testing combination.

Square the average for each testing combination.

Add the ten squared averages together. Call this quantity C.

Multiply the number C by 0.0072. Call this quantity D.

Add the number 0.032 to D. Call this quantity E.

Take the square root of E. Call this quantity F.

Multiply F by 1.645. The result is the Retest Tolerance Limit.

Compute the average of all ten original XRF readings.

Compute the average of all ten re-test XRF readings.

Find the absolute difference of the two averages.

If the difference is less than the Retest Tolerance Limit, the inspection has passed the retest. If the difference of the overall averages equals or exceeds the Retest Tolerance Limit, this procedure should be repeated with ten new testing combinations. If the difference of the overall averages is equal to or greater than the Retest Tolerance Limit a second time, then the inspection should be considered deficient.

Use of this procedure is estimated to produce a spurious result approximately 1% of the time. That is, results of this procedure will call for further examination when no examination is warranted in approximately 1 out of 100 dwelling units tested.

TESTING TIMES:

In the Action Level paint test mode, the instrument takes the longest time to complete readings close to the Federal standard of 1.0 mg/cm². The table below shows the mean and standard deviation of actual reading times by reading level for paint samples during the November 2015 archive testing. The tested instruments reported readings to one decimal place. No significant differences in reading times by substrate were observed. These times apply only to instruments with the same source strength as those tested (2.0 mCi). Instruments with stronger sources will have shorter reading times and those with weaker sources, longer reading times, than those in the table.

Mean and Standard Deviation of Reading Times in Action Level Mode by Reading Level		
Reading (mg/cm ²)	Mean Reading Time (seconds)	Standard Deviation (seconds)
< 0.7	3.48	0.47
0.7	7.29	1.92
0.8	13.95	1.78
0.9 – 1.2	15.25	0.66
1.3 – 1.4	6.08	2.50
≥ 1.5	3.32	0.05

CLASSIFICATION OF RESULTS:

XRF results are classified as **positive** if they are **greater than or equal** to the stated threshold for the instrument (1.0 mg/cm²), and *negative* if they are *less than* the threshold.

DOCUMENTATION:

A report titled *Methodology for XRF Performance Characteristic Sheets* (EPA 747-R-95-008) provides an explanation of the statistical methodology used to construct the data in the sheets, and provides empirical results from using the recommended inconclusive ranges or thresholds for specific XRF instruments. The report may be downloaded at <http://www2.epa.gov/lead/methodology-xrf-performance-characteristic-sheets-epa-747-r-95-008-september-1997>.

This XRF Performance Characteristic Sheet (PCS) was developed by QuanTech, Inc., under a contract with the XRF manufacturer.

**Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102**

APPENDIX E

Photo Log of Components Identified with Lead Based Paint

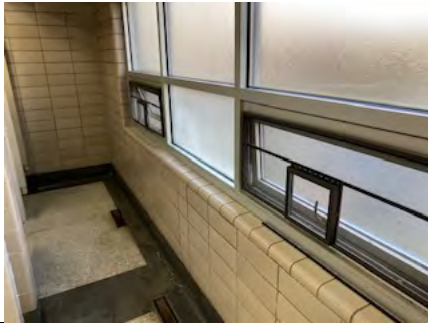
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1111 Cedar Street
Rockford, Illinois 61102



Exterior Building from Southeast Corner.



Exterior Building, Lab Area from West.



Interior Lab Men's Locker Room. Glazed Tile Walls and Window Sills with Lead Based Paint (LBP) identified.



Exterior and Interior Building Throughout. Metal Lintels (Older) with LBP identified.

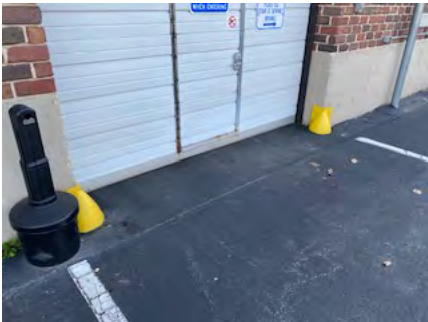


Interior Garage. Painted Floor Stripes (White and Yellow) with LBP identified.



Exterior and Interior Building Throughout. Metal Lintels (Older) with LBP identified.

Comprehensive LBP Inspection
1111 Cedar Street
Rockford, Illinois 61102

 A photograph showing the exterior of a building with a brick wall and a white roll-up door. In the foreground, there are two yellow bollards and a black metal bollard. A small blue sign is visible on the door.	
Exterior Building, West Facade. Metal Bollards (Yellow) with LBP identified.	

CCDD 663 REPORT



CCDD 663 REPORT

**5M Gallon Water Storage Reservoir
Well No. 45 Reservoir Replacement and Site Modifications
1141 Stanley Street
Rockford, Illinois 61102**

**Mr. Matt Baillargeon
City of Rockford
425 East State Street
Rockford, Illinois 61104**

Prepared by:

**GEOCON Professional Services, LLC.
22774 Citation Road, Unit A
Frankfort, Illinois 60423**

June 5, 2023

GEOCON Project No. 23-G0529.1

TABLE OF CONTENTS

1. CCDD Report.....	
2. Appendix A.....	
a. Sample Location Diagram.....	
3. Appendix B.....	
a. IEPA LPC-663 Form.....	
4. Appendix C.....	
a. CCDD Summary Table & Analytical Results.....	
b. Environmental Boring Logs.....	



June 5, 2023

Mr. Matt Baillargeon
City of Rockford
425 East State Street
Rockford, Illinois 61104

Subject: Clean Construction Demolition Debris (CCDD) Certification
5M Gallon Water Storage Reservoir
Well No. 45 Reservoir Replacement and Site Modifications
1141 Stanley Street
Rockford, Illinois 61102
GEOCON Job No.: 23-G0529.1

Dear Mr. Baillargeon:

The following report presents the results of the historical regulatory assessment (HRA) and clean construction demolition debris (CCDD) investigation performed for the above project. The purpose of this HRA is to perform a historical and regulatory review and a site inspection to evaluate if the soils to be excavated for the proposed improvements can be considered "Uncontaminated Soils" as per the IEPA CCDD protocols. This investigation is not equivalent to a Phase I Environmental Site Assessment (ASTM E1527).

The historical review was conducted by reviewing historical aerial photographs and topographic maps online at <http://www.historicaerials.com>. The regulatory review was conducted by reviewing readily available online Federal and Illinois databases including the Illinois Emergency Management Agency (IEMA) list of documented spills and releases, the IEPA Bureau of Land (BOL) waste generators and Leaking Underground Storage Tank (LUST) databases, and the Illinois Office of State Fire Marshal (OSFM) list of all registered Underground Storage Tanks (USTs).

It is understood the project will consist of demolishing the existing reservoir and booster station to construct a new 5M gallon water storage tank. The new tank will have a diameter of 156 feet and 30-foot-high walls. The proposed reservoir will require soil spoils to be hauled off and transported to a CCDD landfill. The amount of haul off was unknown at the time of this report but it is anticipated that 4,000 cubic yards or less will be hauled off for the project.

Ten (10) soil borings were drilled 5/9/23 through 5/12/23. During drilling, a Geocon representative screened the soil samples with a MiniRAE Lit Model PGM-7300 photoionization detector (PID) equipped with a 10.6 eV lamp to assess for the presence of volatile organic vapors (VOVs) in the soil sample headspace. A portion of the soil samples were placed into re-sealable plastic bags and allowed to equilibrate for approximately 20 minutes prior to screening. Then, the PID was inserted into the bag to measure the PID readings. Soil samples did not exhibit

visual/olfactory evidence of petroleum hydrocarbons and PID readings ranged from 0.1 to 6.8 parts per million (ppm), with most values below 0.5 ppm. The results of the PID screening are shown on the Environmental Boring Logs in Appendix C.

Based on review of the readily available information, it is our opinion that the site is a Potentially Impacted Property (PIP) per CCDD criteria due to nearby gasoline, diesel, and used oil LUST/USTs at adjacent sites located to the south of the subject site. Since the site is considered to be a PIP, two (2) samples were recovered from the proposed construction limits and submitted for analytical testing. The material tested consisted of brown sandy clay or sand soils.

Below is a summary of the testing performed for this investigation:

Sample ID	Sample Depth (ft)	Material Type	Tests Performed
S-1	1 to 4 ft	Brown Sandy Clay	VOCs, SVOCs, RCRA Metals, pH
S-2	1 to 4 ft	Brown Sand	VOCs, SVOCs, RCRA Metals, pH

Test results are included in Appendix C of this report. The results have been compared to the IEPA specified CCDD Soil Remediation Objectives (SROs) listed in the table entitled "Maximum Allowable Concentrations of Chemical Constituents in Uncontaminated Soil Used as Fill Material at Regulated Fill Operations."

The test results of the sample recovered were satisfactory for all analytes tested for and within CCDD limits. Based on the results of this investigation, it is our opinion that the soils to be excavated for the proposed parking lot improvements are considered to be "Uncontaminated Soil" as described in Illinois Public Act 96-1416 subject to any noted disclaimers.

It is the responsibility of the "site operator" to immediately stop work if any unexpected conditions are encountered during site excavation operations. Unexpected conditions include soil with unexplained odors, discolorations or staining, the presence of unsuitable deleterious materials or previously undocumented fill soils. If such a condition is encountered, Geocon Professional Services should be contacted to re-evaluate conditions at the site.

Any soils that may be contaminated should not be transported off-site. Materials sent to a CCDD disposal facility are inspected and screened prior to acceptance at the disposal facility. The disposal facility has the option to reject any material that does not meet their standards. Rejected loads are reported to the IEPA and will be returned to the originating site. The rejected soil must then be properly disposed of at a sanitary landfill and the generating site (site operator) must have documentation confirming proper disposal of the rejected loads.

The report's findings are based on conditions that existed on the date of the Geocon site visit and should not be relied upon to precisely represent conditions at any other time. Geocon Professional Services, LLC is not responsible for conditions that were not disclosed in the course of review of the available data sources. Geocon has based the conclusions included in this report on observation of existing site conditions and interpretation of the site history and past usage of the site. This environmental investigation is not intended to be deemed a legal opinion. Environmental conditions are subject to change depending upon future activities and this assessment is descriptive of the present conditions at the project site. As any additional information becomes available, that information should be brought to Geocon's attention to determine if it affects our analysis and recommendations.

The report was prepared for and is intended for the exclusive use of our client. The report's contents may not be relied upon by any party other than the above listed parties without the express written permission of Geocon Professional Services, LLC.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

GEOCON PROFESSIONAL SERVICES, LLC



Joe Abu-Bakr, PE
Project Engineer
Ph: 224-587-9185
Email: joe.abu-bakr@geoconcompanies.com



Brandon Filafusi, EIT
Project Engineer
Ph: 815-823-2623
Email: brandon.filafusi@geoconcompanies.com



APPENDIX A

Sample Location Diagram

General Note:

1. Houses in the Northwest corner of the Area of Site have since been demolished.
2. The city of Rockford owns the entirety of the Area of Site.
3. Proposed new locations for the playground and basketball court are to be reviewed internally by the City.

Sample locations



Gasoline, diesel, used oil LUST/USTs

PROPOSED RESERVOIR LOCATION
WELL 45 RESERVOIR REPLACEMENT
CITY OF ROCKFORD
WINNEBAGO COUNTY, ILLINOIS



FIGURE 4.04-1
 889 of 1009



APPENDIX B

IEPA LPC-663 Form



Illinois Environmental Protection Agency

1021 North Grand Avenue East • P.O. Box 19276 • Springfield • Illinois • 62794-9276 • (217) 782-3397

Uncontaminated Soil Certification by Licensed Professional Engineer or Licensed Professional Geologist for Use of Uncontaminated Soil as Fill in a CCDD or Uncontaminated Soil Fill Operation LPC-663

Revised in accordance with 35 Ill. Adm. Code 1100, as
amended by PCB R2012-009 (eff. Aug. 27, 2012)

This certification form is to be used by professional engineers and professional geologists to certify, pursuant to 35 Ill. Adm. Code 1100.205(a)(1)(B), that soil (i) is uncontaminated soil and (ii) is within a pH range of 6.26 to 9.0. If you have questions about this form, please telephone the Bureau of Land Permit Section at 217/524-3300.

This form may be completed online, saved locally, printed and signed, and submitted to prospective clean construction or demolition debris (CCDD) fill operations or uncontaminated soil fill operations.

I. Source Location Information

(Describe the location of the source of the uncontaminated soil)

Project Name: 5M Gallon Water Storage Reservoir Office Phone Number, if available: _____

Physical Site Location (address, including number and street):

1141 Stanley Street

City: Rockford State: IL Zip Code: 61102

County: Winnebago Township: T44N R1E

Lat/Long of approximate center of site in decimal degrees (DD.ddddd) to five decimal places (e.g., 40.67890, -90.12345):

Latitude: 42.27091 Longitude: - 89.10921

(Decimal Degrees)

(-Decimal Degrees)

Identify how the lat/long data were determined:

☐ GPS ☐ Map Interpolation ☐ Photo Interpolation ☐ Survey ☒ Other

Google Earth

IEPA Site Number(s), if assigned: BOL: 2010306174 BOW: _____ BOA: _____

Approximate Start Date (mm/dd/yyyy): Jun 5, 2023 Approximate End Date (mm/dd/yyyy): Jun 5, 2024

Estimated Volume of debris (cu. Yd.): 4,000

II. Owner/Operator Information for Source Site

Site Owner

Name: _____ City of Rockford

Street Address: _____ 425 East State Street

PO Box: _____

City: _____ Rockford State: _____ IL

Zip Code: _____ 61104 Phone: _____ 815-520-2645

Contact: _____ Matt Baillargeon

Email, if available: _____

Site Operator

Name: _____ City of Rockford

Street Address: _____ 425 East State Street

PO Box: _____

City: _____ Rockford State: _____ IL

Zip Code: _____ 61104 Phone: _____ 815-520-2645

Contact: _____ Matt Baillargeon

Email, if available: _____

This Agency is authorized to require this information under Section 4 and Title X of the Environmental Protection Act (415 ILCS 5/4, 5/39). Failure to disclose this information may result in: a civil penalty of not to exceed \$50,000 for the violation and an additional civil penalty of not to exceed \$10,000 for each day during which the violation continues (415 ILCS 5/42). This form has been approved by the Forms Management Center.

Uncontaminated Soil Certification**III. Basis for Certification and Attachments**

For each item listed below, reference the attachments to this form that provide the required information.

- a. A Description of the soil sample points and how they were determined to be sufficient in number and appropriately located 35 Ill. Adm. Code 1100.610(a):

Review of online databases indicates nearby gasoline, diesel, and used oil LUST/USTs at adjacent sites to the south. Two (2) samples were collected from the proposed construction limits closest to the recognized environmental conditions (RECs) and submitted for analytical testing related to the RECs noted above.

- b. Analytical soil testing results to show that soil chemical constituents comply with the maximum allowable concentrations established pursuant to 35 Ill. Adm. Code Part 1100, Subpart F and that the soil pH is within the range of 6.25 to 9.0, including the documentation of chain of custody control, a copy of the lab analysis; the accreditation status of the laboratory performing the analysis; and certification by an authorized agent of the laboratory that the analysis has been performed in accordance with the Agency's rules for the accreditation of environmental and the scope of the accreditation [35 Ill. Adm. Code 1100.201 (g), 1100.205(a), 1100.610]:

The pH results of 7.9 and 8.2 are within the CCDD range of 6.25 to 9.0 and results of VOCs, SVOCs, and RCRA Metals were satisfactory for all MACs listed in the IEPA MAC Table. A copy of the laboratory analytical results are attached. The test results of the samples recovered were satisfactory for all analytes for and within CCDD limits.

IV. Certification Statement, Signature and Seal of Licensed Professional Engineer or Licensed Professional Geologist

I, Joe Abu-Bakr (name of licensed professional engineer or geologist)

certify under penalty of law that the information submitted, including but not limited to, all attachments and other information, is to the best of my knowledge and belief, true, accurate and complete. In accordance with the Environmental Protection Act [415 ILCS 5/22.51 or 22.51a] and 35 Ill. Adm. Code 1100.205(a), I certify that the soil from this site is uncontaminated soil. I also certify that the soil pH is within the range of 6.25 to 9.0. In addition, I certify that the soil has not been removed from the site as part of a cleanup or removal of contaminants. All necessary documentation is attached.

Any person who knowingly makes a false, fictitious, or fraudulent material statement, orally or in writing, to the Illinois EPA commits a Class 4 felony. A second or subsequent offense after conviction is a Class 3 felony. (415 ILCS 5/44(h))

Company Name: Geocon Professional Services, LLC

Street Address: 22774 Citation Road, Unit A

City: Frankfort State: IL Zip Code: 60423

Phone: (815) 806-9986

Joe Abu-Bakr

Printed Name:


Licensed Professional Engineer or
Licensed Professional Geologist Signature:

Jun 5, 2023

Date:



P.E or L.P.G. Seal:



APPENDIX C

CCDD Summary Table & Analytical Results

PRELIMINARY ASBESTOS INSPECTION

January 31, 2023

City of Rockford
Attn: Matt Baillargeon
1111 Cedar Street
Rockford, IL 61102

Re: Preliminary Asbestos Inspection, 1229 Cedar St., Rockford, IL
AE Job #133.143

Dear Mr. Baillargeon:

On January 6, 2023, a non-destructive NESHAP preliminary inspection was performed at 1229 Cedar St., Rockford, IL, Illinois, in order to determine the presence of asbestos within the building materials. Certified Asbestos Inspector Jeff Anderson (100-20291) performed the inspection in order to determine the presence of asbestos within the building materials. The inspection consisted of visual observation, non-destructive bulk sampling of building materials, and laboratory analysis of suspect asbestos containing building materials by a laboratory that successfully participates in the AIHA Proficiency Analytical Testing (PAT) program. Samples were submitted to Micro Analytical in Milwaukee, WI, for analysis by polarized light microscopy (PLM). The type and quantity (percentage) of asbestos are identified by polarized light microscopy (PLM) following preparation and identification protocols recommended by the National Institute for Occupation Safety and Health (NIOSH) and the National Voluntary Laboratory Accreditation Program (NVLAP). No exterior building materials were sampled.

FRIABLE ASBESTOS – material can be crumbled, pulverized, or reduced to powder by hand pressure; these materials must be removed prior to demolition activities and should be addressed during renovation activities that would disturb the material, such as thermal system insulation. The following friable asbestos containing materials were identified:

- None

CATEGORY 1 NON-FRIABLE – material is pliable (not brittle), breaks by tearing rather than fracturing and does not easily release asbestos fibers upon breaking; these materials should be addressed during renovation activities that would disturb the material, but do not need removal prior to demolition activities (handled as demolition material at a certified landfill) if they are in good condition and not rendered friable during handling, transporting, and disposal. However, most asbestos containing building materials on concrete substrate are removed prior to demolition activities to reduce the overall cost due to landfill charges and the fact that concrete cannot be left on site or recycled with these materials in place. Category I Non-Friable materials include resilient floor coverings, asphalt roofing materials, gaskets, and packing. The following types of Category I Non-Friable asbestos were identified:

- Roofing, assumed

*Please Note: non-friable asbestos containing materials in **good** condition that fall under Category I, such as flooring and/or mastics on wood substrate and roofing materials are not **required** to be removed prior to demolition per the USEPA 40 CFR Part 61 National Emissions Standards for Hazardous Air Pollutants (NESHAP); Final Rule, dated November 20, 1990. However, while demolition is being performed the material must be kept wet and all debris must go to an approved landfill that accepts demolition debris and does not burn, crush, grind or recycle the material. In addition, you must have a trained individual knowledgeable in the provisions of 40 CFR Part 61, Subpart M, on site during the demolition and available for inspection during normal business hours. If*

material becomes damaged or rendered friable during demolition, proper abatement procedures must immediately be instituted.

CATEGORY II NON-FRIABLE – material is not pliable, breaks by fracturing rather than tearing, and does release some asbestos fibers upon breaking; these materials should be addressed during renovation activities that would disturb the material and are removed prior to demolition activities since they are normally rendered friable during demolition and/or handling, transporting and disposal. Category II Non-Friable materials include any non-friable asbestos containing material that is not in Category I (i.e. transite siding). The following types of Category II Non-Friable asbestos were identified:

- None

NON ASBESTOS CONTAINING MATERIALS – The following materials were tested and found to contain *no* asbestos (or less than 1%):

- 2'x4' white lay-in ceiling tile
- Window caulk (<1% Chrysotile by PLM; 0.75% Chrysotile by Point Count Method)
- Brick and mortar
- Cinder block and mortar

EPA guidance recommends analysis of non-friable materials by PLM with gravimetric reduction due to the high number of false negative PLM analyses for these types of materials. Asbestos fibers in these materials are often below the detection capabilities of the optical PLM microscope and cannot be detected. Gravimetric reduction includes high temperature ashing and acid digestion and is normally performed prior to Transmission Electron Microscopy (TEM) analysis. Gravimetric reduction of non-friable samples prior to PLM analysis enhances the detection of fibers. If no asbestos is detected by this method, TEM is recommended for definitive analysis.

Due to the distinct possibility that conditions may exist which could not be identified within the scope of this preliminary inspection or which were not apparent during the site visit, any additional material discovered that has not been listed above must be assumed to be asbestos containing; or, if non-friable material becomes damaged or rendered friable during the renovation/demolition activities, proper abatement procedures must immediately be instituted. You must have a trained individual knowledgeable in the provisions of 40 CFR Part 61, Subpart M, on site during the demolition and available for inspection during normal business hours. It is recommended that this report be sent to the demolition contractor as well.

Lead Containing Paint

On January 31, 2023, a lead containing paint survey was conducted using a Niton XRF. Sample locations ranged from 0.0 to 1.9 ppm lead. For work involving HUD, child-occupied building and other residential units, the Federal Lead Standard is 0.5% lead by weight (5000 ppm) or 1.0 milligram per square centimeter (MG/CM2). Lead-free paint (CPSC*) is defined as <0.009% by weight (<90 ppm.) The requirements of OSHA Lead in Construction Standard, 29CFR 1926.62 are invoked if any lead is present in the sample; there is no minimum concentration. See Appendix D for the XRF Testing Data Sheet.

Hazardous Materials Discovered During Inspection Include:

1. Thermostats (8)
2. Light Ballasts (80)

3. Asphalt Sealant 5 gal pails (2)

If you have any questions, please feel free to contact me at 815/962-9000. Thank you for the opportunity to serve you on this project.

Sincerely,

A handwritten signature in black ink, appearing to read "Jeff. Anderson", with a stylized, flowing script.

Jeff. Anderson
Operations

Appendix A – Laboratory Analytical Report
Appendix B – Photographs
Appendix C – Table of Quantities
Appendix D – XRF Testing Data Sheet

Appendix

A

MICRO ANALYTICAL, INC.

11521 West North Avenue
Milwaukee, WI 53226
(414) 771-0855

BULK ASBESTOS ANALYTICAL REPORT
Utilizing PLM and Dispersion Stain Technique

Customer: Anderson Environmental
& Engineering, Co.
201 N. Sixth Street
Rockford, IL 61107

Report #: 216102
Received: 09-Jan-23
Analyzed: 13-Jan-2023

Job ID: 133.143 - Stanley Street Building

Sample ID	% Asbestos	Non-Asbestos		Color	Texture
		Fibrous Components	Non-Fibrous Components		
1A	None Detected	65% Fibrous Glass	35%	Yellow	Compressed
1B	None Detected	65% Fibrous Glass	35%	Yellow	Compressed
1C	None Detected	65% Fibrous Glass	35%	Yellow	Compressed
2A	<1% Chrysotile		100%	Tan	Compact
2B	<1% Chrysotile		100%	Tan	Compressed
2C	<1% Chrysotile		100%	Tan	Compact
3A	None Detected		100%	Orange	Compact
3A II	None Detected		100%	Brown	Compact
3B	None Detected		100%	Orange	Compact
3B II	None Detected		100%	Brown	Compact
3C	None Detected		100%	Orange	Compact
3C II	None Detected		100%	Brown	Compact
4A	None Detected		100%	Gray	Compact
4B	None Detected		100%	Gray	Compact
4C	None Detected		100%	Gray	Compact

Analyzed By: Aaron Engelman

Test method: EPA/600/R-93/116 and EPA - Appendix E to Subpart E of 40 CFR Part 763. Quantitation is done by Calibrated Visual Estimation which has an accepted Relative Percent Difference of 35. This report may not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This test report relates only to the items tested and shall not be reproduced except in full, without the written approval of MICRO ANALYTICAL, INC.

SAMPLE LOG & SAMPLE NOTES

Date: 01/06/2023_____

Day of Week: Friday_____

Page 1_____ of 1_____

**THIS IS A CHAIN-OF-CUSTODY DOCUMENT.
PLEASE FILL IT OUT COMPLETELY AND SIGN ACCORDINGLY.**

Job Name: Stanley Street Building Pre-Demo Inspection_____ Job # 133.143_____

Building Name: Pump House_____

Sample Area/Lot Number and Name: _____

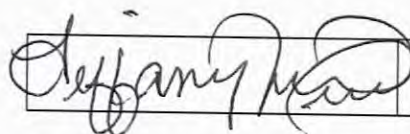
Sample Number	Photo Number	Description of Sampled Material	Sample Site Location
1A-C		CEILING TILE SUSPENDED 2X4 WHITE	OLD OFFICE AREAS
2A-C		WINDOW CAULK	ALL EXTERIOR WALLS
3A-C		BRICK / MORTAR	THROUGHOUT
4A-C		CINDER BLOCK / MORTAR	OLD OFFICE AREAS

Receiving Analyst's Name

Receiving Analyst's Firm

Inspector's Name

Inspector's Firm

 1/9/23

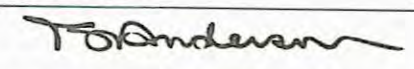
Jeff Anderson 100-20251	Anderson Environmental Co.

Receiving Analyst's Signature

Date Samples Received

Inspector's Signature

Date Samples Collected

MICRO ANALYTICAL, INC.

11521 West North Avenue
Milwaukee, WI 53226
(414) 771-0855

BULK POINTCOUNT ANALYTICAL REPORT
Utilizing PLM and Dispersion Staining

Customer: Anderson Environmental
& Engineering, Co.
201 N. Sixth Street
Rockford, IL 61107

Report #: 216275
Received: 17-Jan-23
Analyzed: 20-Jan-2023

Job ID: 133.143 - Stanley Street Building

Sample ID	% Asbestos	Asbestos Type	Color	Description
2A	<0.25	Chrysotile	Tan	Compact
2B	0.75	Chrysotile	Tan	Compact
2C	0.25	Chrysotile	Tan	Compact

Analyzed By: Jon Yakish

Test methods: EPA/600/R-93/116 and EPA - Appendix E to Subpart E of 40 CFR Part 763. Quantitation is done by Point Count Technique, which has an accepted Relative Percent Difference of 35. This report may not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This test report relates only to the items tested and shall not be reproduced except in full, without the written approval of MICRO ANALYTICAL, INC.

Appendix

B

Property Name: Stanley Street Building

Address: 1229 Cedar Street

City, State: Rockford, IL

Anderson
environmental



Photo 1

Date: 01/06/2023

Location/Facing: Office Ceiling

Description:

Ceiling Tile Suspended 2'X4' White



Photo 2

Date: 01/06/2023

Location/Facing: Exterior Windows

Description:

Window Caulk



Photo 3

Date: 01/06/2023

Location/Facing: Throughout

Description:

Brick / Mortar

Property Name: Stanley Street Building

Address: 1229 Cedar Street

City, State: Rockford, IL

Anderson
environmental



Photo 4

Date: 01/06/2023

Location/Facing: Interior

Description:

Cinder Block / Mortar

Appendix

C

Table 1 - Asbestos Containing Materials
Quantities and Budgetary Estimates
3993 W. State St., Rockford, Illinois

Material Description	Material Location	Asbestos Type	Material Condition	Quantity	Removal cost/unit
Roofing Materials	Roofing	Assumed	Damaged	Unknown	Leave in place for demolition

- *All quantities are estimated and any contractor should field verify quantities prior to bidding on this work.*
 - *Access to the roof was not provided.*

Appendix D

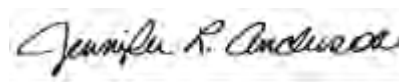
XRF TESTING DATA SHEETS

Date: 1/31/2023 Page: 1 of 1 Job #: 133.143

Facility Name: Stanley Street Facility Address: 1229 Cedar Street, Rockford, IL

Room: _____ XRF Serial Number: 24568 Model #: XLp300A

Inspector Name: Jennifer Anderson Inspector Signature: _____



Sample #	Substrate	Component	Color	Test Location	XRF Result mg/cm ²
1	-	-	-	Test Calibration	1.0
2	Metal	Beams	Blue	First Floor	1.9
3	Brick	Wall	Blue	First Floor	0.5
4	Brick	Wall	White	First Floor	0.05
5	Concrete Block	Wall	Blue	First Floor	0.10
6	Concrete Block	Wall	White	First Floor	0.03
7	Wood	Door	Green	First Floor	0.0
8	Wood	Door Trim	Blue	First Floor	0.0
9	Ceramic	Wall	Grey	Restroom	0.0
10	Metal	Pumps	Dark Blue	Pump Room	1.0
11	-	-	-	Test Calibration	1.0

For more location information
please visit www.strand.com

Office Locations

Ames, Iowa | 515.233.0000

Brenham, Texas | 979.836.7937

Cincinnati, Ohio | 513.861.5600

Columbus, Indiana | 812.372.9911

Columbus, Ohio | 614.835.0460

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin* | 608.251.4843

Milwaukee, Wisconsin | 414.271.0771

Nashville, Tennessee | 615.800.5888

Phoenix, Arizona | 602.437.3733

*Corporate Headquarters

