CITY OF MATTOON, ILLINOIS

BIDDING DOCUMENTS,
CONTRACT DOCUMENTS,
AND SPECIFICATIONS

FOR THE

RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1
IEPA SRF Loan #L17-4844

May 2015

VOLUME 2 OF 2

BIDDING AND CONTRACTING REQUIREMENTS

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MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

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DIVISION 8 – DOORS AND WINDOWS

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PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Standard hollow metal doors, frames and interior window frames.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required.

E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

F. Other requirements as shown in Section 01330 – Submittals.

1.03 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10B, UL 10C.

B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

1. Amweld Building Products, LLC.

2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
6. Firedoor Corporation.
7. Fleming Door Products Ltd.; an Assa Abloy Group company.
8. Kewanee Corporation (The).
9. Mesker Door Inc.
10. Pioneer Industries, Inc.
11. Security Metal Products Corp.
12. Steelcraft; an Ingersoll-Rand company.
13. Windsor Republic Doors.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180)] metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I.

H. Glazing: Division 08 Section 08800 – Glass and Glazing.

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.03 STANDARD HOLLOW METAL DOORS

A. General: Comply with ANSI/SDI A250.8.

1. Design: Flush panel .
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

a. Fire Door Core: As required to provide fire-protection ratings indicated.
b. Thermal-Rated (Insulated) Doors: R-value of not less than 6 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.

3. Vertical Edges for Single-Acting Doors: Square edge.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush)

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).

D. Hardware Reinforcement: ANSI/SDI A250.6.

2.04 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Exterior and Interior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Borrowed Lights: Same as adjacent door frame.

C. Hardware Reinforcement: ANSI/SDI A250.6.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.06 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.07 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, same material as door face sheet.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, same material as frames.

D. Terminated Stops: Where indicated, terminate stops 6 inches (152 mm) above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.08 LOUVERS

A. Provide sightproof louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Fire-Rated Automatic Louvers: Movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated.

2.09 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

2.10 FABRICATION

A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

B. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.

C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

i. Two anchors per jamb up to 60 inches (1524 mm) high.
ii. Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
iii. Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
iv. Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

i. Three anchors per jamb up to 60 inches (1524 mm) high.
ii. Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
iii. Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
iv. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
v. Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.

c. Compression Type: Not less than two anchors in each jamb.
d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers.

a. Single-Door Frames: Three door silencers.
b. Double-Door Frames: Two door silencers.

D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 electrical Sections.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.

5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.11 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: ANSI/SDI A250.10.

B. Field finish paint.

1. Color and Gloss: As selected by Architect.

PART 3 EXECUTION

3.01 INSTALLATION

A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Division 08 Section 08800 – Glass and Glazing and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.02 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Insulated service doors.

B. Related Section:

1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.

B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1.03 SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Show locations of replaceable fusible links.
3. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Seismic Qualification Certificates: For overhead coiling doors**,** accessories, and components, from manufacturer.

E. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

F. Maintenance Data.

1.04 QUALITY ASSURANCE

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

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 PRODUCTS

2.01 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.

B. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from metal to match curtain slats and finish.

C. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.02 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.03 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
2. Keys: Provide two for each cylinder.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.04 CURTAIN ACCESSORIES

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door. Provide pull-down straps or pole hooks for doors more than 84 inches (2130 mm) high.

2.05 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.06 MANUAL DOOR OPERATORS

A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.

B. Push-up Door Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf (111 N).

C. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 30 lbf (133 N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.07 RESERVED

2.08 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ACME Rolling Doors.
b. Alpine Overhead Doors, Inc.
c. AlumaTek, Inc.
d. C.H.I. Overhead Doors.
e. City-Gates.
f. Cookson Company.
g. Cornell Iron Works, Inc.
h. Dynamic Closures Corp.
i. Lawrence Roll-Up Doors, Inc.
j. Mahon Door Corporation.
k. McKeon Rolling Steel Door Company, Inc.
l. Metro Door.
m. Overhead Door Corporation.
n. QMI Security Solutions.
o. Raynor.
p. Southwestern Steel Rolling Door Co.
q. Wayne-Dalton Corp.
r. Windsor Door.

B. Operation Cycles: Not less than 10,000.

C. Fire Rating: As shown on drawings.

D. Curtain R-Value: 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W.

E. Door Curtain Material: Aluminum.

F. Door Curtain Slats: Flat profile slats of 1-7/8-inch (48-mm) or 2-5/8-inch (67-mm) center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

G. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

H. Hood: Aluminum.

1. Shape: Square.
2. Mounting: Face of wall.

I. Locking Devices: Equip door with locking device assembly and chain lock keeper.

1. Locking Device Assembly: Cremone type, both jamb sides locking bars, operable from inside and outside with cylinders.

J. Manual Door Operator: Chain-hoist operator.

K. Hood: Weather and Bird Proof Brushes or Guards.

L. Door Finish:

1. Aluminum Finish: Clear anodized.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

M. Door Bottom Bar:

1. Clear anodized aluminum

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Fire-Rated Doors: Install according to NFPA 80.

C. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

D. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide weathertight fit around entire perimeter.

3.02 DEMONSTRATION

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

END OF SECTION 083323

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Fiberglass Reinforced Plastic (FRP) Doors (Standard Construction Series).
2. Fiberglass Resin Door and Window Frames (Standard Construction Series).
3. Hardware: Fiberglass Reinforced Plastic Weatherstripping, Door Sweeps

B. Related Sections:

1. Section 07920 – Sealants
2. Section 087100 – Door Hardware
3. Section 08800 - Glazing

1.02 QUALITY ASSURANCE

A. Referenced Standards

1. ASTM D 635 - Standard Test Method Rate of Burning.
2. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Material.
3. Laminate Properties – ASTM D 882 Tensile Strength, ASTM D 790 Flexural Strength, ASTM D 2593 Barcol Hardness, ASTM D 256 Impact Resistance, ASTM D 792 Density/ Specific Gravity of Laminate, ASTM D Mechanical Fasteners.
4. Core Properties – ASTM C 177, ASTM D Density/ Specific Gravity.

B. Manufacturer Qualifications: Manufacturer specializing in the manufacturing of FRP doors and frames as specified herein with a minimum of twenty years of documented experience and with a record of successful in-service performance for the applications as required for this project.

C. Installer Qualifications: An experience installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.

D. Source Limitations: Door Hardware and accessories for all FRP doors as specified in Section 087100 shall be provided and installed by the fiberglass door and frame manufacturer.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for the products specified in this Section. Product Technical Data includes the following materials:

1. Submit Manufacturers Certification that products submitted meets requirements as referenced herein.
2. Submit Manufacturer’s details showing core and edge construction.
3. Submit Certification of manufacturer’s qualifications.

B. Shop Drawings:

1. Submit a summary door and window schedule Indicating the specific reference door and window opening numbers, location, door type, window type, frame type, size, handing, accessories and hardware for each door and window opening indicated on drawings.
2. Door, Window and Frame Schedule: Indicate each door and window opening assembly in project; cross-reference to plans, elevations, and details.

C. Color: Submit manufacturer's standard color chips for owner color selection.

D. Warranty Documents: Manufacturer's standard warranty documents, executed by manufacturer's representative, countersigned by Contractor.

E. Operation and Maintenance Manuals: Submit the following documents at project closeout:

1. Manufacturer’s recommended methods and frequency for maintaining optimum condition of fiberglass doors and frames under anticipated use conditions.
2. Manufacturer’s Certificate of Warranty

1.04 PROJECT CONDITIONS

A. Field Measurements:

1. Check existing door and window openings by accurate field measurements before fabrication.
2. Show recorded measurements on final shop drawings.
3. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide individual crated protection for each door, window and frame. Clearly mark each unit with specific door location as referenced on the drawings. Each crate should contain necessary fasteners for installation and installation instructions.

B. Store doors, windows and frames in original container out of inclement weather for protection from the elements.

C. Handle doors, windows and frames pursuant to manufacturer's recommendations.

1.06 WARRANTY

A. Manufacturer's Warranty:
1. Submit Manufacturer's signed original 20-year Warranty covering all FRP doors, windows and frames against failure due to corrosion.

1.07 COORDINATION OF SECURITY ACCESS HARDWARE (RESERVED)

1.08 SINGLE SOURCE RESPONSIBILITY

A. Single source responsibility for Finish Hardware, Steel Doors & Frames, Fiberglass Reinforced Plastic Doors, Windows & Frames and Aluminum Doors Hardware shall be supplied by the same Architectural Hardware Consultant / Supplier.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. CHEM-PRUF DOOR CO. LTD.
2. CORRIM COMPANY

2.02 MATERIALS

A. Fiberglass Mat: Minimum of 1.5 ounces per sq. ft.

B. Resins: Manufacturer's formulation for fabricating unit to meet specified requirements.

C. Anchors: Manufacturer's standard stainless steel expansion anchors for existing openings, and stainless steel masonry tee anchors for new construction.

D. Fasteners: Stainless steel.

E. Glazing: Type specified in Section 08800; factory installed.

2.03 MANUFACTURED UNITS

A. Non-rated Fiberglass Reinforced Plastic (FRP) Doors:

1. Thickness: 1-3/4 inches.
2. Thermal Insulating Value: 'R' factor 11.
3. Construction:

a. Core: Core material shall be 2 psf expanded polyurethane foam completely filling all voids between door plates.
b. Door Plates: 1/8" thick, molded in one continuous piece, with a 25 mil gelcoat of the specified color, integrally molded with at two layers of 1.5 ounces per square foot fiberglass mat and one layer of 16 ounce per square yard unidirectional roving.
c. Yield plate weight shall be 0.97 lbs per square foot at a ratio of 30/70 glass to resin.
d. Door Edges: Minimum three (3) layers resin-reinforced glass fiber mat, nominal 3/8 inch thick, machine tooled.

4. Sizes: Indicated on drawings.
5. Finish: Smooth gloss surface, minimum value 88 in accordance with ASTM D 523.
6. Color: Selected by Architect / Engineer.

C. Non-rated Fiberglass Frames:

1. Construction: Molded one-piece pultruded fiberglass reinforced plastic, minimum 1/4 inch wall thickness, jamb-to-head joints mitered and reinforced with FRP clips and stainless steel fasteners; conforming to SDI requirements for performance equivalent to 16 gage steel frames.
2. Frame profile: Indicated on drawings.
3. Sizes: Indicated on drawings.
4. Finish: Identical in color and texture to door with 25 mil resin gel coat integrally molded into frame at time of manufacture.
5. Color: Selected by Architect / Engineer.

D. Frame Anchors: Non-corrosive types recommended by manufacturer for existing project conditions.

E. Door Hardware: Specified Section 087100.

2.04 FABRICATION

A. Fiberglass Reinforced Plastic (FRP) Doors:

1. Minimum glass fiber to resin ratio: 30 percent.
2. Mortise for lockset, and recess for strike plate in lock stile.
3. Embed steel or stainless steel reinforcement for hinges in fiberglass matrix; provide for hinge leaf recesses in hinge stile.

B. Fiberglass Frames:

1. Mortise for lock strike, and recess for strike plate in lock jamb.
2. Reinforce for hinges and other indicated hardware.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate required openings with contractor.

B. Verify openings are correctly prepared to receive doors and frames.

3.02 EXAMINATION

A. Verification of Conditions:

1. Openings are correctly prepared to receive doors and frames.
2. Openings are correct size and depth in accordance with shop drawings.

B. Installer's Examination:

1. Have installer examine conditions under which construction activities of this section are to be performed and submit written report if conditions are unacceptable.
2. Transmit two copies of installer's report to Owner within 24 hours of receipt.
3. Beginning construction activities of this section before unacceptable conditions have been corrected is prohibited.
4. Beginning construction activities of this section indicates installer's acceptance of conditions.

C. Verify that glazing has been factory-installed.

3.03 INSTALLATION

A. Install door and window opening assemblies in accordance with shop drawings, and the manufacturer's printed installation instructions, installation methods and materials specified in installation instructions.

B. Installation of door hardware is specified in Section 087100.

C. Install door hardware in accordance with manufacturer's printed instructions, using through-bolts to secure surface applied hardware.

D. Site Tolerances: Maintain plumb and level tolerances specified in manufacturer's printed installation instructions.

E. Field alterations of doors, windows or frames to accommodate field conditions is strictly prohibited.

3.04 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding, and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

3.05 CLEANING

A. Clean surfaces of door opening assemblies and sight-exposed door hardware in accordance with manufacturer's maintenance instructions.

3.06 PROTECTION OF INSTALLED PRODUCTS

A. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

3.07 FINAL ACCEPTANCE OF COMPLETE WORK

A. The work shall be complete in every detail and the finished work approved by the Architect / Engineer and Owner before final acceptance.

END OF SECTION 08340

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Exterior manual-swing entrance doors and door-frame units.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: For each exposed finish required.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

1.03 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values for each aluminum-framed entrance.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

1.06 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

C. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Entrance Doors:

a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq.ft. (75 Pa).
b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

D. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 MANUFACTURERS

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

1. EFCO Corporation.
2. Kawneer North America.
3. TRACO.
4. United States Aluminum.
5. Vistawall Architectural Products.
6. YKK AP America Inc.

2.03 EXTERIOR DOORS

A. Manufacturer's standard insulated finish face aluminum door.

1. Material Standard: ASTM B221; 6063-T6 alloy and temper.
2. Door face sheet shall be plain unpatterned architectural quality 5055 alloy aluminum sheet .062" minimum.
3. Manufacturer's face backer panel.
4. Core shall be foam-in-place urethane insulated to minimum R-Value of 6.
5. Door thickness shall be a nominal 1 ¾".
6. Glazing Stops and Gaskets: Beveled or square, snap-on, extruded-aluminum stops and preformed gaskets.]

   a. Provide nonremovable glazing stops on outside of door.

7. Door Hardware: As specified in Division 08 Section "Door Hardware".

B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

1. Nominal Size: 1 ¾ by 4 ½ inches (45 by 115 mm).

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

   a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

   a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.04 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware".

2.05 GLAZING

A. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.06 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.07 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 07920 “Joint Sealants” to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 “Glazing”.

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

END OF SECTION 084113

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes fixed aluminum-framed windows.

1.02 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size required by AAMA/WDMA 101/I.S.2/NAFS.

B. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient.

1.03 SUBMITTALS

A. Product Data: For each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details

C. Samples: For each exposed finish.

D. Product Schedule: Use same designations indicated on Drawings.

E. Field quality-control test reports.

F. Product test reports.

G. Maintenance data.

1.04 QUALITY ASSURANCE

A. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.

B. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
c. Faulty operation of movable sash and hardware.
d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: Two years from date of Substantial Completion.
b. Glazing: 10 years from date of Substantial Completion.
c. Metal Finish: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the same manufacturer as Aluminum-Framed Entrances and Store Fronts.

2.02 WINDOW

A. Window Type: Fixed, butt glazed where shown on drawings.

B. Comply with AAMA/WDMA 101/I.S.2/NAFS.

1. Performance Class and Grade: HC 40 minimum.

C. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

D. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to NFRC 100.

1. U-Factor: 0.43 Btu/sq. ft. x h x deg F (2.5 W/sq. m x K) or less.

E. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.40, determined according to NFRC 200 procedures.

2.03 GLAZING

A. Glass and Glazing Materials: Refer to Division 8 Section 08800 – Glass and Glazing for glass units and glazing requirements applicable to glazed aluminum window units.

B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.04 FABRICATION

A. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.

B. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

D. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

G. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section 08800 – Glass and Glazing and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

2.05 ALUMINUM FINISHES

A. Aluminum Anodic Finish: Class I, clear anodic coating complying with AAMA 611.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows 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 weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

F. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

G. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

H. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

I. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08520

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Commercial door hardware.
2. Cylinders for doors specified in other Sections.

B. Related Sections

1. Section 083323 - Overhead Coiling Doors
2. Section 08340 - Fiberglass Reinforced Plastic Doors and Frames
3. Section 084113 - Aluminum-Framed Entrances

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Details of door hardware, including wiring diagrams.

C. Samples: For each exposed finish.

D. Other Action Submittals:

1. Door Hardware Sets: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.

   a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
   b. Content: Include the following information:

      i. Identification number, location, hand, fire rating, and material of each door and frame.
      ii. Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
      iii. Complete designations of every item required for each door or opening including name and manufacturer.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

1. Installer's responsibilities include supplying and installing door hardware and providing a qualified Architectural Hardware Consultant available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

D. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.05 COORDINATION

A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.

2.02 HINGES, GENERAL

A. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior and Interior Hinges: Stainless steel, with stainless-steel pin.
2. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.
3. Continuous Hinges: Stainless Steel or Anodized Aluminum

C. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors.

D. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors and frames.
3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.03 HINGES

A. Butts and Hinges: BHMA A156.1.

1. Basis of Design: Hager Companies (HAG)
2. (HI-1) BB1191 4.5 x 4.5 (NRP).
3. Subject to compliance with requirements, other available manufacturers are as follows.

a. Baldwin Hardware Corporation (BH)
b. Bommer Industries, Inc. (BI)
c. Cal-Royal Products (CRP)

d. Lawrence Brothers, Inc. (LB)
e. McKinney Products Company
f. Stanley Commercial Hardware

B. Continuous Geared Heavy Duty Hinges

1. Basis of Design: Hager Companies (HAG)
2. 780 Series (HI-2)
3. Subject to compliance with requirements, other available manufacturers are as follows:

a. Pemko
b. McKinney

2.04 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

C. Lock Trim/Levers:

1. Basis of Design: Schlage N-Series, Rhodes Lever, 626 Finish.
2. Subject to compliance with requirements, other available manufacturers are as follows:

a. Falcon Locks.
b. Sargent Manufacturing Co.

D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

E. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.05 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:

1. Bored Locks: BHMA A156.2.

B. Bored Locks: BHMA A156.2**,** Grade 1 Series 4000.

1. Available Manufacturers:
   a. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
   b. Schlage Commercial Lock Division; an Allegion Company (SCH).
   c. Falcon Locks; an Allegion Company.

2.06 AUXILIARY LOCKS AND LATCHES

A. Auxiliary Locks: BHMA A156.5, Grade 1 with interchangeable core. Single cylinder dead bolt with thumb turn.

1. Manufacturers:

   a. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
   b. Schlage Commercial Lock Division; an Allegion Company (SCH).
   c. Falcon Locks; an Allegion Company.

2.07 EXIT DEVICES

A. Exit Devices: BHMA A156.3**,** Grade 1.

B. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

E. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

F. Outside Trim: Lever with cylinder, material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

G. Through Bolts: For exit devices and trim on metal doors.

H. Manufacturers:

1. Basis of Design: Von Duprin, Inc. 98 Series, US32D Finish.

a. (ED-1) 98 Rim.
b. (ED-2) 9875.

2. Subject to compliance with requirements, other available manufacturers are as follows:

a. DORMA Architectural Hardware; Member of the DORMA Group North America (DAH).
b. Monarch Exit Devices & Door Hardware; an Ingersoll-Rand Company (MON).

2.08 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5**,** Grade 1.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins**:** Six.

C. Permanent Cores: Manufacturer's standard; finish face to match lockset; with removable cores.

D. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Manufacturer: Same manufacturer as for locks and latches.

2.09 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference into master key system.

1. Existing System: Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver permanently inscribed with a visual key control number and including the notation "DO NOT DUPLICATE."

1. Quantity: In addition to one extra key blank for each lock, provide three cylinder change keys and five master keys.

2.10 OPERATING TRIM

A. Standard: BHMA A156.6.

B. Materials: Fabricate from stainless steel, unless otherwise indicated.

C. Available Manufacturers:

1. Burns Manufacturing Incorporated (BM).
2. Don-Jo Mfg., Inc. (DJO).
3. Forms + Surfaces (FS).
4. Hager Companies (HAG).
5. Hiawatha, Inc. (HIA).
6. IVES Hardware; an Ingersoll-Rand Company (IVS).
7. Rockwood Manufacturing Company (RM).
8. Trimco (TBM).

2.11 CLOSERS

A. Accessibility Requirements: Comply with the following maximum opening-force requirements:

1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
2. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
3. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4**,** Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Manufacturers:

a. Basis of Design: LCN 400 Series, Aluminum Finish.
b. Subject to compliance with requirements, other available manufacturers are as follows:

1. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
2. Norton Door Controls; an ASSA ABLOY Group company (NDC).

2.12 PROTECTIVE TRIM UNITS

A. Size: 1-1/2 inches (38 mm) less than door width on push side and 1/2 inch (13 mm) less than door width on pull side, by 12" height.

B. Metal Protective Trim Units: BHMA A156.6; beveled top and 2 sides; fabricated from the following material:

1. Material: 0.050-inch- (1.3-mm-) thick stainless steel.
2. Manufacturers:

a. Basis of Design: Hager Companies, US32D Finish.

i. 194S 10 x 34

b. Subject to compliance with requirements, other manufacturers are as follows:

i. American Floor Products Co., Inc. (AFP).
ii. Baldwin Hardware Corporation (BH).
iii. Burns Manufacturing Incorporated (BM).
iv. Don-Jo Mfg., Inc. (DJO).
v. Hiawatha, Inc. (HIA).
vi. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation (IPC).
vii. IVES Hardware; an Ingersoll-Rand Company (IVS).
viii. Pawling Corporation (PAW).
ix. Rockwood Manufacturing Company (RM).
x. Trimco (TBM).

2.13 STOPS AND HOLDERS

A. Stops and Bumpers: BHMA A156.16**,** Grade 1.

1. Provide floor stops for doors unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Silencers for Door Frames: BHMA A156.16, Grade 1; neoprene or rubber; fabricated for drilled-in application to frame.

C. Manufacturers:

1. Basis of Design: Hager Companies, US32D.

a. 234W.

2. Subject to compliance with requirements, other manufacturers are as follows:

a. Architectural Builders Hardware Mfg., Inc. (ABH).
b. Baldwin Hardware Corporation (BH).
c. Burns Manufacturing Incorporated (BM).
d. Cal-Royal Products, Inc. (CRP).
e. Don-Jo Mfg., Inc. (DJO).
f. Door Controls International (DCI).
g. DORMA Architectural Hardware; Member of The DORMA Group North America (DAH).
h. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
i. HES, Inc.; an ASSA ABLOY Group company (HES).
j. Hiawatha, Inc. (HIA).
k. IVES Hardware; an Ingersoll-Rand Company (IVS).
l. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
m. Rockwood Manufacturing Company (RM).
n. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
o. Stanley Commercial Hardware; Div. of The Stanley Works (STH).
p. Trimco (TBM).

2.14 DOOR GASKETING

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on exterior doors and provide continuous smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for both exterior and interior applications. Provide lengths to match specified door and frame sizes.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

G. Manufacturers

1. Basis of Design: Hager Companies.

a. (GA-1) 891S (jamb gasket)
b. (GA-2) 802S (split astragal)
c. (SW-1) 750S (sweep)

2. Subject to compliance with requirements, other manufacturers are as follows:

a. M-D Building Products, Inc. (MD).
b. National Guard Products (NGP).
c. Pemko Manufacturing Co. (PEM).
d. Reese Enterprises (RE).
e. Sealeze; a unit of Jason Incorporated (SEL).
f. Zero International (ZRO).

2.15 THRESHOLDS

A. Standard: BHMA A156.21.

B. Accessibility Requirements: Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch (13 mm) high.

D. Manufacturers

1. Basis of Design: Hager Companies, Mill Finish.

a. (TH-1) 412S-36.
b. (TH-2) 412S-72.
c. (TH-3) 412S-120.

2. Subject to compliance with requirements, other manufacturers are as follows:

a. M-D Building Products, Inc. (MD).
b. National Guard Products (NGP).
c. Pemko Manufacturing Co. (PEM).
d. Reese Enterprises (RE).
e. Rixson Specialty Door Controls; an ASSA ABLOY Group company (RIX).
f. Sealeze; a unit of Jason Incorporated (SEL).
g. Zero International (ZRO).

2.16 FLUSHBOLTS

A. Standard: BHMA A156.16; Stainless steel

2.17 FABRICATION

A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

B. Fasteners: Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Comply with NFPA 80 for fasteners of door hardware in fire-rated applications.

C. Finishes: All metallic hardware to have US32D finish, unless noted otherwise.

PART 3 EXECUTION

3.01 INSTALLATION

A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

C. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

F. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

3.02 HARDWARE SCHEDULE

A. Hardware Group #1: Door 100A

3ea.	Full Mortise Hinge	(H-1)
1ea.	Cylindrical Lock / Latch	
1ea.	Closer	
1ea.	Kickplate	
1ea.	Threshold	(TH-1)
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-1)

B. Hardware Group #2: Doors 600B, 601A, 701B

3ea.	Full Mortise Hinge	(H-1)
1ea.	Rim Exit Device / Latch	(ED-1)
1ea.	Closer	
1ea.	Kickplate	
1ea.	Threshold	(TH-1)
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-1)

C. Hardware Group #3: Door 701A

Active Leaf:

4ea.	Full Mortise Hinge	(H-1)

1ea.	Mortise Exit Device / Latch	(ED-2)
1ea.	Closer	
1ea.	Kick Plate	
1ea.	Threshold	(TH-2)
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-1)
1ea.	Gasket	(GA-2)

Inactive Leaf

4ea.	Full Mortise Hinge	(H-1)
2ea.	Flush Bolt (Top and Bottom)	
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-2)

D. Hardware Group #4: Doors 700A, 700B

Active Leaf:

4ea.	Full Mortise Hinge	(H-1)
1ea.	Cylindrical Lock / Latch	
1ea.	Closer	
1ea.	Kick Plate	
1ea.	Threshold	(TH-2)
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-1)
1ea.	Gasket	(GA-2)

Inactive Leaf:

4ea.	Full Mortise Hinge	(H-1)
2ea.	Flush Bolt (Top and Bottom)	
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-2)

E. Hardware Group #5: Door 600A

Active Leaf:

1ea.	Continuous Gear Hinge	(H-2)
1ea.	Cylindrical Lock / Latch	
1ea.	Threshold	(TH-3)
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-1)
1ea.	Gasket	(GA-2)

Inactive Leaf:

1ea.	Continuous Gear Hinge	(H-2)
1ea.	Flush Bolt (Bottom only)	
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-2)

F. Hardware Group #6: Door 602A

Active Leaf:

3ea.	Full Mortise Hinge	(H-1)
1ea.	Cylindrical Lock / Latch	
1ea.	Closer	
1ea.	Kickplate	
1ea.	Threshold	(TH-2)
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-1)
1ea.	Gasket	(GA-2)

Inactive Leaf

3ea.	Full Mortise Hinge	(H-1)
2ea.	Flush Bolt (Top and Bottom)	
1ea.	Sweep	(SW-1)
1ea.	Gasket	(GA-2)

G. Hardware Group #7: Door 702A

3ea.	Full Mortise Hinge	(H-1)
1ea.	Cylindrical Lock / Latch (Restroom)	
1ea.	Closer	
1ea.	Kickplate	

END OF SECTION 087100

PART 1 GENERAL

1.01 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows
2. Doors

1.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2003 International Building Code by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: As indicated on Drawings.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

1.03 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.04 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Preconstruction adhesion and compatibility test report.

1.05 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.06 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS

A. Tempered Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated

1. Products: Subject to compliance with requirements.

a. AFG Industries, Inc.; Krystal Klear.
b. Guardian Industries Corp.; Ultrawhite.
c. Pilkington North America; Optiwhite.
d. PPG Industries, Inc.; Starphire.

2.03 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal.
2. Spacer: Manufacturer's standard spacer material and construction.
3. 1” thick panel consisting of ¼” lites and ½” spacer.

2.04 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.05 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.06 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.07 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

PART 3 EXECUTION

3.01 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.02 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.03 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.04 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.05 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

DIVISION 9 – FINISHES

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PART 1 GENERAL

1.01 SUMMARY

A. This Section includes surface preparation and the application of paint systems at only the Blower and Electrical Building on the following interior substrates:

1. Concrete and Concrete masonry units (CMU).
2. Steel.
3. Galvanized metal.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each finish and for each color and texture required.

C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.03 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.04 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 PRODUCTS

2.01 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.

C. Colors: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.03 INTERIOR PAINTING SCHEDULE

A. CMU and Concrete Substrates:

1. Latex System: MPI INT 4.2A.

   a. Prime Coat: Interior/exterior latex block filler.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: Interior latex (gloss).

B. Steel Substrates:

1. Quick-Drying Enamel System: MPI INT 5.1A.

   a. Prime Coat: Quick-drying alkyd metal primer.
   b. Intermediate Coat: Quick-drying enamel matching topcoat.
   c. Topcoat: Quick-drying enamel (semigloss).

2. Water-Based Dry-Fall System: MPI INT 5.1C.

   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Topcoat: Latex dry fog/fall.

3. Alkyd Dry-Fall System: MPI INT 5.1D.

   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Topcoat: Interior alkyd dry fog/fall.

C. Galvanized-Metal Substrates:

1. Water-Based Dry-Fall System: MPI INT 5.3H.

   a. Prime Coat: Waterborne dry fall.
   b. Topcoat: Waterborne dry fall.

2. Alkyd Dry-Fall System: MPI INT 5.3F.

   a. Prime Coat: Cementitious galvanized-metal primer.
   b. Topcoat: Interior alkyd dry fog/fall.

3. Latex System: MPI INT 5.3A.

   a. Prime Coat: Cementitious galvanized-metal primer.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: Interior latex (semigloss).

4. Latex Over Waterborne Primer System: MPI INT 5.3J.

a. Prime Coat: Waterborne galvanized-metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (semigloss).

5. Alkyd System: MPI INT 5.3C.

a. Prime Coat: Cementitious galvanized-metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (semigloss).

END OF SECTION 099123

PART 1 GENERAL

1.01 SUMMARY

A. Section includes the requirements for field surface preparation and painting associated with high-performance coatings. Requirements for painting of building components that are not exposed to process water, sludge, gas, or vapors are specified elsewhere. All buildings, except the Blower and Electrical Building, shall receive high-performance coatings.

B. Related Sections:

1. Section 01435 – Manufacturer's Service.
2. Section 01600 – Product Requirements.
3. Section 099123 - Interior Painting.
4. Division 2 through 16 Specifications for specific coating system requirements.

1.02 REFERENCES

A. SSPC Surface Preparation and Paint Application Specifications as published by the Society of Protective Coatings.

B. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings, as published by the National Association of Pipe Fabricators.

C. International Concrete Repair Institute (ICRI) 310.2 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays (formerly No. 03732).

1.03 GENERAL

A. Perform all cleaning, surface preparation, and coating application in accordance with this specification section, the specifications of the Society of Protective Coatings (SSPC) and in accordance with the recommendations of the coating manufacturer.

B. The coating manufacturer shall make available a qualified factory representative to instruct the Contractor's coating applicators in the recommended cleaning, blasting and application procedures to insure that the coatings conform to the coating manufacturer's recommendations and the contract specifications.

C. For all concrete and masonry coatings, provide products of one coating manufacturer in order to achieve standardization for the maintenance, color match and appearance.

D. For all other coatings (steel, copper, plastic, etc.), provide products of one coating manufacturer.

E. Contractor shall coordinate selection of coating manufacturers with equipment suppliers, shop and field coating applicators to conform to this specification. Contractor shall execute purchase orders to reflect coating manufacturer identified in the Contractor's Bid.

1.04 DEFINITIONS

A. "Paint" as used herein means all coating systems, materials, including primers, emulsions, enamels, stains, sealers and fillers and other applied materials whether used as prime, intermediate or finish coat.

B. "Wetted Surfaces" refers to surfaces in direct contact with water, sludge, or exposed to vapors from water or sludge during routine plant operation.

C. "Non-wetted Surfaces" refers to surfaces not in direct contact with water or sludge and not exposed to vapors from water or sludge during routine plant operation.

D. "Interior" refers to surfaces inside buildings or enclosed within structures.

E. "Exterior" refers to surfaces that are outside structures and exposed to the elements.

F. "Buried Interior" refers to interior surfaces below grade.

G. "Buried Exterior" refers to exterior surfaces below grade.

H. "Inside/Submerged" refers to surfaces in direct contact with water and/or the inside surface of a process vessel, piping, channel, or other structure.

I. "Outside/Non-Submerged" refers to surfaces not in contact with water and/or the outside surface of a process vessel, piping, channel, or other structure.

1.05 ABBREVIATIONS

A. The following abbreviations are used within this section and elsewhere in the Contract Documents in reference to products specified under this Section:

1. MDFT: Minimum Dry Film Thickness (mils)
2. MDFTPC: Minimum Dry Film Thickness per coat (mils)
3. MIL: Thousandths of an Inch
4. MS-P: Military Specification - Paint
5. NACE: National Association of Corrosion Engineers International
6. PSDS: Paint System Data Sheet
7. SFPG: Square Feet Per Gallon
8. SFPGPC: Square Feet Per Gallon Per Coat
9. SP: Surface Preparation
10. SSPC: Society for Protective Coatings
11. DISP: Cast Iron and Ductile Iron Surface Preparation as described in this section.

1.06 SUBMITTALS

A. Submittals shall be made in accordance with Section 01330, Submittal Procedures. In addition, the following information shall be provided.

B. Product Data Sheets:

1. For each coating system used herein, furnish a Paint System Data Sheet (PSDS), Technical Data Sheets, and coating colors available (where applicable) for each product used in the coating system. A PSDS form is located at the end of this section.
2. Submit required information on a system-by-system basis.
3. Submit evidence that the coating manufacturer's application recommendations, have been distributed to all subcontractors and independent coating applicators who will apply coatings for work covered under this Contract (Indiscriminate submittal of manufacturer's literature only is not acceptable).

C. Submit coating manufacturer’s certification that zinc-rich coatings, if supplied, are lead-free.

D. Submit coating manufacturer's written instructions for applying each type of coating prior to application.

E. Submit a list of references substantiating the requirement for applicator's experience as specified.

F. Submit a document describing Contractor’s surface preparation and coating application quality control procedure and system. This requirement also applies to all subcontractors and independent coating applicators who will apply coatings for work covered under this contract.

G. Factory Applied Coatings: Submit buyout manufacturer's certification stating that factory applied prime and finish coating systems meet or exceed requirements specified herein. If factory applied shop prime coatings, on buyout items, differ from the herein specified coating manufacturer, for items to be field finish painted, the buyout manufacturers' must provide written confirmation that the coating materials are compatible.

H. Submit a surface preparation and coating application schedule outlining the sequence of work and estimated time required for each item. This shall also include approximate square footage of the surface areas involved with each item.

I. Upon completion of the work, certification from the coating manufacturer indicating that the quantity of each coating purchased was sufficient to properly coat all surfaces. Such certification shall make reference to the square footage figures provided to the coating manufacturer and to the Engineer by the Contractor.

1.07 MANUFACTURER'S QUALIFICATION

A. The coating manufacturer and coating application subcontractor shall have been engaged in the supply of high-performance coatings and application of coatings to steel structures, respectively, each for a five (5) year minimum.

B. The contractor shall require the coating application subcontractor to provide a list of previous experience, and that list shall be submitted to the Engineer. The list shall also indicate previous experience of the proposed job foreman. The coating application subcontractor and job foreman shall have no less than five (5) years' experience of painting wastewater treatment facilities.

1.08 QUALITY ASSURANCE

A. A system of quality control is required of the coating manufacturer to assure and to document that the coatings are manufactured to the standards and specifications specified in the contract documents.

B. A system of quality control is required for the Contractor to assure and to document that the cleaning, blasting and application of all coatings have been made in accordance with the coating manufacturer's recommendations and conditions specified herein.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Coatings are to be delivered to the Contractor, all subcontractors and independent applicators in the original sealed, unopened, dated and labeled containers of the coating manufacturer. At the time of use, the designated name, date of manufacture, color, and name of the coating manufacturer shall plainly show and shall be subject to the inspection of the Engineer or designated representative.

B. Labels on each container shall provide the following information as a minimum:

1. Name or title of material.
2. Federal Specification number, if applicable.
3. Manufacturer's stock number.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.

C. Store coatings in a suitable protected area that is heated or cooled as required to maintain temperatures above 50°F and within the range recommended by the coating manufacturer.

D. Shipping:

1. Where precoated items are to be shipped to the jobsite, protect coating from damage. Batten coated items to prevent abrasion.
2. Use nonmetallic or padded slings and straps in handling.
3. Items will be rejected for excessive damage.

1.10 WARRANTY

A. The bid shall be construed to contain a warranty from the Contractor for a period of 1 year from the date of acceptance for all materials and workmanship.

B. Furnish manufactures standard for coatings and linings

C. Any work proving defective within one year from the date of acceptance shall be redone without any additional expense to the Owner for labor or materials.

1.11 REGULATORY REQUIREMENTS

A. All of the Contractor's activities and equipment used on the jobsite must be in compliance with Federal, State and Local law. Defective or substandard equipment shall not be used. Hoists, ladder, and electrical equipment, scaffolding, hand or powered tools must meet all safety standards.

B. All coatings shall be in compliance with 35 ILL. Adm Code 223; 32 Ill. Reg. 17301 Standards and Limitations for Organic Material Emmissions for Area Sources

PART 2 PRODUCTS

2.01 COATINGS MANUFACTURERS

A. Coatings specified in this section shall be manufactured by:

1. Tnemec Company, Inc.; Kansas City, Missouri.
2. The Sherwin-Williams Company; Cleveland, Ohio.

B. Substitutions for specified coating manufacturer will not be accepted.

2.02 COATING MATERIALS

A. Products shall meet federal, state, and local requirements limiting the emission of volatile organic compounds (VOC's). Specific information may be secured through the local office of the Air Pollution Control Officer.

B. Materials Including Primer and Finish Coats: Produced by same coating manufacturer.

C. Thinners, Cleaners, Driers, and Other Additives: Only as recommended by coating manufacturer of the particular coating and shown on the PSDS supplied by the coating manufacturer.

D. Coating products are listed in the following schedules. The Item Code letter designation will be the paint identification code used in the Coatings Schedule. Low temperature products shall be used in accordance with manufacturer's recommendations and ambient conditions during application and curing.

2.03 APPLICATION SCHEDULE

A. Pumps, heat exchangers, pipe, fittings, valves, pipe supports, and other appurtenances and process equipment.

1. Do not field paint instruments, meters, valve actuators, motors, sheaves, shafts, and adjusting screws at packing glands, belt drives, etc.
2. Shop surface preparation shall be SSPC SP-10 abrasive blast with angular media and 1.5 to 2.0 mil profile for steel surfaces.
3. Shop surface preparation shall be in accordance with NAPF 500-03-04 for ductile iron pipe and NAPF 500-03-05 for ductile iron fittings.
4. Shop prime shall be compatible with field painting:

    a. Tnemec Series 1 Omnithane at 2.5 to 3.5 mils MDFT.
    b. Sherwin Williams Corothane I Galvapac at 2.5 to 3.5 mils MDFT.

5. Surfaces with shop surface preparation and prime coats that do not conform to the requirements listed above for shop-applied prime coat shall be considered to have a non-compatible prime coat. Pumps, heat exchangers, and other process equipment with manufacturer's standard coating or coating as specified elsewhere that does not conform to the requirements listed above for shop-applied prime coat shall be considered to have a non-compatible prime coat.
6. Field surface preparation shall be

    a. SSPC SP-1, Solvent Cleaning, to remove all surface contamination including all traces of asphaltic pipe and fitting coatings and residue.
    b. SSPC SP-2, Hand Tool Cleaning, and SSPC SP-3, Power Tool Cleaning, for areas of damaged prime coat less than 5 square inches to remove all but tightly adherent prime coat.
    c. SSPC SP-11, Power Tool Cleaning to Bare Metal, for removal of areas of damaged prime coat larger than 5 square inches and all areas of rust-contaminated substrate.
    d. Additional field surface preparation for surfaces with non-compatible prime coat shall include scuff sanding to remove surface gloss and chalking and to develop an anchor profile.

7. Field Prime Coat for surfaces with specified shop prime coat shall be touch-up and spot priming with one of the following:

    a. Tnemec Series 1 Omnithane at 2.5 to 3.5 mils MDFT.
    b. Sherwin Williams Corothane I Galvapac at 2.5 to 3.5 mils MDFT.

8. Field Prime Coat for surfaces with non-compatible prime coat shall be a tie-coat, touch-up and spot priming with one of the following:

    a. Tnemec Series 27 F.C. Typoxy at 2.0 to 3.0 mils MDFT.
    b. Sherwin Williams Dura-Plate 235 at 2.0 to 3.0 mils MDFT.

9. Field Intermediate Coat shall be:

    a. Tnemec Series 446 Perma-Shield MCU at 7.0 to 8.0 mils MDFT.
    b. Sherwin Williams Cor Cote HB at 7.0 to 8.0 mils MDFT.

10. Field Finish Coat for non-wetted interior and exterior surfaces shall be:

    a. Tnemec Series 1075 Endura-Shield II at 2.0 to 3.0 mils MDFT.
    b. Sherwin Williams Hi-Solids Polyurethane at 2.0 to 3.0 mils MDFT.
    c. Sherwin Williams Acrolon 218 HS at 2.0 to 3.0 mils MDFT.

11. Field Finish Coat for wetted and submerged surfaces shall be:

    a. Tnemec Series 446 Perma-Shield MCU at 7.0 to 8.0 mils MDFT.
    b. Sherwin Williams Cor Cote HB at 7.0 to 8.0 mils MDFT.

12. Field Finish Coat for steel piping exposed to chlorine shall be:
    a. Sherwin Williams Macropoxy 646 at 7.0 to 8.0 MDFT.

13. Note that application method may require additional coats to achieve the specified dry film thickness.
14. Note that color of second field coat shall be coordinated with color of third field coat.

B. Structural steel, miscellaneous steel fabrications, and miscellaneous steel components and fasteners – wetted and submerged surfaces.

1. Field surface preparation shall be SSPC SP-10 abrasive blast with angular media to provide a 1.5 to 2.0 mil profile.
2. Field Prime Coat shall be:

    a. Tnemec Series 1 Omnithane at 2.5 to 3.5 mils MDFT.
    b. Sherwin Williams Corothane I Galvapac at 2.5 to 3.5 mils MDFT.

3. Field Intermediate Coat shall be:

    a. Tnemec Series 446 Perma-Shield MCU at 7.0 to 8.0 mils MDFT.
    b. Sherwin Williams Cor Cote HB at 7.0 to 8.0 mils MDFT.

4. Field Finish Coat shall be:

    a. Tnemec Series 446 Perma-Shield MCU at 7.0 to 8.0 mils MDFT.
    b. Sherwin Williams Cor Cote HB at 7.0 to 8.0 mils MDFT.

5. Note that application method may require additional coats to achieve the specified dry film thickness.

C. Welded steel and appurtenances – exterior, non-wetted surfaces.

1. Field surface preparation shall be SSPC SP-10 abrasive blast with angular media to provide a 1.5 to 2.0 mil profile.
2. Field Prime Coat shall be:

    a. Tnemec Series 90-97 Tneme-Zinc at 2.5 to 3.5 mils MDFT.
    b. Sherwin Williams Corothane I Galvapac at 2.5 to 3.5 mils MDFT.

3. Field Intermediate Coat shall be:
    a. Tnemec Series N69 Hi-Build Epoxoline at 3.0 to 5.0 mils MDFT.
    b. Sherwin Williams Dura-Plate 235 at 3.0 to 5.0 mils MDFT.

4. Field Finish Coat shall be:

    a. Tnemec Series 1075 Endura-Shield at 3.0 to 5.0 mils MDFT.
    b. Sherwin Williams Hi-Solids Polyurethane at 3.0 to 5.0 mils MDFT.
    c. Sherwin Williams Acrolon 218 HS at 3.0 to 5.0 mils MDFT.

5. Note that application method may require additional coats to achieve the specified dry film thickness.

D. Structural steel, miscellaneous steel fabrications, and miscellaneous steel components and fasteners at exterior areas and interior areas with process equipment, pumps, piping, and sludge storage.

1. Field surface preparation shall be

    a. SSPC SP-1, Solvent Cleaning, to remove all surface.
    b. SSPC SP-2, Hand Tool Cleaning, and SSPC SP-3, Power Tool Cleaning, for areas of damaged coatings less than 5 square inches to remove all but tightly adherent coatings.
    c. SSPC SP-11, Power Tool Cleaning to Bare Metal, for removal of areas of damaged coatings larger than 5 square inches and all areas of rust-contaminated substrate.
    d. Scuff sanding to remove surface gloss and chalking and to develop an anchor profile.

2. Field Prime Coat shall be a tie-coat, touch-up and spot priming with one of the following:

    a. Tnemec Series 27 F.C. Typoxy at 2.0 to 3.0 mils MDFT.
    b. Sherwin Williams Corothane I Galvapac at 2.0 to 3.0 mils MDFT.

3. Field Intermediate Coat shall be:

    a. Tnemec Series N69 Hi-Build Epoxoline at 3.0 to 5.0 mils MDFT.
    b. Sherwin Williams Dura-Plate 235 at 3.0 to 5.0 mils MDFT.

4. Field Finish Coat for interior non-wetted service shall be:

    a. Tnemec Series N69 Hi-Build Epoxoline at 3.0 to 5.0 mils MDFT.
    b. Sherwin Williams Dura-Plate 235 at 3.0 to 5.0 mils MDFT.

5. Field Finish Coat for exterior non-wetted service shall be:

    a. Tnemec Series 1075 Endura-Shield at 3.0 to 5.0 mils MDFT.
    b. Sherwin Williams Hi-Solids Polyurethane at 3.0 to 5.0 mils MDFT.
    c. Sherwin Williams Acrolon 218 HS at 3.0 to 5.0 mils MDFT.

6. Note that application method may require additional coats to achieve the specified dry film thickness.

E. Structural and miscellaneous steel – Hot Dip Galvanized

1. In general, galvanized surfaces are not required to be painted except for touch-up, miscellaneous piping and pipe support components, or as specifically indicated otherwise on the drawings. Touch-up painting is required for all galvanized surfaces to repair all damage to galvanized surfaces. Touch-up painting shall also be provided for non-painted, non-galvanized, ancillary components of galvanized steel assemblies.
2. Where touch-up painting of galvanized surfaces is required, thoroughly abrade surface to be coated with a new, clean wire brush or power tool to remove any zinc salts or other contaminants that may have formed per SSPC-SP11 or SSPC-SP16 as recommended by the coating manufacturer. Clean surface with industrial solvent to remove dirt, dust, grease, oils, and loose zinc slat per SSPC-SP-1, Solvent Cleaning. Prime all areas devoid of galvanizing with one coat of ZRC Compound, overlapping at least 2 inches over existing galvanizing. Coating for galvanized surfaces shall be Z.R.C. Cold Galvanizing Compound, Sherwin Williams Zinc Clad Cold Galvanizing, or equal.
3. Galvanized fasteners and other miscellaneous components of piping and pipe support systems shall be field painted in accordance with the paint system scheduled for the piping or pipe support and the following surface preparation and priming requirements. Wash off oil, grease, and dirt by solvent cleaning in accordance with SSPS SP-1 or water-based alkaline cleaner recommended by the coatings manufacturer. Remove zinc ash residue by washing with a 1 to 2 percent ammonia solution. Phosphate wash/etch the surface with an acidic zinc phosphate solution, mordent solution, T-Wash, GalvaPrep, or equal. Do not over etch galvanized surface. Thoroughly rinse and dry surface after each treatment. Prior to application of the intermediate coat, prime galvanized surfaces with Tnemec Series 27 F.C. Typoxy at 3.0-5.0 mils MDFT or Sherwin-Williams Dura-Plate 235 at 3.0-5.0 mils MDFT.
4. Prepare galvanized surfaces requiring field touch-up according to ASTM D 6386-99 Standard Practice for Preparation of Zinc (Hot Dipped Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

F. Piping to be painted for Identification/Color Code Only

1. Unless noted otherwise PVC, CPVC, HDPE, stainless steel, aluminum, and copper piping shall be painted for the purpose of color coding and identification alone. The color coding can be paint or colored vinyl tape applied in a 12-inch wide field spaced a maximum of four feet with a centered, 2-inch wide band. Paint system shall be:

a. Prime coat of Tnemec Series 27 F.C. Typoxy at 3.0-5.0 mils MDFT or Sherwin-Williams Dura-Plate 235 at 3.0-5.0 mils MDFT.
b. Intermediate coat of Tnemec Series 1075 Endura-Shield II at 2.0 to 3.0 mils MDFT; Sherwin-Williams Hi-Solids Polyurethane at 2.0 to 3.0 mils MDFT; or Sherwin-Williams Acrolon 217 HS at 2.20 to 3.0 mils MDFT.
c. Top coat of Tnemec Series 1075 Endura-Shield II at 2.0 to 3.0 mils MDFT; Sherwin-Williams Hi-Solids Polyurethane at 2.0 to 3.0 mils MDFT; or Sherwin-Williams Acrolon 217 HS at 2.20 to 3.0 mils MDFT.
d. Color band of two (2) additional coats of Tnemec Series 1075 Endura-Shield II at 2.0 to 3.0 mils MDFT; Sherwin-Williams Hi-Solids Polyurethane at 2.0 to 3.0 mils MDFT; or Sherwin-Williams Acrolon 217 HS at 2.20 to 3.0 mils MDFT.
e. Colors shall be as specified below.

G. Concrete Masonry Units – Interior at areas with process equipment, pumps, and piping.

1. Field surface preparation: Allow mortar to cure for a minimum of 28 days. Level protrusions and mortar spatter, all surfaces must be clean, dry and free of oil, grease and other contaminants.
2. Field Prime Coat shall be:

a. Tnemec Series 130 Envirofill applied at a coverage of 60 to 80 square feet per gallon.
b. Sherwin Williams Cement Plex 875 applied at a coverage of 60 to 80 square feet per gallon.

3. Field Intermediate Coat shall be:

a. Tnemec Series 446 Perma-Shield MCU at 7.0 to 8.0 mils MDFT.
b. Sherwin Williams Cor Cote HB at 7.0 to 8.0 mils MDFT.

4. Field Finish Coat shall be:

a. Tnemec Series 1075 Endura-Shield at 2.5 to 3.5 mils MDFT.
b. Sherwin Williams Hi-Solids Polyurethane at 2.5 to 3.5 mils MDFT.
c. Sherwin Williams Acrolon 218 HS at 2.5 to 3.5 mils MDFT.

H. Precast Concrete, Precast Concrete Ceiling Panels, and cast-in-place concrete – Interior at areas with process equipment, pumps, and piping.

1. Field surface preparation: SSPC SP-13, Surface profile in accordance with ICRI CSP 1-3. Fill honeycombs, blow holes, and surface imperfections with one of the following:

a. Tnemec Series 215 Surfacing Epoxy.
b. Sherwin Williams Steel-Seam FT910.

2. Field Prime Coat shall be:

    a. Tnemec Series N69 Hi-Build Epoxoline at 3.0 to 5.0 mils MDFT.
    b. Sherwin Williams Dura-Plate 235 at 3.0 to 5.0 mils MDFT.

3. Field Intermediate Coat shall be:

    a. Tnemec Series 446 Perma-Shield MCU at 7.0 to 8.0 mils MDFT.
    b. Sherwin Williams Cor Cote HB at 7.0 to 8.0 mils MDFT.

4. Field Finish Coat shall be:

    a. Tnemec Series 1075 Endura-Shield at 2.5 to 3.5 mils MDFT.
    b. Sherwin Williams Hi-Solids Polyurethane at 2.5 to 3.5 mils MDFT.
    c. Sherwin Williams Acrolon 218 HS at 2.5 to 3.5 mils MDFT.

5. Apply field prime coat prior to the surface filler only where necessitated by out-gassing.

I. Precast concrete, concrete masonry units, grout, and cast-in-place concrete at containment areas – all surfaces below the flood rim within containment areas.

1. Field surface preparation: SSPC SP-13/NACE 6, Surface profile in accordance with ICRI CSP 5.
2. Field Prime Coat shall be:

    a. Tnemec Series 120-5002 Vinester at 12.0 to 18.0 mils MDFT.
    b. Sherwin Williams Corobond Vinyl Ester Primer at 3.0 to 4.0 mils MDFT.

3. Field Finish Coat shall be:

    a. Tnemec Series 120-5001 Vinester at 12.0 to 18.0 mils MDFT.
    b. Sherwin Williams Cor Cote VEN FF at two (2) coats at 12.0 to 18.0 mils MDFT per coat.

J. PVC Piping – Above grade exterior areas where PVC is exposed to atmosphere.

1. Field surface preparation: All exposed pipe surfaces shall be scuff sanded with 220 grit sandpaper to remove surface dirt, residues, oil and any foreign contaminants and then wiped dry with a clean dry cloth. Petroleum based solvents should not be used on PVC pipes.
2. Two (2) Field Coats of self priming Sherwin Williams Bond Plex B71-200 series waterbased acrylic coating or Tnemec equivalent applied at 2.0 to 3.0 mils MDFT per coat.
3. Color shall be light gray.

K. Surfaces not to be painted

1. Unless noted otherwise instruments, flowmeters, motors, electric actuators for valves & gates, stainless steel equipment & structures, aluminum equipment and structures, solenoid valves, handrail, grating, and electrical conduit & enclosures shall receive manufacturer's shop coatings as specified elsewhere and not receive a field paint system.

2.04 COLORS

A. Provide finish coat colors as scheduled below or as selected by the Owner through the Engineer. Wetted and submerged surfaces shall be gray.

B. Formulate with colorants free of lead, lead compounds, or other materials which might be affected by presence of chlorine or other gas likely to be present at the project.

C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply matches.

2.05 COLOR SCHEDULE

Surface for Application	Tnemec Color Designation
Combined sewage	84BR Weathered Bark with 35GR Black Bands
Non-potable Water	25BL Fountainbleu with 35GR Black Bands
Potable Water	11SF Safety Blue
Chlorine	02SF Safety Yellow
Sewage (Wastewater)	34GR Deep Space
Compressed Air	91GN Balsam
Fuel Oil/Diesel	06SF Safety Red
Plumbing Drains and Vents	35GR Black

Colors not listed herein shall be selected by Owner during construction.
* Includes all process and sidestream lines.

2.06 FILM THICKNESS TESTING GAUGES

A. Provide the use of a magnetic type dry film thickness gauge (Type 1 or Type 2), to test coating thickness specified in mils, as manufactured by:

1. Type 1 – Nordson Corp., Anaheim, CA, Mikrotest, or equal.
2. Type 2 – Defelsko, Positector, or equal.

B. Provide use of an electrical holiday detector, low voltage, wet sponge type to test finish coat, except zinc primer, high-build elastomeric coatings, and galvanizing, for holidays and discontinuities as manufactured by:

1. Tinker and Rasor, San Gabriel, CA, Model M-1.
2. Or equal.

C. Provide a high voltage holiday detector for elastomeric coatings in excess of 20 mils dry film thickness. Unit to be as recommended by the coating manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating for any purpose until completion of curing cycle.

B. All metal surfaces, wetted, non-wetted, interior, exterior, submerged and non-submerged, shall be painted, whether specifically mentioned or not, except as modified herein.

C. No coating shall be applied when the temperatures of the surface to be painted is below the minimum or above the maximum temperature recommended by the coating manufacturer for application or curing for the type of coating being applied. Provide environmental control for painted surfaces when the surface or ambient temperature may range below the minimum or above the maximum recommended temperature during the curing period. No coating shall be applied in a dust or smoke-laden atmosphere.

D. The temperature of the surface to be painted shall also be at least five (5) degrees above the dew point and rising. Coatings shall not be applied to wet or damp surfaces, and shall not be applied in rain, snow, fog or mist, or when the relative humidity exceeds 80%. No coating shall be applied when it is expected that the relative humidity will exceed 80% or that the air temperature will drop below the manufacturer's recommended minimum temperature within 1 hour after the application of the coating. Dew or moisture condensation should be anticipated, or if such conditions are prevalent, painting shall be delayed to be certain that the surfaces are dry.

E. The day's painting should be completed well in advance of the probable time of day when condensation will occur, in order to permit the film an appreciable drying time prior to the formation of moisture.

F. The prime or first coat shall be applied as soon as possible after the abrasive blasting and before <u>any</u> rust blooms occur. Each coat shall be allowed to thoroughly dry before applying the next coat. All work shall be cut in neatly and finished coats shall be uniform in color and texture without streaks, laps, heavy build-up, runs, sags or missed areas.

G. Surfaces that are contaminated by rain, sleet, snow, water, dirt, dust, rust blooms, oxidation, or other foreign substances shall be cleaned, dried, and surface preparation restored or repeated prior to application of coating.

H. Concealed structural steel surfaces shall receive surface preparation and prime, intermediate, and finish coats unless modified herein.

I. Striping: All corners, edges, welds and rough areas on scheduled surfaces shall be painted by brush after the prime coat and before the first intermediate coat.

Coating type shall be the same as that for the following full coat and shall be a color which contrasts with the prime and intermediate coats. All striping shall be allowed to dry for a minimum time equal to manufacturer's published recommendation for time to handle before application of the following full coat.

J. If a particular coat does not have sufficient dry film thickness as specified, an additional coat or coats of the same material shall be applied until the minimum specific dry mil thickness is achieved.

K. Take all necessary precautions to prevent damage to adjacent property, vehicles, etc. by falling debris, paint in any form, overblast, abrasive accumulation, etc. The Contractor will be held directly responsible for any damages caused as a result of this work. The Owner and Engineer shall not accept any liability for damage to adjacent property, vehicles, etc. by falling debris, paint in any form, etc.

L. Provide adequate ventilation which will effectively remove solvents for proper drying of coatings applied on interior surfaces.

M. All coatings shall be applied under the conditions specified herein by a skilled applicator.

N. Protect all surfaces including concrete from paint spills, drips, and overspray. Remove any paint spills, drips, and overspray from these surfaces.

O. Provide minimum 25 foot candles (270 1x.) of lighting on surfaces to be finished.

3.02 SURFACES NOT REQUIRING COATING

A. Remove, mask, or otherwise protect hardware, switchplates, aluminum surfaces, machined surfaces, flanged surfaces, nameplates, factory finished surfaces and other surfaces not intended to be painted. Replace identification markings on mechanical, electrical, or other equipment when abraded, painted, or spattered

3.03 APPLICATION SAFETY

A. Perform painting in accordance with recommendations of the following:

1. Coating manufacturer's instructions.
2. NACE, contained in the publication, Manual for Painter Safety.
3. Federal, state, and local agencies having jurisdiction.

3.04 PAINT MIXING

A. Multiple-Component Coatings:

1. Prepare using all the contents of the container for each component as packaged by coating manufacturer.
2. No partial batches will be permitted. In the sole opinion of the Engineer, this requirement may be omitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.

4. Provide coating manufacturer's small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by coating manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.
7. Maintain continuous mechanical pot mixing during application of zinc primers.

B. Keep coating materials sealed when not in use.

C. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

3.05 PREPARATION OF SURFACES – GENERAL

A. Perform preparation and cleaning procedures in strict accordance with coating manufacturer's instructions and as herein specified for each particular substrate condition.

B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Re-install, following completion of painting of each space or area, removed items by workmen skilled in trades involved.

C. Schedule cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

D. Unless otherwise shown or specified in these specifications, all metal surfaces, interior, exterior, submerged and non-submerged, shall be abrasive blast cleaned in accordance with the Coatings Schedule. In the event of discrepancies or omissions, request clarification from the Engineer before starting work in question. Abrasive blast cleaning shall be in conformance with SSPC visual standards.

3.06 STEEL SURFACE PREPARATION:

A. General:

1. Workmanship for metal surface preparation as specified shall meet current SSPC Specifications as follows:

   a. Solvent Cleaning: SP 1.
   b. Hand Tool Cleaning: SP 2.
   c. Power Tool Cleaning: SP 3.
   d. White Metal Blast Cleaning: SP 5.
   e. Commercial Blast Cleaning: SP 6.
   f. Brush-Off Blast Cleaning: SP 7.
   g. Pickling: SP 8.
   h. Near-White Blast Cleaning: SP 10.
   i. Power Tool Cleaning to Bare Metal: SP11.
   j. Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals: SP16

2. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in these Specifications or in coating manufacturer's specifications, they shall be understood to refer to the applicable SSPC Specifications listed above.
3. Hand tool clean areas that cannot be cleaned by power tool cleaning.
4. Test Sections

    a. Prior to production-scale surface preparation, the Contractor shall prepare a test section for each specified preparation level. Each test section shall be located within the area receiving the respective preparation and shall, by the Engineer's consideration, be representative of the existing surface condition and steel type.
    b. The test sections shall be prepared using the same equipment, materials and procedures as the production scale surface preparation. Each test section shall be in the range of 4 to 9 square feet. The Contractor shall prepare each test section surface to the specified level in accordance with the SPPC visual standards supplied by the Engineer.
    c. Only after a test section has been approved shall the Contractor proceed with production scale surface preparation operations. The visual standards shall be used in addition to the plans and specifications to determine the degree of conformance with the appearance requirements and to determine acceptance of the surface preparation.
    d. No additional compensation will be allowed the Contractor for preparation of test sections.

B. Preblast Cleaning Requirements:

1. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
2. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
3. Clean small isolated areas as above or solvent clean with suitable solvents and clean cloths.
4. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
5. Prepare Welds and Adjacent Areas such that there is:

    a. No undercutting or reverse ridges on weld bead.
    b. No weld spatter on or adjacent to weld or any other area to be painted.
    c. No sharp peaks or ridges along weld bead.

6. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

C. Blast Cleaning Requirements:

1. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness.
2. Select type and size of abrasive to produce a surface profile that meets coating manufacturer's recommendations for particular primer to be used.
3. Use only dry blast cleaning methods.
4. Do not reuse abrasive.
5. Provide a uniform blast profile in the range specified in the Coatings Schedule with a minimal number of embedded particles.
6. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning and disposition of spent aggregate and debris.
7. Blasting shall not be done in dewy, foggy or rainy weather nor when the steel surface is less than five (5) degrees above the dew point and rising.
8. For field blasting, use a low dust abrasive such as Staurolite or equivalent.

D. Post-Blast Cleaning and Other Cleaning Requirements:

1. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
2. Paint surfaces the same day they are sandblasted.
3. Re-blast surfaces that have started to rust before they are painted.

E. Inspections: Schedule with the Engineer as specified herein.

F. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods which involve a solvent or cleaning action.
2. Method meets SSPC-SP 1.

3.07 CAST IRON AND DUCTILE IRON SURFACE PREPARATION

A. Do not burnish the surface of tightly adherent annealing oxide or exposed substrate iron.

B. Do not over-blast as-cast ductile iron surfaces.

C. Provide surface preparation of cast iron and ductile iron piping in accordance with NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings, as published by the National Association of Pipe Fabricators.

1. NAPF 500-03-01 “Solvent Cleaning”
2. NAPF 500-03-02 “Hand Tool Cleaning”
3. NAPF 500-03-03 “Power Tool Cleaning”
4. NAPF 500-03-04 “Abrasive Blast Cleaning of Ductile Iron Pipe”
5. NAPF 500-03-05 “Abrasive Blast Cleaning of Cast Ductile Iron Fittings”

D. For previously uncoated surfaces, perform the following operations in the sequence listed:

1. Solvent clean according to NAPF 500-03-01 after a thoroughly scrubbing the entire surface with a solvent-soaked, stiff-bristle brush.
2. Remove heavy accumulations or deposits of dirt, annealing oxides, rust, and mold coatings as possible with a dull putty knife according to NAPF 500-03-02.
3. Abrasive blast according to NAPF 500-03-04 for pipe and NAPF 500-03-05 Grade #2 for fittings to remove dirt, dust, loose annealing oxides, loose rust, and loose mold coatings. Tightly adhering rust stains, annealing oxide, and mold coatings may remain on pipe. Surface will have a roughened appearance and surface profile of 1.5 mils minimum.
4. Remove all raised slivers, scabs, laminations, or bristles by abrasive grinding according to NAPF 500-03-03 or hand filing. Blast burnished or smoothed areas to provide the specified surface profile.

3.08 CEMENTITIOUS SURFACE PREPARATION

A. Curing and evaluation:

1. Concrete and masonry construction shall be completed and cured for twenty-eight (28) days or more and prior to surface preparation work.
2. Surfaces shall be tested for pH and where required treated to adjust pH to within a range compatible with manufacturer's recommendation for coating products scheduled for application.
3. Test surfaces for moisture content by a polyethylene cover test performed in areas that are most likely to be slow drying.

    a. Securely tape an eighteen (18) inch square piece of 4 mil, clear polyethylene film to the surface.
    b. Examine the film for evidence of moisture condensation after twenty-four (24) hours has elapsed from attachment of the film to the concrete.
    c. Coating application shall not begin until evidence of moisture on the film does not exist at the conclusion of the twenty-four (24) hour moisture test.
    d. Test locations and results shall be approved by Engineer.

B. Contaminants and defects:

1. Surface contaminants such as non-degraded release agents, excess curing compound, fats, oils, wax, grease, etc. shall be removed by scraping and cleaning with a cleaning agent such as trisodium phosphate solution that is approved by the coating manufacturer.
2. Surface voids and defects shall be filled with a patching compound approved by the coating manufacturer.
3. Surface defects such as fins, protrusions, bulges, and moisture spatter shall be removed by grinding or scraping.
4. Do not damage masonry mortar joints or adjacent surfaces.

C. Abrasive blasting and etching:

1. Clean concrete and masonry surfaces by the methods outlined in SSPC SP-13, Surfaces Preparation of Concrete. Use wire brushing, scraping, high pressure water cleaning, mechanical abrasion, track blasting, or sandblasting whereas necessary and as required on the Paint Schedule to achieve the proper ICRI CSP standard. Vacuum clean, air blast clean or water clean to remove dirt, dust and loose material. Steam clean or detergent clean to remove oils, and then wash with a strong detergent solution to remove dust, dirt, scale, paint, oil and grease, efflorescence, stains and contaminants.
2. Abrasive blasting shall be by dry air blast, airless centrifugal wheel blast, or hydroblast. Abrasive blasting shall open up subsurface irregularities such as surface voids, bug-holes, air pockets, etc.
3. Acid etching shall be performed on a damp surface in accordance with manufacturer's recommendations with non-metallic fiber brushes after surface has been pressure washed with clean water and shall be followed by pressure washing with clean water.
4. Abrasive blasting or acid etching SHALL NOT EXPOSE AGGREGATE.

D. Clear coated surfaces:

1. Clear coated masonry surfaces shall be free of discolorations and uniform in texture after cleaning.
2. Prepare concrete floors to be clear coated by acid etching to a uniform texture without excessive surface erosion.
3. Do not blast concrete surfaces scheduled for clear coat finish.

3.09 SCUFF SANDING

A. Surfaces scheduled for surface preparation by scuff sanding shall have the entire surface uniformly abraded to remove surface gloss and chalking and provide an adequate anchor profile for subsequent application of coatings. Scuff sanding shall not appreciably reduce dry film thickness. Scuff sanding shall be performed with 80 to 150 grit sandpaper and hand or power tools (vibratory or low rpm).

B. Surfaces not scheduled for scuff sanding but which have exceeded the coating manufacturer's maximum recommended time to recoat shall be prepared by scuff sanding as described above prior to recoating.

3.10 CONTAINMENT

A. Surface preparation with low-dust abrasives, limiting use of spray application for zinc-rich primers only, and monitoring wind conditions are intended to minimize but do not preclude the need for containment for surface preparation and painting. Provide containment as defined by SSPC Guide 6 (1995), Class 4A, Class 3A or equivalent segmented containment when the following conditions are NOT met by Contractor's operations:

1. No fugitive dust emissions are visible to IEPA personnel, Owner's personnel, Engineer, Engineer's representative, or other observers beyond the limits of the Project area or Owner's property.

2. Paint is applied by rolling and wind speed is less than 15 mph.
3. Coatings are applied with dry-fall conditions that are acceptable to Owner, Owner's personnel, Engineer or Engineer's representative.
4. Containment is not explicitly required by IEPA or Agency representative.
5. Emission of dust or paint particles is not observed at ventilation exhaust at interior areas.

B. The structural adequacy of a containment system and of the structure with a containment system attached shall be the responsibility of the Contractor.

C. Perform surface preparation and painting of interior areas with a mist filter or similar device attached to the ventilation exhaust to prevent emission of dust or paint particles.

3.11 APPLICATION OF COATINGS

A. Apply each coat to uniform finish without runs, sags, brush or roller marks, skips, ropiness or other defect. Apply coatings in accordance with coating manufacturer's recommendations. Allow sufficient time between coats to assure thorough drying of previously applied coatings. Clean surfaces free of loose particles and use tack cloth just prior to applying each coat.

B. Paint units to be bolted together and to structures prior to assembly or installation.

C. Areas inaccessible for painting after final erection shall have the specified surface preparation and coating application prior to final erection.

D. Steel surfaces shall be finished coated prior to the installation of grouted bottoms or application of insulation.

E. Inspections: Schedule with the Engineer as specified herein.

F. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint is of uniform finish, color and appearance.

G. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only.

H. For exposed piping, paint entire pipe surfaces including under/behind supports. Also paint all surfaces of supports including those in contact with the pipe. Painting of concrete saddle supports is not required. Coating applicator shall be responsible for providing temporary pipe supports as necessary during execution of this work.

I. Paint interior surfaces of ducts, where visible through registers or grilles, with flat, non-specular black paint.

J. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

K. Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.

L. Each coat of paint shall be perceptibly different shade or color. Each coat shall be inspected by Engineer before following coat may be applied. Only coats of paint inspected and found satisfactory by Engineer will be considered in determining minimum number of coats applied.

M. Minimum drying time shall comply with that recommended by coating manufacturer. Each coat shall be thoroughly dry before application of succeeding coats.

N. Make edges of paint adjoining other materials or colors sharp and clean without overlapping.

O. Unless otherwise shown or specified in these Specifications paint or coat the work in accordance with the Application Schedule. In the event of discrepancies or omissions in the following, request clarification from the Engineer before starting work in question.

P. Contractor shall minimize excessive film build at surfaces that include exposed fasteners (such as pipe flange bolting) by using a method of coating application (such as HVLP spray) that will provide the necessary control over film build over irregular surfaces. In areas that have, in the sole opinion of the Engineer, excessive film build, Contractor shall be responsible for removal of excessive coatings on exposed fasteners, replacing fasteners that may become damaged by the coating removal process, and re-application of the specified coating system.

3.12 MATERIALS PREPARATION

A. Mix and prepare coating materials in accordance with coating manufacturer's written directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of coatings in clean condition, free of foreign materials and residue.

C. Stir materials before application to produce mixture of uniform density and stir as required during application of materials. Do not stir surface film into the material. Remove film and if necessary, strain material before using.

3.13 SHOP PRIMED OR FACTORY FINISHED SURFACES

A. Inspection: Schedule with Engineer in advance for shop primed or factory finished items delivered to jobsite for compliance with Specifications.

B. Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer to restore the original shop prime millage and texture.

3.14 MANUFACTURER APPLIED PAINT SYSTEMS

A. Repair abraded areas on factory finished items in accordance with the equipment manufacturer's directions.

B. Carefully blend repaired areas into original finish.

3.15 FILM THICKNESS

A. Coverage is listed as either total minimum dry film thickness in mils (MDFT) or the spreading rate in square feet per gallon (SFPG).

B. Number of Coats: Minimum required irrespective of coating thickness. Additional coats may be required to obtain minimum required coating thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

C. Maximum film build per coat shall not exceed coating manufacturer's recommendations.

D. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:

1. Perform with properly calibrated instruments.
2. Recoat and repair as necessary for compliance with the Specifications.
3. All coats will be subject to inspection by Engineer and coating manufacturer's representative.

E. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained, if specified for coating.

F. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.

G. Thickness Testing:

1. After repaired and recoated areas have dried sufficiently, final tests shall be subject to inspection by the Engineer.
2. Where required in the Application Schedule, measure coating thickness specified in mils with a magnetic type dry film thickness gauge as specified.
3. Where required in the Application Schedule, test finish coat, except zinc primer, galvanizing, and elastomeric coatings in excess of 25 mils dry, for holidays and discontinuities with an electrical holiday detector, low voltage, wet sponge type as specified.
4. Where required in the Application Schedule, holiday detect coatings in excess of 25 mils dry with high voltage units recommended by the coating manufacturer.
5. Where required in the Application Schedule, check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.

H. Measure dry film thickness in accordance with SSPC PA 2 for steel and SSPC PA 9 for concrete. MDFT listed in the Coating Schedule is dry film thickness above the substrate profile.

1. For Type 1 gauge, record magnetic pull-off gauge reading for uncoated, prepared substrate or similarly prepared reference panel. Dry film thickness shall be determined by subtracting the reference reading of uncoated substrate from the measured film thickness of coated surface.
2. For Type 2 gauge, the gauge reading is the dry film thickness and no adjustment for substrate profile is required.

3.16 DAMAGED OR DEFECTIVE COATINGS, PINHOLES, AND HOLIDAYS

A. All areas displaying damaged or defective coatings, pinholes, holidays or other defects in the coating shall be marked with chalk that is approved by the coating manufacturer.

B. Feather edges and repair in accordance with recommendations of coating manufacturer.

C. Repair fusion bonded coatings as recommended by original applicator. Applicator shall provide liquid repair kits for this purpose as recommended by coating manufacturer.

D. Apply finish coats, including touchup and damage-repair coats in a manner which will present a uniform texture and color-matched appearance.

E. The coating system applied as part of the repair of damaged or defective coatings, pinholes and holidays shall meet the requirements for the surface preparation and coating system specified for the surface receiving the repair.

3.17 UNSATISFACTORY APPLICATION

A. If item has an improper finish color, or insufficient film thickness, clean and top coat the surface with specified coating material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer and submit a description of the proposed correction to the Engineer.

B. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Apply the prime, intermediate, and finish coats in accordance with the Specifications. Depending on extent of repair and appearance, finish sanding and topcoat may be required for additional areas.

C. Evidence of runs, bridges, sags, skips, laps, or other imperfections shall be cause for rejection as damaged or defective coatings.

D. Repair defects in coating system per written recommendations of coating manufacturer.

E. Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.18 PROTECTION

A. Protect work of other trades, whether to be painted or not, against damage by surface preparation, painting and finishing work in accordance with Section 01760 – Protecting Installed Construction. Correct damages by cleaning, repairing or replacing and repainting in accordance with Section 01760 – Protecting Installed Construction and as directed by Engineer.

B. Provide “Wet Paint” signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

3.19 INSPECTION

A. Leave all staging up until Engineer has inspected surface or coating. Replace staging removed prior to inspection of surface or coating by Engineer.

B. Visual inspection for pinholes, holidays, dry spray, sags and other flaws shall be performed after each coat is applied. All such flaws shall be corrected before the next coat is applied.

C. Holiday Testing: For all inside/submerged steel surfaces, a pinhole free and continuous film is essential. All interior and submerged coated steel surfaces shall receive holiday testing with the specified holiday detector a minimum of seven (7) days after application of the finish coat. Holiday testing shall be conducted in the presence of the Engineer or the Engineer’s Representative. Any areas failing this test shall be marked with chalk that is approved by the coating manufacturer and receive an additional repair coat until satisfactory test results are achieved.

D. If film defects on the inside/submerged surfaces are suspected to involve a significant void or holiday, or the film has been damaged to the substrate, the affected areas shall be masked off with chalk that is approved by the coating manufacturer and spot abrasive blast cleaned in accordance with SSPC-SP 10 and successive coats applied until the specified film thickness is achieved.

E. The final film is to be visually inspected and shall be free of sags, runs, wrinkles and other excessive film build characteristics and surface defects.

F. Field Adhesion Testing shall be performed for tie-coats applied over manufacturer’s standard shop coats. Areas affected by testing shall be repaired to specified coating system. Adhesion testing shall also be performed for any coating applied over questionably prepared substrate at Engineer’s discretion. Field adhesion testing shall be limited to the minimum extent necessary to ascertain if the adhesion of the coat to the substrate is adequate, as determined by Engineer’s subjective evaluation of the testing. Engineer shall choose from the following test options.

1. The first field adhesion test performed shall be a “pen knife test” where the paint coat in question is cut and probed with a pen knife in an attempt to lift it from the substrate coating or surface. If adequate adhesion can be ascertained from the “pen knife test” the adhesion shall be considered adequate and no further adhesion testing shall be required.

2. The next level of field adhesion testing shall be cross-cut testing in accordance with ASTM D-3359, “Measuring Adhesion by Tape Test”. If adequate adhesion can be ascertained from the ASTM D-3359 testing the adhesion shall be considered adequate and no further adhesion testing shall be required.
3. The final level of adhesion testing shall be ASTM D-4541 adhesion testing performed with Hate, Elcometer, or Patti testers. Adequate adhesion strength as determined by ASTM D-4541 shall be not less than 500 psi or the coating manufacturer’s written requirement for adhesion strength.
4. If field adhesion testing cannot separate a tie-coat from a shop coat without the shop coat delaminating from the substrate surface or if the shop coat adhesion strength is demonstrated to be significantly less than the required tie-coat adhesion strength, the tie-coat adhesion shall be considered adequate.

3.20 THICKNESS MEASUREMENTS AND TOLERANCES

A. The thicknesses shown on the Application Schedule are the minimum allowable as defined by SSPC-PA 2. The standard states a specified number of "spot readings" shall be taken on each 100 square feet of surface. Make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area to be measured. The average of five spot measurements for each such 100 square foot area shall not be less than the specified thickness. No single spot measurement in any 100 square foot area shall be less than 80% of the specified thickness. Any one of three readings which are averaged to produce each spot measurement may under-run by a greater amount. The five spot measurements shall be made for each 100 square feet area per SPCC-PA2, Section 3-Number of Measurements for Conformance to a Thickness Specification.

B. Some paints are especially sensitive to high or low film thickness. In all cases, limitations on maximum or minimum film thickness specified in the manufacturers’ instructions shall be followed.

C. The tolerances for the thicknesses indicated shall be as listed in the following table.

Specified MDFT	Minimum Spot Reading Available	Maximum Spot Reading Available	Maximum Average Thickness Available
THICKNESS READINGS IN mils			
1.0	0.8	3.0	2.0
2.0	1.6	5.0	4.0
3.0	2.4	7.0	6.0
4.0	3.2	8.5	7.0
5.0	4.0	9.5	8.0
6.0	4.8	10.5	9.0
7.0	5.6	11.5	10.0
8.0	6.4	12.5	11.0
10.0	8.0	14.5	13.0
12.0	9.6	17.4	15.6
15.0	12.0	23.0	20.0
20.0	16.0	29.0	26.0
25.0	20.0	36.0	32.0
30.0	24.0	42.0	38.0
35.0	28.0	48.0	44.0
40.0	32.0	55.0	50.0
50.0	40.0	68.0	62.0
60.0	48.0	81.0	74.0

3.21 ANNIVERSARY INSPECTION

A. A first anniversary inspection shall be conducted by the Owner, Contractor and coatings manufacturer(s), no less than one (1) year from the date of final acceptance of all factory, shop and field finished painted items. The inspection shall be conducted in accordance with NACE RPO 288-88, inspection of lining on steel and concrete.

3.22 SHOP AND FIELD INSPECTIONS

A. Provide the Engineer with a minimum of seven (7) days advance notice prior to the start of all surface preparation work and coating application work. This notice also applies to the Contractor's sub-contractors.

B. Perform all surface preparation and coating work in the presence of the Engineer or his designated representative, unless the Engineer grants written approval to perform such work in the Engineer's absence.

C. The Engineer reserves the right to designate a NACE Level 3 inspector or other qualified coatings and corrosion professional as his designated representative.

D. All inspections will be conducted in strict accordance with these specifications, the contract documents, the coating manufacturer's recommendations, and all applicable codes and industry standards.

3.23 COATING MANUFACTURER'S SERVICES

A. Provide coating manufacturer's representative to visit fabrication facilities and field locations at intervals during surface preparation and coating as may be required for product application quality assurance, and to determine compliance with coating manufacturer's instructions and these Specifications, and as may be necessary to resolve all problems attributable to, or associated with, the coating manufacturer's products furnished under this Contract.

B. Provide a minimum Field Service Representation by the coatings manufacturer as follows:

1. Initial start-up of coating application: Two (2) trips with one (1) day on-site each, excluding travel time.
2. Intermediate inspection during application: Three (3) trips with one (1) day on-site each, excluding travel time.
3. Final inspection: One (1) trip with one (1) day on-site, excluding travel time.
4. Anniversary inspection: One (1) trip with one (1) day on-site excluding travel time.

END OF SECTION 09960

PAINT SYSTEM DATA SHEET (PSDS) for:

PRIME COAT: (Location or Equipment)

Paint System Number (From Specs):		
Paint System Location (From Specs):		
Coatings Supplier:		
Representative:		
Surface Preparation:		
Color:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats Coverage

INTERMEDIATE COAT:

Paint System Number (From Specs):		
Paint System Location (From Specs):		
Coatings Supplier:		
Representative:		
Surface Preparation:		
Color:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats Coverage

FINISH COAT:

Paint System Number (From Specs):		
Paint System Location (From Specs):		
Coatings Supplier:		
Representative:		
Surface Preparation:		
Color:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats Coverage

MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

DIVISION 10 – SPECIALTIES

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PART 1 GENERAL

1.01 SUMMARY

A. This Section includes warning signs.

1.02 SUBMITTALS

A. Submit product data for each product indicated.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the Occupational Safety and Health Administration (OSHA) and with code provisions as adopted by authorities having jurisdiction.

PART 2 PRODUCTS

2.01 WARNING SIGNS

A. Provide “Danger” and “Caution” signs for installation at the satellite treatment facility. Signs shall be mounted using stainless steel hardware through holes provided in signs and at the locations show in the table below.
B. Danger signs shall be printed with red background and Caution signs shall be printed with safety yellow background.
C. Signs shall be constructed of heavy duty 40 mil thick aluminum with plastic laminate coating, able to withstand spills, weather and cleaning for a 10 year service life.
D. Aluminum signs have a service temperature range from 20°F to 150°F.
E. Sign size shall be 14” x 10”.
F. Signs shall be manufactured by mysafetysign.com or accepted equal.

WARNING SIGNS: LOCATION, DESCRIPTION AND QUANTITY

Building/Structure	Danger: Permit Required Confined Space Entry – Do Not Enter	Caution: Watch Your Step	Caution: Flammable Area	Caution: High Voltage	Danger: Chlorine Gas	Danger: Hot Surfaces	Danger: Hearing Protection Required
Screen	2						
First Flush Tank	4	4					
Influent Pump Station	2	2					
Swirl Concentrator	2	2					
Chlorine Contact Tank	2	2					
Foul Sewer/Drain Pump Station	2	2					
Screen Building			2				
Electrical / Blower Building				2		2	2
Chemical Feed Building			2		2		
Totals	14	12	4	2	2	2	2

PART 3 EXECUTION

3.01 INSTALLATION

A. Warning and Caution signs shall be installed at exterior locations designated in the table above in visible locations for Owner's operations staff. Contractor shall coordinate sign installation with Owner and Engineer.

END OF SECTION 10431

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Portable fire extinguishers.
2. Fire-protection cabinets.
3. Mounting brackets for fire extinguishers.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Fire Extinguishers: Include rating and classification.
2. Fire-Protection Cabinets: Include door hardware, cabinet type, trim style, panel style, and details of installation.

B. Samples: For each exposed cabinet finish.

1.03 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

C. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.04 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Stainless Steel Sheet: ASTM A 666, Type 304.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

C. Acrylic Bubble: One piece.

2.02 PORTABLE FIRE EXTINGUISHERS

A. Available Manufacturers:

1. JL Industries, Inc.
2. Larsen's Manufacturing Company.
3. Potter Roemer; Div. of Smith Industries, Inc.

B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A: 60-B: C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.03 FIRE-PROTECTION CABINET

A. Available Manufacturers:

1. JL Industries, Inc.
2. Larsen's Manufacturing Company.
3. Potter Roemer; Div. of Smith Industries, Inc.

B. Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Construction: Nonrated and fire rated. See Drawings for location and extent of each type.

D. Cabinet Material and Shelf: Enameled-steel sheet.

E. Semirecessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

F. Cabinet Trim Material: Same material and finish as door.

G. Door Material: Stainless steel sheet.

H. Door Style: Full bubble with frame.

I. Door Glazing: Molded acrylic bubble.

1. Acrylic Bubble Color: Clear, transparent.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, with plated or baked-enamel finish.

2.04 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

1. Color: Red.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

2.05 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth.

1. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

PART 3 EXECUTION

3.01 INSTALLATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.

C. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

D. Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

E. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

F. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

G. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

H. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair.

END OF SECTION 10520

PART1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Toilet and shower accessories.
2. Underlavatory guards.

B. Related Work Specified Elsewhere:

1. Accessories in prefabricated shower units: Integral with shower assemblies; specified in Division 15 - Mechanical.

1.02 SUBMITTALS

A. Product Data: For each product indicated.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use room designations indicated on Drawings.

1.03 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace mirrors that develop visible silver spoilage defects within 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Products: Toilet and bath accessories scheduled in Part 2 are products of Bradley Corporation. Subject to compliance with requirements, products of the following will also be considered:

1. Toilet and Bath Accessories:

a. A & J Washroom Accessories, Inc.
b. American Specialties, Inc.
c. Bobrick Washroom Equipment, Inc.
d. General Accessory Manufacturing Co. (GAMCO).
e. McKinney/Parker Washroom Accessories Corp.

2. Underlavatory Guards:

a. Brocar Products, Inc.
b. Truebro, Inc.

2.02 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, No. 4 finish (satin), 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

C. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.03 TOILET AND BATH ACCESSORIES

A. Toilet Tissue Dispenser:

1. Basis-of-Design Product: Bradley Model 5224.
2. Type: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Material: Chrome-plated steel.
5. Operation: Spindleless with tension-spring controlled delivery.
6. Capacity: Designed for 4-1/2- or 5-inch- diameter-core tissue rolls.

B. Liquid-Soap Dispenser:

1. Basis-of-Design Product: Bradley Model 6562.
2. Mounting: Surface.
3. Capacity: 40 oz. liquid soap.
4. Materials: 20 gage stainless steel.
5. Stainless-Steel Soap Valve: Designed for dispensing soap in liquid form.
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

D. Grab Bars:

1. Basis-of-Design Product: Bradley Model 812.
2. Material: Stainless steel, 0.05 inch thick.
3. Mounting: Concealed.

4. Gripping Surfaces: Slip-resistant texture.
5. Outside Diameter: 1-1/2 inches for heavy-duty applications.
6. Length: As shown on drawings.

E. Mirror Unit:

1. Basis-of-Design Product: Bradley Model 780
2. Frame: Stainless-steel angle, 0.05 inch thick.

F. Underlavatory Guard:

1. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

G. Combination Paper Towel Dispenser/Receptacle:

1. Basis-of-Design: Bradley Model 225-10.
2. Mounting: Semi-recessed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

B. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

END OF SECTION 10801

MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

DIVISION 11 – EQUIPMENT

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PART 1 GENERAL

1.01 SUMMARY

A. Furnish and install chlorination and de-chlorination equipment and appurtenances necessary to complete work shown or specified. The equipment is to be supplied by a single equipment supplier for installation by contractor.

B. Related Sections:

1. Section 01330 - Submittal Procedures.
2. Section 01435 - Manufacturer's Services.
3. Section 01782 - Operation and Maintenance Manuals.
4. Section 01817 - Starting and Adjusting.
5. Section 01820 - Demonstration and Training.
6. Section 15260 – Process Piping

1.02 REFERENCES

A. The following references apply:

1. American National Standards Institute (ANSI).
2. American Society for Quality Control (ASQC).
3. American Society of Mechanical Engineers (ASME).
4. American Society for Testing Materials (ASTM).
5. American Water Works Association (AWWA).
6. The Chlorine Institute (CI).
7. Confinement of Substances Hazardous to Health (COSHH).
8. Institute of Electrical and Electronics Engineers (IEEE).
9. International Standards Organization (ISO).
10. National Electrical Code (NEC).
11. National Electrical Manufacturers Association (NEMA).
12. National Fire Code (NFC).
13. National Institute of Occupational Safety & Health (NIOSH).
14. Occupational Safety and Health Administration (OSHA).
15. Standard Fire Code (SFC).
16. Uniform Fire Code (UFC).

1.03 SYSTEM DESCRIPTION

A. Provide a complete vacuum operated, solution feed, 1,500 pounds per day (PPD) flow proportioning control chlorine gas feeder system with automatic shutoff valves, safety equipment and accessories as shown on the contract drawings.

B. The system shall allow the total feed of 1,500 PPD to be applied to a single point of application. The adjustment proportion shall be a feed range of 10:1 (automatic), with the capability to control within +/- 4 PPD of the indicated feed rate.

C. The gas feeder design shall consist of three (3) automatic vacuum regulators at the gas supply (one ton cylinder–mounted containers). The vacuum regulators shall feed gas under vacuum from the source to the point of application up to a feed rate of 1,500 PPD.

D. The de-chlorination system shall consist of a complete package capable of feeding 162 gallons per day (gpd) of sodium bisulfite to a single application point. The system shall include de-chlorination pump skids, metering pumps, tote scale, safety equipments, necessary tubing and fittings.

1.04 SUBMITTALS

A. Submittals shall be as specified in the General Conditions and Section 01330, General Requirements.

B. Submittals for the equipment shall include, but not be limited to, the following:

1. Sufficient information on each component to show that the equipment meets this specification.
2. Manufacturer's literature, illustrations, specifications and engineering data including: dimensions, materials, size, weight, performance data showing motor horsepower and speed.
3. Fabrication, assembly and installation drawings.
4. Dimensional drawings as required for the installation.
5. Electrical wiring diagrams as required for the installation.
6. Data sheets on chemical compatibility of the wet end materials being furnished for each chemical.
7. Documentation demonstrating that the gas feeder manufacturer is certified to the international quality standards ISO 9001 for design, assembly and manufacture.

1.05 QUALITY ASSURANCE

A. The equipment and material to be furnished under this Contract shall be free from defects. The complete gas feed system shall be by one manufacturer having complete system responsibility for the operation of the system.

B. The gas feed equipment shall be manufactured and tested under ISO certification meeting the following standards: ANSI/ASQC9001-1994.

C. All equipment, piping and accessories shall meet Chlorine Institute recommendations.

1.06 DELIVERY STORAGE AND HANDLING

A. Contractor shall be responsible for the delivery, storage and handling of products in accordance with the manufacturer's recommendations.

B. Store the units indoors and deliver to the site protected from the weather. Note that failure to comply with this requirement will be grounds for rejection of the equipment as no longer suitable for use.

1.07 WARRANTY REQUIREMENTS

A. All equipment, unless otherwise stated, shall be warranted by the manufacturer for 12 months from date of start-up not to exceed 18 months from date of shipment.

1.08 SYSTEM START-UP

A. The chlorination and dechlorination equipment manufacturers shall furnish the services of a qualified field engineer to check installation, start-up and instruct operating personnel in the proper operation and maintenance of the equipment.

B. Owner will procure and arrange for delivery to the site the disinfection chemicals required to facilitate start-up.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be shipped and delivered fully assembled, except where partial disassembly is required in order to conform to transportation regulations or for the protection of components.

B. Contractor shall be responsible for unloading and shall have equipment on-site at the time of delivery permitting proper hoisting of the equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Equipment supplied by CIT Superior of Fort Pierce, Florida and Blue White Pump Company of Huntington Beach, California was used as the design basis as specified herein and shown on the drawings.

B. If Contractor proposes to use a supplier or manufacturer or model other than the basis of design, any changes in the layout shall be identified by the Contractor during the submittal process. Any changes to the project design, including but not limited to civil, structural, process mechanical, building mechanical, electrical, controls, accessories, engineering, etc. due to the manufacturer chosen shall be completed by the Contractor at no cost to the Owner. The Engineer and Owner have determined that the following equipment manufacturers met the intent of the specifications contained in this Section.

1. Accepted equal

C. Ton Container Storage Roller Trunnions, Ton Container Scales, and multi-channel Digital Weight Indicator shall be manufactured by Force Flow Equipment, or accepted equal.

D. Chlorinators shall be manufactured by CIT Superior, Wallace and Tiernan, Inc. or Capitol Controls Company, Inc., no substitutions. Information associated with chlorine feed equipments from CIT was used as the basis of design. Contractor can furnish equipments from other manufacturers as listed above provided they meet the design requirements of this project. If the design basis manufacturer is not supplied, the Contractor shall be solely responsible for any and all additional costs associated with changes to civil, structural, process mechanical, building mechanical, electrical, controls, accessories, etc. Contractor shall be responsible for all engineering fees associated with modifying the contract documents as necessary to provide a complete and operational system as determined by Engineer and Owner. Submittals shall include drawings and specifications specific to this project along with a complete list of references for project of the same size or larger. References shall include:

1. Project Location
2. Owner contact information including Name and phone #
3. Design Engineer contact information including Name and Phone #
4. Installing contractor contact information including Name and phone #
5. Design information and final approved submittal drawings.

E. Polyethylene tubing shall be No. 489 as manufactured by Nalgene Company.

2.02 EQUIPMENT

A. Provide the following:

1. Three (3) Scales, ton container.
2. Three (3) sets ton container trunnions.
3. Two (2) Automatic chlorinators and controllers
4. Two (2) Chlorine Injectors.
5. One (1) Residual chlorine analyzer
6. Three (3) 500 PPD ton container vacuum regulators with balance meter.
7. Three (3) Automatic emergency shut off valves.
8. One (1) dual sensor chlorine leak detector.
9. One (1) emergency repair kit.
10. Two (2) external alarm and panic buttons
11. Two (2) channel type diffuser mixers.
12. Two (2) self contained air packs and case.
13. Tubing and fittings as required.
14. High Low Vacuum Alarm Switch

2.03 GAS CHLORINATION SYSTEMS EQUIPMENT

A. Two (2) Automatic feed Chlorinators are required. One unit shall serve as an installed backup. The gas feeder shall automatically regulate chlorine gas feed rates in response to flow and/or residual input signals. The panel mounted unit shall contain an automatic gas control valve, gas Rotameter, and integral programmable controller. Each Chlorinator shall have a maximum capacity of

chlorine gas feed rates in response to flow and residual input signals it shall be capable of feeding 200 to 2000 PPD.

B. The Rotameter shall indicate the gas flow in pounds per 24hours and shall have a maximum indicated capacity of 2000 PPD. The entire panel shall operate under vacuum from the gas inlet connection to the gas outlet connection.

C. The gas flow control valve shall use a modulating motor operated with the motor and electronic components mounted in a NEMA 4X enclosure. The valve shall have a microprocessor-based controller designed to control chemical feed. The valve shall be field configurable for flow proportioning, residual, or compound loop. The compound loop control feature shall have the capability of automatic variable lag time adjustment. All setup, tuning and control adjustment shall be achieved from the face mounted pushbutton panel.

D. Standard features shall include: built-in multiplier: automatic transfer from compound loop control when either the residual or flow signal is lost; bump-less transfer between manual and automatic control, digital display, alarm indication, user configurable alarm contacts, control inputs and a 4-20mA dc output signal.

E. The valve shall be capable of matching the valve plug characteristic to the gas flow meter. This shall insure a true gas flow retransmission signal to remote monitoring instruments such as a recorder or SCADA system without the need for auxiliary differential pressure metering devices. The valve shall operate under sonic gas flow conditions without the requirement for a differential pressure regulator to maintain a constant flow rate with varying vacuum levels.

F. The valve shall be able to accept either 4-20mA or dc inputs. Inputs shall be field selectable, for flow transmitter and/or residual analyzer and one for remote set point. There shall be contact inputs, for remote start / stop.

G. The display shall be a 2-line, 16 character digital display. Display shall display operational parameters as well as alarm conditions. The valve shall be powered by 120 Volt, 60hz, single phase. The valve shall be equipped with a manual control knob (multi-turn) available to position the valve plug when dosage control is in “off” position or if power fails.

H. The valve shall be able to feed chlorine, sulfur dioxide, ammonia or carbon dioxide gases. The maximum feed rate shall match the rotameter capacity indicated above.

I. Gas Chlorinator shall be:

1. Manufactured by CIT/Superior Model AV-2000 or
2. Manufactured by Capital Controls Model WP70CV33
3. Manufactured by Wallace and Tiernan Model V2000

2.04 VACUUM REGULATORS

A. Three (3) 500 PPD ton cylinder Vacuum Regulators are required. The vacuum regulators shall feed gas under vacuum from the source to the point of application up to a combined feed rate of 1500 PPD chlorine.

B. The vacuum regulators shall mount directly on the ton container gas valve by means of a yoke assembly and shall be provided with a gas valve direction indicator and integrated gas Rotameter. The gas Rotameter shall be sized for an operating capacity of 500 PPD and shall be used to maintain equalized withdrawal rates between the three (3) one- ton cylinders.

C. The vacuum regulators shall be constructed of molded plastic, suitable for dry gas service and all springs shall be of tantalum alloy. The corrosion-resistant yoke assembly shall have a fusion-bonded epoxy coating and shall be fitted with a field replaceable inlet valve and filter assembly.

D. Vacuum shall be controlled by a spring-opposed double diaphragm in the vacuum regulator. Pressure shall be prevented from building in the system by means of a spring-loaded, diaphragm actuated pressure relief valve located in the vacuum regulator. Each regulator shall be equipped with a gravity-actuated loss-of-gas indicator. An integrated switch shall be provided to indicate loss of gas.

E. The vacuum inlet shall be ⅝-inch.

F. The vacuum regulator shall be fitted with a gas filter and integral liquid trap with an electric heater, which shall prevent any liquid, which may enter the trap, from reaching the regulator. The heater shall operate on 110 VAC, 60 Hz power and shall be complete with a 10-foot line cord.

G. The following vacuum regulator spare parts shall be provided:

1. One (1) set rate valve O-rings.
2. One (1) set meter gaskets.
3. One (1) replacement filter.
4. One (1) insect screen.
5. One (1) multi-purpose wrench.

H. Vacuum Regulators shall be:

1. Manufactured by CIT/Superior Model VR-5 Regulator with a Model TCA-1 Adaptor for 1-ton container w/110VAC heater, or accepted equal.

2.05 SCALES, TON CONTAINER

A. A quantity of three (3) chlorine scales shall be provided. Ton Cylinder Scales shall be smaller than the cylinder and tilt up to allow for cleaning and inspection. The weigh frame shall be secured to the floor with stainless steel adhesive anchors. The profile shall be ultra low so as not to require a pit. There shall be means to level the frame built into the scale frame. The load cell shall be NTEP approved Stainless Steel shear beam cell with a built-in mechanical overload stop to protect it from damage

during rough cylinder loading. The frame shall be dry powder polyester plastic coated. The trunnions shall be corrosion proof with metal or UHMW polyethylene rollers, requiring no maintenance or greasing. Axles shall be made of stainless steel.

B. Scale shall be of the single load cell design. Weight shall be transferred via levers to a single, NTEP approved load cell of the shear beam strain gauge type. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout. Cable length shall be 20 feet.

C. Indicator shall be housed in a NEMA 4X, UL approved enclosure, and the indicators shall independently monitor up to three (3) scales of the same capacity, as well as monitor the totals of three (3) scales. Each channel shall display net remaining, daily usage, total amount used, rate of feed, days until empty, tare weight and gross weight. A data log function shall store the daily usage for each of the previous 10 days.

D. Dual scale display shall be a 2 line, 16 characters per line, alpha-numeric LCD display with back lighting. Indicator shall be equipped with a 10 key numeric pad with tactile and audible feedback for easy entry of tare and low-level values. All functions shall be menu prompted for ease of operations.

E. A user selectable operation mode shall allow the operator to automatically load the net weight of a full container or manually enter tank tare weight to get the net chemical weight.

F. Full-scale accuracy shall be better than 0.25%. Indicator shall be readable in pound increments. Scale shall be Chlor-Scale Model DR40 and digital display shall be Wizard 4000-3 electronic indicator manufactured by Force Flow Equipment or accepted equal.

G. Each channel (scale) shall have an independent, adjustable 4-20 mA signal (net weight or feed rate).

2.06 TON CONTAINERS, TRUNNIONS/CHOCKS

A. The ton container storage cradles shall be designed to support 4000-pounds, and shall be fabricated of epoxy-coated steel.

B. The storage cradles shall be Model 42SC storage cradles by Force Flow, Capital Controls R-1388, U.S. Filter/Wallace & Tiernan, or accepted equal.

2.07 EMERGENCY SHUTOFF SYSTEM

A. Provide three (3) emergency shut-off systems capable of stopping flow of chlorine gas in the event a leak is registered at the Gas detector.

B. The actuator shall mount to the cylinder without the use of special tools and shall be battery driven. Each actuator shall be furnished with 20 feet of cable.

C. All components of the emergency shut-off system shall be constructed of chlorine compatible, corrosion resistant materials.

D. Power for the operation and control of the actuator shall be provided from an uninterruptible electric battery with built-in charging system. The battery power source shall have sufficient capacity for the full operation of the valve for a minimum of two (2) days after the loss of electric power. In the event of a sustained loss of charging power, the microprocessor shall detect a declining battery charge to initiate valve closure while sufficient power remains to close the valve.

E. The control panel shall be contained within a NEMA 4X electrical enclosure. The microprocessor based controller shall accept signals from sources such as the gas detector. Upon activation of the actuator, the control system shall provide an alarm contact to indicate the valve closure cycle.

F. An emergency "Panic" button shall be connected to the control panel and mounted as shown on the plans.

G. Emergency Shut off system shall be:

1. Manufactured by Halogen of Force Flow as follows:

a. Hexacon Series III
b. Hexacon 3-station Control with Scada interface

2.08 DIGITAL CHLORINE VACUUM ALARM SWITCH WITH ALARM MODULE

A. High vacuum alarm: This alarm shall have a large LED vacuum readout and initiate automatically after 10 seconds of the high vacuum condition. This alarm shall initiate indicating that either the chlorine supply is empty or a chlorine supply valve has been shut off.

B. Low vacuum alarm: This alarm shall have a large LED vacuum readout and initiate automatically after 10 seconds of the low vacuum condition. This alarm shall initiate indicating that either the ejector is not producing sufficient vacuum or a chlorine leak has occurred somewhere within the system.

C. Enclosures: The vacuum alarm switch shall be furnished in a NEMA 4X enclosure. The vacuum sensor shall be housed in a separate enclosure with an oil based chlorine protective device and connected to the vacuum enclosure with electrical cable.

D. Alarm Module: The alarm module shall be provided with both a 95 decibel horn and a strobe light.

E. Digital Vacuum Alarm Switch and Alarm Module shall be:

1. Manufactured by CIT/Superior Model VAS-3 with Model ALM-2 or
2. Manufactured by Capital Controls Model 12425 with 120V horn

2.09 INJECTOR AND VACUUM CHECK ASSEMBLY

A. Where gas solution is to be fed to the Chlorine contact tank, each Chlorinator shall be furnished with a suitably sized chlorine injector (one will be an installed spare for backup or alternating service).

B. Each injector shall be provided with dual back check valves to prevent water from flowing back into the Vacuum regulators. It shall be capable of providing sufficient vacuum to feed up to 2000PPD of chlorine gas.

C. The injector shall be constructed of PVC and other materials compatible with chlorine gas and solution. The injector shall include a 2-inch inlet and outlet with integral union connections. It shall be in the chlorine feed room near the chlorinator panels with a minimum of 5 pipe diameters up and 15 pipe diameters downstream of straight pipe without fittings or valves.

D. Injector flow requirements for 2000 PPD:

At 30 psi back pressure provide 125 gpm @ 70psi inlet pressure

At 40 psi back pressure provide 130 gpm @ 85 psi inlet pressure

At 50 psi back pressure provide 135 gpm @ 100 psi inlet pressure

At 60 psi back pressure provide 145 gpm @ 115 psi inlet pressure

E. The Injector shall have a 1-inch vacuum connection. It may be piped to the chlorinators using rigid PVC Sch. 80 pipe or Vacuum rated reinforced PVC tubing.

F. The Injector/check valve assembly shall be:

1. CIT/Superior Model EJ -20. High capacity 2000 PPD or accepted equal.

2.10 GAS LEAK MONITOR / DETECTION SYSTEM

A. Provide one (1) dual point Chlorine Gas Detection System with continuous monitoring, with two level alarms, and audible/visual alarm modes. One sensor shall be located near the chlorinators and one sensor shall be located near the ton cylinders. Sensors must be mounted within 12" of the floor.

B. The unit shall include a LED 2-line display in a Nema 4X enclosure. It shall provide a 4-20mA output proportional to gas concentrations as well as High and Low alarms with two alarm level settings. One alarm contact shall actuate the remote emergency cylinder shut off valves and one contact shall initiate the fan and lights. A remote alarm light shall be positioned above the entry door to warn operators of a gas leak.

C. Detection System shall be:

1. SD-2 Manufactured by CIT/Superior Model “Gas Detector” or
2. AlarmPak II for remote door alarm

2.11 CHANNEL DIFFUSER

A. The chlorine solution shall be injected through the chlorine injectors to a channel mounted chlorine diffuser. The diffuser shall be mounted across the chlorine contact tank channel to disperse chlorine solution as evenly as possible at the inlet to the tank. The diffuser in the dechlorination basin shall be mounted vertically as shown in the drawing.

B. The diffusers shall be constructed of schedule 80 PVC with sufficient perforations to allow a flow of 125 gpm at less than 0.5 psi pressure drop.

C. For cleaning, the diffusers shall be capable of being removed and replaced.

D. Channel diffusers shall be

1. Chlorine Specialties C365 or accepted equal.

2.12 RESIDUAL ANALYZER

A. Provide a colorimetric type on-line Chlorine residual analyzer. It shall measure either Free or Total chlorine depending on the reagent and buffer solutions used. The unit shall be housed in a Nema 4 enclosure for wall mounting. It shall have a backlit LCD screen to display up to 8 different water quality values and indicate all programming functions and alarms.

B. Input power shall be 120V AC. It shall also have Lithium battery for RTC memory. The unit shall provide a 4-20 mA output proportional to chlorine concentration. This signal shall be connected to the set point controller or Chlorinator to control the Bisulfite feed rate. It shall be run via shielded cable within a separate conduit.

C. The unit shall have a flow through sample cell. A suitable drain shall be provided for the sample overflow. The sample shall be fed from the contact tank sample port by means of a self priming sample pump. Provide lab quality test kit.

D. Residual analyzer shall be

1. Unit to be CIT Superior WG702 FOT or accepted equal.

2.13 SAMPLE PUMP

A. Provide one (1) 120Volt self priming, peristaltic, sample pump. Include (4) spare hoses as shelf spare. It shall be constructed of corrosion resistant materials.

B. The pump shall be capable of delivering up to 1/2 - gallon per minute of wastewater sample through a 1/2 inch I.D. reinforced hose to the residual analyzer. An accessible and replaceable basket strainer shall be located at the sample point to prevent excess solids from being pumped to the analyzer.

C. It shall operate whenever the main pumps are running and stop when the last pump turns off. A solenoid valve connected to the feed water line shall then be activated to supply sample water to the analyzer during extended dry flow periods.

D. The pump(s) shall be

1. Blue White model A3F24-MNK (L) or accepted equal.

2.14 EMERGENCY AIR PACK

A. Furnish one (1) 30-minute pressure type emergency air pack mounted in a yellow wall mounted, molded plastic cabinet located outside the chlorination room

B. Unit shall be NIOSH approved for type I grade D air.

C. Unit shall be

1. MSA Air Hawk industrial or accepted equal.

2.15 EMERGENCY CYLINDER REPAIR KIT

A. Furnish one Chlorine Institute type B ton cylinder repair kit. It shall include all Institute listed repair tools and seal contained in a metal tool box with bright yellow paint and safety markings. It shall include full instructions on the box.

2.16 DECHLORINATION PUMP SKID

A. Furnish and install one dual pump prefabricated skid constructed of lightweight, permanently welded 6060 T6 aluminum with corrosion resistant polyester polyurethane powder coat. There shall two side walls, a pump mounting base, and two rear back plates. Each of the two side walls shall be provided with nine service access cutouts and two accessory mounting slots.

B. The Skid shall include the following items factory mounted and tested.

1. A polypropylene drip tray under each pump
2. ½" diameter schedule 80 PVC rigid piping with common discharge
3. Schedule 80 PVC pipe unions
4. Two chemical inlet ports with isolation valves
5. Flow Indicator
6. Check Valve
7. Pressure Relief PVC Valve 5 to 100 psi adjustable
8. Pump connections – 1/2", reinforced braided PVC tubing (2).
9. Inlet Strainer PVC with removable screen.
10 Calibration Cylinder shall be PVC with PVC end caps with vent
11 Pulsation Dampener 10 cubic inches. With isolation valve
12 Pressure Gauge with GUARD SS liquid filled gauge with PVC guard.

A. The skid system shall be Blue White model CFS Dual Pump Skid or accepted equal.

2.17 METERING PUMPS

A. Furnish (2) pumps mounted and piped on the prefabricated skid (one pump shall serve as backup). Pumps shall be a positive displacement, peristaltic type tubing pump with a brushless variable speed motor, roller assembly located in the pump head, integral tube failure detection system, tube life roller revolution counter with user alarm set-point and flexible tubing with attached connection fittings.

B. The pumps shall have the following features:

1. There shall be no valves, diaphragms, springs, or dynamic seals in the fluid path. Process fluid shall contact the pump tubing assembly and connection fittings only.
2. Pump shall be capable of 24 hour continuous duty, self priming and operating in either direction of flow at the rated maximum pressure of up to 125 PSI (8.6 bar).
3. Pump shall be capable of running dry without damage. Pump shall be capable of operating in either direction without output variation.
4. Suction lift shall be 30 feet of water.
5. Accuracy: +/- 0.5 percent of full scale. Repeatability: +/- 0.5 percent
6. Pump head shall be a single unbroken track with removable clear cover.
7. Enclosure shall be NEMA 4X wash down
8. 120Volt 1-phase power.
9. Maximum pump speed 125rpm
10. Front panel touchpad programmable controls.
11. 2500: 1 turn down
12. 4-20 mA input/output
13. Tube life timer
14. Tube failure alarm

C. Each pump shall be Blue White A4V24MN 158GPH or accepted equal.

2.18 TOTE SCALE

A. Furnish where shown on the plans one 60-inch IBC tote scale. The scale platform shall be constructed of reinforced welded steel with epoxy coat finish. The decking shall be solid steel with plasticized corrosion resistant coating. The platform shall be of a low profile design not greater than 3.5 inches. There shall be four (4) load cells with stainless steel leveling feet designed for up to 6,000 lbs.

B. The Scale indicator shall consist of a NEMA 4X enclosure with a digital 4-1/2 digit LCD display. The unit shall be powered by 120 Volt and include a 20 ft connection cable to the scale platform. It shall include an adjustment to remove the tare weight and provide a 4-20 mA output proportional to just the weight of the chemical remaining in the tote. In addition the indicator shall have adjustable low weight alarm relay outputs.

C. Scale shall be Force Flow 60-DR50TC with SG2 indicator or accepted equal.

2.19 SPARE PARTS

A. Furnish the following Items uninstalled

1. Spare parts kit for Chlorinator
2. Spare parts kit for Vacuum Regulator
3. Spare parts kit for Injectors (chlorine ~~and sodium bisulfite~~)
4. (4) spare hoses for metering pumps
5. Spare parts kit for Residual Analyzer

2.20 SAFETY EQUIPMENT

A. Furnish the following item located near the Sodium Bisulfite system

1. Face shield with head gear
2. Chemical goggles
3. One (1) Pair Chemical gloves (large)
4. PVC Lab Apron
5. Wall mounted double bottle eye wash

2.21 TUBING AND FITTINGS

A. Provide 1/2 inch inside diameter polyethylene tubing for the following installations:

1. Chlorine gas lines from container-mounted regulators to chlorinator cabinets as shown on drawings.
2. Chlorinator vent lines as shown on drawings.

B. Tubing shall meet the following:

1. Rated at 90 psi at 70 degrees Fahrenheit and full Vacuum.
2. FDA approved, low density polypropylene (LDPE).

C. Provide Kynar “Vibra-Pruf” tube fittings with ferrule nuts of the “plastic gripper” design and inserts of the same material as the fitting. Provide fitting with o-rings for vacuum applications on the gas supply.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. The Contractor shall inspect all equipment immediately upon receipt.

B. The equipment shall not be installed, if damaged, until repairs have been made in accordance with the manufacturer's written instructions.

3.02 INSTALLATION

A. The Contractor shall install the equipment in accordance with the drawings and manufacturer's recommendations.

3.03 FIELD TESTS

A. Vacuum Testing shall be done at two times the normal operation vacuum. The vacuum must be held for 5 minutes. Any leaks must be repaired and retested. All tests must be performed in the presence of the Resident Project Representative or Engineer's designated representative and after manufacturer's inspection and certification of the installation.

B. Equipment shall be tested after 4 hours of operation to verify that the equipment can provide the feed rates and controls specified. This initial operation and testing of equipment shall be done by a manufacturer representative as part of start-up service and in accordance with Section 01817 – Starting and Adjusting.

3.04 START-UP SERVICES AND TESTING

A. The equipment manufacturer shall furnish the services of a qualified field engineer to provide start-up and testing in accordance with the manufacturer's written instructions.

B. After start-up and testing, the manufacturer's representative shall instruct operating personnel in the proper operation and maintenance of the equipment.

C. The manufacturer's representative shall provide a minimum of 2 - 8-hour days on-site for start-up and testing, and 1 - 8-hour day on site for operator training.

END OF SECTION

PART 1 GENERAL

1.01 DESCRIPTION

A. Each gate shall consist of the frame, slide, guides, stem, operator and all specified appurtenances.

B. The gates shall be of the size and satisfy the head requirements as shown on the gate schedule provided on the drawings.

C. The Contractor shall furnish and install all slide gates as shown on the gate schedule with all necessary accessories for a complete installation.

1.02 RELATED WORK

A. Section 01330 – Submittals
B. Division 3 – Concrete: Anchoring equipment to concrete
C. Section 055000 – Metal Fabrications
D. Section 05520 – Handrails and Railing
E. Division 15 – Mechanical
F. Division 16 – Electrical

1.03 QUALITY ASSURANCE

A. All gates shall be furnished factory assembled by a manufacturer with no less than five (5) years' experience in the manufacture of gates and equipment included under this specification.

B. All gates shall be checked for proper operation prior to delivery. Prior to shipping, the stem covers and pertinent operator components may be removed from the gates, but must be marked and tagged for proper field erection.

C. All slide gates shall be furnished by the same manufacturer.

D. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561 Standard for Fabricated Stainless Steel Slide Gates.

1.04 SUBMITTALS

A. Submittals shall meet the requirements of Section 01330 – Submittals.

B. The following information shall be provided in accordance with Section 01330:

1. Dimensioned plan, section and elevation views of equipment, showing piping and electrical connections and all mounting support details.
2. Design calculations for the gate, including computations for sizing the gate operator.

3. Manufacturer's catalog data, including indicating dimensions, materials of construction, weights and ancillary appurtenances options provided with each unit.
4. Motor submittal data as required under Division 16 – Electrical.
5. Control description, schematic and wiring diagrams.

1.05 WARRANTY

A. The manufacturer shall specifically guarantee the following:

1. Leakage shall be no more than that allowed by the AWWA C513 Standards during the guarantee period.
2. Slide shall be free of sticking (move freely via operator provided).
3. No spare parts shall be required, excluding the operator.

B. Leakage shall be randomly checked and among the several gates provided herein, annually, or as often thereafter as is practicable due to plant operations, by methods stipulated by the Owner and/or Engineer. Should any unit be found to be not within the leakage rates as guaranteed, the cost of testing that gate shall also be borne by the manufacturer.

C. A written supplier's warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of one (1) year from project substantial completion as defined in Section 00700 of these Specifications. Such warranty shall cover all defects or failures of materials or workmanship which occur as a result of normal operation and service.

1.06 GATE REQUIREMENTS

A. Gates shall be either self-contained or non-self-contained and of the rising stem or non-rising stem configuration as indicated on the gate schedule.

B. Gates shall be substantially watertight under the design head conditions.

C. The seal system shall be factory tested to confirm negligible wear and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 25,000 open-close cycles using a well-agitated sand/water mixture to simulate an abrasive environment.

D. Slide gate frames shall be shipped fully assembled with the invert member welded to the side frames and the slide installed in the frame unless the overall width of the slide gate exceeds 96 inches or the overall height of the slide gate exceeds 25 feet.

E. All welds shall be performed by welders with AWS D1.6 certification.

F. A mill finish shall be provided on stainless steel. Welds shall be sandblasted to remove weld burn and scale. All iron and steel components shall be properly prepared and shop coated with a primer per Section 09900 – Painting.

1.07 DELIVERY, STORAGE AND HANDLING

A. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions

B. Each slide gate shall be shipped with sufficient support and bracing to prevent damage. If necessary, temporary cross-bracing shall be installed to keep the slide gates from warping or other damage due to handling during installation.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Information associated with the equipment from the manufacturer named below was used as the design basis as specified herein and shown on the drawings.

1. Whipps
2. Hydro Gate
3. Rodney Hunt

2.02 MATERIALS

Component	Material
Thimble, frame, guides, slide, yoke and stem guides	ASTM A240, Type 304L stainless steel
Actuator pedestal	ASTM A240, Type 304 stainless steel
Gear housing	ASTM A38 35B/40B, Cast Iron or Ductile Iron
Rising stem thrust nuts	ASTM A276, Type 304 stainless steel
Nonrising stem thrust nuts	ASTM B584, Manganese Bronze
Stem couplings	ASTM B584, Manganese Bronze
Gate actuator lift nut	ASTM B584, Manganese Bronze
Seats	ASTM D4020, Ultra high molecular weight polyethylene (UHMW-PE)
Stem guide bushings	ASTM D4020, Ultra high molecular weight polyethylene (UHMP-PE)
Stems	ASTM A276, Type 304 stainless steel
Anchor bolts and fasteners	ASTM A276, Type 316 stainless steel
Side, Top and Flush-bottom seals	Ethylene propylene diene monomer (EPDM)
Flush-bottom seal retainer	ASTM A276, Type 304 stainless steel
Wedges and pressure pads	ASTM D4020, Ultra high molecular weight polyethylene (UHMP-PE)
Stem cover	Aluminum

2.03 FRAME

A. The frame assembly, including the guide members, invert member and yoke members shall be constructed of formed stainless steel plate with a minimum thickness of ¼ inch.

B. The frame shall be designed with a minimum safety factor of 4 with regard to ultimate tensile, compressive and shear strength and a minimum safety factor of 2 with regard to tensile, compressive and shear yield strength.

C. The gate frame shall be suitable for mounting on a concrete wall, embedded inside a channel or mounted on the channel surface as indicated on the gate schedule.

D. All wall mounted or wall thimble mounted gates shall have a flange frame.

E. The structural portion of the frame that incorporates the seat/seals shall be formed into a one-piece shape for rigidity.

F. Gussets shall be provided to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the guide assembly and shall be positioned to ensure that the load is transferred to the anchor bolts or the wall thimble studs.

G. The frame shall extend to accommodate the entire height of the slide when the slide is in the fully opened position on upward opening gates or downward opening gates.

H. A rigid stainless steel invert member shall be provided across the bottom of the opening. The invert member shall be of the flush bottom type on upward acting gates.

I. A rigid stainless steel member shall be provided across the invert of the opening on downward opening weir gates.

J. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.

2.04 YOKE

A. Self-contained gates shall be provided with a stainless steel yoke across the top of the frame.

B. Yoke shall be formed by two structural members affixed to the top of the side frame members to provide a one-piece rigid assembly.

C. Yokes shall be designed to support the gate operator and associated lifting forces and shall allow for removal of the slide and stem for servicing.

2.05 SLIDE

A. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4 inch.

B. The slide shall not deflect more than 1/720 of its width or 1/16 inch, whichever is smaller, under the maximum design head.

C. The slide shall be designed with a minimum safety factor of 4 with regard to ultimate tensile, compressive and shear strength and a minimum safety factor of 2 with regard to tensile, compressive and shear yield strength.

D. Reinforcing stiffeners shall be welded to the slide and mounted horizontally. Vertical stiffeners shall be welded on the outside of the horizontal stiffeners for additional reinforcement.

E. The stem connector shall be constructed of two angles or plates. The stem connection shall be welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

2.06 SEALS

A. Gates shall be equipped with UHMWPE or J-bulb seat/seals system to restrict leakage and prevent metal-to-metal contact.

B. The seals shall extend to accommodate the entire height of the slide when the slide is in the fully closed or fully opened position.

C. Gates shall be provided with a self-adjusting seal system to maintain efficient sealing in any position of the slide and let water flow only in the open part of the gate. The seal system shall be durable and designed to accommodate high velocities and frequent cycling without loosening or suffering damage.

D. Seals shall maintain the specified leakage rate in both seating and unseating conditions.

E. Seals shall be securely fastened to the frame with stainless steel retainers and shall be replaceable and adjustable without removing the gate from the installed position.

F. All upward opening gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the bottom frame invert member and held in place with attachment hardware.

G. All downward acting weir gates shall be provided with UHMWPE or J-bulb seal across the invert member.

2.07 STEM

A. A threaded operating stem shall be utilized to connect the operating mechanism to the slide.

1. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator.
2. On non-rising stem gates, the threaded portion shall engage the nut on the slide.

B. The stem shall have a minimum outside diameter of 1-1/2 inches.

C. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a tensile strength of not less than 75,000 psi.

D. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise shown on the drawings.

E. The stem shall have a slenderness ratio (L/R) less than 200.

F. In compression, the stem shall be designed for critical buckling load caused by a 40 pound effort on the crank or hand wheel with a safety factor of 2, using the Euler column formula and at least 1.5 times the output thrust of the electric operator with the motor in the stalled condition.

G. The stem shall be designed to withstand the tension load caused by the application of a 40 pound effort on the crank or hand wheel without exceeding 1/5 of the ultimate tensile strength of the stem material.

H. The threaded portion of the stem shall have machine rolled threads of the full Acme type with a 16 micro inch finish or better.

I. Stems of more than one section shall be joined by stainless steel or bronze couplings bolted to the stems.

J. An adjustable threaded stop collar shall be provided on all stems to limit downward travel of the slide.

2.08 STEM GUIDES

A. Stem guides shall be fabricated from stainless steel and equipped with UHMW bushings. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendations.

B. Stem guides shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.

2.09 STEM COVER

A. Rising stem gates shall be provided with an aluminum stem cover. The stem cover shall have a cap, condensation vents and one (1) inch graduations to indicate gate position.

2.10 PEDESTALS

A. The pedestal height shall be such that the handwheel or pinion shaft on the remote crank drive is located approximately 36 inches above the operating floor.

B. Wall brackets shall be used to support the floor stands where shown on the drawings and shall be constructed of stainless steel. Wall brackets shall be reinforced to withstand in compression at least two (2) times the rated output of the manual operator with a 40 pound effort on the crank or handwheel.

C. The pedestal, wall bracket, anchor bolts and accessories shall be provided by the gate manufacturer as part of the gate assembly.

2.11 OPERATORS

A. Gates shall be operated by an electric operator or manual operator as indicated on the gate schedule. The operator shall be mounted on the yoke of self-contained gates or on the pedestal of non-self contained gates.

B. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated as specified below.

C. Electric Operators

1. See Specification Section 15277 Electric Gate and Valve Actuators.

D. Manual Operators

1. Gates shall be equipped with a horizontal handwheel (non-geared) so that the maximum effort to operate the gate does not exceed a 25 pound pull when the gate is closed and subject to its maximum operating head and shall be able to withstand an effort of 40 pounds.
2. An arrow with the word “OPEN” shall be permanently attached or cast onto the operator to indicate eh direction or rotation to open the gate.
3. The hand wheel operator shall be fully enclosed, provided with a threaded cast bronze lift nut to engage the operating stem. The operator shall be equipped with roller bearings above and below the operating nut. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist. The hand wheel shall be removable and shall have a diameter of 15 inches.
4. The crank-operated gearboxes shall be fully enclosed. Gearboxes shall have either single or double gear reduction depending upon the lifting capacity required. Gearboxes shall be provided with a threaded cast bronze lift nut to engage the operating stem. Bearings shall be provided above and below the flange on the operating nut to support both opening and closing thrusts. Gears shall be steel with machined cut teeth designed for smooth operation. The pinion shaft shall be stainless steel and shall be supported on a ball or tapered roller bearings. Positive mechanical seals shall be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist. The crank shall be removable and cast aluminum or cast iron with a revolving nylon grip.
5. All gates having widths in excess of 72 inches and widths greater than twice their height shall be provided with two gearboxes connected by a stainless steel interconnecting shaft for simultaneous operation. Stainless steel flexible couplings shall be provided at each end of the interconnecting shaft. A single crank shall be provided to mount on the pinion shaft of one of the gear boxes.
6. The operator shall be arranged so that the centerline of the handwheel will be between 36 inches minimum and 48 inches maximum from the operating floor.
7. Remote crank drives shall be provided when the operating floor to the top of the yoke exceeds 48 inches. The input shaft of the gear operator shall be coupled and extended to the side of the frame where it shall be supported by means of a pillow block bearing secured to the frame. The pinion extension shall be keyed and equipped with a sprocket and chain. The chain shall be of sufficient length to allow placement of the auxiliary input shaft at approximately 36 inches above the operating floor. The auxiliary input shaft shall be adjustable for proper chain tensioning and shall be supported by a pillow block bearing secured to the frame. The chain shall be covered by a guard designed to restrict access to the chain.

2.12 WALL THIMBLES

A. Wall thimbles shall be provided as shown on the drawings.

B. Wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is mounted.

C. Wall thimble shall be stainless steel construction of adequate section to withstand all operational and reasonable installation stresses.

D. Wall thimbles shall be constructed of ¼-inch minimum thickness stainless steel and the front face shall have a minimum thickness of ¼ inch.

E. The fabrication process shall ensure that the wall thimble is square and plumb and the front face is sufficiently flat to provide a proper mount surface for the gate frame.

F. A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation.

G. Studs and nuts shall be stainless steel.

H. Mastic shall be provided to seal between the gate frame and the wall thimble.

2.13 ANCHOR BOLTS

A. Anchor bolts, minimum diameter of ½ inch, shall be provided by the manufacturer for mounting the gates and appurtenances.

B. The gate manufacturer shall determine the quantity and location of all anchor bolts.

C. If epoxy type anchor bolts are provided, the studs and nuts shall be provided by the gate manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. The equipment shall be installed in accordance with the manufacturer's written recommendations.

B. The installation of the equipment shall be done in such manner to ensure the gate frames will be true, square and plumb. Non-shrink grout shall be used to fill the void between the gate frame and the wall in accordance with the manufacturer's recommendations. Mastic gasket shall be used between the gate frame and wall thimble in accordance with the manufacturer's recommendations.

3.02 INSPECTION

A. Prior to the operation of the gates, the equipment installation shall be carefully inspected and checked by a competent and experienced service representative of the manufacturer. The manufacturer's representative shall make the necessary adjustments, approve the installation and instruct plant operating personnel in the operation of the equipment. Notice of such approval shall be furnished to the Engineer in writing.

3.03 FIELD TESTING

A. Following installation and inspection, the gates shall be operated through at least two (2) complete open/close cycles. If an electric operator is used, limit switches shall be adjusted following the manufacturer's instructions.

3.04 LEAKAGE TESTING

A. Following installation, all gates shall be leak tested by the Contractor. The gates shall have water placed to the high water level as shown on the gate schedule. The Contractor shall supply whatever water may be necessary. The means to isolate the chamber for testing shall also be the Contractor's responsibility as well as providing the necessary pumps, hoses and appurtenances to complete the test. The Contractor's testing procedures shall be submitted to the Engineer for approval and the testing shall be coordinated with the Engineer and Owner.

B. The leakage test shall be performed in accordance with AWWA C561 and the leakage rate shall not exceed the amount allowed by AWWA C561.

END OF SECTION 11285

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. This section includes the requirements to provide submersible, non-clogging, wastewater pump with appurtenances as required and specified.

1.02 RELATED WORK

A. Division 3 - Concrete: Anchoring equipment to concrete.
B. Section 09960 – High Performance Coatings.
C. Section 15260 - Process Piping.
D. Section 15270 – Plant Valves.
E. Section 16220 - Motors.
F. Division 16 - Electrical.

1.03 QUALITY ASSURANCE

A. The pump manufacturer shall perform the following inspections and tests on the pumps before shipment from the factory.

1. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
2. Each pump shall be tested for flow versus head at the design conditions in accordance with the latest edition of the Hydraulic Institute Standards.
3. A written report with certified flow versus head curves stating the foregoing has been completed shall be supplied with each pump at the time of shipment. The curves indicated shall include head, capacity, horsepower, efficiency and input KW.

1.04 SUBMITTAL REQUIREMENTS

A. Submit in accordance with - Section 01330 Submittal Procedures.

B. The submittals for the pumps and accessories shall include but not be limited to the following:

1. Equipment Layout (plan and elevation)
2. Overall Dimensions
3. Anchor Bolt or Mounting Hole Dimensions
4. Weight Total and Weights of Shipping Units
5. Detail Dimensions
6. Materials of Construction
7. Capacity
8. Performance Curves
9. Nameplate Data
10. Wiring Diagrams and Schematics Diagrams

11. Interconnection Diagram (Electrical)
12. Mounting Details
13. Bill of Materials
14. Ambient Conditions Necessary for Efficient Operation

1.05 WARRANTY

A. The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for the pumps and not the motor for a period of one (1) year from the date of startup. The motors shall have a warranty period of (1) year from the date of substantial completion.

PART 2 PRODUCTS

2.01 PUMP MANUFACTURER AND MODEL

A. Base Manufacturer. Information associated with the equipment from the manufacturer named below was used as the basis for the design as specified herein and shown on the drawings.

1. Flygt, N Series Submersible Pumps.

B. If Contractor proposes to use a manufacturer or model other than the basis of design, any changes in the layout shall be identified by the Contractor during the submittal process. Any changes to the project design, including but not limited to civil, structural, process mechanical, building mechanical, electrical, controls, accessories, engineering, etc. due to the manufacturer chosen shall be completed by the Contractor at no cost to the Owner. The Engineer and Owner have determined that the following equipment manufacturers met the intent of the specifications contained in this Section.

1. Fairbanks Morse
2. KSB

2.02 SERVICE CONDITIONS

A. The pumps shall be vertical, submersible, non-clog type pump, designed to handle wastewater and clean water. The pumps shall be furnished as one complete pump system, all of the system components supplied by one manufacturer.

B. The pump unit shall be installed in the wet well when lowered into place on its mating discharge connection. The pump shall be easily removable along two stainless steel guide bars or cables for inspection or service.

C. The pumps shall perform under the following operating conditions:

Influent Pump Station	
1. Pump Capacity	3,615 gpm
2. Total Dynamic Headloss (TDH)	20 ft.
3. Pump Speed	1160 rpm
4. Motor	25 hp
5. Motor Speed	1160 rpm
6. Pump Suction/Discharge Connections	10/10 inch
7. Number of Pumps	4
Foul Sewer/ Drain Pump Station	
1. Pump Capacity @ TDH	1,042 gpm
2. Total Dynamic Headloss Range	1 - 38 ft.
3. Pump Speed	1755 rpm
4. Motor	15 hp
5. Motor Speed	1755 rpm
6. Pump Suction/Discharge Connections	6 inch
7. Number of Pumps	2

2.03 PUMP ASSEMBLY CONFIGURATION

A. Cooling System

1. Motors are cooled by the surrounding environment or pumped media.

B. Cable Entry Seal

1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal.
2. The assembly shall provide ease of changing the cable when necessary using the same entry seal.
3. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

C. Motor

1. The pump motor shall be designed, manufactured, and tested according to section 16220 – Motors.
2. Motors shall be rated for Class I, Division I, Group D.

D. Bearings

1. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The lower bearing shall compensate for axial thrust and radial forces.

E. Mechanical Seal

1. Each pump shall be provided with a tandem mechanical shaft seal system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing.
2. The motor shall be able to operate dry without damage while pumping under load.

F. Pump Shaft

1. Pump and motor shaft shall be the same unit. The shaft shall be stainless steel.
2. The use of stainless steel sleeves will not be considered equal to stainless steel shafts.

G. Impeller

1. The impeller shall be dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design.
2. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater up to 5% concentration as well as grit. A hardened iron impeller shall be used to help guard against the grit and shall have a HRC of 60 meeting ASTM 532.80 Alloy III-A.

H. Volute-Suction Cover

1. The pump volute shall be a single piece with smooth passages of sufficient size to pass any solids that may enter the impeller. Inlet and discharge size shall be as specified.

I. Protection

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.
2. A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote.

J. Spare Parts (for each pump unit provided)

1. 2 sets of all gaskets.
2. Mechanical seal set.
3. Complete replacement bearing set.
4. Any special tools required for pump disassembly.

2.04 MATERIALS OF CONSTRUCTION

A. Pump Housing: Cast Iron.

B. O-rings: Nitrile.

C. Impeller: Cast Iron.

D. Shaft: Stainless Steel.

E. Mechanical Face Seals:

1. Inner Seal ring - Corrosion Resistant Tungsten-carbide.
2. Outer Seal ring - Corrosion Resistant Tungsten-carbide.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall install the pump assemblies in the permanent locations as shown on the drawings and in accordance with the manufacturer's instructions.

B. Contractor shall install interconnecting electrical wiring, conduit, etc. between submersible pumps and control equipment so that when power and control wiring is brought to the control equipment, the submersible pump system will be a complete operational system.

3.02 TESTING

A. Prior to system operation, all equipment shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance by means of a functional test.

B. Field Testing

1. Functional Test - required.
2. Performance Test - required.

C. Before final acceptance of the pumps specified herein, the Contractor shall submit five (5) copies of certified and properly identified performance curves which shall reflect the operating characteristics of each pump model and impeller combination being supplied. The curves shall indicate head, capacity, horsepower, efficiency and input KW.

3.03 FINISHES

A. Shop - All pump assemblies supplied under this section shall receive finishes that are in accordance with the pump manufacturer's standard finish.

B. Field - All pump assemblies shall be touch-up painted with matching paint supplied by the pump manufacturer.

C. Drive Motors - All pump drive motors furnished under this section shall only receive finishes that are in accordance with the motor manufacturer's standard finish. DO NOT apply shop or field coatings to the drive motors.

3.04 MANUFACTURER'S SERVICES

A. The Contractor shall include with his bid the services of the equipment manufacturer's field service technician for a period of one (1) trip for a period of two (2) 8-hour days at the site. This service shall be for the purpose of check-out, initial start-up, certification, and instruction of plant personnel. A written report covering the technician's findings and installation certification shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

END OF SECTION 11310

PART 1 GENERAL

1.01 SUMMARY

A. Under this item, the Contractor shall furnish and make fully operational and install four (4) submersible mixers in the First Flush Tank at the locations shown on the drawings.

B. Furnish and install guide rails/bars/mast installation/removal assembly for each mixer. Furnish and install upper, intermediate and lower guide bar adaptors and any required lateral supports and floor mount assemblies required to provide a complete and operational installation/removal assembly.

C. Furnish and install power cable supports for each mixer.

D. Furnish and install Type 316 stainless steel anchors as recommended by the mixer manufacturer for each mixer.

E. Furnish and install hoists sized by mixer manufacturer to adequately remove each mixer at each location. Provide one manual hoist for each mixer for a total of four (4) hoists.

1.02 RELATED WORK

A. Division 3 - Concrete
B. Section 09960 – High Performance Coating.
C. Section 15260 – Process Piping.
D. Section 16220 - Motors.
E. Division 16 - Electrical.

1.03 QUALITY ASSURANCE

A. The mixer manufacturer shall perform the following inspections and tests on the mixers before shipment from the factory.

1. Propeller, motor rating, and electrical connection shall first be checked for compliance with the specifications.
2. All mixers shall be vacuum tested to establish sealing integrity. All mixers shall be momentarily energized to determine correct rotation and current draw prior to immersion.
3. Prior to shipment, all mixers shall be run dry and/or immersed to determine correct shaft rotation, thrust direction, power consumption and mechanical integrity.
5. After immersion test, all mixers shall be inspected for lubricant seepage and/or water infiltration, insulation defects, and resistance (Ohms).

6. Inspections and tests performed shall confirm the mixer listed has met all established quality assurance standards set for similar materials. All mixers shall be warranted against defects in design, workmanship, and material for a period of one (1) year from the date of acceptance by the Owner.
7. A written report stating the foregoing steps have been done shall be supplied with each mixer at the time of shipment.

1.04 REFERENCE TO STANDARDS (RESERVED)

1.05 SUBMITTAL REQUIREMENTS

A. Submit under the provisions of Section 01330 - Submittal Procedures.

B. The submittals for the mixers and accessories shall include but not be limited to the following:

1. Equipment Layout (plan and elevation)
2. Overall Dimensions
3. Anchor Bolt or Mounting Hole Dimensions
4. Weight Total and Weights of Shipping Units
5. Detail Dimensions
6. Materials of Construction
7. Capacity
8. Performance Curves
9. Nameplate Data
10. Wiring Diagrams and Schematics Diagrams
11. Interconnection Diagram (Electrical)
12. Mounting Details
13. Bill of Materials
14. Ambient Conditions Necessary for Efficient Operation
15. Hydraulic and electrical calculations

1.06 FIRST FLUSH TANK MIXER REQUIREMENTS

A.	Total Tank Volume	289,040 cubic feet
B.	Side Water Depth	22 feet
C.	Total number of mixers required	Four (4)
D.	Mixing requirements	

1. Maintain mixing in the tank configuration shown on the drawings.

1.07 WARRANTY

A. The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of one (1) year from the date of substantial completion.

B. The Contractor shall warrant the units being supplied to the Owner for a period of one year from the date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Base Manufacturer. Information associated with the equipment from the manufacturer named below was used as the basis for the design as specified herein and shown on the drawings.

1. Flygt - Basis of Design

B. If Contractor proposes to use a manufacturer or model other than the basis of design, any changes in the layout shall be identified by the Contractor during the submittal process. Any changes to the project design, including but not limited to civil, structural, process mechanical, building mechanical, electrical, controls, accessories, engineering, etc. due to the manufacturer chosen shall be completed by the Contractor at no cost to the Owner. The Engineer and Owner have determined that the following equipment manufacturers met the intent of the specifications contained in this Section.

1. KSB
2. Wilo-EMU

2.02 GENERAL

A. The mixer shall be capable of handling screened sewage. The mixer shall be designed to allow it to be raised and lowered with angle adjustments to 5º from the horizontal. The mixer shall be easily removed for inspection or service without the need for personnel to enter the tank. A sliding guide bracket shall be an integral part of the mixer unit. The entire weight of the mixer unit shall be guided by brackets which must be capable of handling all thrust by the mixer.

B. Each mixer shall be of the integral design, close coupled, submersible type. All components of the mixer, including motor shall be capable of continuous underwater operation.

2.03 MOTORS

A. Motors shall be provided meeting the requirements of Section 16220-Motors. The mixer motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The motor shall be designed for continuous duty, capable of sustaining a maximum of thirty (30) evenly spaced starts per hour. All motors shall be rated for Class 1, Division 1, Group D service.

2.04 ELASTOMERS

A. All mating surfaces where watertight sealing is required shall be machined and fitted with a double set of Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces.

This will result in controlled compression of the O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

2.05 PROPELLER

A. The propeller shall be of 316 stainless. Each blade shall be laser cut and welded to the hub to ensure that the propeller is properly balanced. The propeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications. Each propeller shall have three (3) vanes.

2.06 CABLE ENTRY

A. The cable entry into the housing shall provide a leak proof seal from any liquid which may enter the terminal compartment.

2.07 BEARINGS

A. All bearings shall have a minimum B-10 rated life of 100,000 hours and shall have inner and outer races of metal construction. Bearings with races made of nonmetallic construction will not be deemed acceptable or meeting the load handling and environmental requirements of this application. The outboard propeller bearing shall be an angular contact bearing. The motor shaft end shall be supported by two bearings. A roller and an angular contact ball bearing shall take up the axial and radial loads while an angular contact ball bearing shall take up the axial loads. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing life and seal life. Mixers without pre-loaded bearings will not be considered acceptable or equal.

2.08 THERMAL SENSORS

A. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator winding and set for 260ºF (125ºC). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

2.09 OIL HOUSING

A. The oil housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design will allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process.

2.10 MECHANICAL SEALS

A. Each mixer shall be provided with two sets of lapped end face type mechanical seals running in oil reservoirs for cooling and lubrication. The mechanical seals shall contain positively driven rotary, corrosion resistant, Tungsten Carbide face rings. In order to avoid seal failure due to sticking, clogging, and misalignment

from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing.

B. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be considered acceptable or equal.

2.11 SEAL SHIELD

A. The mixer shall be equipped with a seal shield that prevents fibrous material from winding up around the shaft and outer seal. The shield shall be welded to the propeller hub and extend towards the motor. The shield shall rotate with the propeller and there shall be a radial micro-gap between the shield and oil-housing.

2.12 HAZARDOUS LOCATION

A. The mixer used shall be certified for use in all Class I, Divisions 1, Group D locations as outlined in Articles 500-502 inclusive of the NEC code.

2.13 GUIDE RAIL SYSTEM

A. The Contractor shall furnish and install a guide rail system to be used to mount each mixer during operation and to guide the units during installation and removal for service. The system shall consist of a bottom anchorage assembly, stop console, guide pipe, fixing bracket and guide holder assembly. All major components shall be constructed of Type 316 stainless steel. They shall be used in connection with a 3 or 4 inch guide pipe as recommended by the manufacturer.

B. The bottom anchorage assembly shall be bolted to the floor of the tank and provide support for the guide pipe. It shall also include a receptacle to accept the guide pipe bottom pivot. The guide pipe must be strong enough to absorb the mixer reload force. The bottom anchorage assembly and guide pipe shall be constructed of AISI 316 stainless steel.

C. The mixer stop console shall be fastened to the guide pipe using high-strength stainless steel bolts. The console shall be strong enough to support the weight of the mixer. The console shall be positioned in such a manner so as to prevent the mixer blade tips from hitting the basin floor. The console shall be constructed of AISI 316 stainless steel.

D. The upper guide holder assembly shall secure the system to the wall of the tank. It shall consist of a fixing bracket and upper guide holder. The system shall provide the lateral support for the guide pipe allowing the possibility of the guide pipe to be positioned at any reasonable angle for flow and energy optimization. The upper guide holder assembly shall be constructed of stainless steel. The assembly shall contain a device to secure the electrical motor cable holder, and it shall be made of AISI 316 stainless steel.

2.14 REMOVABLE CRANE ARM ASSEMBLY

A. Furnish and install one manual crane arm assembly at each mixer location to raise and lower the mixers for installation and service. Each assembly shall consist of a crane arm with telescopic capabilities, a spur gear or worm gear hand winch with brake for load control with stainless steel wire and a hook. The crane arm assembly shall be constructed of corrosion resistant finish. Each assembly shall be suitable for bringing the mixers out of the water and positioning it for safe, efficient service. Each assembly shall be constructed with the crane arm to a height such that there is sufficient clearance of one foot minimum upon removal when a propeller vane is pointing directly downward upon removal.

2.15 ANCHOR BOLTS

A. Furnish and install Type 316 stainless steel epoxy anchor bolts of the size and number recommended by the mixer manufacturer for guide rail system and removable crane arm assemblies.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that anchor bolts are correct size and positioned properly.

3.02 PREPARATION (RESERVED)

3.03 INSTALLATION

A. Install submersible mixers, installation/removal assembly, control equipment and accessories in accordance with manufacturer's instructions and as shown on the drawings.

B. Install interconnecting electrical wiring, conduit, etc. between submersible mixers and control equipment so that when power and control wiring is brought to the control equipment, the submersible mixer system will be a complete operational system.

3.04 MANUFACTURER'S SERVICES

A. The Contractor shall include with his bid the services of the equipment manufacturer's field service technician for a period of two (2) 8-hour days at the site. This service shall be for the purpose of check-out, initial start-up, certification, and instruction of plant personnel. A written report covering the technician's findings and installation certification shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

3.05 TESTING

A. Prior to plant operation, all equipment shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance by means of a functional test.

END OF SECTION 11314

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The work covered by this section consists of furnishing all labor, materials, accessories, tools, equipment, transportation services, and performing all operations required to install fiberglass weirs.

1.02 RELATED WORK

A. Division 11 – Equipment

1.03 SUBMITTALS

A. Complete shop drawings including dimensions and materials shall be supplied for the Engineer's approval.

1.04 WARRANTY

A. The manufacturer shall warrant the equipment being supplied to the Owner against defects in workmanship and materials for a period of one (1) year from the date of final completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Acceptable manufacturers are:

1. MFG Water Treatment Products of Union City, PA
2. Warminster Fiberglass Co., of Southampton, PA
3. Fiberglass Fabricators, Incorporated of Smithfield, RI

B. Substitutions:

1. None

2.02 WEIRS

A. Weir plates, shall be fiberglass reinforced polyester plastic. All surfaces shall be smooth, resin rich, free of voids and porosity, without dry spots, crazes, or unreinforced areas and shall provide for increased corrosion resistance and weathering. A single manufacturer shall supply all fiberglass weirs and baffles.

B. Laminate shall contain a glass content of 30 ± 2% using Type “E” glass with chrome or silane finish. Final laminate thickness shall be within ± 10% of the nominal specified thickness.

C. Weir plates shall be a minimum of ¼” nominal thickness unless noted otherwise on the contract documents and shall be aqua in color. Where weir plates are of non-standard length or non-standard mounting hole configuration such machined or cut edges shall be resin sealed.

D. Ultraviolet resistance is required in all laminates. Surfacing veil is required on all surfaces to increase chemical resistance and provide additional UV absorption.

E. Minimum physical properties shall be as follows:

Property	Req’d Value	Test Method
Tensile Strength	7,500 psi	ASTM D638
Flexural Strength	16,000 psi	ASTM D790
Flexural Modulus	0.8×10^{6}	ASTM D790
Impact, Notches, Izod, foot pound per inch	10.0	ASTM D256
Barcol Hardness	Min. 35	Barcol Impressor ASTM D2583
Average coefficient of thermal expansion-inch per inch, per degree F	16×10^{-6}	GYZJ-934-1
Water absorption, % in 24 hours	0.2%	ASTM D570

F. Locations and mounting details will be as indicated on the drawings.

2.03 GASKETS

A. Provide a ¼-inch thick EPDM gasket between all weirs and their mounting surface. The gasket shall be 6 inches minimum in height and as required to allow for bolt installation and the adjustment in height of weirs. Gaskets shall provide a watertight seal.

PART 3 EXECUTION

3.01 INSTALLATION

A. The installation contractor shall field verify existing dimensions and install the weir in accordance with the Contract Drawings, approved shop drawings and manufacturer's recommendations. Field cutting of panels will be allowed to complete the structure. All field cut or drilled edges shall be sealed per the manufacturer's recommendations. All of the fasteners required for installation shall be supplied by the weir manufacturer.

B. Weirs shall be carefully aligned and leveled to the elevations shown on the drawings. In the completed installation, no variation greater than 1/8" shall exist between any two notches of the weir plate in any one tank. In addition, the average deviation from one quadrant of the weir to any other shall not exceed 1/16". The installation contractor shall apply a suitable sealant between the weir and the wall to prevent the flow of liquid between the weir and the tank wall.

END OF SECTION 11321

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The work covered by this section consists of furnishing all labor, materials, accessories, tools, equipment, transportation services, and performing all operations required to install two (2) new mechanically cleaned, Catenary Bar Screens. Screens utilizing lower sprockets will not be allowed.

1.02 RELATED WORK

A. Division 1 – General Requirements
B. Division 3 – Concrete
C. Division 5 – Metals
D. Section 09960 – High Performance Coatings
E. Section 16220 – Motors
F. Division 16 – Electrical

1.03 QUALITY ASSURANCE

A. At the Engineer's request, the equipment manufacturer shall certify to not less than five (5) years of experience in the application, design, manufacture and operating experience of mechanically cleaned screens, of the type specified, in wastewater treatment plants.

1.04 REFERENCE TO STANDARDS (RESERVED)

1.05 SUBMITTALS

A. Submittals shall meet the requirements of Section 01330 – Submittal Procedures.

B. Complete shop drawings including dimensions and materials shall be supplied for the Engineer's approval.

1.06 WARRANTY

A. The Contractor shall provide warranty for the equipment to be free of material or workmanship defects for one (1) year from the date of final completion. During that year, the Contractor shall, at no expense to the Owner, replace any part or parts which malfunction due to defective manufacture or installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Information associated with the equipment from the manufacturer named below was used as the design basis as specified herein and shown on the drawings.

1. E & I Corporation

B. If Contractor proposes to use a manufacturer or model other than the basis of design, any changes in the layout shall be identified by the Contractor during the submittal process. Any changes to the project design, including but not limited to civil, structural, process mechanical, building mechanical, electrical, controls, accessories, engineering, etc. due to the manufacturer chosen shall be completed by the Contractor at no cost to the Owner. The Engineer and Owner have determined that the following equipment manufacturers met the intent of the specifications contained in this Section.

1. Accepted equal

2.02 DESIGN CRITERIA

A. The heavy duty, fully automatic mechanical self-cleaning, bar screen shall be suitable for installation and operation in a flow channel measuring 3.0 feet wide by 17.0 feet deep, as measured from the nominal elevation of the channel bottom one channel width behind its base. The angle of inclination shall be 75° from horizontal.

B. The point at which all collected material will fall off the discharge chute shall be at least 5.0 feet above the elevation of the operating floor (this is the available clearance for the dumpster to collect the debris).

C. Each screen shall be capable of passing a maximum of 30.0 MGD of raw sewage with an upstream water depth of 15.28 feet based on a nominal unit width of 3.0 feet wide.

2.03 EQUIPMENT

A. Rakes shall approach channel invert from the upstream side of channel and rake upward at the upstream face of the screen with tines between the bars.

B. Framework of screen shall be constructed of Grade 304 stainless steel and cross section with a minimum thickness ¼ inch. Various parts fastened by welding, riveting, or bolting shall be braced as necessary to insure a rigid structure. The side frames shall be minimum ¼ inch formed of structural shapes.

C. Bolts and nuts shall be of Grade 316 stainless steel.

D. Anchor bolts shall be ¾ inches Grade 316 stainless steel furnished by the contractor.

E. Screen bars shall be constructed of Grade 316 stainless steel. The bar rack shall consist of trapezoidal stainless steel bars. The dimensions of the bars are: 3/8 inch by 3/16 inch by 21/2 inches (0.375 inch by 0.1875 inch by 2.5 inches). Round, teardrop or rectangular shaped bars will not be allowed. Bars shall be securely welded into place to form a structurally stable, permanent assembly designed to last the life of the screen. Bars shall be fastened to a dead plate that extends to the point of discharge. Bars shall extend a minimum of 18 inches above the maximum water level. The screen field shall be accurately constructed to give a clear opening of **0.5** inches between the bars. There shall be no space wider than the opening between the bars which would permit passage of larger solids through the screen.

F. Dead plate of Grade 304 stainless steel plate, a minimum of ¼ inch thick shall extend to the point of discharge and shall have 6 inch skirts to help contain the screenings. Dead plate shall be true and flat such that a close clearance between the raking tines and the plate can be maintained during the cleaning cycle.

G. The rakes shall consist of a channel section, 7 inches in depth with a ½ inch thick stainless steel rake plate attached with teeth machined to clean the entire width of the bar rack. The raking tines shall have the tooth profile precision cut of sufficient thickness and depth to insure adequate stiffness and strength to cope with the specified duty cycle. The rakes shall be attached to the chain at approximately every 7 foot. The rakes shall clean the bars from the upstream side of the screen. The rakes shall be fabricated from stainless steel Grade 304.

The rake tines shall penetrate into the screen bar spacing to insure that screenings are completely cleared during each lifting operation. During each cleaning stroke, the raking tines shall engage into the bottom of the bar screen grids at the channel invert. All moving equipment shall be fully replaceable without having to remove the screen from the channel.

H. Screenings transported to the top of the screen shall be discharged positively by means of a scraper mechanism to the discharge chute. The scraper mechanism shall be fitted with shock absorbers that allow the scraper to return to its resting position smoothly without any shock. A scraper blade made of PVC and that is adjustable and reversible shall be provided on the scraper.

I. The drive unit shall mount to the screen head shaft and shall be a helical-bevel gear reducer running in an oil bath.

J. The sprockets shall be cast iron, split, chilled rim, 10 tooth with a 19.58 inch pitch diameter, with chain saver rims. The teeth shall be chilled to a Brinell hardness of 375 for a depth of not less than 3/16 inches

K. The head shaft bearings shall be double row, tapered roller bearings with seals and lubrication fittings. The bearings shall have collars to position the shafting.

L. Chains shall be rollerless type, WS132 welded chain grade 304 stainless steel. Materials other than Grade 304 stainless steel shall not be allowed. The average ultimate strength of the chain shall be minimum 78,000 pound-force. Chain pins shall be stainless steel and hardened.

M. Return rails shall be provided to guide the chain and rakes to the bottom of the channel. The return rails shall be C7 x 9.8 structural channels designed specifically for this project. The return rails shall be manufactured of Grade 304 stainless steel.

N. The drive motor shall be maximum 5 HP, explosion proof rated for Class 1, Division 1, Group D and Class F insulation. The motor shall be an inverter duty rated motor with a minimum 1.15 service factor, rated for continuous duty and designed to operate on 230/460 volts, 3 phase, 60 hertz and be provided with a shear pin device to protect the unit in case of any overload. (Enclosure shall be rated applicable for the specific installation environment.) The drive unit, including the reduction gearbox, shall be directly shaft-mounted and shall be positioned to facilitate maintenance work. The reducer shall be a helical-bevel unit running in an oil bath. The reducer shall have a service factor of 1.25 for 24-hour operation.

O. The drive assembly shall be designed to operate the rakes at approximately 10 feet per minute. The rake and chain system shall be designed to ride over any obstruction that may become impinged upon the bar rack. The system shall be capable of moving out over the obstruction and once past it, moving back to the bar rack to continue cleaning. Systems with chain or links that can only flex in one direction shall not be allowed.

P. A discharge chute shall be provided for each screen to divert screenings discharged from the screen to the dumpster. The discharge chute shall be ¼ inch thick and made of Grade 304 stainless steel. The discharge chute shall be mounted at an angle of 30 degrees. Panels are positioned on both sides to protect from splashing.

2.04 BAR SCREEN CONTROL PANEL

A. A Bar Screen Main Control Panel shall be furnished, completely pre-wired and tested, requiring only wall mounting and connection to external wiring in the field by an electrical contractor. The Control Panel shall include all equipment required to control both bar screens as specified herein. The panel shall be located in a non-classified area where no corrosive gasses are present.

B. Control Panel enclosure shall be sized as required to house equipment and shall be suitable for wall mounting or mounting to strut-type supports. Enclosure shall be rated NEMA 4X. Enclosure shall consist of a door-in-door type where the pilot lights and switches are mounted on an inner panel.

C. The screens shall be controlled by a PLC (programmable logic controller). The PLC shall be used to control the operation of the screens as described herein. The PLC shall include discrete and analog inputs and outputs as required.

D. Each screen shall be controlled in synchronization with a pressure level sensor. Upon reaching a predetermined set point both screens shall begin operation and shall shut down after another predetermined water level set point.

E. When an over current is detected the screen shall automatically stop.

F. Door mounted NEMA 4X indicating lights shall be provided to indicate running and alarm status of the bar screen. Legend plates and a door mounted Alarm Rest push button shall also be provided.

G. A separate Local Operator Station rated NEMA 7 shall be provided. The local panel shall a JOG switch and an Emergency Stop mushroom pushbutton.

2.05 SPARE PARTS

A. The following minimum recommended spare parts shall be provided for mechanically cleaned screens:

1. Ten (10) shear pins.
2. One (1) replacement wiper blade.

PART 3 EXECUTION

3.01 GENERAL

A. Installation shall be in strict accordance with contact documents and requirements of the manufacturer's written instructions and shop drawings. It is the Contractor's responsibility to verify the accuracy of all necessary dimensions in the field to ensure compatibility with the specifications and equipment.

B. The Catenary Bar Screen manufacturer shall inspect the installation of the Mechanically Cleaned Bar Screen to assure that the unit has been installed in accordance with the manufacturers written recommendations.

C. In the event that equipment is supplied which is different than specified, it shall be the responsibility of the Contractor to coordinate and make all changes to related structures, controls, drawings and documentation. All changes must be reviewed and approved by the Engineer prior to any installation of equipment. In addition all costs associated with such changes, including additional time required for review of the changes by the Engineer, shall be borne by the Contractor.

3.02 EQUIPMENT TESTING

A. The Coarse screen shall be started-up and tested following installation inspection to ensure satisfactory operation. The screens shall be run under normal flow conditions to assure the specified performance is met.

3.03 MANUFACTURER'S SERVICES

A. Supplier will provide the services of a factory-trained representative for two (2) trips of one (1) day each to check the installation, to start up each coarse screen system and controller and to train the plant operators on screens operation and maintenance. The factory representative will have complete knowledge of proper installation, operation, and maintenance of equipment supplied. Representative will inspect the final installation and supervise a start-up test of the equipment.

END OF SECTION 11330

PART 1 GENERAL

1.01 DESCRIPTION

A. This section specifies the rotary lobe positive displacement blowers, complete with appurtenances. The aeration blowers shall provide air to the coarse bubble diffusion equipment located within the First Flush Tank.

B. Each unit shall consist of the blower, electric motor, sound enclosure and all specified appurtenances.

C. The Contractor shall furnish and install two (2) rotary lobe positive displacement blowers as shown on the drawings.

1.02 RELATED WORK

A. Section 01330 – Submittals
B. Division 3 – Concrete
C. Section 09960 – High Performance Coatings
D. Division 15 – Mechanical
E. Division 16 – Electrical

1.03 QUALITY ASSURANCE

A. The blower package shall be furnished factory assembled by a manufacturer with no less than five (5) years' experience in the manufacturing of equipment included under this specification.

B. The manufacturer shall perform the following inspections and tests on each blower before shipment from the factory:

1. Factory mechanical inspection
2. Factory mechanical test run
3. ISO 1217 performance test
4. Blower leak test
5. ASME PTC 36 noise test

C. The vibration level as measured at the casing, in the X/Y planes of the bearings shall not exceed 0.3"/sec RMS when operating at the specified operating pressure and speed. The vibration level shall be checked at start-up and documented in the field start-up report.

D. Each rotary lobe compressor stage shall be factory performance tested in accordance with ISO 1217 standards to verify flow and brake horsepower. A slip test shall not be acceptable. The acceptance criteria are +5% tolerance on power and -5% tolerance on flow.

E. Inspections and tests performed shall confirm the blowers supplied have met all established quality assurance standards set for similar materials.

F. The manufacturer shall provide a written report stating the foregoing inspections and tests have been completed.

G. All components shall be supplied by a single manufacturer.

1.04 SUBMITTALS

A. Submittals shall meet the requirements of Section 01330 – Submittals.

B. The following information shall be provided in accordance with Section 01330:

1. Descriptive brochures and blower data
2. Complete performance data at the Design Point and all specified operating conditions indicating:

    a. Actual operating speed (RPM) and percent of maximum rated speed
    b. Capacity in SCFM and ICFM
    c. Design inlet conditions including

        i. Pressure
        ii. Temperature
        iii. Relative Humidity

    d. Horsepower including:

        i. Blower shaft
        ii. Motor
        iii. Package
        iv. dB(A) noise pressure level

    e. Input kilowatts
    f. Efficiency

3. Material list and catalog information showing the blower construction details that includes the following information at a minimum:

    a. Outline installation drawings for each unit.
    b. Blower weight and weights of each individual equipment item.
    c. List of recommended spare parts for five (5) years of operation.
    d. Complete bill of materials listing all components and equipment supplied.
    e. Motor characteristics, specifications and performance per specification section 16220.

1.05 WARRANTY

A. The Contractor shall provide a warranty for all the equipment system components included within this specification for a period of one (1) year from the date of substantial completion. During that year, the Contractor shall, at no expense to the Owner, replace any part or parts which malfunction due to defective manufacture or installation.

1.06 DELIVERY, STORAGE AND HANDLING

A. All equipment shall be completely factory assembled, skid mounted, crated and delivered to protect against damage during shipment.

B. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

C. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

1.07 MAINTENANCE

A. The following spare parts shall be furnished for each blower package:

1. Complete set of matched V-belts
2. One inlet air filter element

B. Spare parts shall be properly bound and labeled for easy identification without opening the packaging.

1.08 BLOWER REQUIREMENTS

A. The blowers shall be capable of supplying a constant volume of air to the first flush tank.

B. All components shall be new.

C. Both workmanship and materials shall be of the very best quality and conform to all applicable sections of these specifications. It shall be understood that components specified establish minimum requirements only and do not relieve the Contractor of responsibility for providing a properly functioning system.

D. The blower package shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and selection of the components shall be based on a minimum useful life of 20 years and a mean time between overhauls of 5 years of continuous operation.

E. No special foundations shall be required. The package shall be installed directly on a concrete slab without grouting the base frame. There should be four (4) easily accessible anchor points.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Universal Blower Pac, Inc.

B. Aerzen USA, Inc.

2.02 OPERATING CONDITIONS

A. Blower

Item	
1. Atmospheric Pressure	14.4 psia
3. Maximum Discharge Air Pressure	12 psig
4. Maximum Inlet Temperature	104°F
5. Maximum Inlet Relative Humidity	90%
6. Maximum Air Flow	750 scfm
7. Motor Horsepower	75 HP
8. RPM at above scfm	2650
9. Quantity	2
10. Sound Limit Required @ 1 meter in Free Field	78

B. Additionally, each blower shall be furnished to meet all guarantee points as specified.

2.03 SOUND ENCLOSURE

A. Each blower shall be supplied with a sound enclosure covering the entire blower package.

B. The enclosure shall provide suitable protection for outdoor or indoor installation based upon location.

C. The enclosure shall be designed for easy inspection and maintenance of all blower package components. Quick access panel, each less than 50 pounds shall be provided for easy and quick access for routine maintenance of the blower and package components.

D. The enclosure shall be designed for the ability to install the blower side-by-side with all maintenance done from the front or back of the package.

E. Electrical components, instrumentation and instrument connections shall not be mounted or interface with the access doors.

F. The enclosure panels shall be made of galvanized steel sheet, powder coated per manufacturer's standard paint system. The skid shall be of the same color. Sound enclosure acoustic material shall comply with UL 94 – HF1 for fire-retardant, self-extinguishing, non-dripping materials.

G. The enclosure and blower package must both be mounted on a skid/oil drip pan designed to meet environment protection standards and for easy transportation and installation.

H. A grounding strip shall be installed between the blower base and package skid to bypass any vibration isolating mounts for grounding continuity.

2.04 BLOWER

A. The casing shall be of one-piece construction, with separate side plates that are bolted and pinned to the housing. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions.

B. Inlet and outlet shall be flanged connections.

C. The impellers shall be timed by a pair of single helical gears with quality equivalent to AGMA 12. Gears shall have hardened and ground teeth and a minimum AGMA service factor of 1.70. Gears shall be mounted via hydraulic expansion onto the shafts with a tapered interference fit and secured by a locknut.

D. Each rotary stage shall be certified "Class Zero" oil free to ISO 8573-1.

E. The timing gears and bearings shall be oil lubricated.

F. An oil sight glass shall be provided on the exterior of the sound enclosure so the operator can easily view the oil level.

G. Each blower shall receive its initial oil filling at the factory. The oil shall be fully synthetic and rated for 16,000 hours of operation between changes.

H. The blower oil sumps shall be piped to a common fill and drain, locate at the front of the sound enclosure.

I. All oil lines shall be industrial quality hydraulic hose and fittings.

J. Design Basis

1. Each blower shall be of the axially twisted tri-lobe rotary lobe positive displacement type.
2. Each rotor shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed. The rotors shall operate without rubbing nor shall they require lubrication. Rotors shall be drop forged in one single piece of AISI 1043 or equivalent. Rotors shall be statically and dynamically balanced per ISO 1940/ANSI S2.19 G2.5.
3. Each impeller/shaft shall be supported by anti-friction bearings, and fixed to control the axial location of the impeller/shaft in the unit. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls.

4. Seals shall be designed to prevent lubricant from leaking into the air stream to prevent oil from leaking out of the machine. The seal shall consist of two rotary slip rings mounted in a retainer with an atmospheric air gap in the center. The rotor shaft shall be protected by a shaft sleeve, with an O-ring under the shaft sleeve to prevent oil migration along the shaft into the air conveying chamber.

2.05 MOTOR

A. The blower motor shall meet the requirements as indicated in specification section 16220.

B. A thermostat set by the motor manufacturer and prewired by the blower manufacturer to a terminal strip shall be provided.

C. Coordination of the starting torque requirement of the blower and motor shall be the responsibility of the manufacturer.

D. The motor shall be “inverter-duty” and comply with all requirements in NEMA MG-1 Part 31.4.4.

2.06 DRIVE

A. Design Basis

1. Each blower package shall be provided with a V-belt drive that shall be of the high capacity type, oil and heat resistant. The drive shall be designed for a minimum service factor of 2.0 times the motor nameplate Hp.
2. Belt tensioning shall be automatic without the use of any spring devices or operator interaction.
3. Sheaves shall be dynamically balanced regardless of the operating speed and hydraulically mounted on the compressor drive shaft.
4. The belt drive shall be guarded in compliance with OSHA regulations. Portions of the guard shall be easily removable allowing for belt inspection and replacement. The guard material shall be perforated galvanized carbon steel.

2.07 BASE

A. Base shall include spring loaded auto-tension device for ease of drive installation and maintenance. Covered forklift slots shall be integral to the base design. In order to reduce stress and vibration in base caused by thermal expansion and attenuation, discharge silencer shall not be integral to the base.

B. The blower base shall be mounted on vibration mounts to minimize transmitted vibrations from the blower system to the surrounding structure.

2.08 ACCESSORIES

A. INLET FILTER/SILENCER

1. Each blower will have a filter/silencer with paper media that removes 99.5% of 2 micron particles and have the attenuation performance of the RIS series inlet silencer. The maximum pressure drop across the clean element shall be less than 2-inches of water column. The filter/silencer shall be Stoddard FH64 or equal. The filter/silencer shall ship loose for remote installation.

B. FLEXIBLE JOINT

1. Each blower shall have a flexible joint located between the blower and discharge silencer to minimize vibration transmission to downstream piping. The joint's elastomer must be rated higher than the maximum expected service temperature and pressure

2.09 COMBINATION BASE FRAME AND DISCHARGE SILENCER

A. The discharge silencer shall be a chamber type design for maximum sound attenuation and shall not use any internal absorption materials.

B. The silencer shall be fabricated of a single shell of pressure vessel quality steel with continuous welds.

C. The silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum design pressure.

D. The silencer shall have a machined flanged inlet connection and bolt directly to the discharge flange of the blower.

E. Insulation shall be provided surrounding the discharge silencer to reduce the heat loss within the sound enclosure.

F. Discharge silencer performance losses shall be included in the entire package pressure calculations.

G. The base frame shall be constructed from welded carbon steel that is designed to maintain alignment of the blower internal components and the drive during operation.

H. The base frame shall be designed to resist distortion while being installed on vibration isolating mounts.

I. The manufacturer shall supply a stainless steel grounding lug fully welded to the base.

2.10 INLET AND OUTLET DISCHARGE CONNECTORS

A. Each blower shall be provided with flexible ANSI style connectors for the inlet and discharge connections.

B. The connectors shall prevent the transmission of noise and vibrations from the blower package into the piping.

2.11 ISOLATION VALVE

A. Each blower shall have a discharge isolation valve. Valves less than two inches in diameter will be ball valves. Valves 2-inches and larger shall be cast-iron wafer-body butterfly type with a locking handle. Valves more than eight feet above the floor shall have a chain wheel operator. The temperature rating of the seat must exceed the maximum anticipated discharge temperature. The valve shall be shipped installed on the system.

2.12 PRESSURE SAFETY VALVE

A. A pressure safety valve shall be provided with each blower package. The valve shall be installed on the discharge side of the blower, downstream of the discharge silencer and upstream of the check valve.

B. The valve shall be set to protect the machine from exceeding its maximum pressure rating and shall be sized to pass 100% of the design flow.

C. The valve shall be field adjustable, spring loaded and housed inside and attenuated by the sound enclosure.

D. The valve shall relieve hot air into a segmented and sealed section of the sound enclosure so the hot air cannot reenter the inlet of the machine.

2.13 DISCHARGE CHECK VALVE

A. A discharge check valve shall be supplied and installed on the discharge line of each blower.

B. The check valve shall be full-bore low pressure drop, flapper type design with a steel body and steel flap embedded in EPDM with full-contact seal.

C. The check valve shall be installed for easy removability without disturbing the discharge piping.

D. Pressure losses produced by the check valve shall be included in the entire package performance calculations.

2.14 COATINGS

A. Equipment shall be shop primed prior to shipment from the factory with a primer compatible with the field applied coating specified in Section 09960 – High Performance Coatings.

2.15 GAUGES

A. PRESSURE GAUGE

1. Each blower shall have a 4" diameter, stainless steel case, brass bourdon tube, liquid filled, 1/4 NPT connection pressure gauge with a 0-15 PSIG

scale on systems operating up to 10 PSIG and 0-30 PSIG for higher pressures. Gauge shall have a 1/4" brass snubber and isolation valve. Gauge shall be Winters 800 or equal.

B. FILTER RESTRICTION GAUGE

1. Each inlet filter shall have a filter restriction gauge that progressively measures vacuum in the filter element. A visual indicator, with a manual reset, shall lock at the current vacuum when the blower is shut off.

PART 3 EXECUTION

3.01 INSTALLATION

A. The equipment shall be installed in accordance with the manufacturer's written recommendations.

B. The manufacturer's technical representative shall verify proper installation, electrical connections and equipment alignment prior to start up.

3.02 FIELD TESTING

A. Each system shall be field tested, after installation, in the presence of the Owner's designated representative(s), to confirm and verify the structural and mechanical compliance of the installation.

B. The field testing shall consist of 3 hours operation of each package under actual operating conditions. The test shall insure that all package components are working properly and vibration levels are within acceptable limits. Flow and pressure readings shall be recorded at 30 minute intervals.

C. The manufacture shall provide a written field test/start up report after completion of testing.

D. See specification section 16220 for motor testing requirements.

3.03 MANUFACTURER'S SERVICES

A. Equipment start-up shall be coordinated with the manufacturer's technical representative. The manufacturer's representative shall inspect the complete installation, calibrate and adjust equipment as necessary and correct or supervise correction of defects or malfunctions.

B. A manufacturer's technical representative shall instruct Owner personnel in the proper operation and maintenance procedures for each system.

C. Two (2) trips for one (1) eight (8) hour day each for start-up and training shall be provided to the Owner by the manufacturer.

END OF SECTION 11370

DIVISION 11 – EQUIPMENT
Section 11376 – Coarse Bubble Diffusion Equipment

PART 1 GENERAL

1.01 DESCRIPTION

A. This section specifies the coarse bubble diffusion equipment for providing aeration within the First Flush Tank.

B. The unit shall consist of the droplegs, manifolds, air distributors, supports, diffusers and all specified appurtenances.

C. The Contractor shall furnish and install the coarse bubble diffusion equipment as shown on the drawings.

1.02 RELATED WORK

A. Section 01330 – Submittals
B. Division 3 – Concrete
C. Division 15 – Mechanical
D. Division 16 – Electrical

1.03 QUALITY ASSURANCE

A. The equipment shall be furnished by a manufacturer with no less than twenty (20) installations of similar size, having been in successful operation for a period of not less than five (5) years. The installations must incorporate the same diffuser model and material as proposed for this project.

B. The manufacturer shall perform an Oxygen Transfer Test prior to manufacturing equipment.

1. A performance test shall be conducted to demonstrate capability of the equipment to meet the specified oxygen transfer requirements.
2. A minimum of three (3) tests for each specified operating condition shall be completed in accordance with ASCE Clean Water Test Procedure, latest edition.
3. Tests shall be conducted in a full scale aeration test tank (minimum of 300 sf) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration. Diffuser density is defined as the ratio of the total tank surface are to the total active diffuser surface area.
4. The test shall be conducted with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and design tank volume.
5. A plot of pounds oxygen per day per 1000 cubic feet of tank volume versus air per 1000 cubic feet of tank volume in tap water at 14.7 psia, 68°F and 0 mg/l dissolved oxygen at the specified submergence shall be provided.

6. The test results shall be certified and stamped by a licensed Professional Engineer.
7. All costs for testing shall be included in the equipment price.
8. All test data shall be submitted to the Engineer prior to manufacturing equipment.

C. The manufacturer shall have an Independent testing agency provide documentation on the longevity of the diffusers. Longevity shall have been demonstrated in at least three (3) full-scale municipal installations operating continuously for a minimum of three (3) years. Testing reports, prepared by an Independent testing agency shall be confirm membrane longevity through compliance with the maximum allowed percent change Durometer 5%, Weight 5% and Permanent Set 0.5%. Data from a minimum of three (3) diffusers from each installation shall be provided. Test reports shall be submitted with the shop drawings.

1.04 SUBMITTALS

A. Submittals shall meet the requirements of Section 01330 – Submittals.

B. The following information shall be provided in accordance with Section 01330:

1. Submittal drawings showing plan, elevation and cross section of the aeration equipment and anchor locations. The drawings shall include at a minimum, pipe sizes and lengths, distances between air distribution headers and location of all diffusers, plugs, supports and expansion joints.
2. Component details of the equipment showing diffusers, diffuser holders, gaskets, retainer rings, supports, threaded union and/or flanged joints and the liquid purge system.
3. Material and manufacturer specifications.
4. Equipment data sheet.
5. Performance data including oxygen transfer calculations and curves.
6. Headloss calculations from the manufacturer's point of responsibility. Calculations should be derived using air at standard conditions and at a design maximum air flow rate per diffuser.
7. Pressure requirements.
8. Operation & maintenance manual and installation instructions, submitted following equipment approval but prior to shipment.
9. Test data from oxygen transfer test results prior to manufacturing equipment.

1.05 WARRANTY

A. The Contractor shall provide a warranty for all the equipment system components included within this specification for a period of one (1) year from the date of substantial completion. During that time, the Contractor shall, at no expense to the Owner, replace any part or parts which malfunction due to defective manufacture or installation.

1.06 DELIVERY, STORAGE AND HANDLING

A. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Tideflex Technologies (A Division of Red Valve Company) – Basis of Design

B. Accepted Equal: If Contractor proposes to use a manufacturer or model other than the basis of design, any changes in the layout shall be identified by the Contractor during the submittal process. Any changes to the project design, including but not limited to civil, structural, process mechanical, building mechanical, electrical, controls, accessories, engineering, etc. due to the manufacturer chosen shall be completed by the Contractor at no cost to the Owner.

2.02 OPERATING CONDITIONS

A. First Flush Tank

1. Aeration system shall be designed to transfer not less than the following pounds of oxygen in clean water at 14.7 psi, 68°F and 9 mg/l dissolved oxygen at 23.13 feet submergence, 10.8 psig pressure at the top of drop and the air rate provided below:

Type of Tank	Dimensions (Diameter x SWD to pipe Centerline)	SOTR (oxygen transfer rate) (lb/hr)	Tank Airflow (scfm)	# Diffusers
First Flush	125' dia x 23.13'	292	1500	108

2. The diffuser shall be capable of orientating the discharge point downward towards the tank floor. The emittence point of air from the diffuser shall not be greater than 4" above the tank floor measured at the high point of the tank floor slope.
3. The diffuser shall be capable of connection to the distribution pipe which shall be located with a minimum of 4" of clearance from the bottom of the pipe to the finished floor elevation.

2.03 STAINLESS STEEL FOR PIPES, FITTINGS AND SUPPORTS

A. See specification 15271 for requirements of stainless steel pipe.

B. Additional requirements:

1. Each drop pipe shall be equipped with a stainless steel lifting lug capable of sustaining twice the static weight of the drop pipe assembly.
2. Stainless steel bolts, nuts and neoprene gasket shall be provided for field connection of each vertical pipe to the non-wetted field routed air supply piping at the top of the tank.
3. Piping shall be a minimum of Schedule-10 304 stainless steel.
4. Manifolds shall be fabricated with fixed threaded union or flanged joints for connection to the air distributors.
5. Manifold, distributor connections and supports shall be designed to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 125°F.

C. Pipe supports

1. 304 stainless steel for all components
2. The assembly support bracing shall be anchored to the concrete wall with drill and tap expansion anchors, the pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the vertical pipe section.
3. Shall meet passivity requirements as required in specification 15271.
4. Support brackets shall allow for a minimum of 2” adjustment in elevation of the lateral pipe.
5. Assembly components shall consist of two riser type clamps minimum width of 2.00” and minimum thickness of 0.190”, two all-thread rods minimum diameter of 0.625”, one neoprene strip minimum 0.125” thick with a length equivalent to the lateral pipe circumference, and double stainless steel nuts. Riser clamps shall provide a minimum of 0.0625” of compression of the neoprene strip when assembled around the lateral piping.
6. Threaded rods shall be anchored to the concrete floor using Epoxy type anchors.
7. The maximum spacing between supports shall be limited to 8 feet as shown on the drawings.

2.04 DIFFUSER CONSTRUCTION

A. The diffuser shall be capable of preventing backflow of the process liquid into the diffuser and distribution piping through the diffuser air emittance opening when the discharge airflow is shut-off.

B. The diffuser shall be capable of complete submersion in a sludge blanket of minimum 3% solids concentration without the use of air to keep the diffusers from clogging or misalignment of the diffuser orientation. The diffuser shall be capable of operating in an on-off blower operation mode without clogging of the diffuser.

C. The elastomer diffuser shall be clamped to a bushing or pipe nipple using a heavy duty clamp to ensure the diffuser will not separate from the connection during operation.

D. All elastomer components shall be constructed of EPDM synthetic elastomer with a leachable oils content of 10% or less.

2.05 EXPANSION JOINTS

A. Expansion joints shall be provided at the end of the vertical air supply piping at the transition point to the lateral distribution.

B. The joint shall be stainless steel compression type as manufactured by Victualic Depend-O-Lok Brand FXE 316SS, or equal, and have a minimum pressure capacity of 50 psi and a maximum temperature rating of 230 F.

PART 3 EXECUTION

3.01 INSTALLATION

A. The equipment shall be installed in accordance with the manufacturer's written recommendations.

B. Discharge orientation of the diffuser shall be shown on the installation drawings.

C. The aeration system shall be leveled such that all diffusers connected to a header are within ¼ inch +/- of a common horizontal plane.

D. The manufacturer's technical representative shall verify proper installation and equipment alignment prior to start up.

3.02 FIELD TESTING

A. The diffuser shall be tested for a dynamic wet pressure of 12 inches +/- 20% water column at 1.0 scfm/diffuser and 2 inches submergence. The diffusers shall be observed for uniform air distribution across the active surface of the diffuser at 1.0 scfm/diffuser and 2 inches submergence. The active surface is defined as the perforated horizontal projected area of the diffuser.

B. Each system shall be field tested, after installation, in the presence of the Owner's designated representative(s), to confirm and verify the structural and mechanical compliance of the installation.

3.03 MANUFACTURER'S SERVICES

A. Equipment start-up shall be coordinated with the manufacturer's technical representative. The manufacturer's representative shall inspect the complete installation and calibrated and adjust equipment as necessary and correct or supervise correction of defects or malfunctions.

B. A manufacturer's technical representative shall instruct Owner personnel in the proper operation and maintenance procedures for each system.

C. Two (2) trips for one (1) eight (8) hour day each for start-up and training shall be provided to the Owner by the manufacturer.

END OF SECTION

PART 1 GENERAL

1.01 SUMMARY

A. The work covered by this section consists of furnishing all labor, materials, accessories, tools, equipment, transportation services, and performing all operations required to install the swirl concentrator equipment as specified and as shown on the drawings.

1.02 RELATED WORK

A. Division 1 – General Requirements
B. Division 2 – Site Work
C. Section 03300 – Cast-in-Place Concrete
D. Section 055000 – Metal Fabrications
E. Section 05510 – Structural Steel
F. Section 05520 – Handrails and Railing
G. Section 05532 – FRP Grating

1.03 QUALITY ASSURANCE

A. At the Engineer's request, the equipment manufacturer shall certify to not less than five (5) years of experience in the application, design, manufacture and operating experience of the swirl concentrator.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single swirl concentrator manufacturer.
2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the swirl concentrator manufacturer.

C. Swirl concentrator manufacturer scope of supply:

1. The swirl concentrator equipment installation will include a tangential inlet pipe, a lower chamber, an under-drain, a separating floor and an upper chamber. The opening between the lower and upper chamber will be fitted with a scum board sealed to the upper floor and an internal baffle.
2. The swirl concentrator manufacturer's scope of supply includes the scum board, internal baffle, vent pipe and associated hardware and anchors for these components.

1.04 REFERENCE TO STANDARDS

A. Equipment shall comply with the latest edition of the applicable codes and regulations including the following

1. American Society of Mechanical Engineers (ASME)
2. American Society for Testing and Materials (ASTM)
3. American National Standard Institute (ANSI)

1.05 SUBMITTALS

A. Submittals shall meet the requirements of Section 01330 – Submittal Procedures.

B. Complete shop drawings including drawings of the tank, scum board, baffle, vent underdrain and their supports with anchoring details, including materials of construction shall be provided for the Engineer's approval.

1.06 WARRANTY

A. The Contractor shall provide a warranty for all of the swirl concentrator equipment system components included within this specification for a period of one (1) year from the date of substantial completion. During that one (1) year, the Contractor shall, at no expense to the Owner, replace any part or parts which malfunction due to defective manufacture or installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Information associated with the equipment from the manufacturer named below was used as the design basis as specified herein and shown on the drawings.

1. John Meunier, Inc. – Hydrovex FluidSep Vortex Separator

B. Alternate manufacturers will be listed by addendum only. Qualified manufacturers interested in bidding on the project will be required to provide a complete project submittal for the proposed equipment that meet the design requirements of this project. All alternate suppliers will provide submittal data through a general contractor that is bidding the project. Any submittals received directly from suppliers or representatives will not be opened or reviewed. If the design basis manufacturer is not supplied, the Contractor shall be solely responsible for any and all additional costs associated with changes to civil, structural, process mechanical, building mechanical, electrical, controls, accessories, etc. Contractor shall be responsible for all engineering fees associated with modifying the contract documents as necessary to provide a complete and operational system as determined by Engineer and Owner. Submittals shall include drawings and specifications specific to this project along with a complete list of references for project of the same size or larger. References shall include:

1. Project Location
2. Owner contact information including Name and phone #
3. Design Engineer contact information including Name and phone #
4. Installing contractor contact information including Name and phone #
5. Design information including flow and removal efficiency, and final approved

submittal drawings

2.02 DESIGN REQUIREMENTS

A. Provide a complete and functional swirl concentrator. The treatment device shall process combined sewage to primary treatment levels including removing gross solids, grit, sand, silts, sediment and floatable debris using a combination of vortex, swirl and gravitational forces. The equipment shall require no outside power source and shall have no moving parts. All captured pollutants, both floatable and settleable solids, shall be removed to a centrally located sump located within the separator.

B. The swirl concentrator shall meet the following performance requirements:

Design Flowrate (MGD)	Underflow Rate (MGD)	Minimum Sediment Removal (%)
15	1.5	20

C. Designs incorporating screens shall not be accepted.

2.03 MATERIALS

A. All steel surfaces of equipment provided by the manufacturer shall be constructed of AISI-304 stainless steel or higher quality.

2.04 EQUIPMENT

A. The swirl concentrator shall be sized and constructed in accordance with the contract documents to provide proper sediment removal at the design flowrate listed above.

PART 3 EXECUTION

3.01 GENERAL

A. Inspect and verify that structures or surfaces on which equipment will be installed have no defects which will adversely affect installation.

B. Inspect all equipment prior to installation and provide a written report stating the findings from the inspection.

C. Promptly report defects, which may affect the Work to the Engineer.

3.02 INSTALLATION

A. Installation shall be in strict accordance with contact documents and requirements of the manufacturer's written instructions and shop drawings. It is the Contractor's responsibility to verify the accuracy of all necessary dimensions in the field to ensure compatibility with the specifications and equipment.

B. In the event that equipment is supplied which is different than specified, it shall be the responsibility of the Contractor to coordinate and make all changes to related structures, controls, drawings and documentation. All changes must be reviewed and approved by the Engineer prior to any installation of equipment. In addition, all costs associated with such changes, including additional time required for review of the changes by the Engineer, shall be borne by the Contractor.

C. The Contractor shall be responsible for coordinating the required manufacturer's staff during system startup and commissioning.

3.03 MANUFACTURER'S SERVICE

A. The Manufacturer's field engineer shall inspect and check the installation after erection and be on site for initial start-up of the equipment. In addition to the start-up time, the Manufacturer's process design engineer shall provide process training and operational assistance during the first 60 days of operation of the new CSO satellite treatment system. The total time for all serviced listed above shall not be less than 2 trips and 4 days at the site.

END OF SECTION 11435

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes providing confined space entry equipment as well as portable floatation devices and accessories for Owner's plant operators to use to maintain the facilities upon completion of the work.

1.02 SUBMITTALS

A. Submit product data for each type of product indicated.

1. Confined space entry equipment: Include rating and classification.
2. All confined space entry equipment associated with the davit system shall be provided by the same manufacturer.
3. Personal flotation devices: Include rating and classification and details of installation.

1.03 QUALITY ASSURANCE

A. OSHA Compliance: Confined Spaces, 29 CFR 1910.146.

B. US Coast Guard: Life Saving and Fire Safety Approvals.

1.04 COORDINATION

A. Coordinate confined space entry equipment with Owner plant staff to ensure that size and fit of equipment are accommodated.

B. Paragraphs 2.01 – 2.06 shall be supplied by the same Manufacturer to ensure functionality and consistent operation.

PART 2 PRODUCTS

2.01 VEST STYLE POSITIONING HARNESS

C. Provide quantity of one (1) vest style positioning harness to be used for confined space entries. Harness shall meet the following minimum specifications.

Feature Description	Specification
Capacity	420 pounds
Brand	DBI-SALA® or accepted equal
Sub Brand	ExoFit™ or accepted equal
Size	X-Large (to be coordinated with Owner)
D-Ring Locations	Back Side Front
Leg Strap Buckle Type	Quick Connect
Padding Location	Shoulder/Back and Leg
Thread/Stitching	Polyester
Label	Vinyl
Padding	Nylon, Polyester, Aerospace Mesh, EVA Foam
Web	Polyester
Web Keeper	Nylon, Polyethylene
Leg Buckle	Zinc Plated Steel
Chest Buckle	Zinc Plated Steel, E-Coat
Torso Buckle	Zinc Plated Steel
Model	1108606
Physical Weight	4.40 lbs.
Product Styles	Vest Style
Product Types	Work Positioning Ladder Climbing Descent Control
Standards	OSHA 1910.66, OSHA 1926.502, Capital Safety Gen. Mfg. Req.

2.02 DIGITAL WINCH

A. Provide quantity of one (1) digital winch to be used for confined space entries. Winch shall meet the following minimum specifications.

Feature Description	Specification
Brand	DBI-SALA® or accepted equal
Sub Brand	Advanced™ or accepted equal
Size	240 ft.
Install Type	Portable
Lifeline Type	Galvanized Cable
Lifeline Length	240 ft. (73 m)
Lifeline	3/16" (5mm) dia. 7x19 Galvanized Aircraft Wire Rope
Hook	Zinc Plated Steel
Label	Polyester, Stamped
Winch/SRL Housing	Cast Aluminum, Powder Coated
Model	8518603
Physical Dimensions	9.00x12.50x11.00 (lbs.)
Physical Weight	50.00 lbs.
Product Styles	Winch
Product Types	Mechanical System
Standards	OSHA 1910.66, OSHA 1926.502, Capital Safety Gen. Mfg. Req.

2.03 OVERLOAD CLUTCH FOR POWER DRIVE DIGITAL WINCH

A. Provide quantity of one (1) overload clutch to be used with digital winch for confined space entries. Clutch shall meet the following minimum specifications.

Feature Description	Specification
Capacity	450 lbs.
Brand	DBI-SALA® or accepted equal
Sub Brand	Advanced™ or accepted equal
Model	8512936
Physical Weight	3.80 lbs.
Product Styles	Pulley
Product Types	Confined Space Entry/Rescue - Accessory
Standards	Capital Safety Gen. Mfg. Req.

2.04 FLOOR MOUNT SLEEVE DAVIT BASE

A. Provide quantity of two (2) floor mount sleeve davit bases and heavy duty sleeve caps to be used with davit hoist system for confined space entries. Base shall meet the following minimum specifications.

Feature Description	Specification
Brand	DBI-SALA® or accepted equal
Sub Brand	Advanced™ or accepted equal
Construction	304 Stainless Steel with PVC sleeve liner
Install Type	Portable
Label	Polyester
Models	8515834 / 8510827
Physical Dimensions	8.10x8.10x10.00 (lbs.) / 3.50x3.50x1.40 (lbs.)
Physical Weight	18.90 lbs. / 0.90 lbs.
Product Styles	Davit Base
Product Types	Davit System
Standards	OSHA 1910.66, OSHA 1926.502, Capital Safety Gen. Mfg. Req.

2.05 WALL MOUNT SLEEVE DAVIT BASE

A. Provide quantity of four (4) wall mount sleeve davit bases to be used with davit hoist system for confined space entries. Base shall meet the following minimum specifications.

Feature Description	Specification
Brand	DBI-SALA® or accepted equal
Sub Brand	Advanced™ or accepted equal
Construction	304 Stainless Steel with PVC sleeve liner
Install Type	Portable
Label	Polyester
Model	8518348
Physical Dimensions	10.00x4.30x9.30 (lbs.)
Physical Weight	12.90 lbs.
Product Styles	Davit Base
Product Types	Davit System
Standards	OSHA 1910.66, OSHA 1926.502, Capital Safety Gen. Mfg. Req.

2.06 5-PIECE DAVIT HOIST SYSTEM

A. Provide quantity of one (1) 5-piece davit hoist system to be used for confined space entries. Davit hoist system shall meet the following minimum specifications.

Feature Description	Specification
Brand	DBI-SALA® or accepted equal
Sub Brand	Advanced™ or accepted equal
Install Type	Portable
Label	Polyester
Model	8518000
Physical Weight	83.20 lbs.
Product Styles	Complete System
Product Types	Davit System
Standards	OSHA 1910.66, OSHA 1926.502, Capital Safety Gen. Mfg. Req.

2.07 MULTIGAS DETECTOR

A. Provide quantity of one (1) 5 gas detector used for confined space entries. Gas detector shall meet the following minimum specifications.

1. Portable gas detector shall be suitable to attach to a person for use in confined space entry. Detector shall monitor, measure and display combustible gases as a % of Lower Explosive Limit (LEL) and 1-100% by volume.
2. Portable gas detector shall be appropriate to enter into Class I, Division 1, Groups A, B, C & D hazardous locations.
3. Portable gas detector shall be ALTAIR 5X Multigas Detector as manufactured by MSA or accepted equal.

2.08 PORTABLE BLOWER AND BLOWER DUCTING

A. Provide quantity of one (1) portable blower used for confined space entries. Portable blower shall meet the following minimum specifications.

1. Plastic, lightweight, corrosion, UV and chemical resistant polyethylene construction.
2. Polypropylene, nine blade fan, steel/powder coated grill with 15 feet of electrical cord, AC powered.
3. Compatible with retractable ducting.
4. Manufactured by Allegro Industries– Part # 9533 or accepted equal.

B. Provide portable blower ducting used for confined space entries. Portable blower ducting shall meet the following minimum specifications.

1. 25 feet of 8” retractable ducting for maximum air handling, bidirectional flow.
2. Constructed of vinyl and polyester materials with PVC coating.
3. Yellow and black weather strip with non-collapsible design.

4. Manufactured by Allegro Industries– Part # 9500-25 or accepted equal.

2.09 LIFE RING AND MOUNTING BRACKETS

A. Provide quantity of four (4) portable life rings and install around perimeter of first flush tank. Portable life rings shall meet the following minimum specifications.

1. Traditional 24” diameter life ring with rope or webbing bonded into the ring. Color shall be orange. Life ring shall be constructed of closed cell plastic with surface that is resistant to weather, extreme temperature and mildew. Rope shall be looped and bonded to the core.
2. Mount life rings with heavy duty three fingered rack, welded stainless steel construction. Rack shall be mounted to guard rail around first flush tank.
3. Life ring and rack shall be Model GO-X-24 (USCG approval #160.050/103/1) as manufactured by Jim Buoy Corporation or accepted equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install floor mount sleeves, wall mount sleeves and mounting brackets at locations shown on drawings with approved mounting hardware.

B. Procure all confined space entry equipment from PART 2 not installed and transfer to Owner prior to substantial completion.

C. Procure life rings and transfer to Owner prior to substantial completion.

END OF SECTION 11811

MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

DIVISION 12 – FURNISHINGS

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12350	Plastic Laminate Casework	12350	1-4

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes Blower and Electrical Building cabinets and countertops.

1.02 SUBMITTALS

A. Product Data: For cabinets, countertop material, and cabinet hardware.

B. Shop Drawings: Include plans and elevations. Show materials, finishes, filler panels, hardware, countertop edge and backsplash profiles, cutouts for plumbing fixtures, and methods of joining countertops.

1. Cabinets: Verify dimensions of installation areas by field measurements before fabrication and indicate measurements on Shop Drawings. Show fillers and scribes if necessary.
2. Countertops: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

C. Samples: For each exposed finish.

1.03 QUALITY ASSURANCE

A. Quality Standards:

1. Cabinets: KCMA A161.1.

a. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semi-exposed location of each unit and showing compliance with the above standard.

2. Plastic-Laminate Countertops: KCMA A161.2.

PART 2 PRODUCTS

2.01 COLORS, TEXTURES, AND PATTERNS

A. Colors, Textures, and Patterns: As selected from manufacturers' full range, unless otherwise indicated.

2.02 CABINET MATERIALS

A. Exposed Materials:

1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, Grade VGS.
2. Vinyl-Faced Fiberboard: Medium-density fiberboard complying with ANSI A208.2, milled to required shapes, with a thermoformed vinyl overlay applied in a vacuum or membrane press.

B. Semi-exposed Materials: Unless otherwise indicated, provide the following:

1. Plywood: Hardwood plywood complying with HPVA HP-1 with Grade C faces stained to be compatible with exposed surfaces.
2. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, Grade VGS.
3. Vinyl-Faced Particleboard: Medium-density particleboard complying with ANSI A208.1, Grade M-2 with an embossed, wood-grain-patterned vinyl film adhesively bonded to particleboard.

C. Concealed Materials:

1. Solid Wood or Plywood: Any hardwood or softwood species, with no defects affecting strength or utility. Hardwood and softwood lumber kiln dried to 7 and 10 percent moisture content, respectively.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Medium-Density Fiberboard: ANSI A208.2.
4. Hardboard: AHA A135.4, Class 1 Tempered.

2.03 COUNTERTOP MATERIAL

A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Formica Corp.
b. Laminart.
c. Nevamar Corp.
d. Pioneer Plastics Corp.
e. Westinghouse Electric Corp.; Specialty Products Div.
f. Wilson, Ralph Plastics Co.

2. Grade: HGS.
3. Color and Pattern: As selected from manufacturers' full range.

B. Particleboard: ANSI A208.1, Grade M-2.

C. Plywood: Exterior softwood plywood complying with PS 1, Grade C-C Plugged, touch sanded.

2.04 CASEWORK HARDWARE

A. General: Complying with BHMA A156.9, of type, material, size, and finish as selected from manufacturer's standard choices.

B. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05091.

C. Pulls: Wire pulls.

D. Hinges: Concealed European-style self-closing hinges.

2.05 CABINET CONSTRUCTION

A. Face Style: Flush overlay; door and drawer faces cover cabinet body members or face frames.

B. Face Frames: 5/8-inch- thick particleboard with plastic laminate on exposed and semi-exposed surfaces.

C. Door and Drawer Fronts: 1/2-inch- thick particleboard with plastic-laminate on faces, backs, and edges.

1. Plastic Laminate: Use same grade, pattern, color, and texture of plastic laminate for backs and edges as for faces.

2.06 PLASTIC-LAMINATE COUNTERTOPS

A. Configuration: Fabricate countertops with the following front, cove (intersection of top with backsplash), backsplash, and end-splash style:

1. Front: Square edge.
2. Backsplash: Square edge.
3. End Splash: Square edge.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install casework without variations in plane of adjoining surfaces; use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework face.

B. Install casework and countertop level and plumb to a tolerance of 1/8 inch in 8 feet.

C. Fasten cabinets to adjacent units and to backing.

1. Fasten wall cabinets through back, near top and bottom, at ends and not less than 24 inches o.c.

D. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.

E. Adjust casework and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

END OF SECTION 12350

MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

DIVISION 13 – SPECIAL CONSTRUCTION

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13901	Level Sensing and Measurement	13901	1-6

PART 1 GENERAL

1.01 WORK INCLUDES

A. The work on this section includes the supply and installation of level transmitters, float switches and all related mounting hardware and equipment as required to furnish a complete and operational electrical system.

1.02 RELATED SECTIONS

A. Division 15 - Mechanical.
B. Section 16010 - General Electrical Requirements.
C. Section 16111 - Conduits and Raceway.
D. Section 16123 - Building Wire and Cable.
E. Section 16190 - Supporting Devices.
F. Section 16902 - Electric Controls and Relays.
G. Section 16903 - Programmable Logic Control Panels
H. Section 16905 - SCADA Systems
I. Section 16950 - Testing Electrical Systems

1.03 REFERENCE TO STANDARDS

A. U.L. Listed.

1.04 DELIVERY, STORAGE AND HANDLING

A. Level measurement equipment shall be stored indoors from time of delivery to jobsite, protected from weather and construction.

1.05 SUBMITTALS

A. Submit under the provisions of Section 01330.

B. Submittal shall include electrical ratings, layout, wiring diagrams, U.L. listing, etc.

1.06 QUALIFICATIONS (RESERVED)

1.07 QUALITY ASSURANCE

A. The level measurement equipment shall be manufactured and supplied by a company regularly engaged in the business of furnishing level measurement equipment. If required by Owner, manufacturer shall submit a certification to a minimum experience of ten years in manufacture of level measurement equipment.

1.09 WARRANTY AND SERVICES

A. The Contractor shall provide warranty for all items under this section for one (1) year from the date of substantial completion. During that one (1) year, the Contractor shall at his expense replace any part or parts which malfunction or corrode due to defective manufacture or installation.

1.11 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 SUBMERSIBLE LEVEL TRANSMITTERS (PRESSURE TRANSDUCERS)

A. Submersible level transmitters shall be provided as follows:

B. The Transducer shall be of the solid-state head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions.

C. The transducer shall be installed in a suitably sized wall-mounted PVC standpipe stilling well with diaphragm face of the sensor 6 inches above the floor of the wet well. Provide a stainless-steel hanging chain and stainless-steel latching ring at top of wet well in order to permit field-removal and adjustment.

D. The transducer housing shall be fabricated of from stainless steel.

E. A hydraulic fill liquid shall be factory installed behind the diaphragm in order to transmit the sensed pressure to the transducer element.

F. Transducer electronics shall provide a 4-20 madc output signal directly proportional to the sensed pressure.

G. The internal pressure of the lower transducer assembly shall be relieved to atmospheric pressure through a heavy-duty jacketed hose/cable assembly and a slack bellows mounted in an upper-assembly enclosure. The sealed breather system shall compensate for variations in barometric pressure and expansion and contraction of air due to temperature changes and altitude as well as prevent fouling from moisture and other corrosive elements.

H. The transducer assembly shall be installed where noted on the drawings and placed in successful operation. It shall be provided with input power and output signal transient protection, associated control elements as specified herein and in accordance with manufacturer's instructions.

I. All components in contact with the wet well environment shall be third party listed for use in a Class 1, Division 1, Group D environment. Provide compatible isolating-type (active) intrinsically-safe barrier if required for hazardous location application.

J. Where indicated on the drawings the Contractor shall include a level display that will convert the 4-20mA signal from the element to feet in a NEMA 4X enclosure. Where mounted exterior include a sun shield. This unit shall re-transmit the 4-20mA signal.

K The Submersible Level Transmitter shall be "Birdcage" Model BC-1000 as manufactured by Blue Ribbon Industrial Components, Winter Park, Florida, or U.S. Filter (Consolidated Electric Company) Bulletin A1000, Model 157GSCI, or equivalent. Level indicator shall be Precisian Digital or equiv.

Location Name	Calibrated Span (USGS)	Transducer Span (psi)	Signal Output
Screen Structure	670.50-687.60	0 – 15 psi	4-20 ma DC
First Flush Tank	661.00-685.00	0 – 15 psi	4-20 ma DC
Influent Pump Station	665.00-693.50	0 – 15 psi	4-20 ma DC
Foul Sewer/Drain Pump Sta.	650.00-691.00	0 – 20 psi	4-20 ma DC
Chlorine Contact Tank	677.90-688.00	0 – 15 psi	4-20 ma DC

2.02 ULTRASONIC LEVEL TRANSMITTER

A. Level indicator / transmitters shall utilize non-contact ultrasonic technology.

B. Unit transducer shall be temperature compensated.

C. Transmitter primary power is to be 120 VAC, 60 Hz, with isolated process signal output of 4-20 ma proportional to measured level into 750 ohm load.

D. Separation between Transducer and electronics shall be up to 1000 feet.

E. Transmitter electronics package shall be furnished in non-metallic NEMA 4X IP65) wall-mount enclosure suitable for outdoor use.

F. Transmitter electronics shall include algorithms for open-channel flow measurement and volume conversion.

G. Transmitter shall have no less than three (3) normally-open (N.O.) form "A" alarm/pump control relays with minimum rating of 5 Amps at 250 VAC. Relay operation shall be field programmable/re-programmable.

H. Display shall be alphanumeric back-lit LCD.

I. On units with a removable programming panel, furnish a minimum of one hand-held programmer for each project.

J. Include a minimum of two (2) bound paper instruction manuals.

K. Operating temperature for electronics shall be no less then -20°to 50°C.

L. Liquid level resolution shall be no less than 0.25% of program range or 0.24", whichever is greater. Calibrated range shall be from 1 ft to 50 feet with resolution of 0.1% of program range or 0.08" whichever is greater.

M. Transmitter shall include a volume conversion algorithm for conversion of horizontal-cylindrical tanks.

N. All transducer components located within a classified location shall be third party listed for use in a Class 1, Division 1, Group D environment.

O. Wet Well Ultrasonic Level Transmitter shall be one of the following:

1. Siemens/Milltronics HydroRanger 200 Model #7ML5034/7ML1034 series
2. Pulsar, Inc; Shalimar, Florida; Ultra-3

P. Compatible Level Transducers for Wet Well Ultrasonic Level Transmitters shall be ambient temperature compensated and shall be Milltronics XPS-10F (applications 1-33 feet) or XPS-15F (applications 1-50 feet), or equivalent. Where noted on project drawings, furnish transducer with 2" MNPT thread for installation into a 2" FNPT field adapter, Milltronics ST-H, or equivalent.

Q. The contractor shall provide factory trained recorder manufacturer's representative for the purpose of field start-up, calibration and commissioning of the equipment. In addition, the factory trained representative shall provide minimum four (4) additional hours instruction for the owner on equipment set-up and maintenance procedures.

Location Name	Calibrated Span (USGS)	Transducer Span (psi)	Signal Output
Chlorine Contact Tank	677.90 – 688.00	0-5psi	4-20mA

2.03 FLOATS

A. Float shall be capable of tripping internal switch within two inches of specified elevation. Float housings shall be stainless steel "ball" approximately 5 inches in diameter.

B. Floats shall be one of the following:

1. U.S. Filter (Consolidated Electric Company); Model 9G-EF
2. Anchor Scientific; Long Lake, Minnesota Roto-Float-SST/NM Type P
3. Contegra; St. Paul, Minnesota Model FS-90

(Unless specified or indicated otherwise on the drawings, all floats shall be normally open, with contact closing on rising water level.)

C. Unless otherwise noted on project drawings, a stainless steel clamp tube shall be furnished with an adapting fitting and two yokes for mounting to a vertically supported one inch Stainless Steel or Schedule 80 PVC pipe. One inch pipe shall be securely fastened to structure or wall at its ends with stainless steel pipe mounting brackets as detailed on drawings.

D. Where floats are noted to be installed in a Class 1, Division 1, Group D environment wet-well, each float shall additionally be furnished with an intrinsically-safe barrier to provide the necessary interface between the classified and non-classified environments. Intrinsically safe barrier shall be F.M. or other third-party listed device.

FLOAT SCHEDULE

Float Location	No. of Floats
RCPS Wet Well	2
RCPS SCREEN CHANNEL	1

Notes:

1. Lengths shall be as required without splicing cable previous to junction box. Contractor shall field measure all float cable lengths required prior to ordering floats. A minimum of 5 feet of slack float cable shall be included in length to allow for adjustments of float actuation level.

2. A - N.O. contacts (contacts open on falling level).
   B - N.C. contacts (contacts close on falling

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify length of float cable required. Running splices or field splicing in boxes other than those indicated on the drawings will not be allowed.

3.02 INSTALLATION

A. Install equipment as detailed on drawings and per manufacturer's requirements.

B. Stainless steel float bodies shall be grounded.

C. Secure slack to cable hangers with corrosion resistant nylon cable ties.

3.03 TESTING

A. Provide factory-trained manufacturer's representative services to inspect completed installation, make all adjustment necessary to place system in trouble-free operation and instruct operating personnel in proper care and operation of equipment. Include four (4) hours additional services in order to instruct owner on use and maintenance of equipment.

END OF SECTION 13901

MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

DIVISION 14 – CONVEYING SYSTEMS

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14650	Davit Crane	14650	1-2

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Extent of work as required by the drawings and these specifications.

B. Chlorine Room Hoist and Trolley.

1.02 RELATED WORK

A. Related Requirements Specified Elsewhere:

1. Section 055000 – Metal Fabrications.
2. Division 16 - Electrical.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements.

1. Governing Codes:

a. 2012 IBC
b. OSHA latest edition.

1.04 REFERENCES

A. Referenced Standard

1. UL and NEMA Compliance: provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA standards.

1.05 SUBMITTALS

A. Product Data and Shop Drawings

1. Before beginning fabrication and work, Contractor shall prepare all shop drawings and other data necessary to show general arrangement of crane and hoist equipment. Drawings and other data shall be submitted to Engineer for review.
2. Submit 6 copies of manufacturer's specifications and installation instructions for complete crane and hoist system, and for each component or product used in system. Include certified laboratory test reports on components as specified or required by Code and include manufacturer's certification stating that actual components provided are identical with ones tested by laboratory. Include complete listing and description of performance and operating characteristics, clearly indicating wherein actual crane and hoist will be in any

way modified from requirements and how these differences (in every case) exceed minimum requirements. Show maximum dynamic and static loads imposed on building structure at all points of support for elevator work. Show maximum and average power demands and requirements for temporary power.

3. Submit shop drawings for crane and hoist system, including typical details of assembly, erection and anchorage drawn at large scale. Submit smaller scale drawings of overall plans, elevations and sections to show travel distances and similar considerations of work. Assemble shop drawings specified into one coordinated submittal.

1.06 TEMPORARY USE AND PROTECTION

A. The hoist and trolley shall not be used for construction purposes or during construction period of building. In case of damage by unauthorized use, any repairs or replacements to restore elevator equipment to its original condition shall be made by Contractor at no expense to the Owner.

1.07 INSTRUCTION AND MAINTENANCE

A. Instruct Owner's personnel in proper use, operation and maintenance of crane and hoist. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for source of an operational failure or malfunction. Confer with Owner on requirements for complete crane and hoist maintenance program.

B. Make final check of each crane and hoist operation just prior to acceptance of crane and hoist work by Owner. Determine that all operating devices are functioning as required.

C. Maintenance Period

1. Starting at time of Owner's acceptance of crane and hoist work, provide complete systematic inspection and maintenance of crane and hoist for a period of 12 months. Furnish trained experts and equipment to check adjust, lubricate and otherwise maintain crane and hoist in operation without defects or deterioration. Replace or repair materials and parts which become defective or deteriorated for any reason except through abuse or misuse by the Owner or occupants of building. Return to project, within 18 hours of time Owner reports defective operation, and proceed with repair and maintenance work to restore operation promptly, at no cost to Owner.

D. Continuing Maintenance

1. Installer shall provide continuing maintenance proposal to Owner, in form of standard yearly (or other period) maintenance agreement, starting on the date the construction contract maintenance requirements are concluded. State the services, obligations, conditions and terms for agreement period, and for renewal options. Include provisions of project guarantee.

E. Maintenance Manuals

1. Submit 1 copy of bound maintenance manual for crane and hoist. Include full maintenance and operating instructions, parts lists, recommended spare parts and emergency parts inventory, sources of purchase and similar information. Content of manual must be acceptable to firm selected by Owner to perform continuing maintenance.
2. Additional requirement as listed in Section 01782 – Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.01 CHEMICAL FEED BUILDING CHORINRE STORAGE ROOM

A. Provide underhung trolley and hoist as indicated below:

1. Hoist Construction

a.	Capacity:	3-ton
b.	Hoist Speed:	2-speed @ 8/16 FPM
c.	Hoist Lift:	10 foot available
d.	Hoist Reeving:	2-part double - 5/16" cable.
e.	Hoist Motor:	2-½ HP minimum. Motors are to be TENV, 30-minute rated with Class "F" motor insulation.

f. Hoist Motor Brake: The electric motor brake shall be a direct acting disc type using a short stroke magnet, operated by rectified D.C. supplied by the brake control. The torque rating of the brake shall not be less than 150 percent of the full load torque rating of the hoist motor and shall quickly set and stop the motor when the power is interrupted. The motor brake shall be equipped with an interlocking device to prevent the motor from operating against a closed brake or a brake requiring adjustment.

g. Hoist Load Brake: Simple regenerative braking, an inherent characteristic of all single and two speed squirrel cage induction motors, shall not be used as a substitute for a mechanical load brake. The automatic mechanical load brake shall be a multiple disc weston type. The brake linings shall be grooved to facilitate circulation of lubricant and shall be bonded to a ratchet disc engaging a silent pawl. The mechanical load brake shall operate in a cooling oil bath and shall not require adjustment between normal overhauls.

h.	Suspension:	Motorized underhung.
i.	Trolley Speed:	Single speed @ 50 FPM with electronic soft-start for reduced starting torque.
j.	Trolley Wheels:	6" diameter fixed axles.
k.	Trolley Motor:	TENV, 30-minute rated with Class "F" motor insulation, 1750 rpm, 2 @ 1/3 hp each.
l.	Motor Protection:	Thermal overload protection is required.
m.	Limit Switches:	Hoist shall include an upper and lower geared limit switch, along with an additional paddle or weight type upper limit switch for back-up. Hoist shall have features to prevent excessive weight overload beyond rated capacity.
n.	Control Enclosures:	NEMA 12 dust tight. Enclosures are to have a vertical hinge.

2. Manufacturers/Suppliers

a. Subject to compliance with these specification requirements, provide products of one of following

i Harrington
ii ACCO Wright
iii Yale Lift-Tech
iv. Accepted equal

PART 3 EXECUTION

3.01 INSTALLATION OF HOISTS

A. Comply with manufacturer's instructions and recommendations for work required during installation.

B. Coordinate installation of hoists with work of other trades, for proper time and sequence and alignment to avoid construction delays.

END OF SECTION 14600

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install and be ready for operation of portable davit crane as shown on the Contract Drawings and as specified herein.

1.02 RELATED WORK

A. Section 03300 – Concrete
B. Section 11310 – Submersible, Non-Clogging, Wastewater Pump
C. Division 5 – Metals

1.03 QUALITY ASSURANCE

A. Qualifications

1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of ten (10) years of experience designing and manufacturing cranes.

1.04 REFERENCE TO STANDARDS – NOT USED

1.05 SUBMITTAL REQUIREMENTS

A. Submit shop drawings in accordance with section 01330.

B. Submit shop drawings for crane, including typical details of assembly, erection and anchorage.

1.06 WARRANTY

A. The manufacturer shall guarantee the entire product for a full year after substantial completion. If the Owner and his Engineer are not completely satisfied with the performance of the products, the manufacturer shall remedy the problem at no cost.

PART 2 EQUIPMENT

2.01 MANUFACTURER

A. Base Manufacturer. Information associated with the equipment from the manufacturer(s) named below was used as the basis for the design as specified herein and shown on the drawings. Contractor's bid may be based on any one of the following manufacturers with the stipulation that all equipment provided shall be from one manufacturer:

1. Thern, Inc. of Winona, MN
2. Ace Industries
3. L.K. Goodwin Company, Inc.

2.02 PERMANENT CRANE ARM ASSEMBLY (RESERVED)

2.03 PORTABLE CRANE ARM ASSEMBLY

A. Furnish and install one (1) powered davit crane arm assembly.

1. The crane shall rotate 360° on a pin and sleeve bearing.
2. The boom shall be adjustable to 4 different lengths and will allow for height adjustment while under load with a ratchet style screw jack.
3. The winch shall have a worm gear power assembly with capacity to easily lift the heaviest stop log with the crane arm assembly at full extension.

a. The electric motor shall be 115 volt single phase and include a power cord with grounded plug and momentary contact-type push button pendant control on a control cord.
b. Provide an internal mechanical brake.

2.04 CONSTRUCTION

A. Crane shall have a capacity of 1,000 lbs. at a hook reach of 36” in the horizontal position with 50 feet of vertical lift below floor, and be constructed of stainless steel.

B. Five socket mount bases – stainless steel.

C. Wire Rope Assembly and eye hook shall be stainless steel with swaged ball fitting. The length of rope shall be as required to retrieve the lowest stop log.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install five (5) socket mount bases at the locations indicated on the drawings (4 at Influent Pump Station and 1 at Foul Sewer Pump Station).

B. Installation of the crane and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the Contractor to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.

3.02 FIELD TESTING

A. After installation, the crane(s) shall be field tested in the presence of the Engineer and Owner to ensure that all items of equipment are in full compliance with this Section.

END OF SECTION 14650

MATTOON, ILLINOIS
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DIVISION 15 – MECHANICAL

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. All applicable requirements of other portions of the Contract Documents apply to the Work of this Section including, but not limited to, all Drawings, all Specifications, General Conditions, and General Requirements including submittals.

1.02 SUMMARY

A. This Section includes general administrative and procedural requirements for mechanical installations to expand requirements specified in Related Documents.

1.03 RELATED WORK

A. Specified Elsewhere:

1. 15064 - Sleeves, Supports, Hangers, Anchors and Seals
2. 15070 - Mechanical Sound, Vibration and Seismic Control
3. 15084 - Piping Insulation
4. 15086 - Refrigerant Piping Insulation
5. 15100 - Plumbing
6. 15120 - Plumbing Specialties
7. 15185 - Refrigerant Piping and Specialties
8. 15260 - Process Piping
9. 15267 - Plant Piping Specialties
10. 15270 - Valves
11. 15277 - Electric Valve and Gate Actuators
12. 15300 – Fire Protection
13. 15400 - Plumbing Equipment
14. 15410 - Plumbing Fixtures
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16. 15764 - Electric Resistance Space Heating Units
17. 15812 - Ductwork
18. 15820 - Ductwork Accessories
19. 15832 - Power Ventilators
20. 15850 - Air Inlets and Outlets
21. 15954 - Air Systems Testing, Adjusting and Balancing

1.04 REFERENCE TO STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

B. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to the Project Representative for a decision before proceeding.

C. Publication Dates: Where the date of issue of a referenced standard is not specified, comply with the standard in effect as of date of Contract Documents.

D. The Engineer has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents; that information may or may not be of significance to the Contractor. Contractor shall directly contact authorities having jurisdiction for information and decisions having a bearing on the Work.

1.05 SUBMITTALS

A. General: Submit in accordance with Division 1, Section 01330 – Submittal Procedures. All requirements of Section 01330 shall be met. The following lists minimum requirements for Submittals covering Building Mechanical items in addition to the requirements set forth in Section 01330. In the event of any conflict between the following and Section 01330, Section 01330 shall prevail.

B. Prior to the performance of any work or installation of any materials, obtain approval from the Project Representative by submitting shop drawings and data sheets.

C. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from Subcontractors and material suppliers directly to the Project Representative will not be accepted or processed.

D. Any items with a tag number must be submitted for approval. Submittals shall provide all pertinent data and information necessary to evaluate each item. Drawings and data sheets shall show:

1. Principal dimensions and details of construction.
2. Weights of principal parts and total weights with information required for the design of supports and foundations.
3. Sizes and locations of piping and connections.
4. Performance data, including pump and fan curves; fan discharge and inlet noise data; certified by the manufacturer for the equipment furnished.
5. Data on electric motors, including break HP of driven equipment, nameplate ratings and classes, and starting and running full load currents.
6. Approval stamp of Underwriters and other authorities having jurisdiction of drawings requiring such approval.
7. Automatic temperature control system including diagrammatic layout of piping, wiring, control device, and equipment, and detailed descriptions of each item of equipment and its function in the system and system operation.
8. Refrigeration for field-assembled systems including description of specialties and pressure drops, layout of piping with lengths, fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.

E. Approval of shop drawings does not release Contractor from responsibility of coordinating his work at job site and taking field measurements. In cases where interferences become apparent, the Contractor shall notify the Project Representative so that such interferences may be resolved prior to proceeding with shop work. No claim will be allowed for work that might have to be moved or replaced based on a claim that work was placed in accordance with dimensions shown on the approved shop drawing.

1.06 RECORD DOCUMENTS

A. Record documents shall be developed in accordance with Division 1, Section 01781 - Project Record Documents. All requirements of Section 01781 shall be met. The following lists minimum requirements for Record Documents covering Building Mechanical items in addition to the requirements set forth in Section 01781. In the event of any conflict between the following and Section 01781 shall prevail.

B. Record Documents: Maintain a clean, undamaged set of Contract Documents and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Documents. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark new information that is important to the Project Representative, but was not shown on Contract Drawings or Shop Drawings.

2. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
3. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
4. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
5. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
6. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
7. Contract Modifications, actual equipment and materials installed.

C. Engage the services of a Land Surveyor or Professional Engineer registered in the State of Illinois to record the locations and invert elevations of underground installations.

1.07 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

A. Operating and Maintenance Manuals shall be developed in accordance with Division 1, Section 01782 – Operation and Maintenance Manuals. All requirements of Section 01782 shall be met. The following lists minimum requirements for Operating and Maintenance Manuals covering Building Mechanical items in addition to the requirements set forth in Section 01782. In the event of any conflict between the following and Section 01782, Section 01782 shall prevail.

B. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:

1. Spare parts list.
2. Copies of warranties.
3. Wiring diagrams.
4. Inspection procedures.
5. Shop Drawings and Product Data.
6. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
7. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
8. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions

9. Servicing instructions and lubrication charts and schedules.

C. All controls and safety devices shall be clearly and permanently marked with embossed or printed plates as to purpose and as to operation and shall be tested in the presence of the Owner's designated representative to insure that he understands their function and purpose.

D. Upon completion of the work, the Contractor shall put the systems into service. The Contractor shall be entirely responsible for the equipment during all testing operations including the turning on and off the apparatus. Each Contractor shall provide the Owner, three 4-hour instruction sessions in the operation of the equipment and systems.

1.08 WARRANTIES

A. Refer to Related Documents for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Compile and assemble the warranties specified in Division 15, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.09 PRODUCT LISTING

A. Prepare listing of major mechanical equipment and materials for the project.

B. When two or more items of same material or equipment are required, they shall be by the same manufacturer. Product manufacturer uniformity does not apply as applicable for project to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in work, except as otherwise indicated.

C. Provide products which are compatible within systems and other connected items.

1.10 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance, and similar essential data. Locate nameplates in an accessible location.

1.11 DEFINITIONS

A. The following terms are used throughout the contract documents. The work will be governed in accord with the definitions.

1. The term "Piping" refers to pipe, fittings, valves, flanges, unions, specialties and accessories and appurtenances necessary for, or incidental to, a complete system.
2. The term “Ductwork" refers to all air delivery, recirculation and exhaust ducts whether of sheet metal or other material, and includes all connections accessories and appurtenances necessary for and incidental to a complete system.
3. The term "concealed work" refers to piping and ductwork above ceilings and within walls, partitions, shafts or service spaces, not normally exposed to view and enclosed on all sides by finish materials. Access to piping and ductwork would be by removal of finish materials.
4. The term "concealed but accessible work" refers to piping and ductwork accessible above or through suspended ceilings, in walls at access panels or in chases with access doors or mandoors.
5. The term "exposed work" refers to piping or equipment normally exposed to view within rooms or open areas.

1.12 COORDINATION OF WORK AND DRAWINGS

A. The layout shown on the Drawings is necessarily diagrammatic but shall be followed as closely as actual construction and as other work will permit. Changes from these Drawings required to make this work conform to the building construction or other work of other trades shall be made by the Contractor without additional cost to Owner but only with the prior approval of the Architect/Engineer. All major changes shall be shown on the Shop Drawings to be submitted before changes are made. Refer to Division 1 – GENERAL REQUIREMENTS for instructions.

1.13 JOB CONDITIONS

A. Field Conditions

1. Contractor shall take his own measurements at the building and shall be responsible for the correctness of same and proper fitting of their work.
2. Adjust all work to fit actual job conditions. Report to the Architect/Engineer all measurements of discrepancies, so that field correctness can be made before fabrication of materials or equipment.

B. Protection of Work

1. The Contractor shall protect his work from injury. Keep all pipe and lines capped or plugged, drained, or otherwise protected from injury, including damage done by freezing, flooding or stoppage from building materials or dirt.
2. The Contractor shall avoid operating machinery in the vicinity of buried pipe if there is the chance the piping could be damaged. If underground piping sustains damage, the damaged pipe shall be uncovered and replaced or patched at the Engineer’s discretion with no additional cost to the contract.
3. The Contractor shall protect equipment and fixtures furnished under his contract from damage during the construction of the building and he shall provide all tarpaulins, drop cloths, barricades, temporary heaters, auxiliary pumping equipment or other precautions as may be required.

4. Any material or equipment that are injured or damaged shall be removed immediately and replaced with new materials or equipment.

PART 2 PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

A. Materials, products, and equipment shall be delivered to job site with factory packaging bearing manufacturer's name or label, and union label whenever practical.

B. Provide for each piece of equipment any special tools required for the operation or adjustment of the equipment and turn over to the Project Representative prior to final approval of the equipment.

C. Exposed machined surfaces of equipment such as shafts, bearing surfaces, gasket surfaces, gears, etc., shall be provided with adequate protection at the factory to prevent physical damage and corrosion prior to installation.

D. Equipment openings and connections shall be provided with adequate covers at the factory to protect the internals, threads, and flanges and prevent entrance of any foreign matter prior to installation.

2.02 MOTORS AND DRIVES

A. Acceptable Manufacturers:

1. General Electric
2. Lincoln
3. Reliance
4. Gould
5. Siemens
6. Louis-Allis
7. Baldor
8. Peerless
9. Century

B. Motors shall be standard NEMA design, of size and characteristics as indicated on the Drawings. Motors shall comply with the specifications set forth in Division 16.

C. Motors shall have the following features:

1. Arrange to operate continuously under full load in an ambient temperature of 40 degrees Centigrade.
2. Motor service factor not less than 1.15, determined by the specific application.
3. Drip-proof unless specific application or U.L. listing requires a hermetic, totally enclosed or explosion proof motor as noted.
4. Provided with either internal or external thermal overload protection. Motors to be used with variable frequency controllers shall have internal thermal overload protection.

5. Permanently lubricated or grease reservoir type bearings. Reservoir type bearings shall have top and bottom screw plugs for flushing and repacking.
6. For convenient access (particularly to clear belt guards) the lubrication fittings shall be extended with pipe and fittings properly secured in place.
7. Windings shall be copper.

D. Drives shall have the following features:

1. Belted motors shall have sliding bases for adjustment of belt tension.
2. Sheaves shall be of the vari-pitch type, except for equipment used with variable speed controllers. Drives and driven sheaves shall be machined cast steel.
3. Belt drives shall be of V-belt type with drive capacity of at least 150 percent of motor horsepower. Belts shall be matched sets when multiple belt drives are used. No fan of integral HP or greater shall have less than two belts.
4. Belt drives, shafts and couplings shall be fully guarded with heavily reinforced expanded metal or woven wire in accordance with OSHA and National Safety Council Standards.
5. Provide openings in the guards all shafts to permit the use of a tachometer.

E. The following Table indicates minimum efficiencies and power factors for three phase motors operating fully loaded at 1800 rpm with electrical characteristics of 200, 230, 460 volts, 60 hertz.

Horsepower	Efficiency	Power Factor
1	82.5	84
1-1/2	84.0	85.7
2	84.0	85.7
3	85.5	85.0
5	86.5	88.0
7-1/2	88.5	81.0
10	89.5	85.5
15	90.0	84.5
20	91.0	86.0
25	91.7	84.0
30	92.0	88.5
40	93.0	83.0
50	93.0	85.5

PART 3 EXECUTION

3.01 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Project Representative.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
14. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items. Additional onetime costs from utilities that may be charged for extending and connecting services to the facility will be separately paid by the Owner. Contractor shall not include these costs in his base bid.

3.02 ELECTRICAL WIRING

A. Contractor furnishing mechanical equipment shall provide all low voltage and line voltage control circuit wiring, conduit and connections and all wiring associated with starter holding coils, unless specifically designated as another contractor’s work.

B. All electrical work shall be in compliance with all State and Local codes and in accordance with specifications set forth in Division 16.

C. Electrical Contractor shall be responsible for all line voltage power wiring and final connections to complete the mechanical systems.

D. Electrical Contractor shall provide power circuit wiring and conduit to mechanical equipment components such as magnetic motor starters, manual motor starters, controller panels, disconnect switches, and motor starter heating elements.

E. Electrical Contractor shall provide all motor starters exterior to equipment unless specified otherwise.

F. The sharing of space within a common conduit by line voltage conductors and by control circuit conductors shall not be permitted.

G. In instances involving motors or electrical devices controlled by another device, such as line voltage aquastat or other line voltage controller, the equipment supplying Contractor shall provide the wiring and conduit between the controller and controlled device and shall connect the switched legs to the power wiring in a junction box located at the controlled device. The Electrical Contractor will provide the junction box and the power wiring between the power source and the controlled device.

3.03 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.04 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Related Documents. In addition, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Project Representative, uncover and restore Work to provide for Project Representative Observation of concealed Work.

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.05 PERFORMANCE

A. All equipment and systems shall be protected against freezing, flooding, corrosion, and other forms of damage prior to acceptance by the Project Representative.

B. Design and fabrication features or proven methods not specifically covered by this specification shall be specifically stated and documented in the proposal.

C. Labor shall be furnished for assembling all pieces of equipment which, due to shipping limitations, have components which arrive on the jobsite disassembled.

3.06 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Arrange for each installer of equipment that requires regular maintenance to meet with the Project Representative's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Spare parts and materials.
2. Tools.
3. Lubricants.
4. Identification systems.
5. Control sequences.
6. Hazards.
7. Cleaning.
8. Warranties and bonds.
9. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

C. Provide, to the Project Representative, maintenance information identical to that to be submitted for Maintenance Manuals. These manuals are beyond those required for Maintenance Manuals. Certification of Substantial Completion cannot be made without documentation of startup, including the issue of above noted maintenance information.

3.07 FINAL INSPECTION

A. Prior to final acceptance, all systems shall be operated to test performance to the satisfaction of the Project Representative.

1. Water shall circulate throughout systems without noise, water hammer, leaks, trapping, or air-binding.
2. Air in ducts shall circulate without excessive noise or vibration.
3. Motors, fans, and other equipment shall operate without excessive noise or vibration.
4. Automatic controls shall maintain specified conditions at control points.
5. Systems shall be balanced to operate within the stated tolerances. If any device does not operate within the stated tolerances, then the entire system shall be considered out of balance and shall be readjusted until all units are within the stated tolerances.
6. Equipment and machines shall have initial lubrication, and be aligned and tuned-up for efficient performance.
7. Heating, ventilating, and air-conditioning systems shall maintain uniform temperatures without drafts.
8. Drains shall flow freely, without excessive noise, leaks or stoppages.

B. Defects demonstrated by inspections and tests shall be corrected to the satisfaction of the Project Representative at the Contractor's expense.

3.08 PROTECTION

A. Guards, barricades, lights, services, etc., necessary for the protection of persons and property shall be furnished and maintained.

B. Existing work such as pavements, lawns, sidewalks, floors, curbs, and other structures and utilities which are damaged or disturbed due to making connections or any phase of operations shall be restored to the satisfaction of the Project Representative and the governing authorities.

3.09 WELDING

A. Welded pipe joints shall be made by the oxy-acetylene or electric process in accordance with ASME B31.9-1982.

B. Welding shall be done with good quality modern welding equipment, by competent operators, and in thorough, first class manner, conforming to AWS Standards.

C. Furnish proof of the competency of each welding operator for both field and shop welds. All welding operators shall pass a standard qualification test such as A.S.M.E., A.W.S. or Hartford Insurance Company procedure and tests.

D. Filler-metal for the welding process shall conform to ASTM A233 “Specification for Mild Steel Arc-Welding Electrodes.” Classification of electrodes shall be one of the following: E6010, E6015, E7016, E7018.

E. When welding will be performed, precautionary measures shall be taken to prevent fire. Remove flammable materials and debris from the area. Provide an appropriate extinguisher nearby.

F. Pipes shall be cut short and cold sprung into place before welding or fabricating to compensate for expansion of lines when hot.

G. Welds shall be of the single vee butt type. Pipe ends shall be shop beveled to 45 degrees to within 1/16 inch of the inside wall surface.

H. The abutting ends of the joints shall be separated before welding to permit complete fusion, tacked in two or more points to maintain alignment, and welded. Welding shall be continuous around the pipe.

I. Welds shall be of sound weld metal, thoroughly fused into the ends of the pipe and to the bottom of the vee, and shall be built up in excess of the pipe wall to give a reinforcement of one-quarter (1/4) the pipe wall thickness and in such a manner that one weld metal will present a gradual increase in thickness from the surface of the pipe to the center of the weld. The minimum width of the weld shall be 2-1/2 times the pipe wall thickness.

J. The fillet welds from flanges of fittings shall be fused into the pipe and plate for a minimum distance of 1-1/2 times the pipe wall thickness and shall be built up to present a minimum throat thickness of depth of weld of 1-1/4 times the pipe wall thickness.

K. Branch connections shall be fabricated by welding. Openings cut into pipe for welded connections shall be accurately made to give carefully matched intersections and welding fittings shall be carefully welded into the pipe system.

L. Welding ells shall be used at all turns in welded pipe lines; no mitered ells will be approved.

M. Where welded mains are smaller than three times the branch diameter, branch connections shall be made with welded tees. Appropriate weld fittings shall be used for all other branch connections.

1. Approved Manufacturers and Models: (Weld Fittings) Subject to compliance with the above specified requirements.

    a. Allied Piping Products
    b. Bonney Forge
    c. Branch Connections
    d. Branchlets
    e. Tube Turn
    f. Thread-O-Lets

N. Welds in piping shall be annealed after welding to remove the welding strains. The temperature need not exceed that causing a dull red, and shall be uniform around the pipe. Welds made in place shall be annealed, but the pipe shall be free to expand and shall be properly supported so as to avoid stresses. Annealing shall always be followed by slow cooling.

END OF SECTION 15050

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. This section covers the requirements to furnish and install sleeves, supports, hangers, anchors and seals for piping and equipment under this contract.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 15050 – Basic Mechanical Materials and Methods
2. Section 15100 – Plumbing.
3. Section 15185 – Refrigerant Piping and Specialties.
4. Section 15832 – Power Ventilators.

1.03 REFERENCE TO STANDARDS

A. Standards: Manufacturer's Standardization Society of the Valve and Fittings Industry, M.S.S.:

1. SP 58: Pipe Hangers and Supports - Materials, Design and Manufacture.
2. SP 69: Pipe Hangers and Supports - Selection and Application.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.

2. Perform work in accordance with industry standards.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products wrapped in factory-fabricated fiberboard type containers.

B. Do not install damaged products; replace and return damaged units to manufacturer.

C. Store hangers, supports and anchors in clean, dry space. Store in original cartons and protect from dirt, physical damage and construction traffic.

1.06 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop Drawings: Locate all piping, and equipment supports with static and dynamic load on each. Locate all sleeving for mechanical equipment. Locate all flashing for mechanical equipment.

C. Product Data: Provide schedule of sealants with type and location for each.

PART 2 PRODUCTS

2.01 PIPING HANGERS AND SUPPORTS

A. Suspension Hangers:

1. Acceptable Manufacturers:

	2-1/2 Inch IPS and Smaller	3 inch IPS and Greater	Copper/Brass Piping, All Sizes
a. Grinnell	Fig. 65	Fig. 260	Fig. CT 65
b. B-Line	Fig. 3104	Fig. 3100	Fig. 3104 CT
c. Persing	Fig. 230	Fig. 200	Fig. 220 CT

2. Adjustable wrought steel clevis type. Copper plated for all hangers in direct contact with copper lines.

B. Adjustable steel yoke pipe roll:

1. Acceptable Manufacturers:

a.	Grinnell	Fig. 171/181
b.	B-Line	Fig. B3110/B3114
c.	Persing	Fig. 322/324

C. Pipe Covering Protection Sleeves for Insulated Pipe:

1. Acceptable Manufacturers:

a. Grinnell Fig. 167 Series
b. B-Line Fig. 35L Series
c. Persing Fig. 400 Series

D. Pipe Covering Protection Saddles for Insulated Pipe:

1. Acceptable Manufacturers:

a. Grinnell Fig. 160 Series
b. B-Line Fig. 3160 Series
c. Persing Fig. 400 Series

E. Pipe Protection/Thermal Insulation Hanger Shields for Insulated Pipe.

1. Acceptable Manufacturers:

a. B-Line Fig. B3195 Series
b. Insul-shield
c. Pipe Shields
d. Uni-grip

F. Hanger Rods, Galvanized All Thread Rod; ASTM A36:

Hanger rod sizes:

Pipe Size	Hanger Rod Diameter
2 inch and smaller	3/8 inch
2-1/2 inch to 3-1/2 inch	1/2 inch
4 inch to 5 inch	5/8 inch
6 inch	3/4 inch
8 inch	7/8 inch
Over 8 inch	As per Hanger Manufacturer Recommendations

G. Wall Brackets:

1. Acceptable Manufacturers:

a. Grinnell Fig. 194/195/196/ Clip Fig. 193
b. B-Line Fig. B3063/B3068/B3067 / Clip Fig. B3063 CP
c. Persing Fig. 153/151/153 / Clip Fig. 153 C

2. Welded steel with capacity as required.

H. Horizontal Pipe Slide Supports:

1. Acceptable Manufacturers:

a.	Grinnell	257 Type 3
b.	Fluorogold	FPS-IT
c.	TOBO	TPS-100

2. Pipe shall be fixed in place by metal hold down clamps anchored to formed steel channels capped with 1/8 inch Teflon sheet. The Teflon shall be securely fastened to the channel by metal screws or by chemical bond or both.
3. Hold down clamps shall be the "one-piece" type. Hold down clamps shall be sized large enough to allow the pipe to slip in the axial direction thereby allowing for expansion or contraction of the pipe.
4. All metal parts shall be galvanized by the manufacturer and prepared and painted by the plumbing Contractor after assembly. All nuts and bolts shall be cadmium plated.

I. Preformed Metal Framing Channels:

1. Acceptable Manufacturers:

a. Unistrut
b. Superstrut
c. B-Line

2. Continuous slotted steel framing channel in gauge and size for capacities required complete with the matching fittings, nuts, bolts and hangers as shown on the drawings.

J. Auxiliary Steel Angle and/or Pipe:

1. Auxiliary steel angle, channels T-sections for the support of piping or equipment shall be AISI-SAE 1020 low carbon steel or harder. Where piping is used for supports, it shall be Schedule 40 black steel.

2.02 CEILING, WALL AND FLOOR PLATES (Escutcheons)

A. Pipe Penetrations:

1. Hinged snap-on style. 3/4 Inch IPS and Smaller, Chromium plated brass. 1 inch IPS and Larger, Chrome Plated Steel. Sized to fit snugly around uncovered pipe, pipe covering, or sleeve extensions as each location necessitates.

B. Hanger Rod Entrance, Finished Room Ceilings

1. Spring ceiling plates. Chrome plated brass.

2.03 FLOOR AND WALL PENETRATIONS

A. Provide noncombustible seals around pipe and duct penetrations for both new and existing construction at:

1. All Floors
2. Exterior Walls
3. Below-Grade Walls
4. 2-Hour and Greater Fire Rated Walls
5. Smoke Partition Walls
6. Where Designated by Code

B. Fire Rated Caulking Compound

1. Acceptable Manufacturers:

   a. Dow Corning - Fire Stop
   b. Standard Oil Engineering Materials Co. - Fyre Putty
   c. 3M - Fire Barrier

2. Intumescent fire barrier caulk that provide seal against fire, smoke, toxic fumes and moisture.
3. Fire caulk shall provide a fire resistance to match the fire resistance of the wall or floor penetrated.
4. Fire caulk shall be UL listed and meet the testing requirements set forth by ASTM E-814-88.

C. Noncombustible pipe penetrations shall consist of:

1. Pipe sleeves.
2. Fireproof fill in annular space.
3. Surface sealing compound.
4. Provide pipe sleeves for the following:

   a. All new construction.
   b. Existing construction except where a smooth core drilled hole may be obtained.

5. Pipe Sleeve Material:

   a. Concrete Construction:

      i. Steel pipe sleeve with square welded steel plate extending no less than 6" beyond sleeve, all rustproofed.

   b. All Other Floors and Walls:

      i. 26 Gauge Galvanized Steel Pipe

6. Pipe Sleeve or Core Drill Size:

   a. Diameter great enough to leave 1/2-inch clearance all around and shall be sized to allow pipe insulation to continue uninterrupted through the wall opening.

7. Pipe Sleeve Length:

   a. Length to suit wall or floor thickness.

      i. In walls, ends flush with each wall face.
      ii. Underside of floors, extend downward approximately 1 inch below bottom of floor surface.
      iii. Above floors, extend upward approximately 3 inch above finished floor surface.

8. Annular Space Filler for Pipes:

   a. Acceptable Manufacturers:

      i. Cheme Ind. - Gripper 1" - 8"
      ii. Thunderline - Link Seal
      iii. Instafoam - Front Pak

   b. Below-Grade Exterior Walls

      i. Mechanical seals consisting of synthetic rubber links with plated steel bolts and Delrin pressure plates that provide hydrostatic sealing.

   c. All Other Walls and Floors

      i. Fire rated caulking compound designed expressly for this purpose.
      ii. Mechanical seals described above.

D. Noncombustible Duct Penetrations Consist Of:

1. 3" high (maximum), 24 gauge galvanized duct collar both sides of the floor or wall.
2. Annular Space Filler for Ducts.

   a. Fire rated caulking compound designed expressly for this purpose.

E. All Other Duct and Wall Pipe Penetrations

1. Pipe Penetrations consist of:

   a. Finished and unfinished space: Pipe sleeve as described in noncombustible pipe penetrations.
   b. 1/2" annular space between pipe and wall.

2. Duct penetrations consist of:

a. Finished and unfinished spaces 3" high (maximum) 24 gauge.
b. 1/2" annular space between duct and wall.

2.04 SEALS, SAFING AND FLASHING

A. Wall and Floor Seals: Wall and floor seals shall be modular mechanical type with interlocking synthetic rubber links. Manufacturers/Models:

1.	Thunderline	No. 300, 400, 500 "Link-Seal"
2.	Clow	No. F-1430, F-1435
3.	Tyler	Nos. F-796, F-797

B. Roof Flashing:

1. Where plumbing vent penetrates roof and flashings must be attached to pipe, the flashing shall be 24 gauge galvanized metal.

C. Sealant:

1. Acceptable Manufacturers:

a.	General Electric	Silicone Construction 1200
b.	DAP	One Part Acrylic Sealant
c.	Dow Corning	Silicone Rubber Sealant

2. Caulking for exterior flashing shall be silicone or butyl rubber.
3. Caulking shall be capable of weathering in temperature ranging from -30 degrees F to 180 degrees F and in direct sunlight maintaining its elasticity and its adherence to the material on which it was applied.
4. Caulking color shall be black or where visible shall be chosen by the Construction Coordinator.

2.05 LOW VELOCITY DUCT HANGERS AND SUPPORTS

A. All horizontal ducts up to 48" wide shall be supported with strap iron hangers placed down side of duct, turned under bottom of ducts and fastened to ductwork. Straps shall be fastened to building construction by approved methods specified.

B. All horizontal ducts over 48" wide shall have angle iron trapeze hangers with rods attached to building construction by approved methods specified.

C. Rectangular Duct Hanger Sizes:

Width	Strap	Spacing
Up 10 18"	1" x 22 ga.	8 ft.
19" thru 24"	1" x 20 ga.	8 ft.
25" thru 30"	1" x 18 ga.	8 ft.
51" thru 60"	1" x 16 ga.	8 ft.

D. Round Duct Hanger Sizes:

Diameter	Strap Band	Rod	Spacing
Up to 26"	1" x 20 ga.	1/4"	10 ft.
27" thru 36"	1" x 18 ga.	3/8"	10 ft.
37" thru 50"	1" x 16 ga.	3/8"	10 ft.
51" thru 60"	1" x 18 ga.	3/8"	6 ft.

E. Trapeze Hanger Angles:

Width	Angles	Rods	Spacing
48" thru 60"	1-1/2" x 1-1/2" x 1/4"	3/8"	8'-0"
61" thru 72"	1-1/2" x 1-1/2" x 1/4"	3/8"	6'-0"
73" thru 96"	2" x 2" x 1/4"	1/2"	6'-0"

F. Vertical Duct Floor Support Sizes:

1. Supports shall be riveted or screwed to duct.
2. Up to 60" wide, 1-1/2" x 1/8" angle.
3. Over 60" wide, 2" x 2" x 3/16" angle.

PART 3 EXECUTION

3.01 HANGERS AND SUPPORTS

A. Hangers in General:

1. All piping shall be supported as specified herein. All structural steel, hanger rods, turnbuckles, beam clamps, angle iron clips, inserts, brackets, floor bases, supports and bracing shall be provided.
2. Provide supports, where pipe changes direction, adjacent to flanged valves, strainers, and fittings and at equipment.
3. Horizontal suspended piping shall be supported with adjustable hanger assemblies. Provide the specified clevis type with weight bearing insulation and protection shield. All hanger rods shall have enough length and threaded length to allow adjustment.
4. Vertical pipe runs shall be supported and laterally braced at every floor level. Support vertical pipe with riser clamps installed below hubs, couplings or lugs, welded to the pipe.

5. Piping shall be supported as follows:

Pipe Sizes	Maximum Spacing Ferrous Pipe	Copper Tubing
2 inch - 1 inch	6 feet	5 feet
1-1/4 inch - 2 inch	8 feet	8 feet
2-1/2 inch - 3 inch	12 feet	8 feet
4 inch - 6 inch	14 feet	8 feet
8 inch - 14 inch	20 feet	---
Over 14 inch	As per Pipe Manufacturers Recommendations	

6. Piping shall be properly supported from hangers securely attached to the building construction using clamps for steel construction, anchors for concrete construction or lag screws or bolts for wood construction or as otherwise detailed on drawings or specified.
7. All piping shall be supported in a manner to minimize undesirable stress on bodies of valves and other fittings.
8. All piping shall be supported from walls on brackets, directly from the floor above, or from auxiliary steel. Do not support pipe from ceilings.
9. No cutting, drilling, welding or burning on any structural steel member shall be allowed. Power driven studs and welding studs shall not be allowed.
10. All bolts and threaded rods shall be used with double nut and washer or single nut, washer, and lock washer wherever a single unsecured nut could work loose and allow either threaded rod or supported piping to drop.
11. Cast in place concrete anchors shall be positioned and secured to reinforcing.
12. All Pipe hangers shall be cleaned and painted with rust resistant paint before installation.

3.02 PIPE MOVEMENT

A. Design and install hangers to resist disengagement from movement of supported pipe.

B. Provide allowances for expansion and contraction of installed piping. Install piping in a manner that will not cause more than negligible stress nor cause leaks due to thermal expansion and contraction. Movement of pipe shall not result in noise generation.

3.03 EQUIPMENT BASES

A. Provide for all floor mounted equipment reinforced concrete housekeeping bases poured directly on structural floor slab 4" thick minimum, extended 6" minimum beyond machinery bedplates. All edges of the pad shall be chamfered. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment. Contractor shall provide these concrete bases, coordinate with Contractor.

B. Concrete supplied for machine base and pad shall have a minimum compressive strength of 3,000 psi and be reinforced with 6 x 6 - W2.1 x W2.1 WWF.

C. Pads shall be doweled into slab floors with one 2 inch dowel rod per 6 square feet of pad, but not less than 4 dowels. Dowel shall project a minimum of 2 inches into the slab and 2 inches into the pad.

3.04 SUPPORT OF UNDERGROUND PIPING

A. Where fill or loose soil of shallow depth is encountered, over-excavate down to firm undisturbed earth and backfill to the proper elevation with bank sand or crushed stone compacted to provide a firm support for the pipelines.

B. Where deep fill or large areas of unstable soil is encountered, support the pipe at least every 10 feet - 0 inch (at each hub of cast iron soil pipe and cast iron water pipe) on concrete piers or concrete blocks with footings set on undisturbed earth, and fill the area between the piers with firmly compacted granular material.

C. At the foot of each plumbing riser, provide a concrete foundation with base set on solid earth for support of the stack.

D. Set all equipment bases, basins, and similar structures on solid undisturbed earth and provide substantial bases.

E. Where loose fill or unstable soil is encountered, provide concrete foundations, properly reinforced and carried down to firm bearing with footings set on undisturbed earth.

F. Design and construction of all bases and foundations must be reviewed by the Construction Coordinator.

3.05 CUTTING, DRILLING AND PATCHING

A. Contractor shall do all cutting and drilling that is required in order that its work may be properly installed and it shall do all patching and repairing required to restore all surfaces to their original condition.

B. Where holes are required, these shall be cut in a careful manner and the openings kept to an absolute minimum.

C. The cutting and drilling into structural members or slabs may be accomplished only upon the prior written concurrence of the Construction Coordinator.

D. Openings in a slab on grade shall be made by scoring with a concrete saw followed by a chiseled clean break. Such floor openings shall be restored using fully compacted granular subgrade and concrete bonded to the vertical pipe installed through the floor. No sleeve is to be placed in such case, and concrete shall be sloped upward around the pipe to prevent water ponding at that point.

E. All patching and repairing shall be done by experienced men in the particular trades to which the respective kinds of work belong; and shall be neatly made, restoring the area to its original condition to the satisfaction of the Construction Coordinator.

3.06 PRIMING

A. Prime coat exposed steel hangers and supports.

3.07 SLEEVES, SEALS, SAFING, FLASHING AND SEALANT

A. Wall and Floor Seals and Sleeves:

1. Setting:

a. Set sleeves in position in advance of concrete work.
b. Provide suitable reinforcing around sleeves.

2. Sleeves shall be cut the same length as the thickness of the walls and 1-1/2" longer than thickness of floors. 1-1/2" shall extend above the floor.
3. Cuts should be square or round and ground smooth.
4. In outside walls and in floors the annular space between the pipe and the sleeves shall be sealed with a flexible link seal as per this Specification.
5. In interior walls the annular space between the pipe and the sleeve shall be sealed tight with oakum.
6. Sleeves shall be sized with 2" of open space between outside pipe and inside of sleeve unless otherwise specified in individual sections.
7. Cuts between sleeves and walls or floors shall be patched with mortar to the approval of the Construction Coordinator.

B. Flashing:

1. Flashing for vent piping shall be soldered or lapped over vent piping and feather out on top of roof. Flashing should be sealed to roof with roofing pitch.
2. Wherever curbs or chimneys penetrate sloped roofs such that the joint formed by the curb or chimney and the roof is a straight line parallel to the ridge of the roof a cricket flashing shall be installed. Thus flashing shall be sloped towards the sides of the curb or chimney at a minimum of 4/12 pitch such that no water may collect above the chimney or curb on the roof surface.
3. Flashing shall extend at least 8" underneath lapping roofing. On sloped roofs the lower flashing shall extend 8" over the top of the roofing and be secured with nails into wood, screws into sheet metal and anchors into concrete.
4. Nails, screws, anchor, and exposed flashing edges shall be covered and sealed with sealant as listed in this Specification.
5. Flashing attached to sheet metal shall be riveted into place with beads of sealant applied between the two metal surfaces and along the exposed edges.
6. All fasteners shall be of the same material as the flashing.
7. Caulking sealant shall not be used to fill gaps in flashing greater than 1/4". Gaps of this size shall be covered by flashing material, fastened and sealed into place.
8. Flashing, sealant and fasteners shall be painted a uniform color as per Construction Coordinator.

3.08 DUCT HANGERS AND SUPPORTS

A. Furnish and install hangers and supports to carry the weight of ductwork, including dampers without incurring vibration, sagging, bending, twisting, buckling, or other deformation in the ductwork or the building structure either during erection, testing, or normal operation. Include as part of the ductwork support systems all necessary auxiliary structural members required to provide support locations where building elements do not occur or are inadequate for attaching loads and as indicated on the Drawings.

B. Each duct shall be hung or supported independently directly to building structure or auxiliary steel without attachments to other supported elements such as piping, conduit, ceilings, equipment or other duct.

C. All horizontal ducts shall be supported with substantial angle and strap trapeze hangers, placed entirely around side and bottom of ducts and securely fastened to the building construction. Angles and straps used to support ducts shall be galvanized. Provide hanger near each circumferential joint.

D. Vertical Ductwork: Unless otherwise indicated support vertical round and rectangular ductwork every 15' or at each floor in building. Unless indicated otherwise by details on Drawings, vertical ductwork shall be supported as specified herein.

3.09 ADJUSTING AND CLEANING

A. Adjust hangers and supports and place grout as required under supports to bring piping and equipment to proper levels and elevations.

END OF SECTION 15064

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes noise limits and vibration isolation for all equipment, piping, and ductwork.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15764 – Electric Resistance Space Heating Units.
2. Section 15832 – Power Ventilators Section.

1.03 REFERENCE TO STANDARDS

A. ASHRAE.
B. BOCA
C. OSHPD in the State of California
D. State and local codes.

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop drawings shall include:

1. Outside diameter free, operating, and solid heights of springs.
2. Angular hanger rod misalignment capability.
3. Design of supplementary and inertia bases.
4. Pressure and temperature ratings, minimum burst pressure and allowable movement capability of flexible connectors.
5. Free and operating heights and size of neoprene pads.
6. Corrosion protection and weather seal details.

1.05 ACCEPTABLE NOISE LEVELS

A. Noise levels are specified for two distinct areas. The first area is for occupied rooms which will use the RC curves from ASHRAE 1997 Fundamentals book for acceptable noise levels. The second area is for mechanical rooms which will use the dBA rated scale.

B. Occupied Rooms - Systems shall be designed for an RC-35 noise level. This level will enable normal office conversation to be intelligible. Octave bands are summarized below. These values are maximums and should not be exceeded.

re. 0.0002 Microbar dB	60	55	50	45	40	35	30	25
Octave Band Center Hz	31.5	63	125	250	500	1000	2000	4000

C. Mechanical Rooms - Systems shall be designed for an NC 70 noise level. This level will enable workers to be present on an 8-hour shift. Octave bands are summarized below. These values are maximums and should not be exceeded.

re. 0.0002 Microbar dB	X	93	79	75	72	71	69	68
Octave Band Center Hz	31.5	63	125	250	500	1000	2000	4000

D. In the event that noise levels are surpassed in either the Occupied Rooms or Mechanical Rooms, noise suppression techniques shall be required, and shall be the responsibility of the Contractor who installs the offending system. The Contractor shall insure that his system is provided with sound attenuation devices to assure compliance with the above maximum acceptable noise limits.

1.06 QUALITY ASSURANCE

A. All isolation materials used by each Contractor shall be supplied by one manufacturer.

B. The manufacturer and his authorized representative shall be responsible for and provide written certification for:

1. Proper Size
2. Type
3. Selection

C. Vibration isolator shall be selected in accordance with weight distribution of the isolated equipment to provide a reasonably uniform deflection.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION DEVICES

A. Vibration isolation devices and materials shall be of the types indicated on schedules and from the following Vibration Isolation Types paragraph. The vibration isolation types establish the minimum criteria to be used in determining the proper type and size of isolators for all equipment requiring them.

2.02 VIBRATION ISOLATION TYPES

A. Type A: Double deflection neoprene mountings with the following features:

1. Acceptable Products

a.	Korfund	F
b.	Mason Industries	ND
c.	Vibration Mountings	R
d.	Kinetics	RD
e.	California Dynamics	RMD
f.	Vibration Eliminator	TD

2. Friction pads on both top and bottom.
3. All metal neoprene covered.
4. Bolt holes shall be provided for floor bolting and equipment mounting.
5. Minimum static deflection of 0.35 inches.

B. Type B: Free standing unhoused stable type isolators having 0.75 inch deflection.

1. Acceptable Products

a.	Korfund	WSC
b.	Mason Industries	SLF-H
c.	Vibration Mountings	AC with base plate
d.	Kinetics	FDS
e.	Vibration Eliminator	OST

2. Leveling bolts which must be bolted to equipment.
3. 1/4 inch neoprene isolation pad.
4. Means of bolting to supported unit and foundation.
5. Outside spring diameter equal to or greater than 0.80 of the design operating height.
6. Minimum 50 percent additional travel between design operating height and solid height.

C. Type C: Housed spring type isolators with vertical limit stops and features similar to Type B.

1. Acceptable Products

a.	Korfund	WSCL
b.	Mason Industries	SLR
c.	Vibration Mountings	AWR
d.	Kinetics	FLS
e.	Vibration Eliminator	KW

2. Housing to serve as blocking during erection.
3. Installed and design operating heights equal.
4. 1/2 inch clearance maintained around spring.
5. Limit stops not in contact during normal operation.

D. Type D: Vibration hanger with steel spring and 1.0 inch deflection neoprene or fiberglass element in a series with the following features:

1. Acceptable Products

a.	Korfund	30VX
b.	Mason Industries	30N
c.	Vibration Mountings	RSH-30A
d.	Kinetics	SFH or SRH
e.	Vibration Eliminator	SNRC

2. Encased in welded hanger bracket.
3. Hanger rod isolation bushing.
4. Minimum 50 percent additional travel between design operating height and solid height.
5. 30 degree angular hanger rod misalignment capability.

E. Type E: Vibration Hanger with precompressed spring and 0.3 inch deflection neoprene or fiberglass element in a series with the following features:

1. Acceptable Products

a.	Kinetics	PCSRH or PCSFH
b.	Korfund	PCVX
c.	Mason Industries	PC30N
d.	Vibration Eliminator	PCSR

2. Encased in welded hanger bracket.
3. Hanger rod isolation bushing.
4. Minimum of 50 percent additional travel between design operating height and solid height.
5. 30 degree angular rod misalignment capability.
6. Deflection indicated by scale on interior side of hanger box.

F. Type F: Vibration hanger with spring and 0.3 inch deflection neoprene or fiberglass element in series with the following features:

1. Acceptable Products

a.	Kinetics	SRH with Eye Bolts
b.	Korfund	WVX
c.	Mason Industries	W30
d.	Vibration Eliminator	SNRC with Eye Bolts

2. Spring rod and housing both have eyebolts for flat steel strap hangers.
3. Encased in welded hanger brackets.
4. Minimum 50 percent additional travel between design operating height and solid height.
5. 30 degree angular rod misalignment capability.

G. Type G: Rectangular structural steel beam bases with the following features:

1. Acceptable Products

a. Korfund WFK
b. Mason Industries WF
c. Vibration Mountings WFB
d. Kinetics SFB
e. Vibration Eliminator HB

2. Designed and supplied by manufacturer for the support of integral equipment.
3. Height saving isolator brackets.
4. Member height a minimum of:

a. 10 percent of the longest span.
b. 6 inches.
c. As shown.

5. Member height a maximum of 14 inches unless specifically recommended by the isolation manufacturer.

H. Type H: Structural steel integral rail bases, with the following features:

1. Acceptable Products

a. Kinetics SBB
b. Korfund ISK
c. Mason Industries ICS
d. Vibration Eliminator HB

2. Designed and supplied by manufacturer for support of non-integral equipment or equipment requiring supplementary support.
3. Height saving isolator brackets.
4. Rail thickness a minimum of:

a. 10 percent of the longest base dimension.
b. As shown.

I. Type J: Reinforced concrete inertia base with the following features:

1. Acceptable Products

a. Korfund RCF
b. Mason Industries KSL
c. Vibration Mountings WPF
d. Kinetics CIB
e. Vibration Eliminator SN

2. Steel members designed and supplied by manufacturer.
3. Concrete placed in welded steel frame by Contractor.
4. Prelocated equipment anchor bolts.
5. Welded-in 1/2 inch diameter reinforcing bars a minimum of 8 inches on center running both ways 1-1/2 inches above bottom.
6. Isolator brackets to reduce mounting height of equipment.
7. Base thickness a minimum of:

a. 8 percent of the longest span between isolators.
b. 6 inches.
c. As shown.

8. Base thickness a maximum of 12 inches unless specifically recommended by the isolation manufacturer.
9. Large enough to support piping elbows when used for base mounted pumps.

J. Type K: Flexible spherical molded neoprene connectors with the following features:

1. Acceptable Products

a.	Mason Industries	MF
b.	Flex-Hose	NN
c.	Minnesota Flexible Corp.	MF

2. Multiple plies of nylon tire cord fabric and neoprene molded and cured in rubber presses.
3. No steel wire or rings used as pressure reinforcement.
4. Straight connectors shall have two spheres.
5. Pre-extended to prevent additional elongation under pressure.
6. Threaded connections for 2 inch diameter and less.
7. Flanged connections for 2-1/2 inch diameter and greater.
8. For operating pressures and temperature limits of:

a. 150 psi @ 220 degrees F.
b. 225 psi @ 170 degrees F.

9. Control cables and anchor plates where required.

K. Type L: Flexible stainless steel hoses with the following features:

1. Acceptable Products:

a.	Flex-Hose	SF-15 or SMN
b.	Mason Industries	BSS
c.	Vibrations Mountings	MFP
d.	Approved Equal	

2. Stainless steel braid.
3. Carbon steel fittings.
4. Annular corrugated seamless hose body.
5. For operating pressures greater than 150 psi and temperatures greater than 220 degrees F. (Maximum pressures and temperatures depend on pipe size.)

L. Type N: Fiberglass isolation mounts with the following features:

1. Acceptable Products:

a.	Kinetics	AC

b. Mason
c. Korfund

2. Fiberglass isolation pad.
3. Steel load transfer plate.
4. Formed steel bolt down bracket.
5. 2 inches static deflection.

M. Type P: Precompressed 5/16" thick molded neoprene isolation pads with the following features:

1. Acceptable Products

a.	Korfund	Korpad
b.	Mason Industries	W
c.	Vibration Mountings	Shear-Flex
d.	Kinetics	N
e.	Vibration Eliminato	200 N

2. 0.35" static deflection.
3. Neoprene jacketed and stabilized during manufacture.
4. Sized for 40 to 60 pounds per square inch loading.
5. Static deflection as required.
6. Steel plates bonded to top of pads where required to spread the equipment load.

N. Type X: Horizontal thrust restraints for ductwork consisting of a spring in series with a neoprene pad with the following features:

1. Acceptable Products

a.	Korfund	VB with Restraint Hardware
b.	Mason Industries	WB
c.	Kinetics	HSR
d.	Vibration Eliminator	Horizontal Restraints

2. Preset for thrust in factory and field adjustable to allow for a maximum of 1/4 inch movement.
3. Assembly furnished with threaded rod and brackets for attachment to both equipment and ductwork or equipment and structure.
4. Deflection equal to vibration isolation of equipment.

O. Type Z: Same as Type P except double thickness (5/8" minimum).

1. Acceptable Products

a.	Mason	Two (2) W
b.	Kinetics	NGD
c.	Korfund	Two (2) Korpads
d.	Vibration Eliminator	Two (2) 200 N

PART 3 EXECUTION

3.01 INSTALLATION

A. All vibration isolators shall be installed in strict accordance with the isolation manufacturer's recommendations.

B. Bolt isolator to equipment and to supporting structure where bolt holes are supplied.

C. Shim or adjust leveling screws to level equipment. Shims shall not interfere with spring action.

D. Verify actual deflected height with design operating height. Replace when they differ by 25 percent or more.

E. Correct interferences with spring action or report to Construction Coordinator when interference is caused by another Contractor.

3.02 CORROSION PROTECTION

A. All vibration isolators exposed to weather (or a corrosive atmosphere when designated) shall have:

1. Steel parts hot dip galvanized.
2. Bolts cadmium plated.
3. Springs hot dip galvanized or neoprene coated.

B. All vibration isolation for interior use shall have the manufacturer's standard paint finish on mountings and springs.

3.03 DUCT CONNECTIONS

A. Where ducts will be connected to air handling units or exhaust fans, flexible duct connections of glass fabric double coated with neoprene rubber shall be used. For exterior applications use a flexible duct connection of glass fabric double coated with Hypalon.

3.04 PIPING VIBRATION ISOLATION

A. Provide Type K flexible connections at the piping connections of each:

1. Base Mounted Pump.
2. Chiller.
3. Installation shall be per the manufacturer's written recommendations and as described below.

B. Type of connection shall be determined by temperature and pressure.

C. Install connection on equipment side of shut-off valves.

D. Install hose parallel to equipment shaft in a horizontal or vertical position.

E. Piping shall be supported on each side of the connection.

F. No flexible elbows will be permitted.

END OF SECTION 15070

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes piping insulation for domestic water and drain and vent piping systems.

1.02 RELATED WORK

A. Section 15100 – Plumbing.

1.03 REFERENCE TO STANDARDS

A. ASTM C553 - Standard Specifications for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial applications.

B. ASTM E84 - Surface Burning Characteristics of Building Materials.

C. ASTM E96 - Water Vapor Transmission of Materials.

D. NFPA 225 - Test of Surface Burning Characteristics of Building Materials.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop Drawings: Submit shop drawings which indicate complete material data, list of materials proposed for this project and indicate K-value, and thickness of material for individual services.

C. Product Data

1. Insulation
2. Adhesives
3. Coatings
4. Jackets
5. Fasteners
6. Bands

1.06 REGULATORY REQUIREMENTS

A. National Fire Protection Association, NFPA: NFPA 255 - Test Methods Surface Burning - Building Materials.

1. Flame Spread: 25 or less.
2. Smoke Developed: 50 or less.
3. Fuel Contributed: 50 or less.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle in strict accordance with manufacturer's instructions.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

E. Coordinate installation with related work under other sections.

1.08 PROJECT CONDITIONS

A. Perform work at ambient and equipment temperatures as recommended by adhesive manufacturer.

PART 2 PRODUCTS

2.01 PIPING INSULATION

A. Fiberglass Piping Insulation: Type P-1

1. Acceptable Manufacturers:

   a. Manville Corp. - "Micro-Lok AP-T".
   b. Owens Corning Fiberglas Corp. - "One Piece" 25 ASJ/SSII".
   c. Certain-Teed - "500E Snap-ON".

2. Glass fiber, rigid molded sectional pipe covering, conforming to ASTM C547, Class II, Mineral Fiber Preformed Pipe Insulation".
3. Conductivity (k) equals approximately 0.23 BTU/HR.,SF.,EF per inch thickness at 75 degrees F.

2.02 INSULATION ACCESSORIES

A. Use the following accessories to install thermal insulations.

1. PVC Fittings Covers

   a. Certain-Teed - "Snap Form"
   b. Schuller Corp. - "Zeston"
   c. Stauffer - "Ultra Jacket"

2. Vapor Barrier Lap Adhesive:

   a. Benjamin Foster 82-07
   b. Chicago Mastic 17-465
   c. Insul-Coustic IC-215

3. Lagging Adhesive:

   a. Benjamin Foster 30-36
   b. Chicago Mastic 16-400
   c. Insul-Coustic IC-102

4. Glass Cloth Jacket:

   a. Benjamin Foster
   b. Insul-Coustic
   c. Schuller Corp.
   d. Owens-Corning

5. Wire:

   a. Number 16 soft copper.

6. Insulation Bonding Adhesive (To Metal)

   a. Benjamin Foster 85-15
   b. Chicago Mastic 17-460
   c. Insul-Coustic I-C 201

7. Insulating and Finishing Cement

   a. Fibrex, Inc.- FBX Super Blend Cement
   b. Keene Corp. - Super Powerhouse
   c. Pabco Insulation

8. Mechanical Fasteners: Welded or adhered pins with speed clip washers.

   a. Gripnail Corp.
   b. Nelson Stud Co.
   c. Stik Klip Manufacturing Co.

9. Bands for Equipment

   a. Outside diameter of insulation is less than 24 inch: 1/2 inch x 0.020 inch (25 ga.) galvanized steel.
   b. Where diameter is 24 inches or larger: 3/4 inch x 0.020 inch.

10. Bands for Piping: 1/2 inch x 0.020 inch galvanized steel.

11. Wire Mesh: 1 inch by 20 gage galvanized hexagonal wire netting.

2.03 METAL JACKET

A. Acceptable Manufacturers and Models: Subject to compliance with the above specified requirements.

   1. Insul-Coustic
   2. Childers Products Co.
   3. Manville Corp.
   4. Pabco Insulation

B. Smooth or textured aluminum jacket 0.02 inch thick.

C. Integral polykraft moisture barrier.

D. Banded locking joins with weatherproof sealant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested and approved before applying insulation materials. Do not apply insulation until piping has been leak tested.

3.02 PREPARATION

A. Verify that surfaces are clean, foreign material removed, and dry.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions. Slip insulation over pipe or slit insulation sections and apply around pipe. Seal longitudinal and circumferential joints with plastic contact adhesive.

B. On exposed piping, locate insulation and cover seams in least visible locations.

C. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperatures:

1. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Insulate fitting valves, with mitre-cut pieces. Seal all joints with plastic contact adhesive.
2. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
3. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
4. No further finish required.

D. For insulated pipes conveying fluids above ambient temperature:

1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Insulate fittings, valves with mitre-cut pieces.
2. For hot piping convey fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
3. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
4. No further finish required.

E. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: ASTM C640 cork, hydrons calcium silicate insulation, or other heavy duty insulating material for the planned temperature range.

F. Finish insulation at supports, protrusions, and interruptions.

G. For pipe exposed in mechanical equipment rooms or in finished spaces below 10 feet above finished floor, finish with PVC jacket.

H. For exterior applications, provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with PVC jacket with seams located on bottom side of horizontal piping.

I. For buried piping, provide factory fabricated assembly with inner all-purpose service jacket with self sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

J. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with PVC jacket with seams located on bottom side of horizontal piping.

K. All insulated exposed pipe risers shall be covered with sheet metal protectors from the floor to 7'-0" above the floor. Protectors shall be 22 gauge galvanized sheetmetal, "U" shaped, with flanges secured to wall.

3.04 PIPING INSULATION

A. Preparation:

1. Do not apply insulation until piping has been leak tested.
2. All surfaces to be insulated shall be dry and free of loose scale, rust, dirt, oil or water.

B. Application:

1. Insulation shall be installed in a smooth, clean workmanlike manner. Joints shall be tight and finished smooth without fishmouths.
2. Insulation shall fit tightly against the surface to which it is applied to prevent air circulation between the insulation and the pipe or equipment to which it is applied.
3. Insulation applied to cold piping or equipment shall be completely vapor sealed, free of pin holes or other openings.
4. Do not use wet insulation materials.
5. All longitudinal joints on vertical pipe runs shall be staggered.
6. Apply insulation to permit expansion or contraction of pipe lines without causing damage to insulation or surface finish.
7. Do not apply mastic or adhesive until all previous applications of mastic and adhesives have thoroughly dried.
8. No bands or staples shall be provided on covering.
9. Provide 24 gauge sheet metal saddle between the pipe hanger/support and the exterior of the insulation. Saddle length shall be the same as insulation inserts.

C. Application at Fittings:

1. Insulation of flanges and flanged fittings shall overlap adjacent pipe covering at least 1 inch. Valves shall be insulated up to the gland only.

2. Pipe line strainers shall be insulated in a manner to permit removal of strainer basket without disturbing insulation of the strainer body.
3. Insulation adjacent to uninsulated flanges shall be tapered back and neatly finished to allow access to and removal of bolts without injury to covering.

3.05 TYPE P-1 INSULATION INSTALLATION

A. Tightly butt together sections of insulation on pipe runs sealing longitudinal seams of jacket with vapor barrier adhesive. Seal end joints with 4 inch wide straps of vapor barrier tape. Seal off ends of insulation with vapor seal mastic at valves, fittings and flanges. No further finish required.

B. PVC fitting jacket shall be used when they are available for the particular application. When molded coverings are not available, the coverings shall be fabricated in the field similar to equipment insulation.

C. Cold Piping:

1. Cover valves, fittings and flanges with insulation having the same thickness as adjacent pipe covering, securing in place with copper wire loops, twisting ends and embedding in insulation. Apply a PVC jacket and finish joints with a 1/16 inch thick seal coat of vapor seal mastic. Apply a pressure sensitive vapor barrier tape over the joint jacket.

D. Hot Piping:

1. Cover valves, fittings and flanges with insulation similar to the adjacent pipe covering, securing in place with galvanized wire loops, twisting ends and embedding in insulation. Apply a PVC jacket and tape ends joints to adjacent pipe insulation.
2. Do not use PVC fitting jackets where the surface of the insulation is above 150 degrees F.

E. Exterior Piping:

1. Exterior above grade piping shall be finished with a weatherproof jacket and stainless steel jacket. Lap and seal joints as per manufacturer's instructions. Place laps to shed water.

3.06 HANGERS

A. Continue insulation through pipe hangers. Provide either rigid insulation inserts or sheet metal inserts at all outside pipe hangers. Provide rigid insulation inserts for piping operating below 60 degrees F. and sheet metal inserts for piping above 60 degrees F.

B. Rigid insulation or wolmanized wood inserts between the pipe and pipe hanger shall be of a thickness equal to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths:

1. 1/2" to 2-1/2" pipe size 10 inches Long

2.	3" to 6" pipe size	12 inches Long
3.	8" to 10" pipe size	16 inches Long
4.	12" and over	22 inches Long

C. Inserts for cold piping shall have a vapor barrier facing of the same material as the adjacent pipe insulation. Seal inserts into insulation with vapor seal mastic.

D. Sheet metal inserts shall be of steel sheet. Gauge shall conform to manufacturer's recommendation for pipe size. Sheet metal inserts shall have insulation filler of the same material as the adjacent pipe insulation.

3.07 PIPE SLEEVES

A. Pipe insulation and vapor barrier shall be continuous through sleeves in walls and floors.

B. Use Type P-1 in sleeves through fire walls or fire rated (2 hour) floor systems, and vapor seal the joint between the two insulations.

C. Provide 26 gauge galvanized steel or 0.020 inch aluminum jacket over insulation on pipe passing through sleeves where annular space sealant is required. See 15050.

D. Where penetrating interior walls, extend the metal jacket 2 inches out either side of the wall and secure each end with a metal band compressing the insulation slightly.

E. Where penetrating floors, extend the metal jacket 2 inches below the floor and 5 inches above the floor. Secure with metal bands.

3.08 INSULATION

A. Type P-1 insulation shall be applied to hot and cold piping as scheduled below. Insulation shall have an integral vapor barrier jacket.

1. Domestic Cold Water:

a	2 Inch IPS or less	1 inch Thick
b.	2-1/2 Inch IPS or Greater	1-1/2 Inch Thick

2. Domestic Hot Water (100 deg. – 220 deg. F)

a.	2 Inch IPS or less	1 Inch Thick
b.	2-1/2 Inch IPS or Greater	1-1/2 Inch Thick

3. Blower Piping (250 deg. – 300 deg. F)

a.	All piping below 8' above finished floor or grade	2 Inch Thick with Aluminum Jacket

4. Coil Condensate Lines

a.	PVC Piping	
	All IPS	1/2 inch thick
b.	Copper Piping	1/2 inch thick
c.	Metallic Piping	
	1 inch IPS or less	1/2 inch thick
	1-1/4 inch IPS or greater	1 inch thick

END OF SECTION 15084

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes insulation of all refrigerant piping.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15185 – Refrigerant Piping and Specialties.

1.03 REFERENCE TO STANDARDS

A. ASTM C916.
B. ASTM C534-88.
C. ASTM C578-87a.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, etc.

C. Product Data: Provide manufacturers data sheets for:

1. Pipe insulation.
2. Insulation jackets.
3. Fitting jacket.
4. Adhesive.

PART 2 PRODUCTS

2.01 PIPE INSULATION

A. Pipe Insulation: Type P-2

1. Acceptable Manufacturers:

a. Armstrong - "Armaflex".
b. B.F. Goodrich - "Flexible Insulation Tubing and Sheeting".
c. Manville Corp. - "Aerotube"

2. Closed cell, flexible foamed plastic conforming to ASTM C534, "Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form."
3. Conductivity (k) equals approximately 0.27 BTU/HR.,SF., EF per inch thickness at 75 degrees F.

PART 3 EXECUTION

3.01 INSULATION INSTALLATION

A. Preparation:

1. Do not apply insulation until piping has been leak tested.
2. All surfaces to be insulated shall be dry and free of loose scale, rust, dirt, oil or water.

B. Application:

1. Insulation shall be installed in a smooth, clean workmanlike manner. Joints shall be tight and finished smooth without fishmouths.
2. Insulation shall fit tightly against the surface to which it is applied to prevent air circulation between the insulation and the pipe or equipment to which it is applied.

3. Insulation applied to cold piping or equipment shall be completely vapor sealed, free of pin holes or other openings.
4. Do not use wet insulation materials.
5. All longitudinal joints on vertical pipe runs shall be staggered.
6. Apply insulation to permit expansion or contraction of pipe lines without causing damage to insulation or surface finish.
7. Do not apply mastic or adhesive until all previous applications of mastic and adhesives have thoroughly dried.
8. No bands or staples shall be provided on covering.
9. Provide 24 gauge sheet metal saddle between the pipe hanger/support and the exterior of the insulation. Saddle length shall be the same as insulation inserts.

C. Application at Fittings:

1. Insulation of flanges and flanged fittings shall overlap adjacent pipe covering at least 1 inch. Valves shall be insulated up to the gland only.
2. Pipe line strainers shall be insulated in a manner to permit removal of strainer basket without disturbing insulation of the strainer body.
3. Insulation adjacent to uninsulated flanges shall be tapered back and neatly finished to allow access to and removal of bolts without injury to covering.

D. Insulation shall be slipped on the pipe prior to connection, and the butt joints shall be sealed. Where the slip-on technique is not possible, the insulation shall be carefully slit and applied to the pipe.

E. Apply sheet insulation to fit as closely as possible to equipment. Support insulation as required.

F. All joints shall be sealed with the manufacturer's recommended adhesive.

G. Do not apply insulation in multiple layers.

H. Do not use Type P-2 insulation in plenums or fire wall penetrations. Use Type P-1 insulation through sleeve and vapor seal the joint between the two insulations. See specification section 15084 for material and installation data of type D-1 insulation.

I. Insulation shall be painted with insulation manufacturer's recommended ultra-violet light protection paint. Apply a minimum of two coats of paint.

3.02 FLEXIBLE FOAM INSULATION SCHEDULE

A. Type P-2 insulation shall be applied to all refrigerant hot gas lines, suction lines and valves; 1/2 inches thick.

END OF SECTION 15086

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes the furnishing and installing of the plumbing fixtures and small diameter piping required for the potable and non-potable water systems.

1.02 RELATED WORK

A. Section 15064 – Sleeves, Supports, Hangers, Anchors and Seals.
B. Section 15084 – Piping Insulation.
C. Section 15120 – Plumbing Specialties.
D. Section 15260 – Process Piping.
E. Section 15400 – Plumbing Equipment.
F. Section 15410 – Plumbing Fixtures.

1.03 REFERENCE TO STANDARDS

A. All plumbing shall be installed in strict accordance with the latest edition of the "Illinois State Plumbing Code".

B. If, in the opinion of the Contractor, there is anything in the plans or specifications that will not strictly comply with the above laws, ordinances and rules, the matter shall be referred to the attention of the Construction Coordinator for a decision before proceeding with that part of the work. No changes on the plans or in the specifications shall be made without the full consent of the Construction Coordinator.

C. The Contractor shall obtain and pay for all licenses, permits and inspections required by the above laws, ordinances and rules for the entire plumbing job called for in these specifications and the accompanying plans.

1. ASME - Boiler and Pressure Vessel Code.
2. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.
3. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
4. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.
5. ASTM A74 - Cast Iron Soil Pipe and Fittings.
6. ASTM B32 - Solder Metal.
7. ASTM B88 - Seamless Copper Water Tube.
8. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
9. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
10. ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
11. ASTM D2564 - Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.
12. ASTM D2665 - Polyvinyl Chloride (PVC) Pipe.
13. AWWA C651 - Disinfecting Water Mains.

14. ASTM D4101 – Specification for Polypropylene Plastic Injection and Extrusion Materials

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop drawings of all the plumbing fixtures and equipment shall be submitted to the Construction Coordinator for review.

1.05 WARRANTY

A. The fixtures and equipment and their installation are subject to the one-year warranty provisions of the General Conditions.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Refer to Section 02500 – Site Piping

2.02 SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. PVC Pipe: ASTM D1785, Schedule 40.

1. Fittings: ASTM D2466, Schedule 40 socket type.
2. Joints: Socket-weld using PVC solvent cement conforming to ASTM D2564.

2.03 SANITARY SEWER AND VENT PIPING, ABOVE GRADE

A. PVC Pipe: Dual marked ASTM D1785 and ASTM 2665, Schedule 40.

1. Fittings: ASTM D2466, Schedule 40 socket type.
2. Joints: Socket-weld using PVC solvent cement conforming to ASTM D2564.
3. Piping located in air plenum shall be insulated with 1” type P-1 insulation.

2.04 DOMESTIC WATER PIPING

A. Unless otherwise shown on the drawings, shall be Copper Tube: ASTM B88, Annealed Temper.

1. Type L – hard drawn above grade, Type K – hard drawn or soft rolled below grade.
2. Fittings: wrought copper solder-joint, ANSI B16.22, Streamline Pattern.
3. Joints: 95-5 Tin-Antimony Solder-Type, Lead free.

a. ASTM B 813 - 93, Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
b. ASTM B 813 - 93, Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.

2.05 FLANGES, UNIONS AND COUPLINGS

A. Pipe Size 2 Inches and Under:

1. Ferrous pipe: 150-psig malleable iron threaded unions.
2. Copper tube and pipe: 150-psig bronze unions with soldered joints.

B. Pipe Size Over 2 Inches:

1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16-inch thick preformed neoprene gaskets.
2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16-inch thick preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contractions, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
2. Sealing gasket: "C" shape composition sealing gasket.

2.06 VALVES

A. All valves shall be supplied with brass identification tags supplied by manufacturer. All valves shall be same size as connected piping except as noted otherwise.

B. Gate Valve, Non-Ferrous Pipe Material, All Sizes:

1. Acceptable Manufacturers:

   a. Hammond IB629
   b. Nibco Number T134
   c. Walworth Number 11

2. Bronze body, union bonnet, bronze mounted gate or wedge style. Rising stem handwheel operated, open CCW, conventional packing gland, re-packable under pressure. Pressure rating: 150 psi WSP; 300 psi WOG. N.P.T. screw ends, ANSI B2.1.

C. Gate Valve, Ferrous Pipe Material, 2 Inch IPS and Smaller Sizes:

1. Acceptable Manufacturers:

   a. Hammond IB629
   b. Nibco Number T134
   c. Walworth Number 11

2. Bronze body, bronze mounted gate or wedge style. Rising stem, handwheel operated, open CCW, conventional packing gland, re-packable under pressure. Pressure rating: 150 psi WSP; 300 psi WOG. N.P.T. screw ends, ANSI B2.1.

D. Ball Valves, All Pipe Material, All Sizes

1. Acceptable Manufacturers:

a. Milwaukee BA100/BA150
b. Nibco 585
c. Hammond Series 806/807

2. 2-Piece Bronze body with brass trim. Chromium plated brass ball with TFE seats. Lever Handle. Stem extension to clear insulation covering jacket (if required). Pressure Rating: 600 psi WOG. Threaded or solder connection as determined by type of pipe.

E. Swing Check Valves, Horizontal Piping, All Pipe Material:

1. Acceptable Manufacturers:

a. Hammond IB946 / IR1124.
b. Nibco T-433-Y / F918B
c. Walworth 3412/8928F Series

2. Bronze body Y pattern 2 inches and smaller; iron body 2-1/2 inches and larger. Renewable discs and seats.

F. Angle Valves, Plumbing Fixture Supply:

1. Acceptable Manufacturers:

a. American Standard 8253.011
b. Eljer 801-0796
c. Kohler K-7666

2. Wheel or 4 arm handle. Brass body, polished chromium plated.

2.07 THERMOMETERS

A. Acceptable Manufacturers:

1. Marshalltown, Figure 254
2. Tel-Tru Manufacturing, Model AA-565R
3. Weiss Instruments Inc.

B. Provide thermometers with, 5 inch diameter dial thermometer, stainless steel case with glass face, black numerals on white face, hermetically sealed, vibration dampened, one percent accuracy, bi-metallic actuation graduated in (EF), range depending on application, variable angle stem-case connection, separable sockets.

2.08 PIPE IDENTIFICATION MARKERS

A. Acceptable Manufacturers:

1. W.H. Brady Company Z400 Indoor
2. Seton Name Plate Corporation Set Mark
3. Craftmark Identification Systems

B. Provide identification markers to identify piping in accord with the State of Illinois Standard Color Code for Piping Identification. Identification markers shall be all-temperature vinyl printed cloth markers with adhesive back or acrylic plastic "snap around" style for application on insulated and bare piping. Letters on markers for use on 3-inch and larger diameter pipe shall be 2-inch high and letters for markers for use on pipe less than 3-inch diameter shall be 1-inch high. Flow shall be indicated by directional arrows adjacent to lettering. Apply markers after painting.

2.09 VALVE TAGS

A. Acceptable Manufacturers:

1. W.H. Brady Company
2. Seton Name Plate Corporation
3. Craftmark Identification Systems

B. Provide a brass valve tag for each valve. Valve tags shall be 1-1/2" diameter and shall have 1/2" high lettering. Valve tags shall have abbreviations of the system in addition to the valve number. Lettering color shall be in accord with the State of Illinois Standard Color Code for Piping Identification. All valve tags shall have #16 brass chain and "S" hooks for secure attachment to valves.

2.10 SHOCK ABSORBERS

A. Acceptable Manufacturers:

1.	Josam	Absorbotron
2.	Jay R. Smith	Hydrotol
3.	Wade	Shokstop
4.	Zurn	Shoktrol

B. Shock absorbers shall have sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system. Stainless steel body and bellows. Factory pre-charged compression chamber. Absorbers shall have been tested and certified in accordance with Plumbing and Drainage Institute Standard WH-201.

2.11 BACKFLOW PREVENTERS

A. Reduced Pressure Principle (RPZ) Type

1. Acceptable Manufacturers:

a.	Wilkins	975, 975XL
b.	Watts	909
c.	Conbraco	Series 40-200
d.	Febco	

2. Reduced pressure principle backflow preventer with test valves. Provide strainer upstream of and bronze ball valves or cast iron gate valves on both sides of backflow preventer. Provide air gap, drain fitting and pipe open sight to nearest drain.
3. Unit shall be ASSE listed 1013, AWWA compliant, UL listed and FM approved.

2.12 THERMOSTATIC MIXING VALVE: TMV-1

A. Acceptable manufacturers - subject to compliance with specifications:

1.	Leonard	Model 210-SB
2.	Symmons	Temp Control
3.	Lawler	Series 4000

B. Provide thermostatic mixing valve for hot water (110°F Adj.) supply to public lavatories.

C. Maximum operating pressure: 125 psi.

D. Solid bi-metal thermostat directly linked to valve porting to control the intake of cold and hot water.

E. Combination straight checkstops on inlets.

F. Copper tube connections.

G. Minimum flow: .5 gpm.

2.13 THERMOSTATIC MIXING VALVE: TMV-2

A. Acceptable manufacturers - subject to compliance with specifications:

1.	Leonard	Model TM-650-STSTL-EXP
2.	Symmons	Temp Control
3.	Lawler	911 Series

B. Provide thermostatic mixing valve to provide tempered water (80°F adj.) for supply to emergency fixture.

C. Emergency fixture mixing valve shall be dual valve, high-low manifold thermostatic mixing valve system. Unit shall have solid bi-metal thermostat, coded dial, adjustable limit stop, angle checkstops on the inlets, ball valve shutoffs at the outlets of each mixing valve, pressure regulating valve with pressure gauges on the inlet and outlet, color coded dial thermometer, inlet piping manifold with unions, and 24" X 18" X 8" deep surface mount steel cabinet with baked white enamel finish. Unit shall be factory pre-assembled and tested. Capacity to handle minimum flow of 3.0 gpm and flow of 20.0 gpm at 10-psig pressure drop.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

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. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure no less than 3 and one-half feet of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Section 09910.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, no inverted valves will be permitted.

N. Vent pipe flashing shall extend all around the pipe onto the roof a minimum of 12 inches in all directions. The flashing shall be carried up, over, and down into the pipe at least 2 inches. Provide and secure flashing ring to roof.

O. Shut-off valves shall be installed to isolate sections of the pipe and fixtures for repairs and maintenance, and in the risers and main branches at points of take-off from their main supplies, even when not indicated on the drawings.

P. Install specialties in accordance with manufacturer's instructions and the Illinois Plumbing Code.

Q. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

R. Encase exterior cleanouts in concrete flush with grade

S. Pipe relief from back flow preventer to nearest drain.

T. Provide cleanouts where shown on drawings and where required by the Illinois Plumbing Code.

3.03 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Install ball valves for throttling, bypass, or manual flow control services.

3.04 ERECTION TOLERANCES

A. Drainage and Vent Pipes

1. Unless shown on the drawings, horizontal soil and waste pipes 4 inches and larger in diameter shall have a minimum grade of 1/8 inch per foot, and less than 4 inches in diameter shall have minimum grade of 1/4 inch per foot. Main vertical soil and waste stacks shall be extended full size to the roofline and above as vents, except that the minimum size vent through roof shall be 3 inches.

2. Where practicable, two or more vent pipes shall be connected and extended as main vent riser above vented fixtures. Where a circuit vent pipe from any fixture or line of fixtures is connected to a vent line serving other fixtures, the connection shall be at least 6 inches above the flood level rim of the waste. Vent and branch vent pipes shall be so graded and connected as to drip back to the vertical stack of gravity.

B. Water Supply Piping

1. Grade horizontal piping at uniform slope of 1/8 inch in 10 feet, or as indicated to low points of the system for emptying the piping of water when needed. Where constant pitch cannot be maintained for long runs, establish intermediate low point and rise to new level. Grade branches to drain to main or riser. At bottom of the riser and at low points, provide and install 1/2-inch brass valves with capped nipple. Where fixtures are connected to risers at lowest level, they may be considered as drains.

3.05 INSTALLATION OF SHOCK ABSORBERS

A. Provide shock absorbers on all hot and cold water lines where indicated on the Drawings, and as required by code.

B. The letter designation of the shock absorbers that are indicated refers to PDI symbols for the classification of shock absorbers as set forth in PDI-Standard WH201.

3.06 VENT STACKS THROUGH ROOF

A. Extend stacks at least 12 inches above finished roof.

B. Provide pipe increaser immediately below roof, installed so upper end is one pipe size larger than stack.

3.07 DISINFECTION OF WATER SYSTEM

A. Disinfect the domestic supply and distribution system, and have such system proven free from pollution-causing growths or organisms, before the system can be considered useable. Such disinfection may be accomplished piecemeal, on segments of the overall system as they approach completion, or on the entire system at one time.

B. Disinfection agent and technique shall be in accordance with the Illinois State Plumbing Code, (latest edition).

C. Provide the disinfection agent, mixing containers, solution pump, accessory equipment and materials, and manpower for disinfection. Notify the Construction Coordinator at least 24 hours before any disinfection procedure is scheduled and an Construction Coordinator's representative will observe the procedure. Provide sampling and laboratory testing.

D. The disinfecting agent shall be granular or powdered calcium hypochlorite, diluted to a solution of 50 milligrams per liter of water. Solution shall be pumped from its drum or other container into the upstream end of the section or system being disinfected, through a disconnected union, unfinished pipe end, or fixture already in place. After the section or system is full of solution and trapped air is purged, the solution shall be held in the pipeline and accouterments for at least 6 hours. During this time, all valves in the section being treated shall be operated from fully open to fully closed to open again, and pump impellers shall be rotated manually.

E. After retention of disinfecting solution for the designated interval, the upstream end of the section being treated shall be connected in its permanent manner, and the section or system shall be flushed with water supplied from the City main. Samples of water that have flowed through the entire treated section or system shall then be collected for laboratory bacteriological analysis.

F. The system will be considered adequately disinfected when samples collected on 2 consecutive days result in laboratory tests that indicate no evidence of pollution. When repeated test show presence of pollution, repeat the disinfection procedure, until acceptable results are obtained.

G. Alternate agents and methods may be used subject to prior written approval of the Construction Coordinator.

3.08 FINAL CLEAN UP

A. After completion of the plumbing installation, flush out the entire system and thoroughly clean to remove all grit, oil, and foreign materials from the piping.

B. Clean all paint, grease, oil, dirt, labels, stickers, from all fixtures, equipment and exterior of the piping.

C. Wash and polish all plumbing fixtures, clean and polish all plated surfaces and touch up all mars and scratches on painted and enameled finishes.

D. Clean all grates and strainers on all floor and roof drains.

E. All surplus materials, debris and tools shall be promptly removed from the premises and all damage to other work promptly made good.

3.09 ELEVATIONS, GRADES AND LINES

A. Pipe Bury

1. Where definite grades, elevations or profiles are not indicated on the Drawings, install pipelines at the following depths, top outside center pipe to finish ground surface:

Fluid in Pipe	Minimum Earth Cover
Water	4 feet - 8 inch
Waste, storm and sanitary	3 feet - 6 inch
Gas	1 foot - 6 inch

3.10 EXCAVATING AND BACKFILLING

A. Contractor's Responsibility:

1. Contractor is responsible for the excavation and backfilling necessary for installation of his work.
2. Perform excavation of every character of sub-surface material encountered, including frangible rock, solid rock, rubble, existing foundations, footings, bases, fluid sand, and muck. The nature of material excavated is not cause for charge in lump sum price.
3. Provide sheathing and bracing as required for protection of workmen, for protection of work installed in the excavation and for compliance with regulatory agency rules.
4. Remove and dispose of surplus excavated material, away from the premises, in a manner that conforms with local regulations. Any surplus earth or materials not removed promptly by the Contractor will be removed by others as directed by the Construction Coordinator and the cost of the removal charged to the Contractor.

B. General

1. Excavation and backfilling in streets and parkways shall be in accordance with the requirements of the City or governing body having jurisdiction.
2. Excavations are to be conducted that no walls or footings are disturbed or injured and with a minimum of disturbances to the subgrade.
3. No power trenching equipment will be permitted inside the building lines, except upon written permission of the Construction Coordinator.
4. Maintain all trenches and excavations free of standing water. Provide all pumping equipment, labor and energy for operating same.
5. Divert dewatering apparatus discharge to natural drainage courses, curbs or storm sewers, not to sanitary sewers.
6. Fill materials, fill placement and compaction procedures are subject to the approval of the Construction Coordinator.
7. If cinder fill is unexpectedly encountered, notify the Construction Coordinator. All pipe and conduits installed in cinder fill shall be encased in six (6) inch thickness of 3000 PSI, normal weight concrete.
8. No piping or other work shall be covered until inspected, tested and reviewed by the Construction Coordinator.

C. Pipeline trenches below concrete slabs on grade or paved area.

1. Excavate 4 inches deeper than planned outside bottom center of pipe.
2. Place a layer of bank sand, or approved equivalent, 4 inches nominal thickness, between trench bottom and pipe to act as uniform support pad and spacer.
3. Fill around and over installed pipe with compacted sand or other approved granular material to underside of concrete slab or base course.
4. Backfill material shall be placed in successive 8 inch thick layers and each layer compacted by pneumatic or mechanical tampers to 90 percent of maximum dry density as established by Modified Proctor Test (ASTM D-1557) for cohesionless soils and 90 percent for cohesive soils.

D. Pipeline trenches through unpaved areas.

1. Provide pipe bedding and backfill material as specified in preceding subparagraph, except that backfill shall terminate 9 inches from the top of the trench excavation.
2. The top 9 inches of the excavation shall be restored with a material type to match the existing materials.
3. In the case of trenching through natural earth or previously backfilled areas, the backfill shall be compacted and mounted 6 inches above existing grade to allow for settlement.

3.11 PIPE JOINTING

A. Cleaning:

1. Care shall be taken to keep pipe compound and all other foreign matter from entering the interior of the piping. Each section of pipe and all fittings shall be carefully inspected for dirt, grease, or other foreign matter on the inside. They shall be properly cleaned before assembly.
2. Thoroughly clean the piping systems after completion to the satisfaction of the Construction Coordinator.

B. Threaded Pipe:

1. Acceptable Manufacturers:

a. Hercules - TFE Pipe Joint or Real Tuff
b. Markal Company
c. Rector Seal - 100% Virgin

2. Threads shall be full and clean cut, and ends of pipe shall be reamed.
3. When screwed joints are assembled, the male thread shall be thoroughly coated with jointing compound to serve as a joint sealer and as a primer for the exposed threads.

C. Bell and Spigot Joints:

1. Joints in bell and spigot cast iron soil pipe shall be made by ramming a ring of oakum into the bell to within 1-1/2 inches of the face of the bell. The bell then shall be poured full at one pouring with molten lead and caulked tight. Trim lead flush with the end of the bell.
2. Compression type joints for bell and spigot cast iron soil pipe made with approved type neoprene insert gaskets.

D. No-Hub Soil Pipe Joints:

1. Joints shall be made with a neoprene gasket covered by a corrugated metal stainless shield secured by two (2) or more stainless steel bands or clamps.

E. Copper Tubing Joints:

1. Brazed Joints

a. Solder: 95-5 on all lines.
b. Clean mating surfaces of tube and fitting to bright sheen and apply flux.
c. Apply solder and heat until the molten solder is drawn into the joint by capillarity and the connection is tight.

3.12 THERMOMETER INSTALLATION

A. Install thermometers in piping and equipment in solid bar Thermowells filled with non-solidifying heat conduction paste.

B. Well material appropriate for type of service, temperature and fluid velocity.

C. Wells shall be located in path of moving liquid, not in stagnant or dead end positions.

D. Wells shall not obstruct flow.

E. Wells on pipes one-inch diameter and smaller shall be increased one pipe size.

F. Provide extension necks on thermometers installed in insulated piping or equipment.

3.13 VALVE TAGGING

A. Attach a valve identification tag and chain to each valve. Each tag shall designate the fluid within the pipe and the valve identification number. Valve identification numbers shall be sequential and begin with the number 1 and start at the source of each piping system.

B. Furnish two copies of a typewritten valve schedule to the Construction Coordinator in an acetate cover. Schedule shall show valve designation, valve size, area served, type of service, type of valve and manufacturer.

3.14 PIPE MARKER INSTALLATION

A. Provide pipe markers on all "exposed" and "concealed but accessible" insulated and bare pipelines.

B. Pipe markers shall be located as follows:

C. On straight runs of pipe at intervals not exceeding 50 feet.

D. At every sectionalizing or main shut off valve.

E. All piping exposed by access panels.

F. All piping mains in accessible chases.

G. On each riser at a point 5 feet above floor or platform.

H. At least once in every room the piping passes through for rooms less than 30 feet long in that direction.

I. For rooms longer than 30 feet, on both sides of a wall or partition through which pipe passes and at intervals not exceeding 50 feet.

J. Markers shall be applied so they can be read when standing on the floor.

3.15 INSPECTION AND TESTING

A. All piping systems shall be tested for leaks and subject to Architect/Engineer's written approval before covering is applied and before backfilling or concealing within the structure.

B. Notify the Architect/Engineer and Owner, three working days before the tests are to be made. Concealed work shall remain uncovered until specified tests have been completed; when necessary, tests on portions of the work may be made so that those portions of the work may be concealed after being proven satisfactory. Repairs or defects that are discovered as a result of inspection or tests shall be made with new materials. Caulking of screwed joints, cracks, or holes will not be accepted. Tests shall be repeated until all defects have been eliminated. Furnish the equipment, material, and labor to accomplish the tests.

C. A water pressure test shall be applied to all parts of the drainage systems, before the pipes are concealed or fixtures set in place. The test may be applied in sections. All openings of each system to be tested shall be tightly closed except the highest openings above the roof and the entire system or sub-system shall be filled with water up to the overflow point of this highest opening. All parts of the system shall be subjected to not less than 10 feet of hydrostatic head except the uppermost 10 feet of the piping directly below the opening. The water shall remain in the system for not less than 30 minutes after which time no leaks at any joints or lowering of the water level at the overflow shall be visible.

D. Cap all open connections in the water piping systems and fill the sections of piping to be tested at 100 pounds per square inch gauge pressure registered at ground floor level. The system shall be carefully inspected and all defective material replaced and leaks repaired. The test pressure shall be held for a minimum period of 1 hour without variation in pressure except that which is due to changes in temperature.

E. Cap up all open connections in the gas piping system. A suitable air chamber shall be attached to the system and compressed air introduced until a pressure of 125 pounds per square inch is reached. The system shall be isolated before the test begins. The test pressure shall be held for a minimum period of 1 hour without variation in pressure except that which is due to changes in temperature.

F. Welding piping shall be subject to a hydrostatic test of not less than 100 pounds per square inch, or 1-1/2 times the working pressure, which ever is the greater at which pressure all welded joints shall be hammered with a three pound hammer, the blows being struck with a sufficient force to jar the pipe and joint, but not so hard as to injure the piping. All welds shall pass this test without showing leaks or any defects.

END OF SECTION 15100

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes requirements to furnish and install all plumbing specialties required for complete plumbing systems.

1.02 RELATED WORK

A. Section 15100 – Plumbing.
B. Section 15400 – Plumbing Equipment.
C. Section 15410 – Plumbing Fixtures.

1.03 REFERENCES TO STANDARDS

A. ANSI A112.21.1 - Floor Drains.

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer shall certify to not less than five (5) years in the manufacture of items specified.

B. Conform with State and local Plumbing Code.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site per manufacturer's recommendations.

B. Accept specialties on site in original factory packaging. Inspect for damage.

C. Coordinate installation with related work under other sections.

PART 2 PRODUCTS

2.01 FLOOR DRAINS

A. FD-1

1. Acceptable Manufacturers

a.	Wade	W-1100
b.	Zurn	ZN-415-5B
c.	Josam	30000
d.	Smith	2010

2. Cast iron body with 4" bottom outlet, combination invertible membrane clamp and adjustable collar with 5" diameter polished nickel bronze strainer. Provide separate seal trap with cast iron body.

2.02 FLOOR CLEANOUTS

A. Acceptable Manufacturers

1.	Wade	W-6000
2.	Zurn	Z-1400
3.	Josam	56010
4.	Smith	4020

B. Cleanouts on buried piping shall be brought up to floor level as shown on the drawings. Diameter shall be same as pipe size up to 4" I.P.S. Diameter shall be 4" on pipes sized grater than 4" I.P.S.

C. Apply teflon paste thread lubricant to male threads of all cleanout plugs in strict accordance with the manufacturer's recommendations.

D. Cast iron adjustable floor cleanout with threaded adjustable housing, flanged ferrule spigot outlet, bronze taper plug, and round nickel bronze scoriated cover.

2.03 WALL CLEANOUTS

A. Acceptable Manufacturers:

1.	Wade	8460-R
2.	Zurn	Z-1441
3.	Josam	58790
4.	Smith	4530

B. Cleanouts in vertical drainage lines shall be installed perpendicular to wall surface. Diameter shall be same as pipe size up to 4" I.P.S. Diameter shall be 4" on pipes sized greater than 4" I.P.S.

C. Apply teflon paste thread lubricant to male threads of all cleanout plugs in strict accordance with the manufacturer’s recommendations.

D. Cast-iron wall cleanout with bronze tapered thread plug tapped and threaded for cover screw. Cleanout shall have a stainless steel round cover secured to plug with a stainless steel screw.

2.04 DIELECTRIC CONNECTIONS

A. Pipe joints connecting dissimilar metals shall be insulating, dielectric connections. Dielectric connections shall also be furnished for joining similar metals in order to isolate cathodically protected pipelines from adjoining pipe sections. Such joints, including dielectric material shall be rated to withstand the temperature, pressure and other characteristics of the service for which it is to be used, including testing pressure.

B. Screwed joints shall be made with insulating unions and couplings.

C. Flanged joints shall be made with insulation gaskets, bolt sleeves and washers.

2.05 FREEZELESS WALL HYDRANT, HB-1

A. Approved Manufacturers

1.	Woodford	Model 65
2.	Wade	W8620
3.	Zurn	Z-1510

B. Hose bibb to be exposed type freezeless, wall hydrant type, automatic drawing with vacuum breaker, brushed chrome finish on brass casting, 3/4" hose thread nozzle. Dimensions to fit one course of standard brick. Operating stem to be hardened stainless steel. Loose tee key to be furnished with each hydrant. Packing nut to be secured with locknut. Large hemispherical (compression type) permanent valve seat. Integral approved vacuum breaker, constructed so that hose connection cannot be made without the protection of the vacuum breaker.

2.06 STANDARD HOSE BIBB, HB-2

A. Approved Manufacturers

1.	Woodford	24P
2.	NIBCO	763V8-LS
3.	Chicago Faucet	

B. Hose bibbs shall consist of a bronze angle valve as specified below and a bronze nipple with pipe threads on one end and ¾” hose threads on the other end.

C. All hose bibbs shall be equipped with anon-removable base faucet vacuum breaker with ¾” male hose thread, on the supply line.

D. Angle valves shall be Class 125. Angle valves shall have cast composition bronze body and bonnet (ASTM B62), copper silicon alloy stem, brass packing gland, Teflon impregnated packing, Teflon disc, and malleable handwheel.

2.07 FLOOR SINK, FS-1

A. Acceptable Manufacturers

1. Wade W-9140-24-16
2. Zurn Z-1900-KC-3
3. Josam 49320A-4
4. Smith 3420-C-13

B. Floor sink with 12" x 12" x 6" cast iron body and 4" inside caulk outlet. Drain shall have seepage flange and clamp collar. Grate shall be 9" x 9" square slotted and shall be in a 3/4 grate configuration. Receptor shall have aluminum bottom dome strainer. Provide separate deep seal trap with cast iron body.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of floor construction to receive drains and cleanouts to required invert elevations.

3.02 INSTALLATION

A. Install items in this section in accordance with manufacturer's instructions and in conformance with state and local plumbing codes at the locations indicated on the drawings.

B. Extend cleanouts to finished floor surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure 18" clearance at cleanout for rodding of drainage system.

C. Connections at right angles to ends of lines shall be made with long radius quarter bends or two eights bends.

D. Connections at right angles to runs of horizontal lines shall be made with wye and eighth bend and eighth bend.

E. Cleanouts shall be full size of pipe served, but need not be larger than 4" inside building or 6" outside building.

F. Install flashing and clamping device on all cleanouts above slab on grade.

G. Fasten floor drains to floor and install flashing except when drain is installed in slab-on-grade.

H. Adjust floor drain strainer grate to be flush with floor. Grate shall be level and true to wall lines.

I. Field coordinate exact location of floor drains with equipment.

J. At substantial completion, fill floor drain traps with clean mineral oil.

END OF SECTION 15120

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This section covers the requirements for all refrigerant piping systems.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15086 - Refrigerant Piping Insulation.

1.03 REFERENCE TO STANDARDS

A. ANSI B31.5
B. ASHRAE 15 - 1989 Safety Code for Mechanical Refrigeration

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, etc.

C. Product Data: Provide manufacturers data sheets for:

1. Pipe.
2. Fittings.
3. Special refrigerant valves.
4. Refrigerant specialties.

PART 2 PRODUCTS

2.01 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigerant piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials use in refrigerant piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

2.02 PIPES AND PIPE FITTINGS

A. General: Provide pipes and pipe fittings in accordance with the following listing:

1. Tube Size 3" and Smaller: Copper tube, Type L, ASTM B88 refrigerant grade, hard-drawn temper; wrought-copper, solder-joint fittings; soldered joints.
2. Soldered Joints: Solder joints using silver-lead solder, ASTM B 32, Grade 96 TS.
3. Ends shall be plastic capped.

B. Pre-charged re-insulated copper refrigerant pipe may be used.

2.03 REFRIGERANT VALVES

A. General: Special valves required for refrigerant piping include the following types:

1. Globe and Check Valves:

a. Acceptable Manufacturers:

i. Henry Valve Co.
ii. Parker Hannifin Corp.; Refrigeration & Air-Cond. Div.

iii. Sporlan Valve Co.

b. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 degrees F. (49 degrees C) temperature rating, 500 psi working pressure.

c. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 degrees F. (121 degrees C) temperature rating, 500 psi working pressure.

2. Solenoid Valves:

a. Acceptable Manufacturers:

i. Alco Controls Div.; Emerson Electric Co.
ii. Automatic Switch Co.
iii. Sporland Valve Co.

b. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, UL-listed, 1/2" conduit adapter, 250 degrees F. (121 degrees C) temperature rating, 400 psi working pressure.

c. Manual Operator: Provide manual operator to open valve.

2.04 REFRIGERANT SPECIALTIES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide refrigeration accessories of one of the following:

1. Alco Controls Div.: Emerson Electric Co.
2. Henry Valve Co.
3. Parker-Hannifin Corp.; Refrigeration and Air-Conditioning Div.
4. Sporlan Valve Co.

B. Refrigerant Strainers: Brass shell end connections, brazed joints, monel screen, 100 mesh, UL-listed, 350 psi working pressure.

C. Moisture-Liquid Indicators: Forged brass, single port, removable cap, polished optical glass, solder connections, UL-listed, 200 degrees F. (93 degrees C) temperature rating, 500 psi working pressure.

D. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.

PART 3 EXECUTION

3.01 INSPECTION

A. General: Examine areas and conditions under which refrigerant piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF REFRIGERANT PIPING

A. General: Install refrigerant piping in accordance with equipment manufacturer's recommendation.

B. Install refrigerant piping with 1/4" per foot (1%) downward slope in direction of oil return to compressor.

C. Provide oil traps and double risers where indicated, and where required to provide oil return.

D. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab.

E. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.

F. Flux, solder and scale shall be thoroughly cleaned from the tube. Tubing shall be filled with nitrogen while soldering to prevent oxidation. Bleed dry nitrogen through refrigerant piping during brazing operations.

G. All tubing shall remain capped until assembled.

H. All equipment shall be maintained absolutely dry and clean during handling and assembly.

I. The system shall be completely leak tested with a halide torch or approved refrigerant leak tester.

3.03 INSTALLATION OF REFRIGERANT VALVES

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions. Remove accessible internal parts before soldering, replace after joints are completed.

1. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards.

B. Charging valves, expansion valves, solenoid valves, back seating type service valves, and any other valves necessary for the safe and proper operation of the refrigerating system shall be included in the installation.

C. Seal caps shall be used on all refrigerant valves.

3.04 INSTALLATION OF REFRIGERANT ACCESSORIES

A. Refrigerant Strainers: Install in refrigerant lines and in accessible location for service.

B. Moisture-Liquid Indicators: Install on refrigerant liquid lines, in accessible location.

C. Refrigerant Filter-Dryers: Install in refrigerant lines and in accessible location for service.

3.05 EQUIPMENT CONNECTIONS

A. General: Connect refrigerant piping to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.06 FIELD QUALITY CONTROL

A. Refrigerant Piping Leak Test: Prior to initial operation, clean and test refrigerant piping in accordance with ANSI B31.5, "Refrigeration Piping". Perform initial test with dry nitrogen, using soap solution to test all joints. Perform final test with 27" vacuum, and then 200 psi using halide torch. System must be entirely leak-free.

B. Repair or replace refrigerant piping as required to eliminate leaks and retest as specified to demonstrate compliance.

3.07 DEHYDRATION AND CHARGING SYSTEM

A. Install core in filter dryer after leak test but before evacuation.

B. Evacuate refrigerant system with vacuum pump, until temperature of 35 degrees F. (2 degrees C) is indicated on vacuum dehydration indicator.

C. During evacuation, apply heat to pockets, elbows, and low spots in piping.

D. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

E. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.

F. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

3.08 ADJUSTING AND CLEANING

A. Cleaning and Inspecting: Clean and inspect refrigerant piping system.

END OF SECTION 15185

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. This section covers the work necessary to provide and test process pipe and fittings that is to be installed above grade, below structures and within five feet of structures. The portions of the Work specified in this section include waste water treatment process piping from influent sewer to treated effluent including all main and side-stream process flows, chemical feed piping, and non-potable 'plant water' piping. Building supply, waste and drain piping requirements are included in other Division 15 sections.

B. Related Sections:

1. Section 02500 – Buried Process Piping: for requirements for process piping to be installed below grade and five feet or more outside of structures.
2. Section 09960 – High Performance Coatings: for painting.
3. Section 11241 – Chlorination and Dechlorination Equipment.
4. Section 15050 - Basic Mechanical Materials And Methods.
5. Section 15064 - Sleeves, Supports, Hangers, Anchors and Seals
6. Section 15070 - Mechanical Sound, Vibration and Seismic Control
7. Section 15084 - Piping Insulation
8. Section 15100 - Plumbing
9. Section 15120 - Plumbing Specialties
10. Section 15267 - Plant Piping Specialties.
11. Section 15270 – Valves.
12. Section 15271 - Stainless Steel Air Header & Fittings Fabrication.
13. Section 15277 - Electric Valve and Gate Actuators.
14. Section 15445 - Packaged Booster Pumping System.
    For Building Services piping & plumbing:
15. Section 15400 - Plumbing Equipment
16. Section 15410 - Plumbing Fixtures

1.02 REFERENCE TO STANDARDS

A. The portions of the work specified in this section shall conform to the following standards, rules, and regulations with modifications and additional requirements as stated in or reasonably inferred from the Contract Documents.

1. Standard Specifications: "Standard Specifications for Construction of Water and Sewer Main in Illinois", 7th ed., 2014.
2. Illinois Recommended Standards for Sewage Works - Title 35, Subtitle C, Chapter II, Part 370 of the Illinois Administrative Code.

3. 10-States Standards: “Recommended Standards for Wastewater Facilities” as issued by the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2004 Edition.
4. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, including all addenda.
5. Illinois Department of Transportation (IDOT): Supplemental Specifications and recurring Special Provisions
6. ANSI/AWWA C104/A21.4-03, American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
7. ANSI/AWWA C105/21.5-99, American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
8. ANSI/AWWA C110/A21.10-03, American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in. for Water and Other Liquids.
9. ANSI/AWWA C111/A21.11-00, American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
10. ANSI/AWWA C115/A21.15-99, American National Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
11. ANSI/AWWA C116/A21.16-03, AWWA Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
12. ANSI/AWWA C150/A21.50-02, AWWA Standard for Thickness Design of Ductile-Iron Pipe.
13. ANSI/AWWA C151/A21.51-02, American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
14. ANSI/AWWA C153/A21.53-00, American National Standard for Ductile-Iron Compact Fittings for Water Service
15. ANSI/AWWA C200-05: Standard for Steel Water Pipe - 6 In. (150 mm) and Larger.
16. ANSI/AWWA C205-07, Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger - Shop Applied.
17. ANSI/AWWA C206-03, Standard for Field Welding of Steel Water Pipe.
18. ANSI/AWWA C207, AWWA Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in. (100 mm through 3600 mm)
19. ANSI/AWWA C208-07, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
20. ANSI/AWWA C219-01, AWWA Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe.
21. ANSI/AWWA C220-05, Standard for Stainless-Steel Pipe, 1/2 In. (13 mm) and Larger.
22. ANSI/AWWA C223-07, Standard for Fabricated Steel & Stainless Steel Tapping Sleeves
23. ANSI/AWWA C226-06, Standard for Stainless-Steel Fittings for Waterworks Service, Sizes 1/2 in. through 72 in. (13 mm through 1,800 mm).
24. ANSI/AWWA C227-07, AWWA Standard for Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe.
25. ANSI/AWWA C228-08, Standard for Stainless-Steel Pipe Flanges for Water Services -- Sizes 2 In. through 72 In. (50 mm through 1,800 mm).

26. ANSI/AWWA C600-93, AWWA Standard for Installation of Ductile-Iron Water Mains and their Appurtenances.
27. AWWA C604-06, Standard for Installation of Steel Water Pipe - 4 In. (100mm) and Larger.
28. ANSI/AWWA C605-94, AWWA Standard for Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
29. ANSI/AWWA C606-04, AWWA Standard for Grooved and Shouldered Joints.
30. ANSI/AWWA C651-99, AWWA Standard for Disinfecting Water Mains.
31. ANSI/AWWA C653-97, AWWA Standard for Disinfection of Water Treatment Plants.
32. ANSI/AWWA C900-07, Standard for PVC Pipe & Fabricated Fittings, 4 In. Through 12 In. (100 mm through 300 mm), for Water Distribution.
33. ANSI/AWWA C905-10, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm).
34. ANSI/AWWA C907-04, Standard for Injection-Molded PVC Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution.
35. ANSI/AWWA C909-02, Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. Through 24 In. (100 mm Through 600 mm), for Water Distribution.
36. ASME - Boiler and Pressure Vessel Codes - Section IX
37. ASME A 13.1, Scheme for the Identification of Piping Systems.
38. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (Inch) Revision and Redesignation of ASME/ANSI B2.1-1968.
39. ANSI/ASME B 16.3 - Malleable Iron Threaded Fittings Classes 150 and 300.
40. ANSI/ASME B 16.14 - Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads.
41. ASME B 16.18-2001 - Cast Copper Alloy Solder Joint Pressure Fittings.
42. ASME B16.22-2001 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
43. ANSI/ASME B 16.39 - Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300.
44. ASME B 16.9 – Wrought Steel Butt Welding Fittings.
45. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (Inch) Revision and Redesignation of ASME/ANSI B2.1-1968.
46. ANSI/ASME B31.1 - Code for Pressure Piping, Power Piping.
47. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
48. ASTM A105 - Standard Specification for Forgings, Carbon Steel, for Piping Components.
49. ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
50. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
51. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
52. ASTM A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

53. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
54. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
55. ASTM A312/A312M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
56. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
57. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
58. ASTM B32-04 - Standard Specification for Solder Metal.
59. ASTM B75-02 - Standard Specification for Seamless Copper Tube.
60. ASTM B88-03 - Standard Specification for Seamless Copper Water Tube.
61. ASTM D1330-04 - Standard Specification for Rubber Sheet Gaskets.
62. ASTM D 1784-03 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
63. ASTM D1785-04a - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
64. ASTM D2000-04 - Standard Classification System for Rubber Products in Automotive Applications.
65. ASTM D2321-04 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
66. ASTM D2464-99e1 Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
67. ASTM D2466-02 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
68. ASTM D2467-04e1 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
69. ASTM D2564-04 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
70. ASTM D2665-04a Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
71. ASTM D2855-96(2002) Standard Practice for Making Solvent-Cemented Joints with PVC Pipe and Fittings.
72. ASTM D2949-01 Standard Specification for 3.25-In. Outside Diameter Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
73. ASTM S2996 Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe.
74. ASTM D4024 Standard Specification for Reinforced Thermosetting Resin Flanges.
75. ASTM D5685 Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced-Thermosetting-Resin) Pressure Pipe and Fittings.
76. ASTM F437-99 Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
77. ASTM F438-04 Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
78. ASTM F439-02e1 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
79. ASTM F441/F441M-02 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

80. ASTM F493-04 Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
81. ASTM F1970-01 Standard Specification for Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems.
82. MSS SP-43 – Wrought Stainless Steel Butt-Welding Fittings.
83. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
84. MSS SP-114 - Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000.
85. NSF/ANSI Standard 14: Plastic Piping System Components and Related Materials.
86. NSF/ANSI Standard 61: Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Section 01330 – Submittal Procedures. In addition, submittals shall include manufacturer's product specifications and dimensional data for all components of the proposed process piping and the following specific information shall be provided by the Contractor:

1. Detail installation drawings of each piping system to the scale indicated on the Contract drawings, locating each support, guide, and hanger, identifying the type by pipe loop number, detail number and catalog number or shop drawing detail number, and showing anchor locations and identifying them by shop drawing detail number.

   a. Before starting fabrication of welded steel piping, furnish the Engineer with pipe design calculations, including thrust restraint, and shop drawings which shall include a laying plan and details of a standard pipe section, special fittings, and bends. Dimensions, coatings, and other pertinent information shall be shown. The laying plan shall show the location of each pipe section and each special length, with each piece numbered or otherwise designated in sequence. All outlets and bends shall be made up into special lengths so that, when installed, they will be located as indicated. Each pipe and fitting shall be marked on the outside to indicate the class of pipe and location number on the laying plan. Pipe shall be furnished and installed in accordance with the reviewed laying plan. All marking shall be coded to the shop drawings.
   b. The piping shop drawings for all piping systems shall be new drawings prepared by the Contractor, not a mark-up of contract drawings, and the shop drawings shall have a bill of material on each drawing defining all items mentioned above. All catalog and descriptive data shall note where the specific item is to be installed.
   c. For fabricated stainless steel pipe, indicate shop and erection details, including cuts, copes, connections, holes, threaded fasteners, welds, gasket materials and accessories. Also include material strengths and grades. Indicate all welds, both shop and field by AWS Welding Symbols A2.4. Provide certifications of all welders that will be

performing work on this project. The certifications shall comply with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

2. Detail installation drawings, catalog information, and complete component specifications for pipe supports, hangers, metal framing components, and other components proposed for support of piping systems. Detailed shop drawings of all supports, including support anchoring devices, shall be included with the submittal.
3. Professional Seals: Each set of drawings and design calculations for fabricated/welded steel piping shall bear the seal of a Licensed Professional Engineer from a state acceptable to the Owner's Engineer, or shall bear the seal of a Licensed Professional Engineer in the State of Illinois.
4. Submit certification that each manufacturer meets the applicable manufacturer's qualifications stated in this section.

B. Submit the following specific information for welded steel process piping prior to the start of work:

1. Procedure specifications and qualification records of all welding procedures for all pipe and associated structural welding to be performed under this Section, in accordance with Section IX of the ASME Boiler and Pressure Vessel Code except as modified by the code listed in Code Requirements of this Section.
2. Welders qualifications shall be submitted for each individual welder scheduled to execute welding work.

C. Submit a copy of the most current published NSF 61 listing of each pipe type, diameter, and lining, to be furnished for potable water service or for any service upstream of potable water in the potable water treatment process.

D. For fabricated stainless steel piping, submit shop drawings and material samples for executing the work included herein.

1. Shop Drawings: Indicate shop and erection details, including cuts, copes, connections, holes, threaded fasteners, welds, gasket materials and accessories.

   a. Include material strengths and grades.
   b. Indicate all welds, both shop and field by AWS Welding Symbols A2.4.
   c. Submit certifications of all welders that will be performing work on this project. The certifications shall comply with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

2. Reports - The following applies to stainless steel specified as ASTM:

a. The supplier shall furnish certification of compliance with the referenced ASTM specification.
b. The certification shall include the Purchase Order number and shall be signed by the supplier's authorized personnel.
c. The Fabricator must provide the Owner with their Positive Material Identification (PMI) Program for review and approval before any fabrication work begins.

1.04 MANUFACTURER'S QUALIFICATION

A. The pipe and pipe support manufacturers shall have been in the design, manufacture, and testing of the specified type of pipe, supports and associated equipment for ten (10) years minimum.

1.05 QUALITY ASSURANCE

A. The manufacturer shall have established an on-going program of quality assurance and shall, upon request, provide auditable records to the Engineer of quality control documentation for the specified materials and equipment through its manufacturing process.

1.06 WARRANTY

A. The pipe and pipe support manufacturer(s) shall provide a written guarantee through the Contractor to warrant the equipment to be free of material or workmanship defects for a period of one (1) year from the date of substantial completion established by the Owner.

1.07 REGULATORY REQUIREMENTS

A. All piping provided under this section shall be installed such that the completed work meets requirements of the Federal Occupation Safety and Health Act of 1970 (OSHA), as may be amended to date of order.

B. All products provided under this section for service in contact with potable water shall be tested and certified by Underwriters Laboratory or NSF International (as an ANSI accredited certifier) against NSF 61: Drinking Water System Components - Health Effects.

1.08 CODE REQUIREMENTS

A. Welded steel process piping shall meet the requirements of the ANSI Code for Pressure Piping B31.1, Power Piping, hereinafter referred to as the Piping Code.

1.09 DELIVERY, STORAGE AND HANDLING

A. In addition to the requirements in Section 01600 – Product Requirements, the ends of pipe shall be covered during shipping.

1. Do not drop, dump, or slide piping materials.
2. Store gaskets out of direct sunlight in a cool, clean, and dry location.

3. Store piping materials in a manner to prevent damage by freezing water.
4. Store mechanical joint, flange joint, and other bolting in a clean, dry location
5. Use slings, hooks, or pipe tongs that have padding and will not damage the coating or lining of pipe or fittings when loading, unloading, stacking, lifting, lowering, or otherwise moving piping materials.
6. Take adequate measures to ensure that dirt, debris, and other deleterious foreign material does not enter pipe or fittings during shipping, loading, unloading, storing, and installing. .

B. If possible, store PVC and CPVC pipe inside. When this is not possible, store pipe on level ground which is dry and free from sharp objects.

1. Store different schedules of PVC and CPVC pipe that are stacked together with the thickest walls on the bottom.
2. If the PVC and CPVC pipe is in pallets, the pallets should be stacked with the pallet boards touching, rather than pallet boards being placed on the pipe to prevent damage to or bowing of the pipe.
3. If the PVC and CPVC pipe is stored in racks, it shall be continuously supported along its length. If this is not possible, the spacing of the supports shall not exceed three feet (3').
4. The PVC and CPVC pipe shall be protected from the sun and be in an area with proper ventilation to lessen the effects of ultraviolet rays and help reduce heat build-up.

C. All austenitic stainless steel pipe shall be protected from exposure and salt water or salt spray during shipment and/or storage. Fabricated air headers shall be stored on-site on supports and kept free from sand, water and other debris. Storage shall be such that it is not damaged, dented or bent.

PART 2 PRODUCTS

2.01 GENERAL

A. The materials to be used for each piping system are shown on the Drawings and listed in the piping schedule.

2.02 PIPE IDENTIFICATION PAINTING & LABELING

A. Painting: All piping shall be painted and color-coded as specified in Section 09960 – High-Performance Coatings. Pipe color-coding shall conform to the color scheme presented in the Illinois Recommended Standards for Sewage Works, Recommended Standards for Wastewater Facilities, and Recommended Standards for Water Works by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers as follows:

1.	Raw Water	Olive Green
2.	Recycled Water	Olive Green
3.	Settled Water	Aqua
4.	Clarified Water	Aqua
5.	Finished Water	Dark Blue
6.	Potable Water	Dark Blue

7.	Non-Potable Water	Dark Blue with 3-inch Yellow Band spaced 30-inches apart
8.	Water Lines for Heating Digesters or Buildings	Blue with 6-inch Red Band spaced 30 inches apart
9.	Backwash Waste	Light Brown
10.	Sludge (process residuals)	Dark Brown
11.	Grit	Dark Brown
12.	Raw Wastewater Sludge	Brown with Black Band
13.	Sludge Recirculation Suction	Brown with Yellow Band
14.	Sludge Recirculation Discharge	Brown
15.	Sludge Draw-off	Brown with Orange Band
16.	Sludge Gas	Orange
17.	Sewer (sanitary or other)	Dark Gray
18.	Alum	Orange
19.	Ammonia	White
20.	Carbon Slurry	Black
21.	Caustic	Yellow with Green Band
22.	Chlorine (gas and solution)	Yellow
23.	Chlorine Dioxide	Yellow with Violet Band
24.	Coagulant Aids	Orange with Green Band
25.	Fluoride	Light Blue with Red Band
26.	Lime Slurry	Light Green
27.	Ozone	Yellow with Orange Band
28.	Phosphate Compounds	Light Green with Red Band
29.	Polymers	Orange with Green Band Purple at wastewater facilities
30.	Potassium Permanganate	Violet
31.	Primary Coagulant	Orange
32.	Soda Ash	Light Green with Orange Band
33.	Sulfuric Acid	Yellow with Red Band
34.	Sulfur Dioxide	Light Green with Yellow Band Yellow with Red Band at wastewater facilities
35.	Compressed Air	Dark Green
36.	Natural Gas	Red with Black Band
37.	Fuel Oil or Diesel	Red
38.	Plumbing Drains and Vents	Black
37.	Other Lines	Light Gray or as directed by Engineer

38. Vent piping shall be color coded for the fluid being venting and labeled "VENT" at 5 foot maximum spacing.
39. Color bands shall be minimum two inches in width.
40. Where the pipe to be color coded is not scheduled for painting, the color coding can be tape or paint applied in a 12-inch wide field spaced a maximum of four feet with a centered, 2-inch wide band.

B. Labeling: At potable water facilities, all piping shall be labeled with pipe markers and direction of flow arrows, type "OPT1-CODE" and "ARROWS ON A ROLL" respectively, as manufactured by Seton Name Plate Company or approved equal. At wastewater facilities, the contents shall be stenciled on the piping, labeling the contents in a contrasting color (35 IAC 370).

C. Pipe labeling, marking, and identification shall conform to ASME A13.1, “Scheme for the Identification of Piping Systems”. Where piping insulation is used the pipe marker size shall reflect the pipe O.D. plus the specified insulation thickness. Pipe markers and flow directional arrows shall be located to meet the following conditions:

1. Pipe markers and arrows shall be placed on all proposed piping wherever such a need is indicated by operating conditions and, in any case, at intervals of not more than 20 feet on continuous lines.
2. Where two or more pipe lines are parallel and adjacent to each other, all lines in the group shall be identified at the same point.
3. Markers and arrows shall be placed on all pipe lines on each side of a partition, wall, floor or similar barrier which interferes with tracing a line.
4. A marker and arrow shall be placed on piping near the point where it becomes embedded.
5. A marker and arrow shall identify all connecting lines including branches.
6. Unless other identification is adequate, a marker and arrow shall be placed near each connection of a pipe line to an item of equipment.
7. Unless the Engineer approves, a marker and arrow shall be placed at or adjacent to each valve.
8. Markers shall be located and oriented in such a manner that they will be easily readable; if practicable, from a standing position at all operation elevations within the plant, and as directed by the Owner and/or the Engineer.

D. Piping nomenclature for pipe provided under this contract shall be as indicated in the description of pipe service in the Piping Schedule and the P&ID Drawings.

2.03 PIPE COUPLINGS AND EXPANSION JOINTS

A. Flexible couplings or expansion joints shall be provided for piping systems and at connections to equipment where shown on the Drawings. The Contractor may propose to install additional flexible couplings to facilitate piping installation, provided that he submits complete details describing location, pipe supports, and hydraulic thrust protection, if required. Acceptable types of flexible couplings and expansion joints shall be as follows:

1. General: Flexible couplings, transition couplings, and flanged coupling adapters shall be provided with thrust ties. Thrust ties shall be attached to steel pipe with fabricated lugs, and to ductile iron pipe with cast-in-place lugs or flange lugs or socket clamps thrust tied across pipe couplings or flanges. Thrust protection shall be adequate to sustain the force developed by 1-1/2 times the operating pressure specified.
2. Sleeve Type Flexible Couplings: Except as noted, sleeve type flexible couplings for use with steel pipe shall be Dresser, Style 38; Smith-Blair, Style 411; Romac 400; or equal. Flexible couplings for use with ductile iron pipe shall be Dresser, Style 138; Smith-Blair, Style 441; Powerseal 3501; Romac 501; or equal, with low alloy steel bolts and nuts.
3. Groove Type Flexible Couplings: Except as noted, groove type flexible couplings for use with steel pipe shall be Style 75 or Style 77, as manufactured by the Victaulic Company. The choice between the two styles shall be based on the pipe line pressure, and pipe diameter. Couplings for

ductile or cast iron pipe shall be Victaulic Style 31. For both steel and ductile/cast iron pipe, the pipe grooves shall be machined to allow maximum separation between joined pipe ends.

4. Transition Couplings: For interior piping, transition couplings used to connect pipes with small differences in outside diameter shall be Dresser, Style 62; Smith-Blair, 413; PowerSeal Model 3501; Romac RC501; or equal, with low alloy steel bolts and nuts where connecting to ductile iron pipe.
5. Expansion Joints: Expansion joints shall be spool-type, hand-laid elastomer bellows expansion joints and shall be reinforced, wide arch type with 125-pound ANSI flanged ends, split galvanized steel flange retaining rings to ASTM A-536, control rods to protect the bellows from overextension and compression sleeves to protect the bellows from compression. The bellows arch shall be nonfilled and lined with a Buna-N, nitrile, or butyl. Lining material shall be NSF-61 listed for potable water service. Expansion joints shall be Red Valve, Style J-1W or Mercer Flexmore, Style 450. Burst pressure shall be four times the working pressure rating. Rated compression, elongation and lateral deflection and minimum working pressure ratings shall be equal to the published catalog data for Red Valve expansion joints as listed above. Flange bolt set for elastomer bellows expansion joints shall include washers over the split steel retaining rings to help provide a leak-proof joint under hydrostatic test pressures.
6. Teflon Expansion Joints: Teflon expansion joints shall be a two arch, three arch or five arch design. The Teflon body is formed over the full sealing face of the flanges. The Teflon is reinforced externally with stainless steel rings between arches. The hardware and flanges are as noted on the drawings. Expansion joints shall be Mercer, Style 800.
7. Concrete Encased Couplings: Couplings encased in concrete shall be sleeve type couplings, Dresser, Rockwell, or equal, and not grooved end type couplings.
8. Dielectric Pipe Fittings and Unions: When connecting piping system of dissimilar materials provide dielectric fittings and unions manufactured by Watts, Series 3000, with gaskets suitable for the intended service. Provide dielectric flanges with insulated bolting at 3” and larger piping.

2.04 PIPING SUPPORT SYSTEMS

A. Piping shall be supported, in general, as described hereinafter and as shown by the pipe support details on the Drawings. Manufacturers' catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover typical locations where standard catalog supports are inapplicable. Where there is a conflict between information shown in pipe support details and these specification requirements, the stricter requirement shall prevail. Pipe supports and hangers shall meet the material, design, manufacture, selection, application, and installation requirements of MSS SP-58 and SP-69.

B. Support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.

C. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the project.

D. All submerged piping supports, guides, and fasteners and those installed below channel, basin, and wet well wall tops and cover slabs shall be stainless steel. Concrete anchors and anchor bolts shall be as specified elsewhere in the Contract Documents and required by support manufacturer. All submerged metal piping shall be electrically isolated from the supports with a wrap of neoprene rubber extending ½-inch beyond the entire contact area between the pipe and support.

E. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.

F. Where piping connects to equipment it shall be supported by a pipe support and not by the equipment. A pipe support or hanger shall be installed within 2 feet of straight pipe or adjacent to each end of a valve, meter, or other in-line device for all piping larger than 4-inch.

G. **Unless noted otherwise on the Drawings**, horizontal pipe support or hanger spacing and hanger rod sizing for metallic pipe shall be as follows:

Pipe Size	Maximum Support and Hanger Span	Minimum Rod Size Single Rod Hangers
1-inch & Smaller	6 feet	3/8-inch
1-1/4 through 2-1/2-inch	8 feet	3/8-inch
3-inch & 4-inch	10 feet	3/8-inch
6-inch	12 feet	1/2-inch
8-inch	12 feet	1/2-inch
10-inch & 12-inch	14 feet	5/8-inch
14-inch	16 feet	3/4-inch
16-inch & 18-inch	16 feet	7/8-inch
20-inch	18 feet	1-inch
24-inch & 30-inch	18 feet	1-1/4-inch
36-inch	14 feet	1-1/2-inch

H. **Unless noted otherwise on the Drawings**, horizontal pipe support or hanger spacing for PVC/CPVC pipe at a maximum operating temperature of 100 degrees F shall be as follows:

Pipe Size	Maximum Support and Hanger Span		
	SCH 40 PVC	SCH 80 PVC	SCH 80 CPVC
½ & ¾ inch	4 feet	4½ feet	5 feet
1 inch	4½ feet	5 feet	5½ feet
1¼ & 1½ inch	5 feet	5½ feet	6 feet
2 inch	5 feet	6 feet	7 feet
2½ & 3 inch	6 feet	6½ feet	7½ feet
4 inch	6½ feet	7½ feet	9 feet
6 inch	7½ feet	9 feet	9½ feet
8 inch	8 feet	9½ feet	10½ feet

I. All piping shall be supported in a manner which will prevent strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in work areas, walkways, equipment access areas or bridge crane runs.

J. Pipe hangers and supports shall be manufactured by Anvil International, Carpenter Patterson, Cooper B-Line, or PHD Manufacturing, Inc. Hangers and supports shall be provided with all rods, bolts, nuts, adjusters, washers, washer plates, upper attachments, and other components as recommended by manufacturer to provide a design load equal to or greater than the hanger or support specified and a complete support system. Hanger and support spacing shall be decreased from what is listed above to accommodate design load of hangers, brackets, supports, and other components as necessary.

K. Unless noted otherwise, pipe hangers and supports shall conform to the following:

1. Pipe clevis hangers shall be MSS SP-58 Type 1: Anvil 260, B-Line B3100, CP 100, or PHD 454 for IPS pipes, Anvil CT-65, B-Line B3104CT, CP-100CT, or PHD 442 for copper pipe, and Anvil 590, B-Line B3102, or CP 100DI for DIOD pipes.
2. Pipe roller hangers shall be MSS SP-58 Type 43: Anvil 181, B-Line B3110, CP 140, or PHD 470.
3. Pipe Roller Support shall be MSS SP-58 Type 41: Anvil 177, B-Line B3122, CP 109, or PHD 480.
4. Pipe stands at pipe barrels shall be MSS SP-58 Type 38: Anvil 265, B-Line B3092, CP 101U, or PHD 876 Adjustable Saddle & Yoke with Anvil 63 Type T, B-Line B3088T, CP 138, or PHD 871 Base Stand.

5. Pipe stands at flanges shall be B-Line B3094 Flange Support with B-Line B3089 Pipe Adjuster and B-Line B3088 Base.
6. Wall-mounted pipe support brackets shall be MSS SP-58 Type 32: Anvil 195, B-Line B3066, CP 84, or PHD 855 for 8-inch and smaller pipes and MSS SP-58 Type 33: Anvil 199, B-Line B3067, CP 139, or PHD 860 for 10-inch and larger pipes.
7. Pipe straps shall be MSS SP-58 Type 26: Anvil 262, B-Line B2400, CP C1108, or PHD 830.
8. Pipe clamps shall be MSS SP-58 Type 3: Anvil 295, B-Line B3144, CP 304, or PHD 525.
9. Buried pipe clamps shall be B-Line B3134, CP 158DB, or PHD 590.
10. Pipe Riser clamps shall be MSS SP-58 Type 8: Anvil 261, B-Line B3373, CP 126, or PHD 551 for IPS pipe, Anvil CT-121, B-Line B3373CT, CP 126CT, or PHD 552 for copper pipe, and B-Line B3132, CP 158, or PHD 580 for DIOD pipe.
11. Offset Pipe clamps shall be Anvil 103, B-Line B-3148, CP 179, or PHD 535.

J. Support of piping with bolted, metal framing system components shall be provided as shown and detailed in the Drawings.

2.05 SERVICE SADDLES FOR FERROUS METAL PIPING

A. Pipe service saddles for all ferrous metal piping except stainless steel shall be Mueller, DR2S; Smith-Blair, Series 313 or 366; Dresser, Style 291; or equal. Service saddles shall be capable of withstanding 150 psi internal pressure without leakage or overstressing. The saddle shall be compatible with the pipe on which the saddle is installed. Taps shall have iron pipe threads unless noted otherwise or other threads are required by adjacent piping or appurtenances. Saddles shall have malleable or ductile iron bodies and galvanized steel straps, steel hex nuts with washers, and neoprene seals. Service saddles shall be of double-strap or triple-strap design.

2.06 FIELD INSTALLED FLANGES AND DISMANTLING JOINTS

A. Provide Field Installed Flanges on ductile iron and steel process piping in lieu of threaded or welded flanges ONLY when type and location of flange are specifically approved by Engineer.

B. Field Installed Flanges shall be one of the following:

1. Flanged Coupling Adapter installed with thrust ties across the joint:

   a. <u>Coupling</u>: Smith-Blair Series 912 for ductile iron piping and Series 913 for steel piping; Dresser Style 128W for steel pipe and ductile iron pipe; Power Seal Pipeline Products Model 3521; Romac FCA501; or equal.
   b. <u>Thrust Ties</u>: Thrust ties shall be designed to fully restrain the joint against all forces developed by the test pressures listed for the pipe. Thrust ties shall conform to the Table of Thrust-Tie Dimensions.

2. Restrained Flange Adapter: EBAA Iron Series 2100 MEGAFLANGE, or Romac RFCA.

3. For installation where shown on Drawings provide set-screw-type, adapter flange rated for 100 psi working pressure and drilling compatible with ANSI B16.1 125 lb. Flanges. Adapter flange shall be Uni-Flange Series 400, EBAA Iron Series 1000 E-Z Flange, Power Seal 3532, or equal.
4. Table of Thrust-Tie Dimensions:

THRUST-TIE DIMENSIONS FOR FIELD INSTALLED FLANGES											
NOMINAL PIPE DIAMETER (INCHES)	GUSSET PLATE THICKNESS (INCHES)	CONTROL ROD DIAMETER (INCHES)	CONTROL ROD BOLT CIRCLE (INCHES)	MINIMUM NUMBER OF CONTROL RODS REQUIRED							
				MAXIMUM SURGE OR TEST PRESSURE							
				50	75	100	125	150	175	200	250
4	NA	0.625	7.500	2	2	2	2	2	2	2	2
4	0.375	0.625	10.250	2	2	2	2	2	2	2	2
5	NA	0.750	8.500	2	2	2	2	2	2	2	2
5	0.375	0.625	11.250	2	2	2	2	2	2	2	4
6	NA	0.750	9.500	2	2	2	2	2	2	2	4
6	0.500	0.625	12.250	2	2	2	2	2	4	4	4
8	NA	0.750	11.750	2	2	2	2	4	4	4	4
8	0.500	0.750	15.000	2	2	2	2	4	4	4	4
10	NA	0.875	14.250	2	2	2	2	3	3	4	4
10	0.750	0.875	17.750	2	2	2	2	3	3	4	4
12	NA	0.875	17.000	2	2	3	3	4	4	6	6
12	0.750	1.000	21.000	2	2	2	3	3	3	4	6
14	NA	1.000	18.750	2	2	3	3	4	4	6	6
14	0.750	1.000	23.000	2	2	3	3	4	4	6	6
16	NA	1.000	21.250	2	4	4	4	6	6	6	8
16	0.750	1.125	25.750	2	2	4	4	4	4	6	6
18	NA	1.125	22.750	2	4	4	4	6	6	6	8
18	0.750	1.125	27.250	2	4	4	4	6	6	6	8
20	NA	1.125	25.000	2	4	4	5	6	8	8	10
20	0.750	1.125	29.750	2	4	4	5	6	8	8	10
22	NA	1.250	27.250	2	4	4	5	5	6	8	10
22	1.000	1.250	32.000	2	4	4	5	5	6	8	10
24	NA	1.250	29.500	2	4	4	5	6	8	8	10
24	1.000	1.250	34.500	2	4	4	5	6	8	8	10
30	NA	1.250	36.000	4	6	7	8	10	14	14	14
30	1.250	1.500	41.750	4	4	6	7	7	8	10	14
36	NA	1.500	42.750	3	6	7	8	10	12	12	15
36	1.500	1.750	49.000	3	4	6	7	9	9	9	12

Thrust ties shall be control-rods installed in flange bolt circle or with gusset plates outside flange O.D. and anchored to weld-on pipe lugs or flange (welded or threaded). Control-rods shall be installed parallel to pipe centerline and equally spaced around bolt circle. Control-rods shall be carbon steel, hot-dipped galvanized, ASTM A307, Grade A with carbon steel, hot-dipped galvanized, ASTM A563, Grade A, hex head nuts and carbon steel, hot-dipped galvanized, plain washers. Gusset plates shall be hot-dipped galvanized, ASTM A36 carbon steel. Gusset plates shall

be attached by a minimum of two flange bolts each. Sizes and quantities based on 60 ksi yield strength and safety factor = 4.

C. Provide Dismantling Joints on ductile iron and steel process piping where indicated on the drawings and where necessary for future disassembly of piping. Dismantling Joints shall be a flanged spool assembly with restraint rods and shall combine a flanged coupling adapter and a flanged spigot into one assembly. Longitudinal adjustment shall be provided by telescoping action of the spigot inside the flanged coupling adapter. The bolting procedure for the flanged coupling adapter and the flanged spigot can be completed after the final installation position is achieved. Dismantling joint and restraint rods shall be rated for the working, test, and maximum pressures of the adjacent piping.

1. Dismantling Joints shall be JCM Model 309; Romac Industries, Model DJ400; Smith-Blair, Inc. Model 975; Dresser Style 131;or equal.
2. Flanges shall be in accordance with AWWA C207 Class D Flange, drilling compatible with ANSI Class 125 and 150 bolt circles.
3. Body and Spigot shall be ASTM A53, ASTM A512, or carbon steel having a minimum yield of 30,000 psi or Ductile Iron ASTM A536. Spigot shall be Schedule 40 pipe.
4. Follower gland shall be Ductile Iron ASTM A536.
5. Gasket shall be NSF 61 Approved. Nitrile (Buna-N) or NBR rubber compounded for water and sewer service in accordance with ASTM D 2000 MBA810Z.
6. Studs shall be ASTM A325 or A307.
7. Tie Rods shall be ASTM A193 GR B7.
8. Coating shall be NSF 61 certified epoxy for potable water service.

2.07 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. All piping penetrations of slabs, floors, walls, and roofs shall be cast ductile iron wall pipes with thrust collars, unless noted otherwise on the drawings.

B. <u>Pipe Sleeves with Modular Link Seal</u>:

1. Where specifically noted on drawings, provide steel pipe sleeve where pipe passes through concrete or masonry walls, floors, slabs, and roofs which are to be watertight and where shown on the Drawings. Pipe sleeves shall be schedule 40 pipe.
2. All pipe sleeves shall be provided with thrust collars. Thrust collars shall be fabricated of steel and shall be continuously welded (both sides) to the pipe sleeve. All welds shall be done in the pipe manufacturer's shop by qualified welder.
3. The annular space between pipes and sleeves shall be watertight. The joint shall be sealed by a modular mechanical unit consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. For non-immersion service, the interconnected rubber links shall be assembled with zinc phosphate-plated steel bolts and nuts and steel pressure plates under each bolt head and nut to prevent the nut from turning when the bolt is tightened. For immersion service, the links shall be

assembled with stainless steel bolts, nuts, and pressure plates. Tightening of the bolts shall cause the rubber sealing links to expand, resulting in a watertight seal between the pipe and sleeve opening. Unless noted otherwise, for applications exposed to groundwater and drinking water, the seal elements shall be EPDM; for exposure to wastewater and stormwater, the seal elements shall ne Nitrile; and for exposure to operating temperatures above 120 degrees F, such as on air piping, the seal elements shall be Silicone rubber. The installed closure shall provide electrical isolation of the pipe from the sleeve. Closures shall be sized according to manufacturer's instructions for the size of pipes shown on the Drawings. Annular mechanical seals shall be Link Seal by Thunderline Corporation, or equal.

4. It shall be the Contractor's sole responsibility to coordinate the pipe sleeve and the annular seal sizes.

2.08 PIPE SUPPORT BEARING PAD

A. Unless noted otherwise, each pipe saddle and anchor strap shall include a bearing pad of 1/16-inch thick red SBR or black neoprene rubber to cover 100% of the contact area between the pipe and the saddle or strap.

2.09 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron Pipe shall be manufactured by one of the following:

1. American Cast Iron Pipe Company.
2. U. S. Pipe and Foundry Company.
3. Griffin Pipe Company.
4. No substitutions will be allowed.

Ductile-Iron Fittings shall be manufactured by one of the following:

1. American Cast Iron Pipe Company.
2. U. S. Pipe and Foundry Company.
3. Griffin Pipe Company.
4. Star Pipe Company.
5. Sigma Corporation.
6. No substitutions will be allowed.

B. Pipe shall be centrifugally cast, Grade 60-42-10, iron, pipe barrels conforming to AWWA C151. Unless noted otherwise, pipe shall have standard thickness cement-mortar lining with seal coat in accordance with AWWA C104 with the exception of air service piping which shall be unlined. Pipe for buried installation shall have a bituminous coating applied to the pipe exterior. Pipe for interior installation shall have an epoxy prime coat on the pipe exterior as specified in Section 09960 - High-Performance Coatings.

1. Flanged pipe barrel thickness shall be in accordance with AWWA C115.
2. Grooved end pipe thickness shall be Class 53 minimum and grooved in accordance with AWWA C606. Rigid radius groove dimensions shall be utilized unless noted otherwise. Pipe ends shall be factory grooved.

3. Buried pipe class shall be as determined by AWWA C150 as a minimum and as follows:

   a. Unless noted otherwise, buried pipe 12-inch diameter and smaller shall be AWWA C151 Pressure Class 350.
   b. Buried pipe larger than 12-inch diameter shall be AWWA C151 Special Thickness Class 52.

C. Evidence of compliance with the ANSI/AWWA standards referenced in this specification shall be provided by an accredited independent third party inspection organization such as NSF International or approved equal.

D. Fittings shall be ductile iron and have standard thickness cement-mortar lining with seal coat in accordance with AWWA C104. Where taps are shown on fittings, tapping bosses shall be provided. Fittings for buried installation shall have a bituminous coating applied to the exterior surfaces and fittings for interior installation shall have an epoxy prime coat as specified in Section 09960 – High-Performance Coatings. A fusion bonded epoxy coating on the interior and exterior surfaces that conforms to AWWA C116 is acceptable in lieu of cement mortar lining and bituminous exterior coating for fittings provided for buried service.

   1. Flanged fittings shall conform to AWWA C110. Flanges shall be flat faced and drilled in accordance with Class 125 ANSI B16.1.
   2. Push-On and Restrained Push-On fittings shall conform to AWWA C110 or AWWA C153.
   3. Mechanical Joint and Restrained Mechanical Joint fittings shall conform to AWWA C110 or AWWA C153.
   4. Boltless Restrained Joint fittings shall conform to applicable sections of AWWA C110 or AWWA C153. Restrained joint fittings shall be a boltless-type joint and capable deflection after assembly. Restrained joint fittings shall be TR Flex, as manufactured by U. S. Pipe and Foundry Company; Flex-Ring, as manufactured by American Cast Iron Pipe Company; or Snap-Lok, as manufactured by Griffin Pipe Products Company.
   5. Grooved End fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12. Fittings conform to ANSI A21.10/AWWA C-110 for center-to-end dimensions. Grooved ends shall conform to AWWA C606.

E. Flanged pipe joints shall conform to AWWA C111 and AWWA C115 for threaded, ductile iron flanges.

F. Push-On pipe joints shall conform to AWWA C111. Push-on joints shall be:

   1. Tyton Joint complete with Tyton gasket and lubricant supplied by pipe manufacturer.
   2. Fastite Joint complete with Fastite gasket and lubricant supplied by pipe manufacturer.

G. Restrained Push-On pipe joints shall conform to AWWA C111. Push-on joints shall be:

1. Tyton Joint complete with Field-lok gasket and lubricant supplied by pipe manufacturer.
2. Fastite Joint complete with Fast-Grip gasket and lubricant supplied by pipe manufacturer.

H. Mechanical Joints shall conform to AWWA C111. Glands 24-inches and larger may be segmented at the manufacturer's option. Mechanical joints shall use a low alloy steel or ductile iron follower gland except where a restrained mechanical joint is required or indicated on the Drawings.

I. Restrained Mechanical Joints shall conform to AWWA C111. Restraint of mechanical joints shall be incorporated into the follower gland and shall include a mechanism to impart multiple wedging action that increases with increasing pipe pressure. Follower glands with restraining mechanisms shall be manufactured of ductile iron conforming to ASTM A536, shall conform to and shall be compatible with dimensions of mechanical joints conforming to AWWA C111 and AWWA C153, shall have a working pressure of 250 psig, and shall have a minimum design safety factory of 2:1. The mechanical joint follower gland with restraint mechanism shall be Series 1100 MegaLug as manufactured by EBAA Iron, Inc.; Uni-Flange Series 1400 as manufactured by Ford Meter Box Company; Stargrip Series 3000 as manufactured by Star Pipe Products; or RomaGrip as manufactured by Romac Industries, Inc.

J. Boltless Restrained Joints shall conform to applicable sections of AWWA C111, shall be a boltless-type joint that is capable deflection after assembly. Restrained joints shall be one of the following:

1. Flex-Ring bell-ends and factory spigot-ends or Flex-Ring bell-ends and Field Flex Rings for field-cut pipe-ends, as manufactured by American Cast Iron Pipe Company.
2. TR Flex bell-ends and factory spigot-ends or TR Flex bell-ends and TR Flex Gripper Rings for field-cut pipe-ends, as manufactured by United States Pipe and Foundry Company.
3. SNAP-LOK – Tyton bell-ends and factory spigot-ends for 6-inch through 24-inch diameter piping. SNAP-LOK – Fastite bell-ends and factory spigot-ends for 30-inch through 48-inch diameter piping. SNAP-LOK FC – Tyton for 6-inch through 24-inch diameter field-cut pipe.

K. Grooved Joint Couplings shall be manufactured in two or more segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, FlushSeal® type, grade to suit the intended service, conforming to ASTM D2000. Mechanical coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to physical properties of ASTM A-183, minimum tensile strength 110,000 psi (758450kPa) as provided standard by Victaulic.

1. Standard Couplings: Designed for use with AWWA sized rigid-radius or flexible radius grooved pipe and fittings, Victaulic Style 31.
2. Transition Couplings: For transition between IPS steel and AWWA ductile iron sized pipe. Housing cast with offsetting, angle-pattern, bolt pads, Victaulic Style 307.

3. Flange Adapters: For use with AWWA grooved end pipe and fittings, for mating to ANSI Class 125 flanged components, Victaulic Style 341.

L. Flanged Joint Bolting: Provide carbon steel, finished, hot-dipped galvanized, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A heavy hex head nuts for flanged joints. Flange bolting shall conform to AWWA C111, including Appendix C, and the length and diameter of nuts, bolts and studs shall conform to the dimensions given in AWWA C115.

M. Mechanical Joint Bolting: Provide anti-rotation, high-strength, low-alloy (Cor-Ten) T-bolts with ASTM A563, Grade A heavy hex head nuts. Bolting shall conform to AWWA C111, including Appendix A.

N. Unless noted otherwise, gaskets for flanged joints shall be 1/8-inch thick, Styrene-Butadiene (SBR) synthetic rubber conforming to AWWA C111, ASTM D-1330 Grade II, and ASTM D-2000 Type AA with Durometer Hardness of 75 Shore A ±5 and air-service piping shall include EPDM gaskets. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in the intended service. Gaskets shall be ring-type for 14-inch and larger pipe diameters and full-face type for smaller sizes with nominal inside diameter, outside diameter, and bolt holes as shown in Appendix A of AWWA C115. SBR Gasket material shall be Garlock Sealing Technologies Style 22, Allstate Gasket, Inc. - Style 1154, Biltrite Corporation Style 20, or equal. Specially designed gaskets with one or more annular rings in the gasket to improve joint performance and supplied by the pipe manufacturer may be substituted with approval from the Engineer.

O. Unless noted otherwise, gaskets for push-on, restrained push-on, mechanical, restrained mechanical, and boltless restrained joints shall be SBR, styrene butadiene rubber, conforming to AWWA C111; air service gaskets shall be EPDM. Where contaminated soil is encountered, elastomers that are compatible with and chemically resistant to the soil contaminants shall be provided. Gaskets for restrained push-on joints shall have stainless steel wedging elements manufactured as part of the gasket.

P. Gaskets shall be manufactured or supplied by the specified pipe and fitting manufacturers.

Q. Lubricant for piping shall be the pipe manufacturer's standard only, no substitutes will be permitted.

2.10 MILL TYPE STEEL PIPE AND FITTINGS

A. Pipe shall be black carbon steel meeting the requirements of ASTM A53, Grade B seamless or electric resistance welded.

B. Unless noted otherwise pipe wall thickness for non-pressure service shall be as follows:

1. 4-Inch through 6-Inch: Schedule 40.
2. 8-Inch through 12-Inch: Schedule 20.
3. 14-Inch through 24-Inch: 1/4-inch.

C. 4-inch through 24-inch fittings shall be Butt-Welding Type, Carbon steel, to match pipe wall thickness, ASTM A234, Grade WPB, meeting the requirements of ANSI B16.9.

D. Branch connections, 4-Inch and Larger shall be:

1. Straight or reducing tees.
2. Standard weight forged steel, ASTM A105, Grade II, commercial welding branch fittings with butt-welding outlet.
3. Use tee for branch outlet full size of run or one size reduced.

E. Flanges shall be forged steel, hub type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Hub flanges or Steel-ring, plate type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Ring flanges. All steel-ring, plate type flanges shall be fabricated with an inside diameter not greater than 1/8-inch larger than the associated pipe outside diameter.

F. Provide carbon steel, finished, hot-dipped galvanized, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A heavy hex head nuts for AWWA Class D flanges and carbon steel, finished, hot-dipped galvanized, ASTM A193, Grade B7 hex head bolts and ASTM A194, Grade 2H heavy hex head nuts for AWWA Class E flanges.

G. Provide 1/8-inch thick gaskets, conforming to ANSI/AWWA C207 for rubber gaskets, for flanged joints unless otherwise specified. Provide flat-faced gaskets between flat-faced flanges and ring gaskets for mating to a raised-face flange.

H. Covered welding electrodes shall be as specified in the welding procedure and welding rod and bare electrodes shall be as specified in this Section.

2.11 FABRICATED WELDED STEEL PIPE AND FITTINGS

A. Pipe shall be Carbon steel, black, electric fusion welded from ASTM A283, Grade C, or ASTM A570, Grade C plate, straight seamed, 1/4-inch thick minimum, unless otherwise indicated in the Piping Schedules shown on the Drawings. Pipe shall be designed and fabricated in accordance with the requirements of AWWA C200 and the ASTM standards referenced therein. Pipe sizes shown in these Documents shall be for nominal outside diameter, unless otherwise noted, and shall conform to the requirements of ANSI B36.10.

B. Joints shall be butt-welded or flanged, as specified herein.

C. Fittings shall be butt-welding-type, carbon steel, to match pipe wall thickness, fabricated from the pipe material in accordance with the dimensions shown in AWWA C208 as four or five-piece fittings. Tees, reducing tees, or laterals shall be as specified in this Section.

D. Flanges shall be:

a. Forged steel, hub type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Hub flanges.

b. Steel-ring, plate type flanges, conforming to ANSI/AWWA C207 for Class D and E Standard Steel-Ring flanges. All steel-ring, plate type flanges shall be fabricated with an inside diameter not greater than 1/8-inch larger than the associated pipe outside diameter.

E. Provide carbon steel, finished, hot-dipped galvanized, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A heavy hex head nuts for AWWA Class D flanges and carbon steel, finished, hot-dipped galvanized, ASTM A193, Grade B7 hex head bolts and ASTM A194, Grade 2H heavy hex head nuts for AWWA Class E flanges.

F. Provide 1/8-inch thick gaskets, conforming to ANSI/AWWA C207 for rubber gaskets, for flanged joints unless otherwise specified. Provide flat-faced gaskets between flat-faced flanges and ring gaskets for mating to a raised-face flange.

G. Covered welding electrodes shall be as specified in the welding procedure and welding rod and bare electrodes shall be as specified in this Section.

2.12 STAINLESS STEEL PIPE AND FITTINGS

A. Stainless steel pipe shall conform to ASTM A312/A312M. Unless notes otherwise in the Drawings or Piping Schedule, pipe shall be Schedule 40S 304/304L.

B. Threaded joints in stainless steel piping, four-inch and smaller, shall conform to ANSI B1.20.1 and be sealed with PTFE tape or non-hardening compound that is NSF 61 listed and compatible with the intended service conditions. Thread seal tape shall meet MIL spec T-27730A-rated and be TT50 260P Pink Plumbers Teflon Thread Seal Tape manufactured by Seal Fast, Inc., or equal. Joint compound shall meet Federal Spec.TT-S-1732 and be Real-Tuff manufactured by Hercules Chemical Company, Inc., or equal for water and compatible chemical service. Threaded joints are designated as “screwed”, “SCR”, or “NPT” in the Drawings and Piping Schedule.

C. Threaded stainless steel fittings, four-inch and smaller, shall be cast and conform to MSS SP-114 and the dimensions in ANSI B16.3. Unless noted otherwise in the Drawings or Piping Schedule, threaded fittings shall be Class 150 304/304L.

D. Welded stainless steel fittings shall be wrought and conform to ASTM A-403 and ASME B 16.9. Unless noted otherwise in the Drawings or Piping Schedule, fittings shall be Schedule 40S 304/304L.

2.13 GALVANIZED STEEL PIPE AND MALLEABLE IRON FITTINGS

A. Galvanized pipe shall conform to ASTM A53/A53M for Hot-Dip Galvanized, Type E, electric resistance welded, or Type S, seamless, Grade A or B. Unless noted otherwise in the Drawings or Piping Schedule, pipe shall be Schedule 80 for Carbon Dioxide service and Schedule 40 for other service.

B. Joints in galvanized piping, four-inch and smaller, shall be threaded conforming to ANSI B1.20.1 and sealed with PTFE tape or non-hardening compound that is NSF 61 listed and compatible with the intended service conditions. Thread seal tape shall meet MIL spec T-27730A-rated and be TT50 260P Pink Plumbers Teflon Thread Seal Tape manufactured by Seal Fast, Inc., or equal. Joint compound shall meet

Federal Spec.TT-S-1732 and be Real-Tuff manufactured by Hercules Chemical Company, Inc., or equal for water and compatible chemical service.

C. Galvanized fittings, four-inch and smaller, shall conform to ANSI/ASTM A16.3 with galvanizing conforming to ASTM A153. Unless notes otherwise in the Drawings or Piping Schedule, fittings shall be Class 300 for Carbon Dioxide service and Class 150 for other service.

D. Galvanized plugs, bushings, and locknuts, four-inch and smaller, shall conform to ANSI/ASTM A16.14 with galvanizing conforming to ASTM A153.

E. Galvanized unions, four-inch and smaller, shall conform to ANSI/ASTM A16.39 with galvanizing conforming to ASTM A153. Unless notes otherwise in the Drawings or Piping Schedule, unions shall be brass to iron seat Class 300 for Carbon Dioxide service and Class 150 for other service.

2.14 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

A. Pipe and fittings shall be the product of one of the following manufacturers:

1. Chevron Phillips Chemical Company – Plano, TX.
2. ISCO Industries .

B. The HDPE pipe shall be manufactured in a plant capable of providing continuous quality control through inspection. The facility shall have the necessary testing equipment to verify that the pipe meets the requirements of AWWA C901 or C906, NSF Standard #61 and ASTM standards.

C. The HDPE fittings manufacturer's facility shall have the necessary testing equipment to verify that the fittings meet the requirements of AWWA C901 for sizes 1/2" to 3" and AWWA C906 for sizes 4" through 54".

D. Polyethylene pipe and fittings shall be made from resin meeting the requirements of the Plastic Pipe Institute as PE 3408. The resin shall meet the requirements of ASTM D3350-02 with a cell classification of 345464C.

E. High-density polyethylene pipe and fittings can be supplied by different manufacturers as long as they meet the above ASTM D3350-02 cell classification.

F. Pipe 3 Inches and smaller shall have a manufacturing standard of ASTM D3035. Pipe shall be DR 17 (100 psi WPR) unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

G. Pipe 4 Inches and larger shall have a manufacturing standard of ASTM F-714. Pipe O.D. sizes 4" to 24" shall be available in both steel pipe sizes (IPS) and ductile iron pipe sizes (DIPs). Pipe O.D. sizes 26" to 54" shall be available in steel pipe sizes (IPS). Pipe shall be DR 17 (100 psi WPR) unless otherwise specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw

material. All pipes shall be suitable for use as pressure conduits, listed as NSF 61 and per AWWA C906 Pressure Class (PC) 100 have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe. Peak flow water velocity of 5 ft/sec shall be used in the hydraulics engineering design.

H. HDPE butt fusion fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02, and approved for AWWA use. Butt fusion fittings shall have a manufacturing standard of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.

2.15 POLYVINYL CHLORIDE (PVC) SCHEDULE PIPE AND FITTINGS

A. PVC Schedule pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454-B (Type 1, Grade 1 PVC 1120) as identified in ASTM D 1784.

1. PVC Schedule 80 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785.
2. PVC Schedule 80 fittings shall conform to ASTM D 2467.
3. PVC Schedule 80 threaded fittings shall conform to ASTM D 2464.
4. PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785.
5. PVC Schedule 40 fittings shall conform to ASTM D 2466.
6. Unions and flanges meet the requirements of ASTM F 1970 with gasket that is compatible with intended service.
7. Solvent cement and primer shall conform to ASTM D 2564 and shall be as recommended by the pipe and fitting manufacturer. Cement shall be listed by manufacturer for compatibility with specific chemical service. Cement for chemical piping systems shall be IPS Weld-On CPVC 724 or Ipex Zirtec 24 CPVC cement or shall be listed by manufacturer for compatibility with specific chemical service.
8. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer.
9. All pipe and fittings shall be manufactured in the United States.
10. Pipe and fittings shall conform to NSF Standard 61 and NSF Standard 14.

B. Unless noted otherwise, provide solvent-cement joints, except where connecting to valves and equipment with flanged or threaded connections that may require future disassembly.

C. Flanges shall be flat faced, compatible with ANSI 125-pound drilling, and the same Schedule as the adjacent piping, unless noted otherwise. Flange gaskets shall be full-faced, 1/8-inch thick, material suitable for the intended service. Chemical service gaskets shall be 100% expanded PTFE. When mating flange has raised face, use flat ring gasket and provide filler gasket between OD of raised face and flange OD to protect PVC flange from bolting moment. Provide

flange bolting of Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts. Provide bolts and nuts with washers on each side, of the same material as the bolts and nuts.

D. Threaded joints shall be sealed with PTFE tape or non-hardening compound that is NSF 61 listed and compatible with the intended service conditions. Thread seal tape shall meet MIL spec T-27730A-rated and be TT50 260P Pink Plumbers Teflon Thread Seal Tape manufactured by Seal Fast, Inc., or equal. Joint compound shall meet Federal Spec.TT-S-1732 and be Real-Tuff manufactured by Hercules Chemical Company, Inc., or equal for water and compatible chemical service.

2.16 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE AND FITTINGS

A. Pipe and fittings shall be manufactured from virgin rigid CPVC (chlorinated polyvinyl chloride) vinyl compounds with a Cell Class of 23447-B (Type IV, Grade 1) as identified in ASTM D 1784.

1. CPVC Schedule 80 pipe shall be Iron Pipe Size (IPS) conforming to ASTM F 441.
2. CPVC Schedule 80 fittings shall conform to ASTM F 439.
3. CPVC Schedule 80 threaded fittings shall conform to ASTM F 437.
4. CPVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM F 441.
5. Unions and flanges meet the requirements of ASTM F 1970 with gasket that is compatible with intended service.
6. Solvent cement and primer shall conform to ASTM F 493 and shall be as recommended by the pipe and fitting manufacturer. Cement shall be listed by manufacturer for compatibility with specific chemical service. Cement for chemical piping systems shall be IPS Weld-On CPVC 724 or Ipex Zirtec 24 CPVC cement or shall be listed by manufacturer for compatibility with specific chemical service.
7. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer.
8. All pipe and fittings shall be manufactured in the United States.
9. Pipe and fittings shall conform to NSF Standard 61 and NSF Standard 14.

B. Provide solvent-cement joints, except where connecting to unions, valves, and equipment with flanged or threaded connections that may require future disassembly and where noted otherwise.

C. Flanges shall be flat faced, compatible with ANSI 125-pound drilling, and the same Schedule as the adjacent piping, unless noted otherwise. Flange gaskets shall be full-faced, 1/8-inch thick, material suitable for the intended service. Chemical service gaskets shall be 100% expanded PTFE. When mating flange has raised face, use flat ring gasket and provide filler gasket between OD of raised face and flange OD to protect CPVC flange from bolting moment. Provide flange bolting of Type 316 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts. Provide bolts and nuts with washers on each side, of the same material as the bolts and nuts.

D. Threaded joints shall be sealed with PTFE tape or non-hardening compound that is NSF 61 listed and compatible with the intended service conditions. Thread seal tape shall meet MIL spec T-27730A-rated and be TT50 260P Pink Plumbers Teflon Thread Seal Tape manufactured by Seal Fast, Inc., or equal. Joint compound shall meet Federal Spec.TT-S-1732 and be Real-Tuff manufactured by Hercules Chemical Company, Inc., or equal for water and compatible chemical service.

2.17 PVC DRAIN, WASTE, AND VENT (DWV) PIPE AND FITTINGS

A. Drain, waste and vent process pipe and fittings (indicated as DWV in the Piping Schedule or on Drawings) shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454-B as identified in ASTM D 1784.

1. PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785 and ASTM D 2665.
2. PVC DWV fittings shall conform to ASTM D 2665.
3. All pipe and fittings shall be manufactured in the United States.
4. Pipe and fittings shall conform to NSF Standard 14.

B. Piping shall be joined by solvent cement joints that shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564.

C. The installed piping shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds.

2.18 COPPER AND COPPER ALLOY PIPE AND FITTINGS

A. Tubing: Copper, seamless, ASTM B88, type and temper as follows:

1. Buried: Type K, annealed soft or hard, drawn, temper.
2. Exposed: Type K, hard, drawn, temper.

B. Fittings: Commercially pure wrought copper, socket joint, ASTM B75, dimensions conforming to ASME B16.22. Cast copper fittings shall conform to ASME B 16.18.

C. Solder: 95-5 wire solder (95 percent tin, 5 percent antimony), ASTM B32, Grade 95 TA. Cored solder is unacceptable.

2.19 SUMP PUMP DISCHARGE HOSE & FITTINGS

A. <u>Hose</u>: The sump pump discharge hose shall meet the following:

1. Model - Dayco Products, Series 7257.
2. Tube - Black EPDM.
3. Cover - Black EPDM.
4. Reinforcement - Multiple textile piles with helix wire.

5. Temperature Range - -30°F to 200°F.

B. Fittings: The sump pump discharge hose fittings shall meet the following:

1. Type: "Andrews" or "Boss-Lock" cam and groove couplers.
2. Material: Solid brass.

C. Hose Banding: Each hose end shall be secured to its fitting by a minimum of two (2) 3/8-inch wide by 0.025-inch thick type 316 stainless steel bands, installed with 316 stainless steel buckles.

2.20 FRP PIPING

A. FRP piping system shall conform to the respective specifications and standards and to the requirements specified herein. Pipe, fittings, and joint adhesives shall be supplied by the same manufacturer. Threaded fittings or mechanical couplings will not be permitted.

B. FRP pipe shall be manufactured by the filament winding process using an amine cured epoxy thermosetting resin. Pipe for acid or caustic service shall have a resin-rich corrosion barrier reinforced with surfacing veil. Pipe shall have tapered bell and spigot joints and pressure rating of 225 psig at 210 degrees F in accordance with ASTM D2996. Adhesive for joining pipe shall be manufacturers standard for the system specified.

C. Flange and fittings shall be manufactured using the same materials as the pipe. Flanges shall be flat face-type flanges with raised integral sealing rings inside and outside of bolt hole circle and ANSI B16.5 bolt patterns. Flanges shall comply with ASTM D4024. Fittings shall comply with ASTM D5685.

D. Gaskets shall be 1/8 inch full face, 60-70 durometer, Buna-N rubber for clean water service, nitrile for wastewater service, and as shown on the Drawings or pipe schedule or recommended by manufacturer for the service.

E. Flange bolting shall be stainless steel bolts, nuts, and washers.

F. Unless noted otherwise, FRP pipe and fittings shall be NOV Fiber Glass Systems Red Thread II for general service and Green Thread for acid and caustic service.

2.21 FABRICATED STAINLESS STEEL PIPING FOR AIR

A. Fabricated stainless steel piping shall be manufactured by Felker Brothers Corporation or Bristol Piping Systems.

B. Piping materials shall be in accordance with ANSI B36.19.

1. Pipe shall be stainless steel, conforming to ASTM A312 for Schedule 10S, AISI 304L alloy for air service, and AISI 316L alloy for digester gas.
2. Fittings shall be wrought stainless steel, ASTM A403, AISI 304L alloy for air service, and AISI 316L alloy for digester gas, and comply with ANSI B16.9 for dimensions. Fittings for digester gas service shall be provided with flange joint ends.

3. Joints shall be butt weld except where screw or flanged joints are required adjacent to valves or equipment and at all fittings for digester gas piping.

4. Flange Joints:

   a. Flanges for air piping shall be Van Stone style, 304L SS, slip-on type with rolled-angle face rings and back up flanges. Flanges shall be welding neck or slip-on, raised face, in accordance with ASTM A182, F316L, and ANSI B16.5 for dimensions.
   b. Flanges for digester gas piping shall be AISI 316L alloy, welding neck or slip-on type with raised face conforming to ASTM A182 and MSS SP51 for Class 150LB flanges with bolt hole and circles in accordance with ASME B16.5 dimensions.
   c. Flat face flanges shall be provided to mate to flat face flanges at valves, equipment, etc.
   d. Flanges with butt-welded ends shall be in accordance with ANSI B36.19 for wall thickness, ANSI B16.5 for dimensions, and ANSI B16.25 for beveled edges.
   e. The finish for gasket contact faces of flanges shall be in accordance with ANSI B16.5.
   f. Flange bolting shall conform to ASTM A193.

   g. Gaskets for air piping shall be full face gasket complying with ANSI B16.21 for non-asbestos hypalon, viton, or Teflon bonded EPDM gasket.
   h. Gaskets for digester gas piping shall be G-10 glass-epoxy-laminated, 316 stainless steel core with spring-energized PTFE seal, providing electrical isolation, and rated for sour gas service. Digester gas piping gaskets shall be LineSeal Type E for flat-face flanges and Type F for raised-face flanges, or equal.

5. Dielectric flange isolation shall be provided at all flange joints between dissimilar metals. Dielectric isolation shall include two G-10 glass epoxy washers and full-length G-10 glass epoxy sleeves at each flange bolt and nut. Isolation washers and sleeves shall be manufactured by LineSeal, Pipeline Seal and Insulator, or equal.

6. Fabricate all welded parts and assemblies from sheets and plates of stainless steel, AISI 304L alloy for air service and AISI 316L alloy for digester gas service, with a 2D finish conforming to ASTM A240.

7. Fabricate non-welded parts and pieces from sheets and plates of stainless steel, AISI 304L alloy for air service, and AISI 316L alloy for digester gas service, conforming to ASTM A240 or ASTM A276.

8. Fabricate all pipe products in accordance with ASTM A-778 and all fittings in accordance with ASTM A-774, latest edition with dimensional tolerances conforming to ASTM A554.

9. The maximum heat treatment temperature for the straight grades and “L” grades of austenitic stainless steel pipe shall be 2050 degrees F.

C. Welding

1. All surfaces to be welded shall be cleaned to remove oils, grease and other contaminants prior to welding.
2. All fabricator welding shall be metal inert gas (MIG), tungsten arc welding (TIG) or plasma-arc welding inert gas processes.
3. Filler metal shall be of matching composition ER316L and argon or argon-helium gas mixtures shall be used for the root weld and coverage gases.
4. The weld joint shall be beveled, with a land no greater than 0.062". The joint shall be tack welded using gas TIG along with appropriate protective inert coverage gases.
5. All root pass welds shall be made using the TIG process. Completion of the weld can be made by TIG or the MIG welding process. Inert gas root purge should be maintained for the completion of the weld joint.
6. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of joint.
7. Interior weld beads shall be smooth, evenly distributed with an interior projection not exceeding 1/16" beyond the I.D. of the pipe or fittings.
8. Continuously weld both sides of face rings and flanges.
9. All welders or welder operators shall be certified to meet the requirements of this specification. This shall include all position welding capability, using string bead TIG welding techniques.
10. Welders shall be experienced in the weld fabrication of stainless steel pipe and shall be required to show proof of experience.
11. Welder certification shall be in accordance with ASME Code Section IX. Welder certifications shall be provided by the fabricator when they make their shop drawing submittal.

D. Corrosion Protection and Finishing

1. Procedure:

    a. Pre-clean all outside weld areas to remove weld splatter with the use of stainless steel brushes and/or deburring and finishing grinding wheels.
    b. Finish clean to remove all carbon deposits, light oxide films and similar contaminants by full immersion pickling and rinsing, to aid the regeneration of a uniform corrosion resistant chromium oxide film as follows:
    c. Completely immerse all stainless steel assemblies and components in an acid solution as described in Section 6.2.11 of ASTM A380-88. The acid shall be a nitric-hydrofluoric solution as defined in Table A.2.1 of Annex A2 of ASTM A380.
    d. Provide a final thorough rinse using ordinary industrial or potable water and dry in conformance per Section 8.3 of ASTM A380.

2. Corrosion protection techniques not using full immersion methods will not be acceptable.

3. At least two weeks prior to cleaning the piping system the Manufacturer shall notify the Owner/Engineer of the schedule so that the Owner/Engineer can observe the procedure, if desired. If full immersion pickling is not observed by the Owner/Engineer, the Manufacturer shall verify that cleaning has been performed per the above specifications. Non-properly cleaned piping will be cause for rejection of the system.
4. Flange bolting shall be coarse-thread, 18-8 series stainless steel bolts, studs, and nuts with 18-8 washers at each nut.

PART 3 EXECUTION

3.01 PIPE PREPARATION AND HANDLING

A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. The interior and exterior protective coating shall be inspected, and all damaged areas repaired in Accordance with Division 9, Section 09960 – High-Performance Coatings. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

B. Use proper implements, tools, and facilities for the safe and proper protection of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage to the pipe and coatings. Do not drop or dump pipe into trenches under any circumstances.

D. Cut copper pipe square and remove burrs. Clean both inside of copper fittings and outside of pipe before sweating. Take care to prevent annealing of fittings and hard-drawn tubing when making connections.

E. Bends in soft temper copper pipe shall be long sweep, wherever possible. Bends shall be shaped with bending tools and shall be made without appreciable flattening, buckling, or thinning of the tube wall at any point.

3.02 EXISTING CONDITIONS

A. The Drawings indicate the general arrangement and location of structures, supports, piping, ducts, and equipment. Should it be necessary to deviate from arrangements or location indicated in order to meet existing conditions or site conditions, or due to interference with other work, make such deviations as offsets, rises and drops in piping that may be necessary, whether shown or not, without a change in Contract Price or Time. Extreme accuracy of the data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for the assistance and guidance of this Section and exact locations, distances, and elevations shall be governed by actual site conditions.

B. Where cutting-in and joining to existing piping is required, Contractor shall coordinate the actual dimensions of existing piping layout and components with the new work.

1. Cut ends of pipe shall be square, beveled and deburred. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Dress cut ends of pipe in accordance with the type of joint to be made.
2. Mating, gasket, and sealing surfaces of existing flanges, grooves, threads, and pipe ends shall be cleaned of all loose and adherent dirt, debris, grease, joint compound, gasket material, rust, paint, and other deleterious material that could interfere with the integrity of the joint.
3. Piping components, pipe linings, and coatings damaged by Contractors operations shall be restored to their condition prior to the Work.
4. Temporary caps and blind flanges and all couplings and connections to existing piping shall be rated for the full test pressure of the pipe and be installed drip tight.
5. Unless noted otherwise, temporary caps and all couplings and connections to existing piping shall include thrust restraint to accommodate the full test pressure of the piping system.

3.03 INSTALLATION OF BURIED PIPING

A. Buried piping below structures shall be installed as required for buried plant piping in Section 02500 subject to the following additional requirements.

B. For excavation below and within 5 feet of structures refer to Division 2 specifications and Structural Drawings for this Contract. Provide excavation to accommodate installation of piping with trench bottom for bedding as specified below to support pipe barrels at required line and grade.

C. Bedding and Backfilling shall comply with the requirements of Division 2 specifications and Structural Drawings for this Contract and the following additional requirements.

1. Foundation, Haunching, Initial Backfill and Final Backfill Material in pipe excavation and trench areas below structures and buildings shall be CLSM as defined in Specification Section 03001.
2. Backfill with flowable fill for the full width of the trench from trench bottom to the bottom of footing for pipes under footings, to the bottom of compacted granular material for pipes under floor slabs and other structures.
3. Pipe and fittings in contact with flowable fill shall be encased in polyethylene in accordance with AWWA C105. Flowable fill shall not be allowed to obstruct the bell face or bolting of any pipe or fitting.

D. Provide cast-in-place concrete thrust blocking all crosses, tees, bends, plugs, fire hydrants and valves against undisturbed earth as detailed in the drawings. Backfill thrust blocks a minimum of 24 hours after placement. Thrust blocks or misplaced concrete shall not contact the bell face or fasteners of any pipe, fitting, or valve.

3.04 INSTALLATION OF EXPOSED PIPING

A. Unless shown otherwise, piping shall be parallel to building lines. Hangers on adjacent piping shall be aligned where possible on common size ranges.

B. All pipe flanges shall be set level, plumb, and aligned. All flanged fittings shall be true and perpendicular to the axis of the pipe. All bolt holes in flanges shall straddle vertical centerline of pipes.

C. Unions shall be installed where required for piping or equipment installation, even though they are not shown on the Drawings. Unless noted otherwise, install dielectric union or dielectric flange at each transition from copper to iron and copper to steel piping material.

D. Pipe taps to the pipe barrel are acceptable only where specifically indicated on the Drawings. Unless noted otherwise, pipe tap connections shall only be made at a tapping boss of a fitting, valve body, or equipment casting and pipe tap connections to steel piping shall be made only with a welded thread-o-let connection.

E. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

F. Unless noted otherwise, straight runs of piping equal to ten pipe diameters upstream and five pipe diameters downstream of flow measuring devices shall be smooth and unobstructed.

3.05 EXPANSION PROVISIONS

A. No pipe support or hanger, no floor, wall, or ceiling penetration, no equipment, valve, pump, or gate connection, and no combination of any of these shall be installed so as to restrict the thermal expansion of contraction of piping systems. Contractor shall provide specified expansion provisions to accommodate thermal deflections.

3.06 VENTS AND DRAINS

A. Vent the high points and drain the low points of all pipelines, except gravity flow services, whether shown on the Drawings or not, with 3/4-inch ball valves on those pipelines 2-1/2-inch and larger and 1/2-inch ball valves on those pipelines 2-inch and smaller. Similarly, each high point of those pipelines running through stepped galleries shall be vented through a ball valve to the gallery floor scupper, whether shown or not.

3.07 WALL PIPES AND PIPE SLEEVES

A. Wall pipes and pipe sleeves embedded in concrete roofs, walls, floors, and slabs shall be embedded as specified in Division 3 – Concrete, and as shown on the drawings. Primary support for all pipes, fittings, and castings embedded in concrete roofs, walls, floors, and slabs shall be by the formwork. The reinforcing steel shall provide secondary support if needed. Adequate measures for the precise alignment and rigid support of wall castings during concrete construction shall be Contractor's sole responsibility.

3.08 INSTALLATION OF FLEXIBLE COUPLINGS, FLANGED COUPLING ADAPTERS, AND SERVICE SADDLES

A. Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean surface for the gasket. Care shall be taken that the gaskets are wiped clean

before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used for bolt tightening.

3.09 FLANGE BOLTING

A. Inspect and prepare the mating surfaces of the flanges for a clean and proper surface finish.

B. Place the gasket centered on the flange. Ensure that it is not displaced, pinched or otherwise damaged during joint assembly.

C. Lubricate threaded fasteners prior to assembly with lubricant approved by the gasket and piping manufacturers. Use anti-gall lubricant for stainless steel bolting such as Fastorq AG.

D. Fully support piping at correct elevation and alignment prior to tightening flange bolting.

E. Run the fasteners down by hand or low-speed, low-torque power tool. Replace defective fasteners that do not hand tighten.

F. Tighten bolting in a uniform, star pattern. Torque bolting as recommended by gasket and piping manufacturers.

G. Install studs to full depth thread engagement in tapped holes. Provide studs and bolts to extend through entire thread depth of nuts in final assembly.

3.10 TESTING

A. General: Conduct pressure and leakage tests on all newly installed pipelines. Furnish all necessary equipment and material and make all connections to the pipe, as required. The Engineer will monitor the tests. Test pressures and type of test shall be as specified in the Piping Schedule shown on the Drawings.

B. Testing New Pipe Which Connects to Existing Pipe: New pipelines which are to be connected to existing pipelines shall be tested by isolating the new pipe with special valves or blind flanges as necessary.

C. Preparation and Execution:

1. Buried Pressure Piping: Conduct pressure and leakage tests in accordance with AWWA C-600, Hydrostatic Testing. Test pressures shall be as indicated on Pipe Schedule in Drawings. Buried pressure piping under structures shall be tested prior to backfilling and shall be “leak tight”. No drop in pressure and no testing allowance is acceptable for buried piping under structures.
2. Exposed Pressure Piping: Conduct the tests on exposed piping after the piping has been completely installed, including all supports, hangers, and anchors, but prior to insulation. All exposed pressure pipe shall be leak tight with no pressure drop at the specified pressure.

D. Hydrostatic Leak Tests:

1. Equipment: Furnish any and all equipment required for successful completion of the hydrostatic tests. Provide any and all plugs, taps, connections, caps, valves, bracing, support, etc. necessary for successful performance and completion of hydrostatic tests.
2. Procedure: Water shall be used as the hydrostatic test fluid unless otherwise specified. Test water shall be potable water or clean water of such quality as to minimize contamination and corrosion of the materials in the piping system. Vents at all high points of the piping system shall be opened to purge air pockets while the piping system is filling. Venting during the filling of the system also may be provided by the loosening of flanges having a minimum of four bolts or by the use of equipment vents. All parts of the piping system shall be subjected to the test pressure specified in the Piping Schedule or shown on the Drawings.
3. Gravity piping shall be tested with 10 feet of water to include the highest horizontal vent in the filled piping. Where vertical drain and vent systems exceed 10 feet in height, the systems shall be tested in 10 vertical foot sections as the piping is installed. Refer to Sections 15050 and 15100 for testing of building sewer and drains.
4. The hydrostatic test pressure shall be continuously maintained for a minimum time of 30 minutes and for such additional time as may be necessary to conduct examinations for leakage. Examination for leakage shall be made at all joints and connections. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected at the Contractor's sole expense.
5. Buried Gravity Process Piping Lines: Conduct pressure and leakage tests in accordance with pressurized watermain testing requirements of AWWA C-600. Test pressures shall be as listed in the Pipe Schedule. Buried gravity piping under structures shall be tested prior to backfilling and shall be “leak tight”. No drop in pressure and no testing allowance is acceptable for buried gravity process piping.

E. Test Records: Records shall be made of each piping system installation during the test and recorded on the form provided in the contract documents (Document 00685 – Pipe Line Pressure Testing Record). These records shall include but not limited to the following:

1. Date of test.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, to include such items as:

    a. Leaks (type, location).
    b. Repairs made on leaks.

6. Certification by Contractor and signed acknowledgement by Engineer.

3.11 INTERIM CLEANING

A. Care shall be exercised during fabrication to prevent the accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, etc. within pipe sections. All piping shall be examined to assure removal of these and other foreign objects prior to assembly. Shop cleaning may employ any conventional commercial cleaning method if it does not corrode, deform, swell, or otherwise alter the physical properties of the material being cleaned.

3.12 FINAL CLEANING

A. Following assembly and testing and prior to final acceptance, all pipelines installed under this section, except plant process air lines and instrument air lines, shall be flushed with water and all accumulated construction debris and other foreign matter removed. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the Engineer. Accumulated debris shall be removed through drains 2-inch and larger or by removing spools and valves.

3.13 CORROSION PROTECTION OF ATMOSPHERIC EXPOSED ACCESSORIES

A. All atmospheric exposed surfaces of black and hot-dip galvanized steel, brass, copper and bronze piping components including, but not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves and fasteners shall be painted in accordance with the coatings schedule and Division 9, Section 09960, High-Performance Coatings whether specifically listed or not.

3.14 CORROSION PROTECTION FOR CARBON STEEL PIPE

A. All surfaces, interior and exterior, shall be painted in accordance with the coatings schedule and Division 9, Section 09960 – High-Performance Coatings whether specifically listed or not.

3.15 PIPE PAINTING AND COLOR CODING

A. Painting of piping systems shall be as specified in Division 9, Section 09960 – High-Performance Coatings, and in accordance with the Piping Schedule shown on the Drawings. Paint systems specified shall be applied to piping prior to insulating. Identification and color coding shall be applied to the exterior covering of insulated piping.

3.16 DISINFECTION – REFER TO SECTION 02515

3.17 INSTALLATION OF DUCTILE-IRON PIPE

A. Care shall be taken not to damage the cement lining when handling the pipe. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut. Dress cut ends of pipe in accordance with the type of joint to be made. Dress cut ends of push-on joint pipe by beveling, as recommended by the pipe manufacturer. Dress cut ends of pipe for flexible couplings and flanged coupling adapters as recommended by the coupling or adapter manufacturer.

B. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the jobsite with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

C. Flanged pipe joint assembly shall conform to AWWA C111, Appendix C. Prior to connecting flanged pipe, the faces of the flanges shall be thoroughly cleaned of all oil, grease, and foreign material. The rubber gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to assure proper seating of the flange gasket.

D. Push-On and Restrained Push-on pipe joint assembly shall conform to AWWA C111, Appendix B. Join pipe in accordance with the manufacturer's written instructions and recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted.

E. Mechanical and Restrained Mechanical joint assembly shall conform to AWWA C111, Appendix A. Join pipe in accordance with the manufacturer's written instructions and recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted. Torque-limiting wrenches shall be used to ensure uniform bolt tightening.

F. Restrained Joint: Assemble pipe joints in accordance with the manufacturer’s written instructions and recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted.

G. Grooved Joint: Pipe ends shall be clean and free from indentations and projections, in the area from pipe end to groove. All grooved components shall be of one manufacturer. The gasket style and elastomeric material shall be verified as suitable for the intended service as specified. Install per manufacturer’s recommended practices.

H. Field gauge barrel of cut end of pipe. Do not install pipe with ends that exceed dimensional tolerances provided in AWWA C151

I. Clean bell socket immediately prior to insertion of gasket and/or pipe end. Lubricate gasket and plain end of pipe with pipe lubricant that conforms to contract documents prior to assembly of push-on, restrained, and mechanical joints. Apply lubricant to clean surfaces only. If pipe end becomes contaminated with foreign material prior to joint assembly, clean and re-lubricate pipe end prior to proceeding with joint assembly. If bell socket and/or gasket becomes contaminated with foreign material prior to joint assembly, remove gasket, clean and re-lubricate gasket and bell socket, re-lubricate gasket, and replace gasket in bell socket prior to proceeding with joint assembly.

J. Place timber header between the jacking or pushing device and pipe bell or pipe end when pushing pipe into joint.

K. Make any required deflection in mechanical joints after hand tightening gland bolting but prior to tightening the bolting to normal bolt torque. Tighten mechanical joint gland bolting uniformly to normal bolt torque while maintaining a uniform clearance between the gland and the face of the bell. Normal bolt torque for mechanical joint bolting is the torque listed in AWWA C600 and manufacturers published recommendations.

L. Do not field weld piping except where specifically approved by engineer or where welded joints are indicated in the contract documents.

M. Do not install restraining gaskets on push-on joint plugs or caps. Install push-on joint plugs with set-screw restraint. Install push-on joint caps with harness-type restraint. Install boltless restrained joint plugs and caps with restraint harness in lieu of joint restraint that would hinder future removal of plug or cap.

3.18 INSTALLATION OF MILL TYPE AND FABRICATED WELDED STEEL PIPE AND FITTINGS

A. Provide welding in accordance with the latest editions of Section IX, ASME Boiler and Pressure Vessel Code except as modified by the piping code listed in this Section.

B. Welding Procedure Specifications:

1. Qualify all welding procedure specifications prior to fabrication in accordance with the ASME Boiler and Pressure Vessel Code, Section IX except as modified by the code listed in CODE REQUIREMENTS of this Section.
2. Identify all welding procedure specifications by number and reference the procedure number on all fabrication Drawings.

C. Welding and Welding Operators:

1. Qualify all welders and welding operators prior to fabrication in accordance with the ASME Boiler and Pressure Vessel Code, Section IX except as modified by the code listed in CODE REQUIREMENTS of this Section.
2. Include qualifications for all welding positions to be employed in the fabrication.
3. Make qualification records available for review by the Engineer.

D. Materials:

1. Use welding products within the limits recommended by their manufacturers.
2. Keep electrodes, filler wires, and fluxes clean, dry, and properly stored according to manufacturer's recommendations. Do not use electrodes, filler wires, or fluxes that are damp, greasy, or oxidized.
3. Do not use backing rings.

4. Consumable inserts may be used if included in the qualified welding procedure specification. Match the chemistry of the consumable insert with the base metal and weld metal chemistry.

E. Weld Identification:

1. Assign each qualified welder or welding operator an individual identification number or symbol.
2. Permanently mark each pressure weld with the identification of the welder or welding operator who performed the weld. If more than one welder or welding operator welds a joint, each shall apply their identification in a manner to indicate the part of the weld they completed.

F. Procedure:

1. Clean surfaces to be welded free of paint, oil, dirt, scale, oxides, and other material detrimental to welding. Clean in a manner that will not lead to contamination of the weld or adjoining base metal.
2. No welding shall be performed if there is any rain, snow, sleet, or high wind in contact with the weld area or if the ambient temperature is below 32 degrees F.
3. If the ambient temperature is less than 32 degrees F, local preheating to a temperature warm to the hand is required.
4. Tack Welds:

    a. Remove completely if not made by a qualified welder using the same procedure as for the completed weld.
    b. If not removed, make tack weld with an electrode the same as, or equivalent to, the electrode to be used for the first weld pass.
    c. Completely remove cracked tack welds.

5. Clean each layer of deposited weld metal with a power-driven wire brush, prior to depositing each subsequent layer of weld metal, including the final pass.
6. Chip or grind out surface defects which will affect the soundness of the weld.
7. Weld Passes:

    a. 4-inch and Under Pipe: Minimum of a full root and second pass.
    b. 6-inch through 24-inch Pipe: Minimum of three weld passes using the specified electrode.
    c. Greater Than 24-inch Pipe: Minimum of three weld passes using the specified electrode.

8. Welds: Welds shall be free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity, slag inclusions, and other defects in excess of the limits prescribed in the Piping Code.
9. Branch Connections: Branch connections shall fit and groove-weld in accordance with the details described and shown in the Piping Code.
10. Do not field weld epoxy-lined and/or coated pipe except as specifically approved by the Engineer.

G. Fabrication:

1. End Preparation:

a. Machine shaping of pipe ends is the preferred method.
b. Oxygen or arc cutting is acceptable only if the cut is smooth and true and all slag is removed either by chipping or grinding.
c. Beveled ends for butt welding shall meet the requirements of ANSI B16.25.
d. Grooved Ends: Meet the requirements of the grooved end coupling and fitting manufacturer.

2. Cleaning:

a. Before Welding: Surfaces shall be clean and free of paints and coatings, oil, rust, scale, slag, or other material detrimental to welding.
b. After Welding: After completion of shop or field fabrication and after erection, clean all piping inside and outside to remove all loose scale, weld spatter, dirt, loose debris, and foreign material.

3. Alignment and Spacing:

a. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
b. Root Opening of the joints shall be as stated in the welding procedure specification.

H. Required Examinations:

1. Perform examinations in accordance with the Piping Code.
2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this Section.
3. Examine at least one of each type and position of weld made by each welder or welding operator.
4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above. Examine, progressively, two additional welds for each examination found to be unsatisfactory.

I. Inspection: Provide access to the Engineer for inspection of all shop and field work and review of all records of examinations.

3.19 INSTALLATION OF HDPE PIPE AND FITTINGS

A. Butt Fusion Joining:

1. Plain end pipe and fittings shall be made using butt fusion. The butt fusion procedures shall be in accordance with the manufacturer or the PPI. The

fusion equipment operator shall receive training using the recommended procedure. The Contractor shall be responsible to verify that the fusion equipment is in good operating condition and that the operator has been trained within the past twelve months. The fusion equipment shall be equipped with a Datalogger. Records of the welds (heater temperature, fusion pressure, and a graph of the fusion cycle) shall be maintained for five (5) years. Fusion beads shall not be removed.

2. Heat Fusion Training. The supplier of the pipe and fittings shall provide a person certified by the pipe manufacturer and the fusion equipment manufacturer to train contractor fusion equipment operators and inspectors representing the Owner.

B. Other Joining Methods:

1. Mechanical Joining. Polyethylene pipe and fittings may be joined together using Flanges or Mechanical Joint (MJ) adapters. These fittings shall be made from PE 3408 HDPE, with a Cell Classification of 345464C as determined by ASTM D3350-02. Flanged and MJ adapters shall have a manufacturing standard of ASTM D3261. They shall have a pressure rating equal to the pipe unless otherwise specified on the plans.
2. Electrofusion Couplings. Polyethylene pipe and fittings may be joined using approved electrofusion couplings. Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR) of the fitting.

C. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce joint weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.

D. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused. The size of the heating iron shall be larger than the size of the outlet branch being fused.

E. Mechanical joining will be used where the butt fusion method cannot be used. Mechanical joining will be accomplished by either using a ductile iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring. Where Mechanical

joints are used, these connections must be made using components that meet Factory Mutual requirements and show the FM logo.

F. Socket fusion, hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

3.20 INSTALLATION OF PVC AND CPVC PRESSURE AND DWV PIPE AND FITTINGS

A. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564 for PVC joints and ASTM F 493 for CPVC joints. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC and CPVC compounds.

B. All rigid PVC and CPVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Pipe shall be installed parallel with, or at right angles to, the structural members of buildings or rolled for a constant offset along curved structures; vertical runs shall be straight and plumb.

C. Buried plastic pipe shall be laid by snaking the pipe from one side of the trench to the other. Offset shall be as recommended by the manufacturer for the maximum temperature variation between time of solvent welding and during operation.

D. Install plastic pipe in accordance with ASTM D 2321 “Underground Installation of Thermoplastic pipe for sewers and other gravity-flow applications.”

H. Only strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to overtighten these fittings. Pipe shall not be laid when the temperature is below 40 degrees F, nor above 90 degrees F when exposed to direct sunlight. Ends to be joined shall be shielded from direct sunlight prior to and during the laying operation.

I. Provide adequate ventilation when working with pipe joint solvent cement.

J. Shorten factory-beveled PVC pipe spigots to reduce length of bevel to within AWWA standard for mechanical joints.

K. Clean bell socket immediately prior to insertion of gasket and/or pipe end.

L. Lubricate gasket and plain end of pipe with pipe lubricant that conforms to contract documents prior to assembly of push-on, restrained, and mechanical joints. Apply lubricant to clean surfaces only.

M. If pipe end becomes contaminated with foreign material prior to joint assembly, clean and re-lubricate pipe end prior to proceeding with joint assembly.

N. If bell socket and/or gasket becomes contaminated with foreign material prior to joint assembly, remove gasket, clean and re-lubricate gasket and bell socket, re-lubricate gasket, and replace gasket in bell socket prior to proceeding with joint assembly.

O. Do not remove factory-installed gaskets without written approval from pipe joint manufacturer and consent of engineer.

P. Do not over-home pipe spigot ends into rubber-gasketed PVC pipe bells.

Q. Make any required deflection in mechanical joints after hand tightening gland bolting but prior to tightening the bolting to normal bolt torque.

R. Tighten mechanical joint gland bolting uniformly to normal bolt torque while maintaining a uniform clearance between the gland and the face of the bell.

S. Normal bolt torque for mechanical joint bolting is defined as the mechanical joint bolt torque listed in AWWA C600 and manufacturers published recommendations.

3.21 INSTALLATION OF FRP PIPE AND FITTINGS/BELL & SPIGOT

A. Shall be in accordance with the manufacturer's written instructions and installation procedures as approved by the Engineer. Submit design and installation drawings that indicate and detail recommended installation procedures including provisions for expansion, anchors, thrust blocks, supports, vent, and drain connections.

B. Inspection: prior to preparation and assembly, the Contractor shall inspect pipe for physical damage and make repairs in accordance with the manufacturer's written instructions, except that over wrapping the damaged or defective area with any type patch or other material will not be permitted.

C. Preparation: Sand surfaces to be bonded, including those formed or shaved at the factory, not more than 2 hours prior to assembly. Clean and remove sanding dust to obtain surfaces suitable for bonding. Sanded surfaces which come in contact with hands, equipment, or dirt must be re-sanded. Dry and re-sand damp or wet bonding surfaces as required by the manufacturer. During rain or cold weather, prepare joint and assemble under a protective cover with heat applied. Pipe cut to length in the field shall have ends square within 1/16 inch for all diameters through 12 inch pipe. Form spigot ends using tools recommended by the manufacturer. Align and fit prepared joints prior to application of adhesive.

D. Adhesive Mixing and Application: Adhesive materials, mixing, and application shall be in accordance with manufacturer's instructions including limitations on adhesive shelf life and pot life.

3.22 INSTALLATION OF FABRICATED STAINLESS STEEL PIPING

A. Joint Assembly:

1. Fully support and align piping on permanent pipe supports prior to tightening flange joints. Flange faces shall be parallel within 1/16 inch per foot of diameter and flange bolt holes shall be aligned within a maximum offset of 1/8 inch.
2. Clean gasket and mating surfaces of flanges prior to assembly. Correct all damaged mating surfaces of flanges.

3. Clean and lubricate threaded fasteners with a lubricant that conforms to manufacturer's recommendations prior to assembly. Prevent lubricant from contacting flange gaskets and face of flange.
4. Install stainless steel fasteners with hand tools or low-speed power tools.
5. Carefully insert gasket between the flanges to prevent damage to the gasket surfaces.
6. Ensure the gasket is central in the flange. Do not use tape to secure the gasket to the flange. If it is necessary to secure the gasket to the flange, use a light dusting of spray adhesive (e.g. 3M type 77). Do not use jointing compounds or release agents.
7. Line up the joint components (including the flanges and the gasket) and examine them to ensure that an acceptable fit has been obtained. Take care when bringing the flanges together, to ensure that the gasket is not pinched or otherwise damaged.
8. Do not reuse flange gaskets.
9. Install stud and bolt fasteners with a minimum 2 to 3 threads visible above the nut.
10. Tighten bolting in a cross bolt tightening pattern in five passes: (1)hand tight, (2)30% torque, (3)60% torque, (4)full torque, and (5)check at full torque. Repeat the fifth pass if any rotation of fasteners is observed.

B. Provide purge points, blinds, and temporary pipe supports as required for purging and testing of piping systems.

1. Purge points shall include a 316L stainless steel thread-o-let welded to the fabricated piping; 1" Schedule 40S stainless steel nipple; 1" NPT, standard-port, lever-actuated 316 stainless steel ball valve, and 1" 316 stainless steel pipe plug. Ball valve shall be provided with material components rated for sour gas service in accordance with NACE MR 0175/ISO 15156.
2. Provide 316 stainless steel pipe blinds to isolate digester gas from pressure test medium; to isolate valves from test pressures above their rated working pressure; and to isolate equipment from test pressures and testing medium. Pipe blinds shall be provided with material components rated for sour gas service in accordance with NACE MR 0175/ISO 15156.

3.23 FABRICATED STAINLESS STEEL PIPING TESTING AND EXAMINATION

A. Hydrostatic Pressure Test

1. Each length of assembly shall be subjected to the hydrostatic test in accordance with the ASME/ASTM specification to which the pipe is manufactured or ASTM-A530/ASME-SA530. Where there is a choice in the specification of Hydrostatic Test or other Non-Destructive Examination, Hydrostatic Testing shall be performed. The header assemblies shall be hydrostatic or air tested to a pressure of 25 psi.

B. Radiography

1. A radiography examination shall be performed on 15% of the butt and socket welds. Radiography shall be in accordance with ASTM-E94 with quality level in accordance with ASTM-E142. Acceptance criteria shall be in accordance with ANSI/ASME B31.3 Table 327.4.1A or ASME Section VIII Division 1, UW-51.

C. Liquid Dye Penetrant

1. A liquid dye penetrant inspection shall be made for 100% of all welds. Liquid Dye Penetrant in accordance with ASTM-E165 with acceptability of surface flaws in accordance with ASTM-E433. Acceptance criteria for evaluation indications and acceptance shall be in accordance with ASME Section VIII Division 1, Appendix VIII.

3.24 FABRICATED STAINLESS STEEL GAS PIPING INSPECTION, TESTING & PURGING

A. Prior to start-up and Substantial Completion, all digester gas piping shall be inspected and pressure tested to determine that the materials, design, fabrication, and installation comply with the requirements of NFPA 54.

1. Inspection shall consist of visual examination, during or after manufacture, fabrication, assembly, or pressure tests as appropriate.
2. Supplementary types of nondestructive inspection techniques, such as magnetic-particle, radiographic, and ultrasonic shall not be required unless specifically listed herein or in the engineering design.
3. Where repairs or additions are made following the pressure test, the affected piping shall be tested after repairs are complete.
4. Minor repairs and additions are not required to be pressure tested, provided that the work is inspected and connections are tested with a noncorrosive leak-detecting fluid or other leak-detecting methods approved by the Engineer and authority having jurisdiction.
5. Where new branches are installed, only the newly installed branches shall be required to be pressure tested.
6. Connections between the new piping and the existing piping shall he tested with a noncorrosive leak-detecting fluid or approved leak-detecting methods.
7. 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 of the piping system and test medium in an adjacent section, unless two valves are installed in series with a valved "telltale" located between these valves.
8. A valve shall not be subjected to the test pressure unless it can be determined that the valve, including the valve closing mechanism, is designed to safely withstand the pressure.
9. Regulator and valve assemblies fabricated independently of the piping system in which they are to be installed shall be permitted to be tested with inert gas or air at the time of fabrication.
10. Test Medium. The test medium shall be air, nitrogen, carbon dioxide, or an inert gas.
11. OXYGEN SHALL NEVER BE USED.

B. Test preparation.

1. Pipe joints, including welds, shall be left exposed for examination during the test with the exception of covered or concealed pipe end joints that have been previously tested in accordance with this code.
2. Expansion joints shall be provided with temporary restraints, if required, for the additional thrust load under test.
3. Appliances and equipment that are not to be included in the test shall be either disconnected from the piping or isolated by blanks, blind flanges, or caps. Flanged joints at which blinds are inserted to blank off other equipment during the test shall not be required to be tested.
4. Where the piping system is connected to appliances or equipment designed for operating pressures of less than the test pressure, such appliances or equipment shall be isolated from the piping system by disconnecting them and capping the outlets.
5. Where the piping system is connected to appliances or equipment designed for operating pressures equal to or greater than the test pressure, such appliances or equipment shall be isolated from the piping system by closing the individual appliance or equipment shutoff valves.
6. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage, and bracing suitably designed to resist test pressures shall be installed if necessary.
7. Prior to testing, the interior of the pipe shall be cleared of all foreign material.

C. 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 due to leakage during the pressure test period.

1. The source of pressure shall be isolated before the pressure tests are made.
2. Mechanical gauges used to measure lest pressures shall have a range such that the highest end of the scale is not greater than 5 times the test pressure.
3. The test pressure to be used shall be no less than 1½ times the proposed maximum working pressure, but not less than 3 psi (20 kPa), irrespective of design pressure.
4. Where the test pressure exceeds 125 psi (862 kPa), the test pressure shall not exceed a value that produces a hoop stress in the piping greater than 50 percent of the specified minimum yield strength of the pipe.
5. Test duration shall be not less than ½ 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 10 minutes. The duration of the test shall not be required to exceed 24 hours.

D. Detection of Leaks and Defects.

1. The piping system shall withstand the 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 the presence of a leak unless such reduction can be readily attributed to some other cause.

2. The leakage shall be located by means of an approved gas detector, a noncorrosive leak detection fluid, or other approved leak detection methods. Matches, candles, open flames, or other methods that provide a source of ignition shall not be used.
3. Where leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

E. Piping System Leak Check.

1. Test Gases. Leak checks using fuel gas shall be permitted in piping systems that have been pressure tested in accordance with Section 8.1.
2. Turning Gas On. During the process of turning gas on into a system of new gas piping, the entire system shall be inspected to determine that there are no open fillings or ends and that all valves at unused outlets are closed and plugged or capped.
3. Leak Check. Immediately after the gas is turned on into a new system or into a system that has been initially restored after an interruption of service, the piping system shall be checked for
4. Leakage. Where leakage is indicated, the gas supply shall be shut off until the necessary repairs have been made.

F. Placing Appliances and Equipment in Operation. Appliances and equipment shall not be placed in operation until after the piping system has been tested and purged in accordance with the Contract Documents.

G. Purging.

1. Removal from Service. When gas piping is to be opened for an addition, a modification, or service, the section to be worked on shall be isolated from the gas supply at the nearest convenient point and the line pressure vented to the outdoors or to ventilated areas of sufficient size to prevent accumulation of flammable mixtures. The remaining gas in this section of pipe shall be displaced with an inert gas as required below.

   a. 2½ inch nominal pipe size: piping greater than 50 feet shall be purged.
   b. 3 inch nominal pipe size: piping greater than 30 feet shall be purged.
   c. 4 inch nominal pipe size: piping greater than 15 feet shall be purged.
   d. 6 inch nominal pipe size: piping greater than 10 feet shall be purged.
   e. 8 or larger inch nominal pipe size: any length of piping shall be purged.

2. Placing in Operation. When piping full of air is placed in operation, the air in the piping shall be displaced with an inert gas prior to introduction of digester gas. The digester gas flow shall be continued without interruption until the vented gas is free of inert. The point of discharge shall not be left unattended during purging. After purging, the vent shall then be closed.

a. 3 inch nominal pipe size: piping greater than 30 feet shall be purged.

b. 4 inch nominal pipe size: piping greater than 15 feet shall be purged.

c. 6 inch nominal pipe size: piping greater than 10 feet shall be purged.

d. 8 or larger inch nominal pipe size: any length of piping shall be purged.

3. Discharge of Purged Gases. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner by ventilation of the space, control of purging rate, and elimination of all hazardous conditions.
4. Placing Appliances and Equipment in Operation. After the piping system has been placed in operation, all appliances and equipment shall be purged and then placed in operation, as necessary.
5. Provide a minimum of two portable multigas detectors to monitor the discharge of purge gases. Multigas detectors shall monitor lower explosive limit (LEL), oxygen, hydrogen sulfide, and the inert purge gas.

H. Suggested Method of Checking for Leakage

1. Use of Lights. Artificial illumination used in connection with a search for gas leakage should be restricted to battery operated flashlights (preferably of the safety type) or approved safety lamps. In searching for leaks, electric switches should not be operated. If electric lights are already turned on, they should not be turned off.
2. Leak Check Not Using a Meter. This test can be done using one of the following methods:
3. At an appropriate checkpoint, install a manometer or pressure gauge at the supply pressure inlet to the piping system. Momentarily turn on the gas supply, and observe the gauging device for pressure drop with the gas supply shut off. No discernible drop in pressure should occur during a period of 3 minutes.
4. Leakage is indicated if a pressure drop is indicated at the gauge. If all equipment and other device connections are examined and found to be tight, the piping shall be considered to be leaking.

I. Suggested Emergency Procedure for Gas Leaks

1. Where an investigation discloses a concentration of gas inside of a building or area of the work, it is suggested the following immediate actions be taken:
2. Clear the room, building, or area of all occupants. Do not re-enter the room, building, or area until the space has been determined to be safe.
3. Use every practical means to eliminate sources of ignition. Take precautions to prevent smoking, striking matches, operating electrical switches or devices, opening furnace doors, and so on.
4. If possible, cut off all electric circuits at a remote source to eliminate operation of automatic switches in the dangerous area.

5. Safety flashlights designed for use in hazardous atmospheres are recommended for use in such emergencies.
6. Notify all personnel in the area, Owner, and Engineer.
7. Ventilate the affected portion of the building by opening windows and doors.
8. Investigate other structures and buildings in the immediate area of the leak to determine the presence of gas.

END OF SECTION 15260

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Included in this section is the furnishing and installing of the pipe specialties listed herein and any necessary appurtenances to obtain a complete and functional system.

1.02 RELATED WORK

A. Section 15260 – Process Piping
B. Section 15270 – Valves

1.03 SUBMITTALS

A. The Contractor shall submit shop drawings on all equipment specified to the Engineer for approval. The shop drawings shall include location of use, detailed drawings of equipment, specifications of equipment and all other pertinent information necessary to describe the equipment.

PART 2 PRODUCTS

2.01 HOSE CONNECTORS (PLANT WATER SUPPLY)

A. The Contractor shall supply the following items. These items will allow hydrants specified in Section 15270 “Plant Valves” to be connected to 1-1/4” diameter hoses specified in Section 15267 “Plant Piping Specialties”. Each of the hydrants shall be supplied with the following items which shall be constructed of brass:

1. (2) 2-1/2” Female NPT x 1-1/4” Male NPT
2. (1) Dust Plug

2.02 HOSE

A. The Contractor shall supply hose in the size and quantity listed below and at the locations listed below. The hose shall be immune to the effects of mildew and shall have an ozone resistant synthetic lining. The hose shall be the type that does not require drying. The hose shall be of the double jacketed type, U.L. listed, non-collapsing. EPDM rubber inside and outside with polyester cord reinforcement.

2.03 HOSE NOZZLES

A. The Contractor shall supply pistol grip nozzles for Washdown of the site. The nozzle shall be used with the washwater hose, as specified. The nozzle shall have a 3/4 inch NPT threaded swivel hose connection. They shall have a rated flow capacity of 75 gpm to not less than 375 gpm with a flow mechanism that automatically reacts to

water volume changes to produce an effective stream. The nozzles shall have an adjustable flow stream from a flush to a straight stream to a fog. The pistol grip nozzles shall have handle operated built-in ball shutoff valves. The unit shall be constructed of a lightweight corrosion resistant material. Hose nozzles shall be manufactured to provide 70 gpm at 50 psi.

B. The nozzles shall be as manufactured by Akron Brass Company, or equal.

2.04 HOSE REELS

A. The stationary hose reels shall be mounted in the locations shown on the plans according to manufacturer's recommendations.

2.05 PRESSURE GAUGES

A. Where indicated on the drawings, the Contractor shall tap pipelines and shall install 1/2 inch gauge cocks to receive 1/2 inch pressure gauge fittings. The fittings shall include a pet cock for air bleedoff located below the gauge and a shutoff valve to allow removal of the gauge. The gauges shall be Ashcroft Model 1279, Wesler, or equal. Gauges shall have 4-1/2" diameter dial, phenol turret design, 1/2" NPT lower stainless steel connection, 1% accuracy, glycerine fill and overload safety stop. The gauges shall have diaphragm seals and the seals shall be Ashcroft Type 50-100SB-047-CG, or equal. All gauges on pump discharge lines shall have impulse dampeners.

2.06 EXPANSION COUPLINGS

A. The Contractor shall furnish and install expansion couplings at the locations shown on the plans.

2.07 TRANSITION COUPLINGS

A. The Contractor shall furnish and install transition couplings where shown on the plans or as required in the field.

B. The transition couplings shall be used where pipe materials change. Pressure pipe transition couplings shall be as manufactured by Smith-Blair, Inc., or equal. Non-pressure transition couplings shall be as manufactured by Fernco, or equal.

2.08 PIPE EXPANSION JOINTS

A. Flexible spherical molded neoprene connectors with the following features:

1. Multiple plies of nylon tire cord fabric and neoprene molded and cured in rubber presses.
2. No steel wire or rings used as pressure reinforcement.
3. Straight connectors shall have two spheres.
4. Pre-extended to prevent additional elongation under pressure.
5. Threaded connections for 2 inch diameter and less.
6. Flanged connections for 2-1/2 inch diameter and Greater.
7. For operating pressures and temperature limits of:

a. 150 psi @ 220 degrees F.
b. 225 psi @ 170 degrees F.

8. Control cables and anchor plates where required.
9. Acceptable Products

a.	Mason Industries	MF
b.	Flex-Hose	NN
c.	Minnesota Flexible Corp.	MF
d.	Senior Flexonics Pathway	Series RA

10. Provide filled arches on raw sewage applications

2.09 COUPLING HALVES

A. Type: Quick-disconnect, cam-locking type.

1. Materials:

a.	Body	Aluminum
b.	Gasket	Buna-N

2. Connections: Male cam-lock half x Female NPT, Female cam-lock half x Male shank or NPT as required by drawings.
3. Accessories: Provide non-locking dust cap and dust plug
4. Standards: meet MIL-C-27487F.

B. Manufacturers: Andrews; or Equal.

2.10 MONITOR HYDRANT

A. The Monitor Hydrant shall be self-draining, non-freezing type with a depth of bury as indicated on the plans. The hydrant shall be furnished with a 2” horizontal FIP inlet and a 2” FIP vertical outlet. The hydrant shall contain a non-turning operating rod that is operated with a 1-1/2” pentagon wrench, that shall be provided. The operating rod shall be contained within a steel casing pipe with a locking cover. When open, the valve shall be 100% unobstructed and the drain hole shall be covered. The operating drive mechanism shall be of bronze to bronze design with an aluminum plunger and be removable from the hydrant for servicing without excavating the hydrant. The hydrant manufacturer shall provide a 2” riser pipe that terminates approximately 7” above grade that includes a 2” FNPT pipe thread coupling as shown on the drawings. The contractor shall supply the 2” steel riser pipe for connection between the monitor hydrant and monitor riser pipe assembly. The hydrant shall be #77 Mainguard 2” Post Hydrant as manufactured by Kupferle Foundry Co. or equal.

2.11 MONITOR RISER PIPE ASSEMBLY

A. The Monitor Riser Pipe Assembly shall be provided by the Monitor Hydrant manufacturer and include a 4’-6” long, 2” diameter steel pipe painted safety red. The top of the Monitor Riser Pipe Assembly shall be furnished with an air release valve, 2” full bore brass ball valve, 2” brass type “F” cam and groove quick disconnect

adapter, and 2” brass dust cover. The bottom end shall be furnished with a 2” MNPT thread for connection to the contractor supplied 2” steel riser pipe. In addition the Monitor Hydrant manufacturer shall provide a 7” diameter by ¾” thick steel deck mount flange with four (4) non-threaded 0.58” diameter bolt holes. The steel deck mount flange shall be welded to the bottom of the Monitor Riser Pipe Assembly with enough of the 2” MNPT threaded end extending out from the landing for connection of the contractor supplied 2” steel riser pipe.

2.12 MONITOR ASSEMBLY

A. The Monitor Assembly shall include an Elkhart Brass Sidwinder #8492 Elk-O-Lite Monitor with a 2” brass type “B” cam and groove quick disconnect coupler. The Monitor shall be capable of 360 degree horizontal rotation and allow for vertical positioning with stop locations at 90 degrees above and 45 degrees below the horizontal plane. The outlet of the monitor shall include a 1-1/2” #281-A stream shaper and a #187 aluminum nozzle tip with a 1-1/2” female inlet and 1-1/4” outlet. The monitor assembly shall be as manufactured by Kupferle Foundry Co. and Elkhart Brass Mfg Co or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. Install piping specialties as shown on drawings and recommended by manufacturer.

END OF DOCUMENT 15267

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The work included in this section is the supply and installation of all piping valves and accessories necessary for their proper operation as shown on the drawings and specified herein. All valves shall be standard commercial products of reputable manufacturers.

1.02 RELATED WORK

A. Section 15260 - Process Piping
B. Section 15277 - Electric Valve and Gate Actuators

1.03 QUALITY ASSURANCE

A. The contractor shall establish and maintain quality control of all valves and accessories on the project. To assure contract compliance, the contractor shall maintain records of his quality control efforts as listed below.

B. Check for damage to and defects in material.

C. Check for proper storage of valves and accessories and provide a systematic list of valves and accessories on site along with their location.

D. Check to see that all valves and accessories incorporated into the piping systems have been submitted and reviewed.

E. Coordinate valve submittal and piping submittals to assure correct dimensions, etc.

1.04 REFERENCE TO STANDARDS

A. References to standards are included in the text for each type of valve.

1.05 SUBMITTALS

A. Submittals shall meet the requirements of Section 01330 – Submittal Procedures.

B. All types of valves shall be submitted for review. Sufficient information shall be presented to allow proper evaluation. Complete dimensional information is required.

C. The submittals shall reference the plan sheets and indicate the intended use for the valve submitted.

1.06 STORAGE AND HANDLING

A. Valves shall be stored on site on pallets and kept free from sand and other debris. Storage shall be such that no water is trapped in or on any part of the valves.

B. Valves shall not be lifted by the handwheel or operator. Manufacturer's recommendation for handling must be followed.

1.07 WARRANTY

A. The valves furnished and installed are subject to the one year warranty provisions of the General Conditions.

PART 2 PRODUCTS

2.01 EXTENSION STEMS

A. Buried Valves

1. All buried valves shall have hot dipped galvanized steel extension stems keyed to the valve and the operating nut brought to within 6" of the finished grade.

B. Non-Buried Valves

1. Extension stems shall be 304 stainless steel and extended to the top of concrete unless otherwise shown or specified on the drawings.

2.02 STEM GUIDES

A. Cast iron stem guide are required at a minimum of 5 ft. intervals on non-buried valves. Stem guides shall be as manufactured by Rodney Hunt, or equal.

2.03 CHAIN WHEEL OPERATORS

A. Valves manually operated (without an electric operator) with centerlines more than 6'-0" above a finished floor elevation shall be provided with galvanized chain wheel operators and guides and galvanized chain.

2.04 VALVE BOXES

A. Valve boxes shall be furnished with extension stems and actuating nut extended to within 6” of the top of the box. The valve box shall extend to the finished grade. A tee wrench shall be provided for the buried valves (1 per 6 valves). Buried and submerged valves shall be furnished with a completely sealed actuator.

2.05 PLUG VALVES

A. Type: Resilient seated eccentric plug, lever operated 8" and smaller and worm gear operators with handwheels on valves 10" and larger, unless otherwise

specified or shown on Drawings. Valves shall provide driptight shutoff in both directions.

B. Plug valve materials shall be as specified in the table below.

1.	Body	Cast Iron
2.	Bearing	316 SS
3.	Gasket	Styrene-Butadiene Rubber binder
4.	Plug	Eccentric, 316 SS, ductile iron, cast iron
5.	Plug Facing	NBR
6.	Stem Seal	NBR packing or U-cup
7.	Bonnet	Bolted, Cast Iron
8.	Coating interior and exterior except plug and seat	High Solids Epoxy 12 mils min dry film thickness

C. Connections:

1. Exposed: Flanged Class 125 ANSI B16.1
2. Buried: Mechanical Joint

D. Standards: AWWA C517 Resilient-Seated Cast-Iron Eccentric Plug Valves

E. Installation: Unless necessary due to installation conditions and approved by Engineer, the valves shall be installed:

1. Horizontal Pipe: the plug shall rest in the upper half of the body when the valve is open. The seat shall be on the upstream end.
2. Vertical: the seat end shall be on the upper half of the body.

F. Manufacturers: Dezurik PEC; Clow Eccentric; Val-Matic Cam-Centric; Milliken; and Pratt. No substitutions will be considered.

2.06 BUTTERFLY VALVES

A. Type: butterfly valves shall be lugged and designed for air service up to 250°F, 10 position positive latching lever operated 8" and smaller and worm gear with handwheels on valves 10" and larger, unless otherwise specified or shown on Drawings.

1. Materials:

a.	Body	Ductile Iron
b.	Seat	EPDM
c.	Disc	Ductile Iron
d.	Shaft	316 SS(up to 150psi) 416 SS(up to 200psi)
e.	O-Ring	EPDM

2. Connections: threaded lugged compatible with class 125 ANSI B16.1 and class 150 ANSI B16.5.
3. Standards: meets AWWA C504 for shaft diameter and body wall thickness.

4. Installation: Unless necessary due to installation conditions and approved by the Engineer, the valves shall be installed 8 pipe diameters downstream from the nearest pump or elbow, and the higher pressure on the seat side.
5. Manufacturers: Dezurik BOS; Crane 44. No substitutions will be considered.

2.07 CHECK VALVES

A. Type: 3 inch and smaller for water service.

1. Materials:

a.	Body	Bronze
b.	Disc	Bronze
c.	Hinge Pin	SS
d.	Seat Ring	Bronze

2. Connections: threaded ends
3. Manufacturers: Hammond IB946; Nibco T-433-Y; Stockham B-321; Crane 37. No substitutions will be considered.

B. Type: 4 Inches and Larger for water service lever and weight swing check.

1. Materials:

a.	Body	Cast Iron
b.	Disc	Cast Iron
c.	Disc Ring	Bronze
d.	Seat Ring	Bronze
e.	Hinge Pin	SS
f.	Cushion Cylinder	Hard Coated Aluminum

2. Connections: Flanged class 125 ANSI B16.1
3. Standards: AWWA C508 for 2-24 inch
4. Installation: per mfg recommendations
5. Manufacturers: Apco 6000LW; M&H 159; GA Industries 220. No substitutions will be considered.

2.08 MUD VALVES

A. Type: non-rising stem, electric actuator operated. See Actuator specifications for details on the actuator.

1. Materials:

a.	Body	Cast Iron
b.	Stem	Bronze
c.	Stem Nut	Bronze
d.	Gate	Cast Iron

e. Seat Ring — Bronze

f. Extension Stem w/ couplings and operator — Bronze, 1-1/4" Dia min

2. Connections: Flanged class 125 ANSI B16.1

3. Extensions: 5 foot max stem guide spacing

4. Standards: meets AWWA C504 for shaft diameter and body wall thickness.

5. Installation: per mfg recommendations

6. Manufacturers: Trumbull, Hydrogate, Troy. No substitutions will be considered.

2.09 BALL VALVES

A. Type: 3 inch and smaller full port with a steel zinc plated vinyl covered lever actuator.

1. Materials:

a. Body — Bronze

b. Ball — Bronze with hard chrome plating

c. Ball Seat — TFE

2. Connections: threaded

3. Standards: 600 PSI WOG cold service

4. Installation: per mfg recommendations, unions at each end of valve

5. Manufacturers: NIBCO, Apollo, or Milwaukee. No substitutions will be considered.

2.10 SOLENOID VALVES

A. Type: 3/8 inch to 2 ½ inch 120 volt ac, slow opening/closing. Normally open or normally closed as shown or specified on the drawings.

1. Materials:

a. Body — Brass

b. Plug — Stainless Steel

c. Seats — Buna-N

2. Connections: threaded, unions at each end of valve

3. Standards: service up to 150 psi

4. Installation: per mfg recommendations

5. If indicated on the drawings as a classified area. The valve shall be furnished with a Type 4 enclosure (explosionproof and watertight) with a 1/2-inch NPT conduit fitting.

6. Manufacturers: ASCO. No substitutions will be considered.

2.11 GROUNDWATER PRESSURE RELIEF VALVES (RESERVED)

2.12 TELESCOPING VALVES (RESERVED)

2.13 SOUR GAS BALL VALVES (RESERVED)

2.14 GATE VALVES

A. Type: Resilient seated gate valve (Buried Installation).

B. Buried gate valve shall be iron body, bronze mounted, double disc, non-rising stem. Ends shall be as required for proper installation with adjoining pipe. The valves shall open counterclockwise and shall be furnished with valve boxes and extension stems as specified above.

C. Standards: AWWA C509 Resilient Seated Gate Valves

D. Installation: Unless necessary due to installation conditions and approved by Engineer, the valves shall be installed per manufacturer recommendations.

E. Manufacturers: Mueller Company or equal

2.15 IN-PIPE CHECK VALVES

A. Type: Elastomeric inline “CHECKMATE” check valves

B. Installation: As per manufacturer’s recommendations using stainless steel expansion clamps

C. Manufacturers: Tideflex Technologies

PART 3 EXECUTION

3.01 VALVE ACTUATORS

A. Unless otherwise specified on the drawings, or referenced sections, valve actuators shall be furnished and factory installed by the valve manufacturer.

3.02 VALVE INSTALLATION

A. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.

B. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply approved joint compound to threads prior to making joints. Joints shall be watertight at test pressures before acceptance.

3.03 VALVE STEM ORIENTATION (UNLESS OTHERWISE INDICATED ON THE DRAWINGS)

A. All valves installed in horizontal runs of pipe having centerline elevations 4-feet 6-inches or less above the finish floor shall be installed with their operating stems vertical.

B. Valves installed in horizontal runs of pipe having centerline elevations greater than 4-feet 6-inches above the finish floor shall be installed with their operating stems horizontal.

C. If adjacent piping prohibits the stem orientation listed above, the stems shall be installed above the valve horizontal centerline as close to horizontal as possible.

D. Valves installed in vertical runs of pipe shall have their operating stems orientated to facilitate the most practicable operation.

E. Valves installed in suspended solids application, (i.e. grit, slurry and backwash water) shall be positioned with the plug or wafer horizontal axis and rotating to the top of valve body when open.

F. Inverted operating stems will not be permitted unless specifically approved by the Engineer.

3.04 VALVE LOCATIONS

A. Locate valves in accessible locations. Locate valves so that separate supports can be provided and installed where necessary.

B. Provide and install valves for shut-off and isolating service on equipment, vertical risers and individual systems.

3.05 VALVE INSULATION

A. Where insulation is indicated, install extended stem valves and arrange in a proper manner to receive insulation.

3.06 RELIEF VALVE OUTLETS

A. All relief valve outlets shall be piped full size to adjacent floor drains or as shown on the drawings. Where no floor drains are provided, piping shall be piped straight down to within 3-inches of the floor.

3.07 TESTING

A. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints and valve stem packing shall show no visible leakage under test. Tighten or repack stem packing, and repair joints that show signs of leaking prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor will be held responsible for any damage caused by the testing.

END OF SECTION 15270

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. This specification describes the scope of work and technical requirements for the fabrication of the stainless steel air piping and accessories.

1.02 RELATED WORK

A. Section 11370 – Rotary Lobe Positive Displacement Blower
B. Section 15260 – Process Piping
C. Section 15270 – Valves

1.03 QUALITY ASSURANCE

1.04 The Contractor shall establish and maintain quality control of all piping and fittings on the project. To assure contract compliance, the Contractor shall maintain records of his quality control efforts as listed below.

A. Check for damage to and defects in material.

B. Check for proper storage of piping and fittings and provide a systematic list of piping and fittings on site along with their location.

C. Check to see that all piping and fittings incorporated into the piping system have been submitted and approved.

D. Coordinate piping submittals to assure correct dimensions, etc.

1.05 REFERENCE TO STANDARDS

Unless otherwise stated in the technical specification, all work shall be performed in accordance with the following Codes and Standards:

A. OSHA – Occupational Safety and Health Administration

B. ANSI – American National Standards Institute

C. ASTM – American Society for Testing and Materials

D. AWS – American Welding Society

E. AISI – American Iron and Steel Institute

F. ASME – American Society of Mechanical Engineers

G. AWWA – American Water Works Association

1.06 SUBMITTALS

A. The Fabricator shall submit shop drawings and material samples for executing the work included herein. These submittals shall conform to the requirements of Section 01300.

B. Shop Drawings

1. Indicate shop and erection details, including cuts, copes, connections, holes, threaded fasteners, welds, gasket materials and accessories. Also include material strengths and grades.
2. Indicate all welds, both shop and field by AWS Welding Symbols A2.4.
3. Provide certifications of all welders that will be performing work on this project. The certifications shall comply with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.

C. Reports

1. The following applies to **stainless steel** specified as ASTM in the PRODUCTS AND FABRICATION:
   The supplier shall furnish **certification of compliance** with the referenced ASTM specification. The certification shall include the Purchase Order number and shall be signed by the supplier's authorized personnel.
2. The Fabricator must provide the Owner with their Positive Material Identification (PMI) Program for review and approval before any fabrication work begins.

1.07 STORAGE AND HANDLING

A. The air headers shall be stored on-site on supports and kept free from sand, water and other debris. Storage shall be such that it is not damaged, dented or bent.

B. All **austenitic stainless steel pipe** shall be protected from exposure and salt water or salt spray during shipment and/or storage.

1.08 WARRANTY

A. The air-header furnished and installed are subject to the two-year warranty requirement.

PART 2 PRODUCTS AND FABRICATION

2.01 MANUFACTURERS

A. Felker Brothers Corporation

B. Bristol Piping Systems.

2.02 STAINLESS STEEL PIPE

A. Pipe: Stainless steel, ASTM A312 304L.

B. Joints: Butt weld except where screw or flanged joints are required adjacent to valves or equipment. Flange joints shall be Van Stone style, 304L SS slip-on type rolled-angle face rings and back up flanges.

C. Fittings: Wrought stainless steel, ASTM A403 ANSI B16.9 for dimensions.

D. Flanges: Welding neck, or slip-on, raised face, ASTM A182, F316L, ANSI B16.5 for dimensions.

E. Gaskets: Full face gasket per ANSI B16.21 non-asbestos hypalon, viton, or Teflon bonded EPDM gasket.

F. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240.

G. Fabricate non-welded parts and pieces from sheets and plates of 304L stainless steel conforming to ASTM A240 or ASTM A276.

H. Fabricate all pipe products in accordance with ASTM A-778 and all fittings in accordance with ASTM A-774, latest edition with dimensional tolerances conforming to ASTM A554.

I. Flanges with butt-welded ends shall be in accordance with ANSI B36.19 for wall thickness, ANSI B16.5 for dimensions, and ANSI B16.25 for beveled edges.

J. The finish for gasket contact faces of flanges shall be in accordance with ANSI B16.5.

K. The maximum heat treatment temperature for the straight grades and “L” grades of austenitic stainless steel pipe shall be 2050° F.

L. Piping materials shall be in accordance with ANSI B36.19.

M. Welding

1. All surfaces to be welded shall be cleaned to remove oils, grease and other contaminants prior to welding.
2. All fabricator welding shall be metal inert gas (MIG), tungsten arcwelding (TIG) or plasma-arc welding inert gas processes.
3. Filler metal shall be of matching composition ER316L and argon or argon-helium gas mixtures shall be used for the root weld and coverage gases.
4. The weld joint shall be beveled, with a land no greater than 0.062”. The joint shall be tack welded using gas TIG along with appropriate protective inert coverage gases.

5. All root pass welds shall be made using the TIG process. Completion of the weld can be made by TIG or the MIG welding process. Inert gas root purge should be maintained for the completion of the weld joint.
6. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of joint.
7. Interior weld beads shall be smooth, evenly distributed with an interior projection not exceeding 1/16" beyond the I.D. of the pipe or fittings.
8. Continuously weld both sides of face rings and flanges.
9. All welders or welder operators shall be certified to meet the requirements of this specification. This shall include all position welding capability, using string bead TIG welding techniques.
10. Welders shall be experienced in the weld fabrication of stainless steel pipe and shall be required to show proof of experience.
11. Welder certification shall be in accordance with ASME Code Section IX. Welder certifications shall be provided by the fabricator when they make their shop drawing submittal.

N. Corrosion Protection and Finishing

1. Pre-clean all outside weld areas to remove weld splatter with the use of stainless steel brushes and/or deburring and finishing grinding wheels.
2. Finish clean to remove all carbon deposits, light oxide films and similar contaminants by full immersion pickling and rinsing, to aid the regeneration of a uniform corrosion resistant chromium oxide film as follows:

    a. Completely immerse all stainless steel assemblies and components in an acid solution as described in Section 6.2.11 of ASTM A380-88. The acid shall be a nitric-hydrofluoric solution as defined in Table A.2.1 of Annex A2 of ASTM A380.
    b. Provide a final thorough rinse using ordinary industrial or potable water and dry in conformance per Section 8.3 of ASTM A380.

3. Corrosion protection techniques not using full immersion methods will not be acceptable.
4. At least two weeks prior to cleaning the piping system the Manufacturer shall notify the Owner/Engineer of the schedule so that the Owner/Engineer can observe the procedure, if desired. If full immersion pickling is not observed by the Owner/Engineer, the Manufacturer shall verify that cleaning has been performed per the above specifications. Non-properly cleaned piping will be cause for rejection of the system.
5. Furnish all nuts, bolts, and washers in 18-8 series stainless steel.
6. Gaskets: Furnish all gaskets necessary to complete the stainless steel pipe installation. Gaskets shall be fiber-reinforced neoprene with a durometer hardness No. 45 to 50 (Shore A).

PART 3 TESTING AND EXAMINATION

3.01 TESTING

A. Hydrostatic Pressure Test

1. Each length of assembly shall be subjected to the **hydrostatic test** in accordance with the ASME/ASTM specification to which the pipe is manufactured or ASTM-A530/ASME-SA530. Where there is a choice in the specification of Hydrostatic Test or other Non-Destructive Examination, Hydrostatic Testing shall be performed. The header assemblies shall be hydrostatic or air tested to a pressure of 25 psi.

B. Radiography

1. A radiography examination shall be performed on 15% of the butt and socket welds. Radiography shall be in accordance with ASTM-E94 with quality level in accordance with ASTM-E142. Acceptance criteria shall be in accordance with ANSI/ASME B31.3 Table 327.4.1A or ASME Section VIII Division 1, UW-51.

C Liquid Dye Penetrant

1. A liquid dye penetrant inspection shall be made for 100% of all welds. Liquid Dye Penetrant in accordance with ASTM-E165 with acceptability of surface flaws in accordance with ASTM-E433. Acceptance criteria for evaluation indications and acceptance shall be in accordance with ASME Section VIII Division 1, Appendix VIII.

END OF SPECIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes the requirements for electric motor operated valve and gate actuators, for the valves specified in Section 15270 and gates specified in Division 11.

1.02 GENERAL

A. Like items of equipment provided hereunder, although for different services, shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturers service, unless specified otherwise.

B. See Conditions of the Contract and Division 1 – General Requirements, which contain information and requirements that apply to the work specified herein and are mandatory for this project.

C. See Division 11, Section 11285 – Slide Gates.

D. See Division 15, Section 15270 – Valves, which contains information and requirements that apply to the work specified herein and are mandatory for this project.

E. See Division 16, Section 16220 – Motors 600 volts and below.

1.03 REFERENCE TO STANDARDS

A. The portions of the work specified in this section shall conform to the following standards, rules, and regulations with modifications and additional requirements as stated in or reasonably inferred from the Contract Documents.

1. AWWA C540: Standard for Power-Actuating Devices for Valves and Sluice Gates.
2. NPFA 70
3. National Electrical Code

1.04 SUBMITTALS

A. Submittals shall be made in accordance with Section 01330 – Submittal Procedures, Division 1 – General Requirements, and Section 15270 – Valves. In addition, the following shall be submitted for each individual actuator.

1. Materials of construction.
2. Dimensional drawings.

3. General arrangement drawing shall show shaft, diameter and key connection.
4. Electrical characteristics of position switches (where applicable).
5. For manual operation of electrically operated valves, provide force requirements for hand wheels, cranks, etc.
6. Full cycle operating time.
8. Electrical wiring diagrams.
9. Motor insulation class.
10. Motor running Full Load Amps (FLA).
11. Details on electronic controls and wiring (4 to 20 ma analog; Profibus network interface, etc.).
12. One set of detailed installation/instructions for each actuator.

1.05 MANUFACTURER'S SERVICES

A. A factory manufacturer's representative for the equipment specified herein shall be present at the jobsite and/or classroom designated by the Owner for a period of time as specified in Division 1, Section 01435 – Manufacturer's Service.

1.06 WARRANTY

A. In addition to the warranty specified in Section 15270 – Valves, the actuator manufacturer shall warrant each actuator for a minimum of 36 months of operation up to a maximum of 42 months from time of shipment. This warranty shall be held in effect regardless of pre commissioning storage conditions in a typical indoor or outdoor environment as long as the actuators are not disassembled or physically abused. This warranty shall be enforced even if special storage procedures (such as the use of plastic bags, desiccants, and the energizing of heaters) are not utilized.

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS:

A. Rotork.
B. AUMA
C. Limitorque

2.02 MUD VALVE ACTUATORS

A. The basis of design for the mud valve actuators has been designed around the AUMA SA multi-turn.
B. The actuator shall be capable of working with the mud valves specified in section 15270 and the electrical requirements within the drawings and Section 16.
C. Gearbox torque and sizing shall be as specified from the mud valve manufacturer.

2.03 ACTUATORS

A. The actuators supplied under this section shall consist of the following basic components:

1. Motor phase and power supply shall be as shown on electrical drawings and specified and incorporate motor, integral reversing starter, local control facilities, and terminals for remote control and indication connections.
2. A device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator.
3. Ability to carry out the setting of the torque, turns, and configuration of the indication contacts without opening or removing any electrical compartment covers.
4. Two-way communication must be possible to facilitate downloading actuator setup.
5. Diagnostic information shall be available from both an integrally mounted display window and through non-intrusive means of reading and writing data to the actuator.
6. Separately sealed terminal compartment to prevent moisture ingress. The primary fuses must be located in the STC for ease of replacement. Terminal identification must be clearly marked as an integral part of the terminal strip.
7. Manual hand wheel with automatic re-set lever for emergency non-power operation. The maximum rim pull must not exceed 80 pounds.
8. Local indicator of valve position. Digital local position indication in 1% increments.
9. Non-Intrusive local electrical control push button/rotary switch for electrical control of valve position.
10. Padlockable Local-remote control selector switch.
11. A drive sleeve and/or spline adapter board and keyed to the shop drawings by the Actuator Manufacturer for four (4) 90-degree positions.

2.04 ACTUATOR GEARING

A. The actuator gearing shall be totally enclosed in an oil or grease filled gearcase suitable for operation at any angle.

B. All main drive gearing must be of metal construction. The gear box must be of ductile iron construction. Aluminum is not acceptable.

C. The drive design should permit the gearcase to be opened for inspection or disasembled without releasing the stem thrust or taking the valve out of service.

D. The actuator gear units shall be lubricated with heavy food grade oil or grease. The lubricant shall be suitable for ambient conditions of minus -40 to +160 degrees F.

E. The actuator lubricant shall be suitable for installation in any position without operational detriment or loss of lubricant.

2.05 ACTUATOR SAFETY FACTORS

A. Gate actuators shall be designed and supplied to provide the safety factors as required by the most current edition of AWWA C540 for the torque values established by the gate manufacturer.

B. Valve actuators shall be designed and supplied to provide the safety factors as

required by the most current edition of AWWA C540 or AWWA C504 for the torque values established by the valve manufacturer.

2.06 ACTUATOR CYCLING

A. The gate actuators shall be designed and supplied to provide the open-closed operating cycle times as listed in the Gate Actuator Schedule.

B. The valve actuators shall be designed and supplied to provide uniform standard open-closed operating cycle times as provided by the manufacturer.

2.07 MOTOR AND MOTOR OPERATIONS

A. For non-butterfly valves, the electric motor shall have minimum Class F insulation, and shall be selected for operation at 104°F ambient temperature for at least 15 minutes or for 2 full valve stroke operations, whichever is greater, at 33% of the maximum dynamic torque required by AWWA C540. The motors should be of an external frame type. The actuator should not require recalibration if the motor is removed or replace.

B. The motors shall be provided with an embedded thermostat on one winding to prevent overheating in excess of insulation Class F limit, with an ambient temperature of 104°F.

C. The actuators shall be provided with an electronic phase detector to automatically correct the phase orientation in the event of reverse motor operation.

D. Three-phase actuators shall furnished with integral single-phase protection.

E. The actuators shall be supplied with an integral reversing motor starter selected to permit the cycle of starts given on the Valve and Actuator Schedule. An integral control transformer shall be provided, sized to supply 120VAC for control of the motor starter, and all other 24VDC power requirements of the actuator.

F. The motor shall be de-energized in the event of stall when attempting to unseat a jammed valve.

2.08 RIM PULL REQUIREMENTS

A. For emergency manual operation of valves and gates, the gear box gearing shall be selected so that the rim pull requirements will meet AWWA C504 and C540 without exceeding an 80-pound maximum, with the following size and hand wheel diameter relationship listed below.

B. Maximum Gate Hand Wheel Diameter: 18”

C. Valve size and rim pull requirements are as follows:

VALVE SIZE	MAXIMUM HAND WHEEL DIAMETER
12" or Less	12"
14" and Larger	24"

2.09 ACTUATOR CONTROLS

A. The actuators shall be provided with integral local-remote switch. This control shall permit operation from either a local push button/rotary switch installed on the actuator, or from remote locations. The remote locations (if used) shall be connected to the actuator by a twisted pair of conductors and shall be of a digital communication type or conventional hard wiring (multiple conduit wire cable). All local controls shall be non-intrusive in design.

B. The actuators shall permit selection of either momentary contact for maintained operation, or non-maintained contact (jogging or inching) control operation. These two modes of operation shall be field selectable without removal of the actuator covers for local and remote operation.

C. The actuators shall be provided with a handwheel for manual operation in the event of a power failure, or other emergency. The handwheel shall be declutchable and shall be automatically disengaged upon electrical rotation of the drive motor, preventing injury to operating personnel. Engagement of the manual drive or reengagement of the motor drive shall not cause damage to the actuator – even with the motor running,

The manual drive shall be completely independent of the electric drive such that the failure of any one gear shall not result in the loss of both electric and manual operation.

D. The actuators shall be stopped at the extreme open or close positions by either position contacts or by torque limit sensor and contacts. The type of position control motor shutdown shall be selected consistent with the valve or gate type and without removing actuator covers.

E. The position contacts (switches) shall be positively controlled by a gear mechanism, and shall be pre-set by the valve or gate manufacturer when the actuator is mounted. These position contacts shall be field adjustable and non-intrusive. The position detection electro-mechanical, and shall offer repeatability of 0.10% of valve shaft rotation, or better.

F. The valve torque detection mechanism will be electro-mechanical. Torque indication base on motor current is not acceptable. The torque limits values shall be set when the actuator is mounted, and shall be field adjustable. Mechanical torque springs shall be replaceable without the removal of the actuator.

G. The actuators shall be provided with an interrupter-timer operation mode to reduce opening/closing speed. In this mode the motor 'on' and 'off' time periods shall be user-adjustable over any selectable portion of the stroke. Interrupter function shall be active for both local and remote control.

2.10 REMOTE POSITION/ACTUATOR STATUS INDICATION

A. In the event of a power loss or failure, the position contacts and local display must continue to operate. 24 volt control which provides feedback will not continue to work, this will require an auxiliary power supply by others.

B. The actuator must utilize an encoder directly geared to the drive mechanism for position. A position encoder dependent upon battery backup is not permissible.

C. The position of the actuator and valve must be updated contemporaneously, even when the power supply is not present if an incremental encoder is utilized.

1. Four contacts shall be provided with an option for an additional three (total of seven) that can be selected to indicate any position of the valve/gate with each contact selectable as normally open (NO) or normally closed (NC). The contacts shall be rated at 5A, 120V AC, 30V DC.
2. As an alternative to providing position, any of the four (option for eight) above contacts shall be selectable to signal one of the following:

    a. Opening and Closing
    b. Moving (Continuous or Pulsing)
    c. Motor Running
    d. Motor Stalled
    e. Open or Close Interlock Active
    f. ESD Active
    g. Motor Tripped on Torque in Mid-Travel
    h. Motor Tripped on Torque Going Open
    i. Motor Tripped on Torque Going Closed
    j. Pre-Set Torque Exceeded
    k. Thermostat Trip
    l. Lost Main Power Phase
    m. Customer 24V DC or 24 V AC Supply Lost
    n. Battery Low (if battery included)
    o. Actuator Alarm
    p. Valve/Gate Alarm
    q. Control Alarm
    r. Local Stop
    s. Local Selected
    t. Remote Selected
    u. Blinker

3. Provision shall be made in the design for the addition of a contact-less transmitter to give a 4-20mA analog signal corresponding to valve travel for remote indication when required.
4. Provision shall be made in the design for the addition of a current torque transmitter (CTT) to provide a 4-20mA signal corresponding to valve torque demand for remote indication when required.

2.11 LOCAL POSITION INDICATION

A. The actuator shall provide a local display of the position of the valve/gate, even when the power supply is not present. The display shall be able to be rotated in 90 degree increments in order to provide easy viewing regardless of actuator mounting position.

B. The local display should be large enough to be readable from a distance of six (6) feet when the actuator is powered up.

C. The actuator shall include a digital position indicator with a display from fully open to fully closed in 1% increments. Red, green, and yellow lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained even when the power to the actuator is isolated.

2.12 INTEGRAL STARTER AND TRANSFORMER

A. The reversing starter, control transformer, and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation buildup.

1. For ON/OFF service, this starter shall be an electromechanical or solid-state type suitable for 60 starts per hour and of a rating appropriate to the motor size.
2. For a modulating duty, a solid-state starter shall be supplied that is suitable for up to a maximum of 1,200 starts per hour.

B. The controls supply transformer shall be fed from two of the incoming three phases. The primary and secondary windings shall have short circuit and overload protection. It shall have the necessary tappings and be adequately rated to provide power for the following functions:

1. 24V Dc output, or alternate 110V AC output, where required for remote controls.
2. Supply for all the internal electrical circuits.

2.13 INTEGRAL PUSH-BUTTONS AND SELECTOR

A. The necessary wiring and terminals shall be provided in the actuator for the following controls:

1. Connections for external remote controls fed from an internal 24V DC supply and/or from an external supply of 208 volt, 3 phase, 60 Hz to be suitable for any one or more of the following methods of control:

a. Open, Close and Stop

b. Open and Close
c. Overriding Emergency, Shutdown to Close (or Open) Valve from a selectable “Make” or “Brake” Contact
d. Two-Wire Control, Energize to Close (or Open), De-Energize to Open (or Close)

2. Selection of maintained or push-to-run control for modes (A) and (B) above shall be provided and it shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of approximately 300 ms.
3. Each motor actuator shall include factory-installed Profibus Network Interface.
4. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 2.0kV.

2.14 MONITORING & DIAGNOSTICS FACILITIES:

A. Facilities shall be provided for monitoring actuator operation and availability as follows:

1. Monitor (availability) relay, having one change-over contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the "Remote" position and thermostat is not “tripped” to indicate that the actuator is available for remote (control room) operation.
2. Where required, it shall be possible to provide indication of thermostat trip and "Remote" selected as discreet signals.
3. Provision shall be made to display valve torque demand as a percent of rated actuator torque and position simultaneously, in order to facilitate valve trouble shooting and diagnostics.

2.15 WIRING AND TERMINALS

A. Internal wiring shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and three-phase power. Each wire shall be clearly identified at each end.

B. The terminals shall be embedded in a terminal block of high tracking resistance compound.

C. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal.

D. The terminal compartment of the actuator shall be provided with a minimum of three threaded cable entries.

E. All wiring supplied as part of the actuator shall be contained within the main enclosure for physical and environmental protection. External conduit connection between components are not acceptable.

F. Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards.

G. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

1. Serial Number
2. External Voltage Values
3. Wiring Diagram Number
4. Terminal Layout

2.16 ENCLOSURE

A. Actuators shall be 'O' ring sealed, watertight to NEMA 6, and shall at the same time have an inner watertight and dustproof 'O' ring seal between the terminal compartment and the internal electrical elements of the actuator fully protecting the motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling.

B. Enclosure must allow for temporary site storage without the need for electrical supply connection.

C. Enclosures shall included, at a minimum, a thermostatically controlled space heater.

2.17 ACTUATOR TYPES

A. Mud Valves: Installation for valves shall be coordinated with the valve manufacturer for rising/non-rising stem, torque and other requirements.

B. Open-Close: Typically on isolation valves which are fully open or fully closed.

C. Position Open-Close: Typically on throttling valves which are opened to a pre-determined position or closed.

D. Position: Typically on gates which can be infinitely positioned between open and closed but not modulating.

PART 3 EXECUTION

3.01 DELIVERY OF EQUIPMENT

A. The valve actuators supplied under this section shall be delivered to the valve manufacturer in the manner described in Section 01600 – Product Requirements.

B. The valve actuators supplied under this section shall be installed on its accompanying valve listed in the Valve and Actuator Schedule, by the valve manufacturer as specified in Section 15270 – Valves.

3.02 INSTALLATION

A. Following installation of the valves and actuator assemblies, by the Contractor, the valve and actuator manufacturers shall jointly activate, test, de-bug, make any and all adjustments and/or repairs necessary to the equipment furnished. The valve and actuator manufacturers shall demonstrate operation and provide operator training as specified in Section 01435 – Manufacturer's Services.

B. The valves and actuators assemblies will be installed by the Contractor in the open, exposed to the full range of unprotective environmental conditions, for up to 18 months before the normal operating 480V power supply is connected.
The actuator's electrical and electronic components, shall be either installed in an enclosure which will prevent damage from the temperature range that can be expected, and from both external moisture, and internal condensed moisture, or the actuators shall be provided with thermostatically controlled electric heaters to prevent damage from condensed moisture, and/or low temp supply.

3.03 FINISHES

A. All actuator assemblies supplied under this section shall receive finishes that are in accordance with the actuator manufacturer's standard finish.

3.04 MANUFACTURERS SERVICE AND CERTIFICATES

A. Provide manufacturer's service in accordance with Section 01435 – Manufacturer's Services, Division 1 – General Requirements.

B. Provide manufacturer's certificate(s) in accordance with Section 01330 – Submittal Procedures of Division 1 – General Requirements.

END OF SECTION 15277

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This work includes connection to existing sprinkler riser, complete wet pipe fire protection system as described by National Fire Codes, and all applicable sections and State and local codes, and design by hydraulic calculations, of sprinkler mains, branch lines, sectional valves, and sprinkler head locations based on water flow densities shown on the drawings.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 15050 - Basic Mechanical Materials & Methods
2. Section 15064 - Sleeves, Supports, Hangers, Anchors and Seismic Control
3. Section 15100 - Plumbing

1.03 REFERENCES

A. NFPA

1.04 SUBMITTALS

A. Submit in accordance with Division 1.

B. Product Data:

1. Sprinkler Heads
2. Pipe and Fittings
3. Valves and Switches
4. Pipe Hanger and Supports

C. Shop Drawings:

1. Hydraulic Calculations
2. Sprinkler Head and Piping Design

D. Record Drawings: Prepare and submit 5 set of record drawings to Construction Coordinator

1. The drawings shall include all information as required by NFPA 13.

2. The drawings shall also show the system as installed including all deviations from the approved shop drawings.
3. The drawings shall be on uniform size sheets no smaller than the contract drawings.
4. Final testing shall be conducted only after receipt of the as-built drawings.

E. Operation and Maintenance Manuals: Submit operation and maintenance manuals for pumps, valves, pressure switch and all related devices and specialties.

1.05 QUALITY ASSURANCE

A. Manufacturer shall have no less than five (5) years' experience.

B. Conform to State and local codes.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site per manufacturer's recommendations.

B. Protect installed components from damage by securing areas and by leaving factory packaging in place.

1.07 EXTRA MATERIALS (SPARE PARTS)

A. Provide spare sprinkler heads, wrench and cabinet as required by NFPA 13.

PART 2 PRODUCTS

2.01 PIPE

A. Steel Pipe:

1. ASTM A120 or ASTM A53, Schedule 40.
2. Uncoated black pipe unless otherwise noted.
3. Joints

a. Screwed, ANSI B2.1.
b. Welded, ANSI B31.10.
c. Flanged, ANSI B16.5.
d. Mechanical Joints

i. UL Listed or FM approved.
ii. Mechanical grooves couplings or push-on couplings, ASTM A-47.

2.02 VALVES

A. Provide valves in accordance with NFPA 13 and NFPA 24 and as follows:

1. All valves shall be suitable for working water pressures as scheduled. All valves shall open by counterclockwise rotation.
2. Riser and sectional control valves shall be iron body, bronze trim, approved OS&Y type.
3. Each interior control valve shall be provided with adequate means for mounting an electrical supervisory contact unit.
4. Drainage and test valves shall be all-bronze, glove, angle, or gate valves.
5. Check valves 2 inch and smaller shall be all-bronze with screwed ends. Check valves 2-1/2 inch and larger shall be iron body, brass mounted with flanged ends and non-ferrous metal set rings and bearings. Check valve in the fire department connection piping shall have a ball drip with discharges to the outside of the building. Check valves shall be flanged clear opening swing-check type with flanged inspection and access cover plate.

2.03 FITTINGS

A. Provide fittings in accordance with NFPA 13, 14 and 20 and suitable for working pressure as scheduled. Provide fitting for changes in direction of piping and for all connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.

2.04 PIPE SYSTEM WORKING PRESSURES

A. All pipe, valves, and fittings shall be provided suitable for water pressures of 175 psi.

2.05 PIPE AND HANGER SUPPORTS

A. Provide pipe supports, sway braces, hangers, and clamps conforming to NFPA 13 and listed by UL or approved by FM.

2.06 SPRINKLER HEADS

A. All heads shall have the following features:

1. Heads shall be heat responsive automatic type listed by UL and be FM approved.
2. 155 degrees fusible element. Provide higher temperature for heads located in danger zone as defined in NFPA Number 13 and FM 2-8.
3. Nominal 1/2 inch orifice. Standard brass body. Style as specified for the particular type.
4. Pattern, body deflectors capable of flowing Q = K times square foot of P, in which Q = U.S. gallons per minute water delivery through an open sprinkler head. K = 5.3 - 5.8, dimensional constant. P = Pounds per square inch residual gauge pressure at point of attachment of head inlet to pipe nipple or pipe fitting.

5. Capable of remaining closed and leak-proof at temperatures less than 155 degrees against 100 psig pressure.

B. Type A, Glass Bulb Upright:

1. Acceptable Manufacturer - Viking Model M or approved equal.
2. Liquid filled frangible glass capsule style fusible element.
3. Upward spray pattern against deflector having edges cupped downward.
4. Wax over polyester coating on brass, bronze or other copper alloy body.
5. 1/2 inch male N.P.T.

C. Spare Sprinkler Heads:

1. Provide one metal cabinet containing a stock of spare sprinkler heads, 6 per type and rating installed. Cabinet shall be in an approved location where the temperature will not exceed 100 deg. F.
2. Furnish in original shipping containers with identifying labels, twelve spare sprinkler heads and one installation tool of each type.

2.07 WATERFLOW DETECTORS AND FLOW SWITCHES

A. Acceptable Manufacturers - Viking Model Number BH-1001 or approved equal.

B. Provide a waterflow detector immediately downstream from each zone isolating control valve. Such indicators shall have the following features:

1. Listed by UL.
2. Detects sustained flow of water into zone.
3. Pipe insertion type. Flow detecting element in pipe, but no water in indicator chamber.
4. Element detects flow and actuates electric switch through time delay mechanism.
5. Adjustable time delay in 0 to 90 second range. Initial factory setting: 35 and 45 seconds.
6. Single pole double throw microswitch for 120V/60Hz/10/ rated for 2 amps.
7. Annunciator, alarms and alarm relay specified in Section 16721 - Fire Alarms.
8. Install a 24 inch minimum downstream from zone isolating valve or pipe fitting, and in accordance with manufacturer's standards.

2.08 SUPERVISORY (TAMPER) SWITCHES

A. General: Provide a tamper switch for each interior sprinkler system control valve. Tamper switches shall be UL listed as "Extinguishing System Attachment" for the location and type of valve supervised. Tamper switches shall be double pole, double throw. Operation of the switch shall cause a supervisory signal to be transmitted to the fire alarm control panel upon not more than two complete turns of the valve wheel or a closure of ten percent, whichever is less.

2.09 WATER PRESSURE GAUGES

A. Standard Bourdon style.

B. Dial diameter 3 inches to 3-1/2 inches.

C. Range 0 - 300 psi with no stop at 0.

D. Brass case.

E. Replaceable glass dial cover.

F. Black numerals on white face.

G. 1/4 inch male N.P.T. connection.

2.10 COMBINATION CHECK/ALARM VALVE

A. Acceptable Products: Viking Model E or approved equal.

B. Listed by UL and Factory Mutual approved as a fire protection wet sprinkler system supervisory control device and for operation in a vertical pipeline, flow upward, with a check against downward flow.

C. Designed and fabricated for at least 175 psig cold water working pressure, 350 psig test pressure.

D. Cast iron body, bronze mounted. Moving parts, bushings and bearing of brass, bronze, stainless steel, rubber or neoprene. Bronze seat ring; rubber or neoprene faced disc ring.

E. Flanged ends, ANSI 16.1 Class 125. 1/16 inch thick full ring flange gaskets.

F. Tapping bosses integrally cast with valve body, with shop-tapped N.P.T. openings as follows:

1. 1 above and 1 below valve seat, for pressure gauges.
2. 1 above seat, for main drain.
3. 1 above seat, for connection to retarding chamber.
4. 1 below seat, for alarm test connection to retarding chamber.

G. Size same as connected pipeline indicated on Drawings.

2.11 ALARM RETARDING CHAMBER

A. Acceptable Products - Viking Model B-2.

B. Water holding tank expressly designed and manufactured for use between a fire protection wet sprinkler system check/alarm valve and a pressure actuated alarm switch, to reduce the possibility of false alarms due to instantaneous surges of flow or pressure.

C. Listed by UL and Factory Mutual approved.

D. Capacity approximately 2 gallons.

E. Corrosion resistant interior coating not deleterious to potable water.

F. Designed and manufactured for at least 150 psig cold water working pressure, 300 psig test pressure.

G. 3/4 inch NPT inlet, outlet and drain. Restricted orifices on inlet and outlet, sized and correlated to allow minor flow into chamber from system side of check/alarm valve, and bleed a lesser quantity to drain, so that chamber pressure does not increase significantly unless check/alarm valve opens widely in response to open sprinkler heads.

PART 3 EXECUTION

3.01 SPRINKLER SYSTEM

A. Provide a complete wet pipe automatic sprinkler fire protection system for all areas of the buildings except for the areas shown otherwise. The fire protection system shall be designed and installed in accord with all applicable sections of the National Fire Codes, State and Local Codes.

1. The Sprinkler Contractor shall field verify the available water flow and pressure at the utilities water connections.
2. Locations and quantity of fire equipment, piping and sprinkler heads are general and schematic in nature. The Sprinkler Contractor by design and field coordination shall establish exact location and quantity of sprinkler components and sprinkler system.
3. Sprinkler heads shall be located in the center of the ceiling tiles.

B. Drain and Test Connections

1. Each fire protection water pipeline drain connection shall consist of:

a. Pipeline tie in zone supply riser or equivalent header. Threaded, flanged, or mechanical coupling ends on running ends of tee, appropriate for the particular riser or header. Threaded side outlet of tee, N.P.T. standard.
b. Drain pipe and angle valve connected to tee side outlet.

Riser or equivalent Header Pipe Size	4" and larger	3-1/2" to 2-1/2"	Less than 2-1/2"
Tee Side Outlet, Pipe Nipple, Angle Valve and Drain Pipe Size	2"	1-1/4"	3/4"

c. Angle Valve: Brass body, brass mounted, male N.P.T. ends, handwheel operated, open counterclockwise, vandal-protected removable handwheel.
d. Drain Pipe: Material and method of jointing same as used throughout system.

2. Test Connection

a. Provide test connection at the end of each section of the sprinkler system.
b. Test pipe shall be 1 inch diameter terminating in a smooth bore, 1/2 inch brass valved outlet, discharging to the atmosphere or through a suitable air gap to the drainage system.

C. Pipe: Install piping as shown on the drawings and as determined by design in accordance with NFPA 13 and NFPA 14. Provide total sprinkler system not to exceed 110 percent of the required flow. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

D. Support of Piping

1. Provide hangers to securely support fire protection piping from building structure.
2. Hangers shall have a minimum load-carrying capacity of the weight of the water-filled piping plus two hundred-fifty (250) pounds applied at the point of support.
3. Location and installation of hangers shall comply with NFPA Number 13.

E. Sprinkler Heads: Space, locate and position sprinkler heads in accordance with NFPA 13.

F. Sleeves: Provide standard weight steel pipe sleeves for pipes passing through walls, floors, and partitions.

1. Sleeves through walls in finished spaces shall be flush.
2. Where located in the floor construction the sleeves shall project not less than 2 inches above the floor line.
3. For firestopping, refer to Section 15050, "Basic Materials and Methods."

G. Escutcheons: Provide escutcheons for pipes passing through walls, partitions, or suspended type ceiling.

1. Escutcheons shall be provided where pendant sprinkler heads penetrate ceilings or sidewall heads penetrate walls.
2. Escutcheons shall be chrome plated steel.

H. Accessories: Provide all test and drain lines as required by NFPA 13. Provide pressure gauges, signs, and other such appurtenances as required for a complete installation in accordance with NFPA 13. Provide nameplate data sign at the main controlling valve to identify the system as a hydraulically designed system indicating the location and basis for design in accordance with NFPA 13.

1. Provide signs at inspector's test valve, drain valve, alarm test, and alarm bypass valves.
2. Construct labels and nameplates in conformance with Section 15050 "Basic Materials and Methods".

I. Drain: Connect all drain piping to outlets as indicated.

1. All sprinkler piping shall be so installed that it can be thoroughly drained, and where practicable shall be arranged to drain at the main drain valve.
2. The main drain valve shall be capable of a full discharge test without allowing water to flow onto the floor.
3. All drips and drains shall conform to NFPA 13.

J. Inspector's Test Valve: Provide inspector's test valve in accordance with NFPA 13, supplied from the highest and most remote part of the system in relation, to the riser assembly, and discharged to the outside of the building or to a building drain. Install test valves conveniently accessible within 7 feet of floor.

3.02 SPRINKLER GUARDS AND WATER SHIELDS

A. Provide guards on sprinklers within 7'-0" of finished floor or wherever sprinklers may be subject to mechanical damage.

3.03 TESTING

A. Final Inspection and Testing: Advise when hydrostatic and alarm test have been completed and all necessary corrections made, so as to permit final inspection and testing.

1. At the final inspection, a material and test certification shall be provided in accordance with NFPA 13.
2. The final tests shall be performed in the presence of the Architect/Engineer representative and the local fire authority.
3. Final inspection shall include fall flow testing through both the main drain and the inspector's test connection.
4. Provide all equipment, services, and labor to properly perform and supervise required tests.

END OF SECTION 15300.

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The extent of the work as required by the drawings and these specifications. This section includes the requirements to furnish and install the following plumbing equipment:

1. Water Heaters.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 15100 – Plumbing.
2. Section 15120 – Plumbing Specialties.
3. Division 16 - ELECTRICAL

1.03 REFERENCE TO STANDARDS

A. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Product Data:

1. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Provide electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions.

1.05 QUALITY ASSURANCE

A. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).
2. American Society of Mechanical Engineers (ASME).

3. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
4. National Electrical Manufacturer's Association (NEMA).
5. Underwriters Laboratories (UL).

B. Manufacturer shall certify to not less than five (5) years in the manufacture of items specified under this section.

C. Perform work in strict accordance with State and local Plumbing Codes.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site in accordance with manufacturer's instructions.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 COMMERCIAL ELECTRIC WATER HEATER, WH-1

A. Manufacturers:

1. Smith, Model DEN
2. Rheem
3. State
4. Lochinvar

B. Type: Automatic, electric, vertical storage tank.

C. Performance:

1. Storage: 100 gal. capacity
2. Heating Element Size: 9kw, zinc plated copper
3. Number of Immersion Heaters: 5
4. Minimum recovery rate: 205 gph with 90 degrees F temperature rise
5. Maximum working pressure: 150 psig

D. Tank: Glass lined welded steel, thermally insulated with foam insulation and encased in corrosion-resistant steel jacket, baked-on enamel finish.

E. Controls: Immersion style thermostat, magnetic contactors, element fusing per N.E.C., temperature range adjustable from 110 to 170 degrees F. Limit switches which require manual reset.

F. Flanged, or screwed-in nichrome elements, enclosed controls and electrical junction box.

G. Unit shall be UL listed and approved by the National Sanitation Foundation

H. Accessories:

1. Brass water connections and dip tube, drain valve
2. Cathodic protection by a high density magnesium anode
3. ASME rated, self-enclosing temperature and pressure relief valve (Watts, Blue Ribbon model, or equal)
4. Vacuum relief valve

2.02 COMMERCIAL ELECTRIC WATER HEATER, WH-2

A. Acceptable Manufacturers – Subject to compliance with specifications:

1. Model ELSF-10
2. Fheem
3. State
4. Lochinvar

B. Type: Automatic, electric, vertical storage

C. Performance:

1. Storage: 10 gal. capacity
2. Heating Element Size: 1.5 k2, zinc plated copper
3. Number of heating Elements: 1
4. Minimum recovery rate: 6.8 gph with 90 degrees F temperature rise
5. Maximum working pressure: 150 psig

D. Tank: Glass lined welded steel, thermally insulated with foam insulation and encased in corrosion-resistant steel jacket; baked-on enamel finish.

E. Controls: Automatic water thermostat, temperature range adjustable from 110 to 170 degrees F.

F. Flanged, or screwed-in nichrome elements, enclosed controls and electrical junction box.

G. Accessories: Brass water connections and dip tube, drain valve, high density magnesium anode, ASME rated, self-closing temperature and pressure relief valve (Watts, Blue Ribbon model, or equal).

2.03 EXPANSION TANKS

A. Acceptable Manufacturers

1. Amtrol
2. Bell & Gossett
3. Wessels
4. Armstrong

B. Provide prepressurized, diaphragm type expansion tank suitable for domestic water systems constructed for 125 psig working pressure. Tank shall be ASME unfired pressure vessel labeled.

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

A. General:

1. Coordinate with plumbing piping and related work to achieve operating system.
2. Flushing: After piping, valves and accessories are connected, but prior to startup and testing, flush heater unit under full system pressure.
3. Upon completion of testing and adjusting, clean parts of heater units to remove grease, sludge, and foreign substances.
4. Extend relief valve discharge full size to floor drain or service sink. Do not create trip hazard.
5. Rigidly bracket all drain pipes to heater or wall.
6. Provide 4” high square concrete housekeeping pad under water heater extending 3” past sides. Safe pan required unless installed on a slab on grade.
7. Provide dielectric unions, shut off valves, and thermometers on both supply and discharge piping.
8. Provide a vacuum relief valve at in the supply water pipe to the unit.
9. Provide a thermal expansion tank in the supply water pipe to the unit.

B. Electric Water Heater

1. Install water heater in accordance with manufacturer’s instructions and to NEC requirements.
2. Provide disconnect switch at unit.
3. See Division – 16 ELECTRICAL specifications.

END OF SECTION 15400

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This section includes requirements to furnish and install the following plumbing fixtures:

1. Water Closets.
2. Lavatories.
3. Service Sinks.
4. Sinks.
5. Urinals.

1.02 RELATED WORK

A. Specified Elsewhere:

1. Section 15100 – Plumbing.
2. Section 15120 – Plumbing Specialties.
3. Section 15400 – Plumbing Equipment.

1.03 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.

D. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).

E. IAPMO/ANSI Z124.2 - Plastic Shower Receptors and Shower Stalls.

F. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, carriers, trim, and finishes.

C. Manufacturer's Installation Instructions.

D. Maintenance Data: Include fixture trim exploded view and replacement lists.

1.05 QUALITY ASSURANCE

A. Manufacturer shall have no less than five (5) years experience.

B. Conform to State of Illinois Plumbing Code.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site per manufacturer's recommendations.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.07 EXTRA MATERIALS (SPARE PARTS)

A. Provide two of each model faucet washers or valve repair kits, and two of each model flush valve service kits.

PART 2 PRODUCTS

2.01 WATER CLOSETS, WC-1

A. Bowl

1. Acceptable Manufacturers:

a.	American Standard	2257.103 “Afwall”
b.	Gerber	25-030 “Ultra Flush”
c.	Kohler	K-4330
d.	Eljer	111-1505 “Auburn”
e.	Crane	3-446E “Placidus”
f.	Zurn	Z 5610

2. ANSI/ASME A112.19.2; White vitreous china elongated bowl, wall hung, back outlet. Siphon jet flushing action with water saving (1.6 gallon) flush design. 1-1/2 inch top spud, 1-1/2 inch supply drop pipe. Passageway for 2-1/4 inch sphere, minimum. Exposed pipe, valves, fittings shall all be chromium plated.

B. Flush Valve

1. Acceptable Manufacturers:

a.	Sloan	Royal 8115
b.	Zurn	ZER 6000 AV-2-CPM
c.	Delany	

2. ASME A112.18.1; Chrome plated, exposed diaphragm type flush valve with vacuum breaker and screw driver stop with protective cap, escutcheon and two wall bumpers. Valve must be set with centerline of supply 24 inches above top of fixture. Maximum 1.6 Gallons per flush cycle.
3. Valve shall be sensor type with DC motor actuator, battery powered automatic sensor. Actuator shall have push button override.

C. Seat

1. Acceptable Manufacturers:

a. Bemis
b. Church
c. Olsonite
d. Beneke
e. Zurn Z5955SS-AM-STS

2. Solid white, anti-microbial plastic, elongated type, open front, extended back, handicapped seat, top of seat at 17” to 19” above finished floor, with self-sustaining stainless steel check hinge, brass bolts, less cover. Maximum thickness 1-1/2 inches.

D. Wall Mounted Carrier

1. Acceptable Manufacturers:

a. Jay R. Smith.
b. Josam.
c. Zurn.
d. Wade.

2. ANSI/ASME A112.6.1; single or double, horizontal or vertical, right or left hand, as required by the floor and/or wall construction, cast iron construction adjustable type suitable for no hub installation, adjustable back anchor foot, leveling device, body length as required, required 2 and 4 inch inlets, heavy duty ABS closet couplings, adjustable feet, adjustable face plate, bowl saver nuts, and one-piece chrome plated washer/nuts and integral test cap and closet gasket.
3. Carrier shall be suitable for blow or siphon jet fixture as required. All anchorage points to be securely bolted to floor with drilled-in steel expansion anchors. Grout all carriers into concrete masonry walls. When dimension from the plate to finished wall exceeds manufacturer's recommendations, additional rod support feet shall be provided.

2.02 WALL HUNG LAVATORY, LAV-1

A. Basin

1. Acceptable Manufacturers:

a. American Standard Lucerne 0356.015

b.	Eljer	Delwyn 051-1848
c.	Kohler	Greenwich K-2030
d.	Gerber	Monticello 12-458
e.	Crane	Norwich 1H American Standard
f.	Zurn	Z5341

2. ANSI/ASME A112.19.2; 20 inch x 18 inch white vitreous china body. Single hole faucet penetrations. Rigid chromium plated supply pipes. Chromium plated angle stop valve on each supply pipe. Grid drain with perforated strainer and chromium plated, cast brass, 1 1/4" offset tailpiece and P-trap. Mounting height at each location is dimensioned on the Architectural Drawings, or as directed by the Architect/Engineer.

B. P-Trap and Supply Pipe Insulation

1. Acceptable Manufacturers:

a.	Truebro	Lavguard
b.	Brocar	Trap Wrap
c.	McGuire	Pro Wrap
d.	TCI Products	Skal Gard
e.	Zurn	Z8946-3-NT

2. Drain and supply pipes shall be covered with protective pipe covering. Covering to be molded, anti-microbial, closed cell vinyl. Supply pipe covers shall give access to angle stop valve handles without damaging covers.

C. Faucet

1. Acceptable Manufacturers - Subject to compliance with the specifications:

a.	American Standard	#2385.003	Reliant+
b.	Chicago Faucet		
c.	Elray		
d.	T & S Brass		
e.	Moen		
f.	Zurn	Z7440-CST-HS	

2. ASME A112.18.1M; All metal construction, stainless steel, deck mounted, single lever handle lavatory faucet less waste, with plug button in lift rod hole, 3/8” O.D. copper inlets and vandal resistant 0.5 gpm water economy aerator.

2.03 SERVICE SINK, SS-1

A. Basin

1. Acceptable Manufacturers:

a.	Kohler	Bannon K-6714
b.	Eljer	Rollins 242-0150

c. Gerber
d. Crane

2. 22” X 18” enameled cast iron service sink with drilled back for faucet. Faucet holes shall be 8” on center. Sink shall be supplied with wall hanger and stainless steel rim guard. Sink shall be furnished complete with 3” trap standard with cleanout plug and shower.

B. Faucet

1. Acceptable Manufacturers:

a.	Chicago Faucet	305-VB-R
b.	T & S Brass	
c.	Royal Brass	

2.04 EMERGENCY SHOWER / EYE WASH

A. ESH-1

1. Acceptable Manufacturers:

a.	Haws Co.	8317
b.	Bradley	S19-310GG
c.	Chicago Faucet	

2. Provide combination emergency shower/eyewash unit. Shower shall have 10" diameter ABS plastic shower head. Eye/face wash shall be of corrosion resistant stainless steel and have double gentle flow eye/face wash heads with dust covers. Shower valve shall be 1" IPS non-self-closing with 8" diameter, pull ring and rod. Eye wash valve shall be instant action non-self-closing valve activated by stainless steel push flag. Eyewash shall have dual automatic pressure compensating devices to assure steady water flow. 14" x 3-1/2" aluminum sign designed for wall mounting; sign to read “EMERGENCY SHOWER AND EYEWASH".

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions. Plumbing fixtures shall be set and connected to soil, waste, and vent and cold and hot water supplies in a neat,

finished and uniform manner, in accordance with state and local plumbing codes.

B. Install components level and plumb. Fixtures of each class and the connection to some shall be of equal height, plumb and at right angles to the wall unless otherwise directed.

C. Install and secure fixtures in place with wall carriers and bolts.

D. Seal fixtures to wall and floor surfaces with non-hardening sealant, color to match fixture.

E. Caulk cast iron flange to soil or waste pipe. Seal joint with beeswax gasket with horn. Do not use putty.

F. Fixture traps, easily removable for servicing and cleaning, shall be installed on every plumbing fixture except those having integral traps. Unless otherwise indicated on the drawings, a combination fixture need have only one trap if one compartment is not more than 6 inches deeper than the other and the waste outlets are not more than 30 inches apart.

G. Type of fixture trap shall be water-seal, self-cleaning "P" trap. Trap water seals shall be not less than 2 inches and not more than 4 inches. Each trap, except integral traps or those that are readily removable, shall have an accessible brass cleanout of ample size, protected by the water seal.

H. The nominal size of each fixture trap shall be same as the fixture drain to which it is connected. The size of the fixture drain for fixtures with integral traps shall not be smaller than the fixture outlet.

I. Exposed pipe connections under pressure shall be iron pipe size seamless tubing, capable of withstanding a working pressure of 100 psi. Each connection to faucet shall be provided with an air chamber of full pipe diameter and not less than 12 inches long.

J. Fixture trim, traps, faucets, escutcheons, and waste pipes that are exposed to view shall be brass with polished chromium plating over nickel finish. Exposed supplies shall be brass pipe plated in the same manner.

K. All faucets shall have metal indices; be of one pattern, design, or compression type with the replaceable seats; and be of the same size as the supply pipes to the fixtures.

L. On each supply line to each fixture provide IPS chrome plated brass nipple through wall with escutcheon plate and angle type loose-key or screwdriver stop. Stops shall have screwed inlets.

M. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons at all piping penetrations through floors, walls, and ceilings.

N. Anchor piping securely in wall or wall space to prevent damage when supply nipples are installed or removed and to prevent vandalism to exposed piping and flush valves.

O. Flush valves shall withstand 100# pull in all directions. Flush valves shall be diaphragm type, with vacuum breaker.

P. Establish 1/4" clearance between shower floor and building wall. The entire area between the receptor and the building floor has a 1/2" layer of mortar in order that the shower floors be level. Accessible shower basins must have ADA compliant threshold.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Coordinate faucet locations in epoxy resin counter tops with general work.

3.04 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.05 CLEANING

A. After plumbing fixtures have been installed, the fixtures and trimmings shall be thoroughly cleaned of all grease, oil, dirt, labels and stickers, and other foreign matter, and all packing materials shall be promptly removed from the premises.

3.06 PROTECTION OF FINISHED WORK

A. All work shall be maintained in clean and proper operating condition until accepted by the Construction Coordinator.

3.07 FIXTURE HEIGHTS

A. Install fixtures to heights above finished floor as indicated on architectural drawings.

3.08 FIXTURE ROUGH-IN SCHEDULE

	Hot Water	Cold Water	Waste	Vent
Lavatory:	1/2 inch	1/2 inch	1-1/4 inch	1-1/4 inch
Water Closet (Flush Valve):		1 inch	4 inch	2 inch
Emergency Shower		1 1/4 inch (Tempered)		
Hose Bibb		3/4 inch		

END OF SECTION 15410

PART 1 GENERAL

1.01 DESCRIPTION

A. Work under this section includes, but is not limited to furnishing and installing a factory built skid mounted duplex booster pumping station as shown on the project drawings, indicated herein, and as necessary for a complete and operational system.

1.02 RELATED WORK

A. Section 15260 – Process Piping
B. Division 16 - Electrical

1.03 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Factory System Test

1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, and rated horsepower. Factory operational test shall simulate actual performance anticipated for the complete station.

E. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

F. Manufacturer's Start-up Services

1. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.
2. When discharge piping, electrical connections, and electrical inspection have been completed, the pump station representative shall be contacted for start up. A minimum one-week notice shall be given to manufacturer representative prior to scheduled start up date. During start up, the complete pumping system shall be given a running test of normal start and stop, and fully loaded operating conditions. During this test, each pump shall demonstrate its ability to operate without undue vibration, or overheating, and shall demonstrate its general fitness for service. All defects shall be corrected and adjustments shall be made to the pumping station for satisfactory operation. System problems or concerns will be corrected by the subcontractor, in conjunction with the factory representative. Testing shall be repeated until satisfactory results are obtained, as determined by the engineer.

1.04 MANUFACTURER'S REFERENCES

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

B. American National Std. Institute (ANSI) / American Water Works Association (AWWA).

C. American Society for Testing and Materials (ASTM)

D. American Society of Mechanical Engineers (ASME)

E. National Electrical Manufacturers Association (NEMA)

F. Underwriters Laboratories (UL)

G. Institute of Electrical and Electronics Engineers (IEEE)

H. National Electrical Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)

I. Miscellaneous Reference

1. Hydraulic Institute Std. for Centrifugal, Rotary and Reciprocating Pumps.
2. ISO 9001 International Organization for Standardization.

1.05 SUBMITTALS

A. Submittals shall be in accordance with Division 1, Section 01330 – Submittals.

B. Complete shop drawings including dimensions and materials shall be supplied for the Engineer's approval.

C. Product Data

1. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), minimum suction pressure (PSI) and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and control shall be fully described.

D. Shop Drawings

1. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder drawings shall illustrate motor branch and pressure control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

1.06 WARRANTY

A. Warranty

1. All components of the pump station shall be manufactured, assembled and tested as a unit by a single supplier. The pumping station must be a standard catalog item with the manufacturer. The supplier must assume system responsibility. The manufacturer must warrant the complete pump station assembly. Individual component warranties are desirable. However, individual warranties honored solely by the manufactures of each pump station component will not be acceptable.

B. Warranty Period

1. Warranty period shall be in accordance with the General Conditions.

PART 2 PRODUCTS

2.01 GENERAL

A. Manufacturers and Models: Subject to compliance with the specified requirements:

1. Grundfos - Boosterpaq
2. Goulds - Aquaforce

B. Provide a complete skid mounted duplex pump station. System shall require only suction and discharge piping connections and a single point 480V AC, 3 phase power connection with one main circuit breaker and a single point connection for alarm and status indication for the entire skid. Packaged skid shall include all power transformers required for controls. Any ancillary wiring for power or controls required for a complete and fully operational system shall be the responsibility of the installing contractor.

C. The system must produce a maximum of 150 gallons per minute needed (150 GPM per pump with one pump redundant) at 128 feet of total dynamic head, as well as adjust itself automatically and efficiently with the pump or pumps supplied to any flow rate below the maximum down to and including 0 GPM. This shall be accomplished with complete absence of water hammer or surge during start up or shutdown of any pump on the system.

D. Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure.

2.02 PUMP STATION COMPONENTS

A. SKID BASE

1. Pump station base shall be designed and fabricated to provide proper structural support for all attached equipment, and provide anchor bolt support. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation to site, off loading, installation, and operation. Main structural members shall be constructed from heavy weight steel with a reinforcing channel for larger stations. Steel base shall be shot blasted, primed, and painted as per paint specification. Provisions shall be made in the station base for off-loading and handling the station at the site of installation. Base shall include steel plate mounted under pump and motor and shall be of compact design for most standard doorways.

B. PRESSURE TRANSDUCER

1. Pressure transducer/s shall be utilized for providing all pressure signals for the pump system controller.
2. Pressure transducer shall be a solid-state bonded strain gage type with an accuracy of plus/minus 0.20% and constructed of 17-4 pH stainless steel
3. Unit shall be rated for station discharge pressure as specified, and shall provide gauge pressure output, rather than an absolute.
4. Pressure transducer shall be 4-20mA analog type with 7- 33 VDC supply range.

C. PUMP MOTOR CONTROLS

1. Each pump motor shall have its own full voltage across the line NEMA 3R pump panel. The control panel and controls shall be built in accordance with NEC, and shall comply with UL standards
2. The 480V 3 phase pump panel shall be fusible or circuit breaker type with Hand/Auto switch and main power disconnect handle on the side of the enclosure.
3. Fuses, breakers, and overload relays shall be sized in accordance with the manufacturer of the motor it controls.
4. All components shall be UL listed.
5. All equipment and wiring shall be mounted within the enclosure and each device shall be labeled for proper identification.
6. All adjustments and maintenance shall be accessible from the front of the control enclosure.
7. A complete wiring circuit diagram and legend with terminals, components, and wiring completely identified shall be provided.

D. PUMPS

1. Pumps shall be of the vertical multi-stage centrifugal design.
2. Pump Construction.

    a. Suction/discharge base, pump head - Ductile Iron (ASTM 65-45-12)
    b. Shaft couplings, flange rings -Ductile Iron (ASTM 65-45-12)
    c. Shaft - 431 Stainless Steel
    d. Motor Stool - Cast Iron (ASTM Class 30)
    e. Impellers, diffuser chambers, outer sleeve - 304 Stainless Steel
    f. Impeller wear rings - 304 Stainless Steel
    g. Intermediate Bearing Journals -Tungsten Carbide
    h. Intermediate Chamber Bearings: Leadless Tin Bronze
    i. Chamber Bushings: Graphite Filled PTFE
    j. O-rings: EPDM

3. The shaft seal shall be a single balanced metal bellows cartridge with the following construction:

    a. Bellows - 904L Stainless Steel

b. Shaft Sleeve, Gland Plate, Drive Collar - 316 Stainless Steel
c. Stationary Ring - Carbon
d. Rotating Ring – Tungsten Carbide
e. O-rings - EPDM

3. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

E. INTEGRATED VARIABLE FREQUENCY DRIVE MOTORS.

1. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (FVD) built and tested as one unit by the same manufacturer.
2. The VFD shall be of the Pulse Width Modulation (PWM) design using current Insulated Gate Bipolar Transistor (IGBT) technology and be capable of operating the pump at varying RPM's to maintain the system design pressure with varying flows from 0 to 150 gallons per minute.
3. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher than the normal operating range. The switching frequency shall be reduced before motor speed is reduced.
4. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
5. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.
6. The integrated VFD motor shall include protection against the following:

   a. over voltage
   b. under voltage
   c. phase imbalance
   d. VFD over temperature
   e. Motor over temperature
   f. excessive temperature
   g. input transient

7. The integrated VFD motor shall have as a minimum the following input/output capabilities
   a. Speed Reference Signal – 1-10 VDC, 4-20 mA
   b. Digital Input remote ON/OFF
   c. Digital Output Fault (NO or NC)
   d. Communications port (RS 485 type connection)
8. The motor shall have a Totally Closed Fan Cooled (TEFC) enclosure with a NEMA C face, Class F insulation motor windings with a temperature rise no higher than Class B and a service factor of 1.15.

9. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

E. PUMP STATION CONTROLLER

1. The pump system controller shall be a standard product developed and supported by the pump manufacturer.
2. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.
3. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
4. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power.
5. The controller shall have built in data logging capability. Logged vales shall be graphically displayed on the controller and able to be exported to computer via standard connection. A minimum of 3600 samples per logged value with the following parameters available for logging:

    a. Estimated flow-rate
    b. Speed of pumps
    c. Inlet Pressure
    d. Discharge Pressure
    e. Power Consumption
    f. Controlling parameter (process value)

6. The controller shall display the following as status readings from a single display on the controller (this display shall be the default):

    a. Current value of discharge pressure
    b. Most recent existing alarm (if any)
    c. System status with current operating mode
    d. Status if each pump with current operating mode and rotational speed as a percentage (%)
    e. Estimated flow-rate (calculated)

7. The controller shall have as a minimum the following hardware inputs and outputs:

    a. 3 analog inputs
    b. 3 digital inputs
    c. 7 digital outputs
    d. Ethernet Connection
    e. Field service connection to PC for advanced programming and data logging.

8. Pump System programming (field adjustable) shall include as a minimum the following:

    a. Water shortage protection
    b. Transducer settings (Suction and Discharge Analog supply/range)
    c. PI controller (proportional gain in integral time) settings
    d. High system pressure indication and shut-down
    e. Low system pressure indication and shut-down
    f. Low suction pressure/level shutdown (digital contact)
    g. Low suction pressure/level warning (analog signal)
    h. Low suction pressure/level shut-down (analog signal)

9. The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).
10. The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).
11. The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).
12. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.
13. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point.
14. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

    a. High System Pressure
    b. Low System Pressure
    c. VFD Trip/Fail (per pump)
    d. System Power Loss

15. The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions. The control panel shall include, but not be limited to:

a. Main control panel disconnect
b. Pump Run lights (green)
c. System Fault Light
d. Surge Arrestor

16. The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).
17. The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable).
18. The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power.
19. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours).
20. The actual pump performance curves (5th order polynomial) shall be loaded (software) into the pump system controller or be able to input manually into controller based on three points on pump curve of pumps controlled.
21. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.

F. SEQUENCE OF OPERATION

1. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure (system set-point). The system controller shall receive an analog signal (4-20mA) from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 96% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. As flow demand decreases the pump speed shall be reduced while system set-point pressure is maintained. When all pumps in operation are running at low speed the system controller shall switch off pumps when fewer pumps are able to maintain system demand.
2. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

G. CHECK VALVES

1. Each centrifugal pump shall be fitted with a check valve on the discharge piping.
2. Check valves shall be sized to fit the control valve intake and shall conform to requirements set forth in Division 15.

H. PRESSURE TANK

1. Provide pre-pressurized Series “B” (ASME) bladder tank to maintain pressure on the plant water supply.
2. Tank to be designed and constructed per ASME Section VII, Division 1. Tank shall be constructed of carbon steel and designed with replaceable heavy duty butyl rubber bladder for a maximum working pressure of 125 PSI.
3. Provide pre-pressurized, diaphragm type expansion tank constructed for 125 psig working pressure.
4. Tank shall be ASME unfired pressure vessel labeled.
5. Minimum tank acceptance volume shall be 44 gallons.
6. Acceptable manufacturers:

    a. Amtrol
    b. Wessels
    c. Bell and Gossett
    d. Armstrong

I. PRESSURE RELIEF VALVE

1. The modulating pressure relief valve shall be attached to a discharge line common to all pumps on the system. The discharge of the pressure relief valve shall be piped to the intake of the skid by the Contractor. Fluid should not be allowed to discharge from the pressure relief valve unless there is a system failure.

J. STATION ISOLATION VALVES

1. The pump station shall have lug style butterfly type isolation valves sized to fit the intake and discharge manifold. These valves shall be placed on the inlet and outlet ports of the skid. Valves body shall be ductile iron (ASTM 536), epoxy coated. Disc shall be made of ASTM A-351 stainless steel, Shaft shall be made of 316 stainless steel.
2. Each pump shall have a full port isolation ball valve at the suction and discharge of each pump. Seats and stem packing shall be virgin PTFE. Stem shall be bottom loaded blowout proof design with fluorocarbon elastomer O-ring to prevent stem leaks.

K. PRESSURE GAUGES

1. Pressure gauges shall be installed on the suction and discharge headers.

2. The gauges shall be installed on ¼" gauge cocks to receive ¼" pressure gauge fittings. The fittings shall include a pet cock for air bleed-off located below the gauge and a shutoff valve to allow gauge removal.
3. The pressure gauges shall be 2.5" diameter, bourdon tube type, glycerin-filled and have stainless steel case, bezel and internal parts.
4. All gauges on pump discharge lines shall have pulsation dampeners.
5. All gauges used in non-potable water applications shall have diaphragm seals to prevent gauge contamination.
6. Gauge accuracy shall be 1%. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.
6. Acceptable manufacturers:

    a. Ashcroft
    b. Weksler
    c. Dwyer

L. PIPING

1. All piping shall be prefabricated to manifold all pumps on the skid assembly together with the pressure tank and then on to the station isolation valve. All piping shall be flanged stainless steel welded to ANSI flanges. All Piping shall conform to the requirements set forth in Division 15.

M. WIRING

1. The system shall be fully wired and grounded using UL listed, stranded copper wire with 600 volt rating. All wiring shall be sized large enough to adequately supply power to the pump motors. Seal tight conduit and fittings shall cover all exposed wiring. The contractor supplying the equipment is responsible for checking pump motor rotation and pump station start up. All wiring shall conform to requirements set forth in Division 16.

N. PAINTING

1. All major components and piping shall be shop painted by the manufacturer shall be sand blasted to white metal, powder coated, and oven baked. Final painting shall conform to requirements set forth in Specification Section 09900 – Painting.

O. TESTING

1. The completed pump station shall be fully tested by the manufacturer prior to shipment. Full range test as well as a pressure hold test shall comply with requirements.

P. WARRANTY AND MANUALS

1. The pump station and all components shall be warranted against defects in material and workmanship for a period of one year from date of shipment. An installation sheet and operator manual shall be provided by the manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. UNLOADING AND STORAGE

1. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacture shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. FIELD INSTALLATION

1. Install, level, align, and lubricate skid mounted pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacture at time of delivery.
2. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping.
3. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
4. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.03 FIELD QUALITY CONTROL

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition;

and conforms to the specified operating characteristics.

2. The contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gauge readings, ampere draw, pump controls, and pressure controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

B. Manufacturer's Start-up Services

1. Co-ordinate station start-up with manufactures technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures. An (8) eight hour (maximum) start-up and training session for the equipment shall be provided to the owner by the manufacturer.

3.04 CLEANING

A. Prior to acceptance, inspect installation for excessive dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

3.05 PROTECTION

A. The pump station should be placed into service immediately. If operation is delayed, drain liquid from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

END OF SECTION 15445

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This section includes requirements to furnish and install electric resistance unit heaters and duct heaters.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 16010 – General Electrical Requirements.
2. Section 16170 – Grounding and Bonding.

1.03 REFERENCE TO STANDARDS

A. UL
B. NEC
C. OSHA

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State of Illinois and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, power requirements, wiring, diagrams, etc.

C. Product Data: Provide data on operating equipment characteristics.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Unit heaters shall be fully assembled when delivered to site.

B. Coordinate placement of anchors and equipment.

PART 2 PRODUCTS

2.01 HORIZONTAL UNIT HEATERS:

A. Acceptable manufacturers:

1. Chromalox LUH
2. Indeeco
3. Berko

B. General: Electric unit heater for suspended mounting, with fan forced air distribution over electric resistance heating coils and horizontal discharge.

C. Cabinet shall be fabricated of heavy welded steel protected by phosphate primer with powder coated baked enamel.

D. Discharge louver shall have individually adjustable blades.

E. Unit shall be equipped with a propeller type, direct drive fan.

F. Motor shall be totally enclosed, epoxy painted, and shall have built-in thermal overload protection.

G. Fan blades shall be epoxy coated aluminum and shall be provided with wire fan guard.

H. Heating element shall have a steel sheath with cold rolled steel fins.

I. Unit shall be furnished with pre-wired, self-contained control center including magnetic contactor control circuit transformer, control fuses, and branch circuit motor fuses, with terminal strip and conduit access for external 120V thermostat circuit.

J. Provide one-stage, remote mounted, line voltage, pilot duty device thermostat. Thermostat shall incorporate a shielded nickel plated sensing bulb attached directly to the bottom of the enclosure. The case shall be sealed with gasket O-rings rings. The adjustable knob shall provide control within ± 2-1/2 deg. F. Control shall have a positive off position. Enclosure shall be NEMA 4.

K. Accessories:

1. Provide line voltage disconnect switch for each input circuit.
2. Provide terminal blocks for power and control wiring connections.

2.02 EXPLOSION PROOF UNIT HEATER, UH-1

A. Acceptable Manufacturers:

1. Chromalox CXH-EP
2. Indeeco T3C
3. Approved Equal

B. General: Explosion proof electric unit heater for suspended mounting, with fan force air distribution over electric resistance heating coils and horizontal discharge, suitable for installation in high humidity and corrosive environments.

C. Cabinet: Fabricate cabinet of heavy gauge die formed and welded steel protected by zinc chromate primer with polyester powder coating.

D. Discharge Louver: Provide adjustable discharge louver.

E. Supply Fan: Spark proof propeller type direct drive. U.L. Listed motor shall be totally enclosed epoxy painted and shall have permanently lubricated ball bearings. Motor shall have built-in thermal overload protection. Fan blade shall be epoxy coated aluminum and shall be provided with suitable fan blade protection using wire guard.

F. Heating Element: Liquid to air heat exchanger, copper tube/integral aluminum fins, propylene glycol heat transfer liquid.

G. Capacity: See Equipment Schedule

H. Thermostat: Provide one-stage, remote-mounted line voltage pilot duty device and shall incorporate a shielded nickel plated sensing bulb attached directly to the bottom of enclosure. The case shall be sealed with gasket and “O” rings. The adjustable know shall provide control within ±2-1/2°F. Control shall have a positive OFF position. Enclosure shall be NEMA 4.

I. Accessories:

1. Provide contractor control for unit installed in NEMA 4 enclosures
2. Provide line voltage disconnect switch for each input circuit.
3. Provide terminal blocks for power and control wiring connections.

2.03 SURFACE MOUNTED ELECTRIC WALL HEATERS

A. Acceptable manufacturers:

1. Chromalox RFI
2. Indeeco
3. Berko

B. General: Electric unit heater for surface wall mounting, with fan forced air distribution over electric resistance heating coils and horizontal discharge.

C. Cabinet shall be fabricated of 18 gauge steel.

D. White architectural bar grille

E. Concealed access door for tamper-proof adjustable control.

F. Motor shall be totally enclosed, and shall have built-in thermal overload protection.

G. Heating element shall have a steel sheath with cold rolled steel fins.

H. Unit shall be furnished with pre-wired, self-contained control center with terminal strip and conduit access for low voltage control circuit.

I. Built in 2-pole thermostat operating between 45 deg. F and 85 deg. F

PART 3 EXECUTION

3.01 PREPARATION

A. Verify size, type, mounting location and clearances for all equipment.

3.02 INSTALLATION

A. Unit heaters and controls shall be installed as detailed on the plans and as required by manufacturer. Contractor shall maintain minimum distance from combustibles as required by manufacturer. Where required, stiffener plates shall be installed to walls to assist in supporting heaters.

B. All unit heaters and controls shall be tested after installation for correct operation, current draw and airflow.

3.03 FIELD QUALITY CONTROL

A. Operate installed unit heaters to demonstrate compliance with requirements. Repair or replace faulty accessories, as required to obtain proper operation and performance.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust position and thermostat for proper setting.

B. Cleaning: Clean factory-finished surfaces. Repair any marred on scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15764

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes fabricated ductwork.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15820 – Ductwork Accessories.
2. Section 15850 – Air Inlets and Outlets.

1.03 REFERENCE TO STANDARDS

A. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, First Edition" for fabrication and installation of low pressure.

B. ASHRAE Standards: Comply with ASHRAE handbook and Product Directory, 1988 Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of low pressure ductwork.

C. NFPA Compliance: Comply with ANSI/NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

D. Field Reference Manual: Have available at project field office, copy of "SMACNA HVAC Duct Construction Standards - First Edition".

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Shop Drawings: Indicate layout of ductwork and equipment, including coordination dimensions and clearances.

C. Product Data: Provide manufacturers data sheets for the following items:

1. Duct Sealant.
2. Duct Cement.
3. Duct Liner.

PART 2 PRODUCTS

2.01 DUCTWORK

A. Ductwork Materials

1. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A90, ANSI/ASTM A 525 and A527, lockforming quality.

a. Coating: G90 zinc coating (1.25 oz./S.F.).

2. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view, provide materials, which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, strains and discolorations, and other imperfections, including those that would impair painting.

B. Miscellaneous Ductwork Materials

1. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

2. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for fabrication/installation detail) as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
3. Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement (type applicable for fabrication/ installation detail) as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
4. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
5. Duct Liner: Fibrous glass complying with ASTM C 1070, Type I, ASHRAE 62-89, NFPA 90A and 90B.

    a. Thickness: 1 inch.
    b. R-Value: 8.0
    c. Sound Absorption Coefficient (NRC): .70
    d. Constructed to operate under duct velocities up to 5000 fpm.
    e. Surface coatings shall not support microbial growth including fungus and bacteria.

6. Duct Liner Adhesive: Comply with Adhesive and Sealant Council, Inc. (ASC) ASC-A-7001.
7. Duct Liner Fasteners: Comply with SMACNA MF-1.

C. Fabrication

1. Shop fabricate ductwork in 4, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs. Pre-assembly work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match mark sections for reassembly and coordinated installation.
2. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards - First Edition", for 1" W.G., positive or negative.
3. Shop fabricate ductwork of gages and reinforcement complying with ASHRAE Handbook and Product Directory, 1988 Equipment Volume, Chapter 1 "Duct Construction", for 2" W.G., positive or negative.
4. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
5. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Section 15820 "Duct Accessories" for accessory requirements.

6. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.
7. The weight of steel shall be less as described in the SMACNA Manual "HVAC Duct Construction Standards", 1985 Edition, except that the minimum steel thickness shall be 24 gauge; and all ductwork with the longest side 84 inches or greater shall be constructed of 16 gauge steel.
8. See SMACNA Manual for reinforcement.

2.02 STAINLESS STEEL

A. All ductwork indicated as stainless steel shall be 316 stainless steel sheets.

B. All seams and joints shall be externally welded and ground flush and smooth.

C. Thickness of stainless steel sheet shall be 18 gauge minimum.

2.03 ALUMINUM SHEET

A. Aluminum alloy, Commercial Designation 3003 temper H14.

B. The thickness of aluminum sheet used in duct work shall not be less than:

Dimensions of Longest Side	Minimum Thickness
Up thru 12 inches	0.020 inch
13 inches thru 30 inches	0.025 inch
31 inches thru 54 inches	0.032 inch

C. See SMACNA Manual for gage and reinforcement for larger dimensions.

PART 3 EXECUTION

3.01 INSTALLATION

A. Ductwork:

1. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (55 leakage) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Duct system shall be sealed to Class C requirements. Install each run with minimum of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.
2. Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
3. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise, indicated, run ductwork in shortest route which does not obstruct useable space or

block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

4. Electrical Equipment Space: Do not run ductwork through electrical equipment spaces and enclosures.
5. Where ducts pass through interior partitions conceal space between construction opening and duct or duct-plus-insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2".
6. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
6. Support ductwork in manner complying with SMACNA "Low Pressure Duct Standards - 5th Edition" hangers and supports section.

3.02 SEALING AND PRESSURE TESTING DUCTS

A. As a minimum, seal all ducts according to SMACNA Seal Class A.

B. Lock all seams in ductwork and hammer flat; make absolutely tight against air leakage. Lap joints with inside lap in direction of air travel. Install sufficient slip joints in the ducts to take care of expansion and contraction.

3.03 CLEANING AND PROTECTION

A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment of air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

END OF SECTION 15812

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. This section includes the requirements for ductwork accessories required for the work.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15812 – Ductwork.
2. Section 15954 – Air Systems Testing, Adjusting and Balancing.

1.03 REFERENCE TO STANDARDS

A. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, First Edition".

B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

C. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems," pertaining to installation of ductwork accessories.

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 2 years.

C. Installer:

D. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

E. Installation:

1. Perform work in accordance with State and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B. Product data: Provide manufacturers data sheets for the following:

1. Locking quadrants.
2. Turning vanes.
3. Flexible connections.
4. Duct Take-offs.
5. Dampers.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle in strict accordance with manufacturer's instructions.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification.

C. Store new materials in original wrapping and protect from weather and construction traffic.

D. Protect new materials against dirt, water, chemical, and mechanical damage.

E. Coordinate installation with related work under other sections.

PART 2 PRODUCTS

2.01 VOLUME DAMPERS

A. Approved Manufacturers:

		Up to 12" high	Over 12 high
1.	Air Balance	AC-111	AC-2
2.	Air Louvers and Dampers	DG-10	DG-12
		Up to 12" high	Over 12 high
3.	Arrow United	150VCD	395
4.	Dowco	AVS	AVO
5.	Ruskin	MD25	CD35
6.	Vent Products	5101	5103

B. Low Pressure Manual Dampers: Provide dampers of single blade type or multiblade type, constructed in accordance with SMACNA "HVAC" Duct Construction Standards".

C. Manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 3/16 inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers shall be capable of 100% shut-off of air movement in the duct. Dampers shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum width of 12 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated and as required to properly balance the system.

2.02 DUCT SLEEVES, FRAMED PREPARED OPENINGS, CLOSURE COLLARS

A. Duct Sleeves. Duct sleeves shall be provided for round ducts 15 inches in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 15 inches in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 20 gauge galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53, Schedule 20 shall be used. Sleeve shall provide 1-inch clearance between the duct and the sleeve or 1-inch clearance between the insulation and the sleeve for insulated ducts.

B. Framed Prepared Openings: Openings shall have 1-inch clearance between the duct and the opening or 1 inch clearance between the insulation and the opening for insulated ducts.

C. Closure Collars: Collars shall be fabricated of galvanized sheet metal not less than 4 inches wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 15 inches in diameter or less shall be fabricated from 20 gauge galvanized steel. Collars for round ducts larger than 15 inches and square, and rectangular ducts shall be fabricated from 18 gauge galvanized steel. Collars shall be installed with fasteners on maximum 6-inch centers, except that not less than 4 fasteners shall be used.

2.03 DUCT ACCESS DOORS

A. Approved Manufacturers:

1. CESCO
2. Air Balance
3. Ruskin
4. Keys

B. Duct Access Doors: Access doors shall be provided in ductwork where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA-06. Access doors shall be 22 gauge galvanized steel with an extruded aluminum frame and esther gaskets. Latches shall be zinc plated. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 15 by 18 inches, unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 24 by 24 inches or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.04 TURNING VANES

A. Acceptable Manufacturers:

1. Anemostat products Div.,: Dynamics Corp. of America.
2. Hart & Cooley Mfg. Co.
3. Approved Equal

B. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" o.c., supported with bars perpendicular to blades set 2" o.c., and set into side strips suitable for mounting in ductwork.

2.05 DUCT HARDWARE

A. Acceptable Manufacturers:

1. Hart & Cooley Mfg. Co.
2. Ventfabrics, Inc.
3. Young Regulator Co.

B. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

PART 3 EXECUTION

3.01 PREPARATION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 degree elbows in supply. Return and exhaust air systems, and elsewhere as indicated.

C. Install flexible duct connections wherever ductwork connects to vibration isolated equipment.

D. Install thermometer in each air handling unit outdoor air intake duct, mixed air plenum, supply duct and return air duct in Mechanical Equipment Rooms.

E. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer touch-up paint.

3.05 VOLUME DAMPERS.

A. Provide volume dampers where shown on the drawings and specified to properly equalize the ventilating systems.

B. Ventilation Contractor shall provide volume dampers at all locations, as required by the Testing and Balancing Contractor.

C. Construct the dampers so that there will be no movement in the damper when the systems are in operation.

D. Install extension rods and provide locking adjustable quadrants.

E. After installation of volume dampers, safe off and caulk between frame of damper and duct or opening to prevent air leakage around perimeter of damper. Leakage rate shall not exceed SMACNA's Leakage Class 3 Level.

END OF SECTION 15820

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The extent of work as required by the drawings and these specifications. This work includes roof exhausters and associat7ed mounting hardware, as required to provide complete and operational ventilation and exhaust systems.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15812 – Ductwork.
2. Section 15954 – Air Systems Testing, Adjusting and Balancing.

1.03 REFERENCE TO STANDARDS

A. UL

B. NEC

C. AMCA

D. ASHRAE

E. SMACNA

F. American Conference of Governmental Industrial Hygienists, “Industrial Ventilation, 21st Edition”

1.04 QUALITY ASSURANCE

A. Manufacturer:

1. To the greatest extent possible obtain materials from only one manufacturer, even though several may be specified as acceptable manufacturers.

B. Supplier:

1. Subcontract furnishing of the materials only to a recognized material supplier who has been furnishing materials in the same area as project for a period of not less than 5 years.

C. Installer:

1. Subcontract installation of materials to a company specializing in the installation in performing work of this section with a minimum 5 years experience. Assign work to experienced tradesmen in compliance with trade union jurisdictions.

D. Installation:

1. Perform work in accordance with State of Illinois and local building codes.
2. Perform work in accordance with industry standards.

1.05 SUBMITTALS

A. Submit under the provisions of Division 1, Section 01330 – Submittal Procedures.

B. Shop Drawings: Indicate layout (plan and/or elevation) of equipment, dimensions, materials, mounting bolt layout and dimensions, power requirements, wiring diagrams, etc.

C. Product Data:

1. Provide data on operating equipment characteristics for each fan.
2. Rooftop supports and roof curbs.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept material on site in shipping containers with labeling in place. Inspect for damage.

PART 2 PRODUCTS

2.01 CABINET FANS

A. Acceptable manufacturers: Subject to compliance with specifications.

1.	Penn	ZJ
2.	Carnes	VCD
3.	Greenheck	SP
4.	Cook	Gemini
5.	Breidert	BF
6.	Acme	V

B. General Description: Ceiling mounted, centrifugal, direct drive exhaust fan. Unit shall be UL listed and bear the AMCA Certified Ratings Seal for sound and air performance.

C. Housing: Heavy-gage, galvanized steel fan casing.

D. Fan Wheel: Steel centrifugal wheel.

E. Fan, motor and wheel shall be able to be removed without disturbing housing.

F. Grille shall be constructed of non-yellowing high strength polymer and shall comply with all OSHA requirements.

G. Accessories: Fan shall be supplied with the following accessories:

1. Wall switch control.
2. Hooded Roof Cap.
3. Counter balanced gravity backdraft damper.
4. Hanging vibration isolators.

2.02 PROPELLER SIDEWALL FANS

A. Acceptable Manufacturers:

1.	Greenheck	SB
2.	Cook	SWB
3.	Cames	LWBA
4.	Breidert	BT
5.	Acme	DCK
6.	Penn	Breezeway
7.	Twin City Fan	

B. General Description: Belt or direct driven propeller fans as indicated consisting of fan blades, hub, housing, orifice ring, single speed motor, drive, and accessories.

C. Fan shall be AMCA certified and come complete with OSHA compliant motor guard, wall housing and all necessary structural support angles, and counterbalanced gravity damper.

D. Fan blades shall be statically and dynamically balanced. Propeller shall be locked to motor shaft by a square key.

E. Motor drive frame assemblies and fan panels shall be constructed of steel and shall be welded with prepunched mounting holes.

F. Motors shall be permanently lubricated, heavy duty type.

G. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.

H. Accessories: The following items are required as indicated:

1. Wall Housing: Steel with heavy gauge mounting flanges and prepunched mounting holes for flush exterior installation.
2. OSHA compliant Motor Side Guard: welded steel wire cage completely enclosing the motor and drive side of the fan.
3. Motorized Damper with line voltage actuator.
4. Fan, housing, damper and all accessories and hardware shall be protected by corrosion resistant high performance thermosetting epoxy powder coating.

2.03 CENTRIFUGAL ROOF EXHAUSTERS

A. Acceptable Manufacturers:

1.	Carnes	VW
2.	Cook	PW
3.	Greenheck	GW
4.	ILG	CWD
5.	Penn	Domex
6.	Breidert	WXD
7.	Acme	ACW-D

B. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base with venture inlet cone.

D. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

F. Accessories: The following items are required as indicated:

1. Disconnect Switch: Nonfusible type, with thermal and overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch mesh, 16-gage aluminum or brass wire.
3. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.

   a. Blades: Die-formed sheet aluminum
   b. Frame: Extruded aluminum, with waterproof, felt blade seals
   c. Linkage: Nonferrous metals, connecting blades to operator.
   d. Operators: Manufacturer’s standard electric motor

2.04 ROOF CURBS AND EQUIPMENT SUPPORTS

A. Provide roof curbs and equipment supports where shown and detailed on the drawings, and as required for various roof penetrations and/or equipment support.

B. Roof Curbs:

1. Acceptable Manufacturers:

   a. Custom Curb, Inc. - Model CRC-1
   b. Pate Co. - Model PC-5
   c. ThyCurb - Model TC-1
   d. Roof curb may be furnished by equipment manufacturer.

2. Roof curbs hall be constructed using minimum 18 gauge galvanized steel (14 gauge for curbs supporting HVAC units, or as deemed necessary by curb manufacturer), with fully mitered and welded corners, 3" integral cant, integral base plates, internally reinforced with 1" x 1" x 1/8" steel angle (curbs with any side longer than 3'-0") factory insulated with 1-1/2" thick three pound density fiberglass insulation, and factory installed pressure treated wood nailers.
3. Minimum height of curb shall be 12" above finished roof.
4. Curbs shall be constructed to match slope of roof and provide a level top surface for mounting of mechanical equipment or insulated top cover cap.
5. Cant shall be raised to accommodate thickness of roof deck insulation. This height shall be additive to the above specified curb height.
6. Curb shall be provided at all roof penetrations including, but not limited to, HVAC units, duct openings, pipe penetrations, column penetrations, and exhaust fans.

PART 3 EXECUTION

3.01 PREPARATION

A. Visually inspect for signs of damage, impact damage would appear as whitening of the surface or star shaped cracks or crazes.

3.02 FAN INSTALLATION

A. Install fans where shown on plans. Exact equipment locations shall be coordinated with all other contractors and trades. Any equipment installed without the proper coordination shall be removed and reinstalled at the expense of that Contractor.

B. Coordinate exact opening sizes with equipment manufacturer.

C. Check all bolts to assure that none have loosened.

D. Before wiring the motor, rotate fan wheel by hand to check for free rotation and to assure that the impeller has not shifted such that it would be rubbing against the fan housing.

E. Install all accessory equipment that is not already preassembled with fans.

F. Run conduit from inside building, along inside corner of the curb to the junction box.

G. Safety disconnect and motor overload protection shall be tested upon successful completion of installation.

H. All fans, dampers and controls shall be tested after installation for correct operation, current draw and air flow.

I. Fans shall be installed as detailed on the plans and as required by the manufacturer. Contractor shall maintain minimum service clearances as required by manufacturer.

J. All equipment shall be set or hung level and securely fastened in place and shall be set or hung true to building wall lines.

3.03 ROOF-CURB AND EQUIPMENT SUPPORT INSTALLATION

A. Curbs: Shall be installed in strict accordance with manufacturer's published instructions and as detailed on the drawings.

1. Size of curbs and required options shall be coordinated by curb manufacturer and Contractor prior to fabrication.
2. Shop drawings shall be submitted for review and acceptance.

a. Submittal shall include manufacturer's guarantee that curbs will be free of defects in materials and/or workmanship for a period of five years.

B. Roof curbs shall be coordinated with work of General Contractor.

C. Flashing and miscellaneous steel framing provided by General Contractor.

D. Mechanically fasten equipment to curb.

END OF SECTION 15832

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. Extent of work as required by the drawings and these specifications. Work includes all supply, return and exhaust air inlet and outlet devices including grilles, registers, and louvers.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15812 – Low Pressure Ductwork.
2. Section 15820 – Ductwork Accessories.
3. Section 15954 – Air Systems Testing, Adjusting and Balancing.

1.03 REFERENCE TO STANDARDS

A. Referenced standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance. Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters."
4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.04 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

1. Schedules: Submit schedule(s) for all items. Schedules shall be formatted to match those provided with the specification and drawings for ease of comparison and shall contain all rated performance information.
2. Product Data: Provide manufacturers data sheets for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, performance, and mounting details for each of the following items:

   a. Diffusers.
   b. Registers.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle in strict accordance with manufacturer's instructions.

B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification.

C. Store new materials in original wrapping and protect from weather and construction traffic.

D. Protect new materials against dirt, water, chemical, and mechanical damage.

E. Coordinate installation with related work under other sections.

PART 2 PRODUCTS

2.01 LOUVERS

A. Acceptable Manufacturers:

1.	Ruskin	ELF375D
2.	American Warming & Ventilating	LE-21
3.	Greenheck	ESD-403
4.	Arrow United	465-35
5.	Dowco	DBE
6.	Louvers & Dampers, Inc	
7.	Vent Products	

B. General: Drainable louvers where shown; of size, shape, and capacity indicated; designed for a wind load of 20 psf.

C. Performance: Provide louvers that have maximum free area, and minimum pressure drop for each type as listed in manufacturer's current data, complying with louver schedule. Louvers to have maximum of 0.01 oz/sf of water penetration.

D. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation.

E. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.

F. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

2.02 MOTORIZED DAMPERS

A. Acceptable Manufacturers:

1. Ruskin - Model IL35
2. Dowco
3. Arrow United
4. Air Balance
5. Vent Products

B. Provide insulated motorized dampers where shown, and of sizes as scheduled, on the drawings.

C. Construction to have the following features:

1. Blades shall 6" wide, 16 gage galvanized steel on 6" centers. Insulation shall be completely enclosed with galvanized steel outer skin. Blade edge seals shall be PVC coated polyester fabric.
2. Damper shall be of opposed-blade type and equipped with permanently lubricated stainless steel sleeve bearings.
3. Have interlocking edges with extruded vinyl blade seals and flexible metal, compressible jamb seals.
4. Damper linkage shall be concealed in damper frame.
5. Air leakage shall not exceed 4-cfm/square foot.
6. Have solid stops on all four sides.
7. Damper shall be complete with provisions for installation of actuator and linkages.
8. Dampers shall be complete with control shaft extension. End of shaft shall be notched to indicate damper blade position. Outboard support bearings shall be provided with all single section dampers for field mounted actuators. Factory installed jackshaft shall be provided with all multiple section dampers.
9. Damper actuators shall be provided with disconnect switches.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 DIFFUSERS, REGISTERS AND GRILLES INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers and registers as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

D. Adjust throw to not exceed velocities of 50 FPM in occupied zones.

E. Install diffusers, registers and grilles in a manner that they will be vibration free during operation.

F. Where the interior surfaces of ductwork are visible through the face of diffusers, registers and grilles, paint interior visible surfaces with one coat of flat black acrylic paint.

3.03 LOUVER INSTALLATION

A. General: Install louvers and dampers as shown on the drawings and in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

3.04 MOTORIZED DAMPERS

A. Install damper plumb and square with proper alignment.

B. Install damper with proper orientation to airstream.

C. After installation of motorized damper, safe-off and caulk between frame of damper and duct or opening to prevent air leakage around perimeter of damper. Leakage rate shall not exceed SMACNA's Leakage Class 3 level.

D. Each motorized damper installation shall allow observation of damper operation.

END OF SECTION 15850

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

A. The extent of work as required by the drawings and these specifications. This work includes testing, adjusting and balancing of all air handling equipment and systems including exhaust fans and accessories.

1.02 RELATED WORK

A. Specified elsewhere:

1. Section 15832 – Power Ventilators.
2. Section 15850 – Air Inlets and Outlets.

1.03 REFERENCE TO STANDARDS

A. SMACNA

B. NEBB

C. AABC

D. TABIC

1.04 QUALITY ASSURANCE

A. Only qualified personnel shall perform testing and balancing work.

B. Submit evidence that the personnel who will perform the testing and balancing of the project systems are qualified personnel for review and approval by the Construction Coordinator prior to performing the work.

C. Submit a list of completed projects successfully tested and balanced by the submitted qualified personnel for review and approval, by the Construction Coordinator, prior to performing the work.

D. When the Contractor does not have qualified personnel on his staff he shall employ them from other firms or subcontract the work to a test and balance firm normally engaged in this type of work.

E. Perform all corrective measures caused by faulty installation at Contractor's own expense. Retest, readjust and rebalance systems until satisfactory results are achieved.

1.05 SUBMITTALS

A. Submit in accordance with Division 1, Section 01330 – Submittal Procedures.

B Submit Data Sheet on each item of testing equipment for Construction Coordinator approval. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.

C. Submit a report containing all test data and other related information recorded during testing and balancing, placed on appropriate forms for Construction Coordinator review and approval. Reports shall certify that the methods used and results achieved are as specified.

1.06 QUALIFICATIONS

A. Qualified personnel are:

1. Personnel who have been certified by one of the following organizations.

a. AABC - Associated Air Balance Council.
b. Certified TBAB - Certified Testing, Balancing and Adjusting Bureau.
c. NEBB - National Environmental Balancing Bureau, Illinois Chapter.
d. SMARTA - Sheet Metal, Air Conditioning & Roofing Contractors Trade Association of Illinois.
e. TABIC - Test and Balancing Institute for Certification.

2. Personnel with a general engineering or mechanical engineering degree from an accredited four-year college.

PART 2 PRODUCTS

2.01 AIR BALANCE INSTRUMENTS

A. Velometer with probes and Pitot tube.

B. Rotating vane anemometer.

C. ASHRAE Standard pitot tubes, stainless steel 3/16 outside diameter, lengths 18" and 36".

D. Magnehelic differential air pressure gages, 0 to 0.5", 0 to 1.0" and 0 to 5.0" water pressure ranges, each arranged as a portable unit for use with a standard Pitot tube.

E. Combination inclined-vertical portable manometer, range 0 to 5.0" water.

F. Portable type hook gage, range 0 to 12" water.

G. Portable flexible U-tube manometer, magnetic mounting clips, range 0 to 18" water.

H. Static pressure probe for induction unit.

I. Conical or pyramidal shaped hood.

2.02 SYSTEM PERFORMANCE MEASURING INSTRUMENTS

A. Insertion thermometers, with graduations of 0.5 deg. F.

B. Sling psychrometer.

C. Tachometer, centrifugal type.

D. Revolution counter.

E. Clamp-On Volt-ammeter.

F. Portable recorders for temperature and humidity.

PART 3 EXECUTION

3.01 AIR SYSTEMS

A. Test, adjust and balance systems in accord with the following:

1. Preliminary:

a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals. Inspect all system components for proper installation and operation.
b. Use manufacturer's ratings for all equipment to make calculations except where field test shows ratings to be impractical.
c. Verify that all instruments are accurately calibrated and maintained.
d. Install clean filters.

2. Central System:

a. Test adjust and record exhaust fan RPM to design requirements within the limits of mechanical equipment provided.
b. Test and record motor voltage and running amperes including motor nameplate data and starter heater ratings.
c. Test and record system static pressure, suction and discharge.
d. Test and adjust system for design outside air, cfm.
e. Test and record heating apparatus entering air temperatures, dry bulb.

3. Verification:

a. Prepare summation of readings of observed cfm for each system, compare with specified cfm and verify that duct losses are within specified allowable range.
b. Verify design cfm at fans.

3.02 CONTROL SYSTEM

A. The HVAC Contractor shall set and adjust automatically operated devices to achieve sequence of operations.

B. Testing organization shall verify all controls for proper calibration and list those controls requiring adjustment.

3.03 SYSTEM PERFORMANCE REPORT

A. After the conclusion of balancing operations, make temporary installation of portable recorders and simultaneously record temperatures summer and winter conditions at representative locations in each system inside of building.

B. Construction Coordinator will direct test locations.

C. Make recordings during summer and winter for a seven-day period, continuous over a weekend and including at least one period of operation at outside conditions within 5 degrees F wet bulb temperature of 75 deg. F for maximum summer design condition and within 10 degrees F dry bulb temperature of minus 3 deg. F for minimum winter design conditions.

D. Report of test results shall include original recording and two reproductions.

3.04 REPORT SUBMITTAL

A. Fill in test results on appropriate forms.

B. Submit three certified copies of test reports to the Construction Coordinator for approval.

C. Include in report a list of instruments used and last date of calibration.

END OF SECTION 15954

MATTOON, ILLINOIS
RILEY CREEK CSO SATELLITE TREATMENT FACILITY – CONTRACT 1

DIVISION 16 – ELECTRICAL

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PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is general in nature and applicable to electrical system work. Contractor is also directed to other sections of Division 16 - Electrical for additional related specifications for items described in this section.

B. Work included in this section shall apply to installation and testing of all materials and equipment necessary to completely install electrical system as shown on drawings and as described herein in these specifications, or as may be necessary for a complete and operational electrical system.

C. Unless otherwise noted, all electrical equipment shown on project drawings shall be furnished under Division 16.

D. Drawings pertaining to this installation indicate general location of conduits, wiring, distribution and motor control centers, lighting and outlets, and other details necessary for installation of system.

E. Electrical installation as shown on drawings and as specified herein is based upon best available information, with regard to characteristics of mechanical equipment specified. In the event changes are necessary in order to accommodate mechanical equipment furnished, necessary revisions will be made with approval of Owner's representative.

F. Any minor changes in location of equipment, to include conduits, outlets, etc., from those shown on drawings, shall be made without extra charge if so directed by Owner's representative. These changes shall be any changes in location that, had new location been the bid-upon location, would not have resulted in an increase in contract construction cost over that actually bid.

G. All electrical equipment shall be installed in conformance with applicable sections of NPFA 70 - National Electrical Code, respective equipment manufacturer's directions, as detailed on drawings and as specified herein. Any installations which void U.L. listing (or other third party listing) and/or manufacturer's warranty of a device or equipment shall NOT be permitted.

H. RELATED CONTRACT WORK DESCRIBED ELSEWHERE IN THESE SPECIFICATIONS:

Electrical Contractor shall note that it is **not** the intent of these Division 16 specifications herein to be all-inclusive of electrically related work to be performed as part of this contract.

Contractor shall also comply with electrical requirements in these sections of the specifications, including, but not limited to, wiring of motors, control panels furnished by others, HVAC equipment and all other electrically powered equipment furnished by others under this project.

1.02 LAWS AND ORDINANCES

A. In installation of this work, Contractor shall comply in every respect with requirements of National Electrical Code (NEC), National Board of Fire Underwriters, and any state and local requirements, laws and ordinances as may be applicable.

B. If, in opinion of the Contractor, there is anything in drawings or specifications that will not strictly comply with above laws, ordinances and rules, the matter shall be referred to the attention of the Owner's representative for a decision before proceeding with that part of the work. No changes on drawings or in specifications shall be made without the full consent of Owner's representative.

C. Contractor shall obtain and pay for all licenses, permits and inspections required by above laws, ordinances and rules for entire electric wiring job called for in these specifications and accompanying drawings.

1.03 DRAWINGS

A. Drawings for electrical work will be a part of electrical drawings to which will be added, during the period of construction, any other detail drawings as may be necessary in opinion of Owner's representative, to show proper installation of various appliances or equipment with relation to project.

B. Drawings and specifications are intended to be descriptive only, and any error or omissions of detail in either **shall not** relieve Contractor from obligations thereunder to install in correct detail any and all materials necessary for complete and operating electrical systems to extent shown on drawings and described in this specification.

C. Contractor shall, during progress of job, record any and all changes or deviations from original drawings, and, at completion of project, shall deliver to Owner's representative a **single** marked-up set of "as-built" drawings.

1.04 SHOP AND ERECTION DRAWINGS

A. This Contractor shall prepare shop drawings for all parts of his work. Before commencing any work or providing any material, Contractor shall submit for approval of Owner's representative all drawings relating to construction, arrangement or disposition of equipment entering into contract, and show complete equipment with manufacturer's specifications of same.

B. Shop drawings of all distribution and motor control centers, panels, power and lighting systems, fixtures, wire, cables, devices, etc. shall be submitted for approval, as well as complete details of all systems not shown in detail on drawings.

C. SHOP DRAWINGS SHALL BE FULLY DESCRIPTIVE OF ALL MATERIALS AND EQUIPMENT TO BE INCORPORATED INTO THIS PROJECT. CONTRACTOR SHALL CAREFULLY CHECK ALL SUBMITTED SHOP DRAWINGS, MAKING SURE THEY ARE COMPLETE IN ALL DETAILS AND COVER SPECIFIC ITEMS AS HEREINAFTER SPECIFIED.

D. Shop drawings shall be submitted in sufficient quantity as required by the General Conditions.

E. No material or equipment shall be allowed at the site until shop drawings approved by the Engineer are received by the Resident Engineer at the site.

F. The following information shall be clearly marked on each shop drawing, catalog cut, pamphlet, specifications sheet, etc. submitted:

PROJECT TITLE:
BRANCH OF WORK: ELECTRICAL
NAME OF BUILDING OR LOCATION:
PAGE OF DRAWINGS OR SPECS WITH WHICH EQUIPMENT COMPLIES:
DATE:
SUBMITTED BY:

PART 2 PRODUCTS

2.01 PRODUCTS SHALL BE AS SPECIFIED IN OTHER SECTION AND AS DETAILED ON THE DRAWINGS.

PART 3 EXECUTION

3.01 EQUIPMENT STORAGE

A. Except as indicated below, **all** electrical equipment considered to be a part of this contract shall be stored before installation in a warm, dry, **indoor area** so as to protect the equipment from physical damage, freezing, dirt and any other harmful effects.

B. The following electrical equipment shall be permitted to be stored outdoors on pallets or without direct contact with the earth, under tarpaulins or plastic covers:

1. Conduit. Does not include boxed fittings, etc., which shall be stored indoors.
2. Cable Tray. Does not include boxed hardware, which shall be stored indoors.
3. Ground Rods.
4. Wire and Cable.
5. Rebar.
6. Strut-type framing members. Does not include boxed hardware, which shall be stored indoors.
7. Exterior pad mount transformers.
8. Exterior Pad-Mounted Med. Voltage Switchgear.
9. Other electrical equipment not listed herein, with written approval of the Owner's Authorized Representative.

C. The following electrical equipment shall be permitted to be stored exposed outdoors on pallets or without direct contact with the earth:

1. Light Poles. Does not include light fixtures or boxed hardware, which shall be stored indoors.
2. Other electrical equipment not listed herein, with written approval of the Owner’s Authorized Representative.

D. The installation of electrical equipment shall not begin until the structure, if required, within which the equipment is to be permanently housed, is complete enough to provide protection from weather and vandalism (i.e. roof, windows and temporary padlockable or permanent doors installed).

E. The Contractor will be responsible for ensuring conformance with these procedures.

3.02 EQUIPMENT MOUNTING

A. All equipment and materials shall be installed and completed in a first-class workmanlike manner. The right is reserved to direct the removal and replacement of any item, which in the opinion of the Owner's Representative and/or Architect/Engineer does not present an orderly and reasonably neat or workmanlike appearance, provided such items can be properly installed in an orderly way by usual methods in such work.

B. The approximate location of all equipment and devices is shown on the Drawings. The Owner's Representative and/or Architect/Engineer reserves the right to change the location of all equipment or devices 6 feet in any direction at no additional cost provided such changes are requested before final installation.

C. Install all equipment with ample space allowed for removal and repair. Provide ready accessibility to removable parts of equipment and to all wiring without moving equipment which is installed or which is already in place. Provide access panels for all devices installed above non-accessible ceilings and/or within walls or partitions.

D. Install electrical equipment with due consideration to ventilating ducts, HVAC equipment, mechanical piping, etc., adjusting locations as necessary.

E. Electrical equipment shall be installed to maintain minimum clearances per Article 110 of NEC and ANSI C2 (National Electrical Safety Code.)

F. Electrical Contractor shall be responsible for furnishing and setting all anchor bolts required to install Electrical Contractor's equipment.

G. Where concrete mounting pads are required for electrical equipment mounting, Electrical Contractor shall furnish all concrete and form work necessary to complete the installation.

H. Where electrical equipment is located on damp or wet walls or locations as directed, it shall be "stand-off" mounted a minimum of ½" from wall in a manner so that rear of equipment is freely exposed to surrounding air. Method of mounting shall be approved by Owner’s representative before equipment is mounted.

I. Unless otherwise noted, top of safety-switches, control panels, and similar equipment shall be 5’-0” above finish floor or finish grade.

J. Enclosures for panelboards, switches or overcurrent devices shall not be used as junction boxes, auxiliary gutters or raceways for conductors feeding through or tapping-off to other switches or overcurrent devices, unless adequate space for this purpose is provided and the equipment is listed for this use.

K. In order to maintain NEC ratings and classifications of cables, do not combine conduit contents or modify conduit materials of construction unless specifically directed or shown otherwise on project documents.

L. Per NEC 300.11(A) (2), when independent electrical equipment support wires are installed within dropped-ceiling areas, they shall be distinguished by color, tagging, or other permanent effective means.

3.03 COORDINATION

A. Provide day-to-day coordination with the work of other contractors engaged in this project. Execute the work in a manner not to interfere with other Contractors, and vice-versa.

B. Coordinate with other contractors regarding the location and size of pipes, raceways, ducts, openings, devices, so that there may be no interferences between installation or of the progress of any contractor.

C. Coordinate installation of equipment and wiring with the established construction schedule.

D. Provide temporary platforms and handrails as required, to allow installation of electrical components and raceway systems.

3.04 PROTECTION OF WORK

A. Protect work from injury by keeping all conduit and boxes capped and plugged or otherwise protected. This includes damage by freezing and/or stoppage from building materials, sand, dirt, or concrete.

B. Protect all equipment and fixtures from damages during the project, provide all tarpaulins, drop cloths, barricades, temporary heaters or auxiliary equipment.

C. All materials or equipment damaged during construction shall be repaired or replaced with new items to the satisfaction of the Architect/Engineer.

END OF SECTION 16010

PART 1 GENERAL

1.01 WORK INCLUDES

A. Electrical demolition.

1.02 RELATED WORK (RESERVED)

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT (RESERVED)

PART 3 EXECUTION

3.01 EXAMINATION

A. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND NOT TO INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED.

B. Where walls, ceilings, etc., are indicated as being removed on general plans, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, wiring, systems, etc., from the removed area.

C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.

D. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit, wire and equipment to facilities or equipment which shall remain in operation following demolition. Extension of conduit wire equipment shall be compatible with surrounding area.

E. Coordinate scope of work with all other Contractors and the Owner's representative at the project site. Schedule removal of equipment and electrical service to avoid conflicts.

F. Bid submittal means Contractor has visited the project site and has verified existing conditions and scope of work.

G. Prior to beginning any work, the Contractor shall field determine all existing circuits and equipment powered by these circuits in the areas of demolition.

3.02 PREPARATION

A. Disconnect electrical systems scheduled for removal.

B. Coordinate utility service outages with the Owner's representative.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work as outlined in the plans.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Where possible, remove abandoned wiring and raceway to source of supply. Abandoned conduits which extend to below grade shall be removed to minimum of 1'-0" below grade and capped to prevent entry of water.

D. Remove exposed abandoned raceway. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

E. Disconnect abandoned outlets and toggle switches and remove devices. Remove abandoned outlets and toggle switches if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes which are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Place existing fluorescent ballasts in E.P.A. approved containers for P.C.B.'s and dispose of them in an E.P.A. approved landfill. Provide documentation that P.C.B. disposal requirements have been met.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CONTINUITY OF SERVICE DURING ELECTRICAL DEMOLITION

A. Contractor shall maintain continuity of service to all existing electrical equipment to be removed or replaced until such equipment is no longer needed to maintain process operation at the facility. This may require temporary relocation of equipment to be removed, temporary wiring of equipment to be removed and temporary power generation using portable generators as required to maintain operation of critical process equipment at the facility.

B. Contractor shall note that the proposed improvements under this contract shall occur at an existing treatment plant that must remain in operation during the improvements. Construction sequencing to minimize power outages at the facility is mandatory.

C. There shall be no power outages of any kind or duration whatsoever without the written consent of the owner's authorized representative. Failure to comply with this requirement could result in substantial penalty charges being assessed the contractor.

D. With assistance and approval of the owner's authorized representative(s), the contractor shall develop a written electrical demolition sequence schedule as part of the overall Electrical Construction Sequence Schedule. No electrical work shall begin without this written construction sequence schedule.

E. Prior to beginning of any work requiring a power outage of any kind or duration, the contractor shall have all labor, material and equipment on site and ready for use.

F. Maximum duration of any single power outage, whether partial or complete, shall be eight (8) hours - however this maximum duration shall only apply in low flow conditions and, again, only with the written approval of the owner's authorized representative.

G. Whenever possible, the contractor shall coordinate the electrical power outages to coincide with relevant process interruptions schedules by other contractors and trades on this jobsite. This will minimize the number of process flow interruptions the facility must sustain.

END OF SECTION 16060

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is conduits, raceways and fittings required for operation and maintenance of facility.

1.02 RELATED SECTIONS

A. Division 11 – Equipment
B. Division 13 – Special Construction
C. Division 15 – Mechanical
D. Section 16010 – General Electrical Requirements
E. Section 16123 – Building Wire and Cable
F. Section 16190 – Supporting Devices

1.03 REFERENCE TO STANDARDS

A. Federal Specifications WW-C-581d
B. Federal Specifications WW-C-540c
C. Federal Specifications WC-1094-A
D. ANSI C80.1
E. ANSI C80.3
F. ANSI C80.5
G. UL Standard UL-1
H. UL Standard UL-6
I. UL Standard UL-651
J. UL Standard UL-797
K. UL Standard UL-1479
L. NEMA RN1
M. NEMA RN2
N. NFPA 70 (NEC)
O. NEMA TC-2
P. NEMA TC-3
Q. NEMA TC-7

1.04 DELIVERY, STORAGE AND HANDLING

A. Conduits shall not be shipped loose, but shall be bundled by sizes. Threads of metal conduits shall be protected by plastic caps. Fittings shall be stored in boxes. All equipment shall be stored on pallets to prevent contact with earth and shall be covered with plastic sheeting to protect them from dirt and weather.

1.05 SUBMITTALS (SUBMIT ONLY ON TYPES APPLICABLE FOR PROJECT)

A. Submit under provisions of Division 1.

B. Schedule 40 Galvanized Rigid Steel Conduit

C. PVC Coated Galvanized Rigid Steel Conduit

D. Schedule 40 Aluminum Rigid Conduit

E. Rigid PVC Conduit

F. Liquid Tight Flexible Metal Conduit

G. Explosion-proof Flexible Metal Couplings

H. High-Density Polyethylene Conduit (Unit Duct)

I. Fittings and Conduit Bodies

J. Expansion/Deflection Fittings

K. Lay-In Wireway

L. Conduit Seals

1. Conduit Fire Stopping
2. Conduit Water Seals
3. Conduit Explosion Proof Seals

1.06 QUALIFICATIONS

A. All materials shall be purchased new from suppliers/manufacturers regularly engaged in the business of electrical conduit, ducts and fittings.

1.07 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION
Note that all types specified below may not be used on every project. Refer to project drawings for individual project requirements.

A. Schedule 40 Galvanized Rigid Steel Conduit:

Conduit shall be of heavy wall type fabricated from mild steel tubing and shall have a hot-dipped galvanized inner and outer coating, with a final coating of zinc chromate. Conduit and installation shall comply with all requirements in NEC Article 344. Mounting hardware shall be corrosion resistant, stainless steel, or galvanized steel.

B. PVC Coated Galvanized Rigid Steel Conduit:

PVC coated galvanized rigid steel conduit shall be Robroy Industries Plasti-Bond,

or equivalent. PVC coating shall be a minimum of 40 mils in thickness and permanently fused to hot-dipped galvanized rigid steel conduit. A urethane inner coating shall be applied to the conduit interior and a clear urethane coating shall be applied over the galvanized threads. Conduit and installation shall comply with all requirements in NEC Article 344. Mounting hardware shall be corrosion resistant: PVC coated supporting devices with stainless steel hardware.

C. Schedule 40 Rigid Aluminum Conduit

Conduit shall be of 6063 aluminum alloy, T-1 temper (Former designation T-42). Rigid aluminum conduit shall be third-party listed for use in classified (hazardous) locations. Conduit and installation shall comply with all requirements in NEC Article 344. Do not utilize steel or iron conduit fittings with aluminum conduit. Mounting hardware shall be corrosion resistant: stainless steel or aluminum.

D. Rigid PVC Conduit:

Conduit shall be Schedule 40 or Schedule 80, as noted on the drawings, PVC, 90°C, UL rated or approved equivalent. Material shall comply to NEMA Specification TC-2 (Conduit), TC-3 (Fittings-UL-514), and UL-651 (Standard for rigid nonmetallic conduit). Conduit and fittings shall carry a UL label (on each 10 foot length of conduit and stamped or molded on every fitting). Conduit and fittings shall be identified for type and manufacturer and shall be traceable to location of plant and date manufactured. Markings shall be legible and permanent. Conduit shall be made from polyvinyl chloride C-300 compound which includes inert modifiers to improve weatherability, heat distortion. Clean rework material, generated by manufacturer's own conduit production, may be used by same manufacturer, provided end products meet requirements of this specification. Conduit and fittings shall be homogeneous plastic material free from visible cracks, holes, or foreign inclusions. Conduit bore shall be smooth and free of blisters, nicks or other imperfections which could mar conductors or cables. Conduit, fittings and cement shall be compatible to assure system integrity and shall be Carlon Plus 40 (Schedule 40) or Plus 80 (Schedule 80) as shown on project drawings, or equal. Conduit and installation shall comply with all requirements in NEC Article 352. Mounting hardware shall be corrosion resistant: nonmetallic support straps or PVC conduit clamps with stainless steel hardware, designed for the installation of PVC conduit, which allows the conduit to expand and contract freely over varying temperature changes.

E. Liquid Tight Flexible Metal Conduit (Non-Hazardous Areas):

Liquid tight flexible metal conduit shall consist of polyvinyl jacket over flexible hot dip galvanized steel tubing. Flexible conduit shall be completely sealed from liquids, dust, dirt and fumes, be resistant to oil, gasoline, grease and abrasion. Jacket shall also be sunlight resistant. Flexible conduit shall be U.L. listed and comply with Article 351 of NEC. Flexible conduit shall be Flexi-Guard Type UAG, as manufactured by O-Z/Gedney, or equal. Conduit and installation shall comply with all requirements in NEC Article 350.

F. Liquid Tight Flexible Non-Metallic Conduit (Non-Hazardous Areas):

Liquidtight Flexible Non-Metallic Conduit shall be non-conductive, non-corrosive, resistant to oil, acid, ozone and alkaline, and crush, abrasion and strain resistant. Conduit shall maintain internal I.D. even in tight radius bends. Conduit shall be UL Listed for use as indicated in Article 356 of the NEC, UL Listed for outdoor use, and sunlight resistant. Trade sizes 1/2", 3/4" and 1" shall be UL Listed for direct bury. Conduit shall be suitable for use at conduit temperatures of 80°C dry, 60°C wet and 60°C oil resistant as required by section 15-6 of ANSI/NFPA 79-1985 and UL 1660. Liquidtight non-metallic flexible conduit shall be Carlon Carflex Type LFNC-B, or equivalent.

G. Flexible Couplings w/stainless-steel braid (Hazardous Areas/Explosion Proof):

Flexible couplings used in hazardous areas shall be suitable for use in Class I, Div. I, Group D areas and shall comply with all requirements of Articles 500 and 501 of the NEC. Note: Due to corrosive environments, ALL explosion-proof flexible metal couplings shall be constructed with Stainless Steel braided construction over woven cotton braid impregnated with asphalt. Do NOT utilize bronze-braid explosion-proof flexible conduit as it is quickly corroded by hydrogen-sulfide gas. All explosion-proof flexible couplings shall additionally be liquid tight and listed for wet locations. Explosion-proof flexible couplings shall provide a continuous electrical grounding path which meets, or exceeds, NEC & UL requirements. Explosion proof flexible conduit shall be Crouse-Hinds ECGJH#### -S516 (Male-to-Male) or ECLK#### -S516 Series (Male-to-Female), or equivalent, where # indicate manufacturer's code designation for coupling trade-size and length

H. High-Density Polyethylene Conduit (Unit Duct)

Unit duct shall be installed with additions, options and exceptions as noted herein. Unless otherwise specified, the Polyethylene Duct shall be Schedule 40 and comply with the following:

1. NEMA TC-7 Smooth Wall Coilable Polyethylene Electrical Plastic Duct
2. ASTM D-3485 Standard specification for Smooth Wall Coilable Polyethylene (PE) Conduit (Duct) for preassembled wire and cable.
3. ASTM D-2477 Standard Specifications for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
4. ASTM D-3350 Standard Specifications for Polyethylene Plastics Pipe and Fittings Materials
5. NEC Art 353 High Density Polyethylene Conduit; Type HDPE Conduit.
6. U.L. 651B Continuous length HDPE

Materials used for the manufacture of the polyethylene conduit and casing shall be high-density polyethylene that meets or exceeds a cell classification of 334430C (Black) or 334430E (Colored Shell) per ASTM D-3350. Recycled and reclaimed materials from outside the manufacturer's plant shall not be utilized in manufacture. Black material shall contain a minimum of 2% carbon black for

long-term protection against UV degradation. The base resign used in the manufacture of the product shall contain a high-quality anti-oxidant package. The wall thickness shall be in accordance with ASTM D-2447. Conduit or casing shall be continuously marked with durable printing at intervals no greater than five (5) feet. Coils and reels shall have sequential footage marks. In order to prevent the entrance of dirt and water, the open ends of each length of reeled flexible duct, and all installed lengths prior to termination, shall be sealed by plastic caps. Polyethylene duct shall be Tamaqua, CPChem (Division of Chevron Phillips Chemical), Cablecon (by Integral Corp.) or equivalent. All fittings shall be specifically designed for use with polyethylene conduit. All terminations of polyethylene conduit to other conduit types shall be made utilizing fittings listed for the purpose. Solvent bonding of polyethylene conduit shall utilize American Polywater Corp. BonDuit Conduit Adhesive, or approved equivalent. Conduit and installation shall comply with all requirements in NEC Article 353.

I. Fittings and Conduit Bodies:

Unless otherwise specified, all fittings and conduit bodies shall be manufactured from the same type of material as the conduit system (aluminum, galvanized steel, PVC, etc.) Field Modifications to Existing Rigid Metal Conduit Systems ONLY:

Where modifications to existing rigid conduit installations make threading of field cuts impossible, use Type HK series couplings by Thomas & Betts/Steel City, or equivalent.

J. Expansion and Deflection Fittings

Where noted on project drawings, or required by the nature of construction location, furnish conduit Expansion, Deflection or Expansion/Deflection Fittings. Expansion and deflection fittings shall be compatible with other conduit materials and be type AX (expansion), DX (deflection) or AXDX (expansion/deflection) as manufactured by O-Z/Gedney, or equivalent.

K. Lay-In Wireway:

Unless otherwise indicated on the drawings, lay-in wireway installed in dry (non-hosedown) interior areas shall be NEMA 1 hinge cover steel enclosed wiring trough. Lay-in wireway installed outdoors or in interior areas subject to hosedown or wet conditions shall be NEMA 3R, 4 or 4X as noted on the drawings. Wireway shall be sized as shown on drawings, as a minimum, or as required by NEC, and shall be as manufactured by Square D, Hoffman, or equivalent. Install all hinged wireways with hinges on bottom such that doors will not interfere with maintenance and installation when open.

L. Pull Cords

Each empty conduit shown or described on the drawings shall be furnished with a pull cord to facilitate future conductor installation. Cord shall consist of non-deteriorating, non-metallic, non-cotton construction such as polyester or nylon material. Minimum tensile strength of all pull strings shall be 200#. Leave

minimum of 12 inches slack at each termination or end. Any references on project drawings to “pull wire” shall be interpreted as a pull cord as described herein.

2.02 SEALING

A. Fire Seal (Fire Stopping Material):

1. Fire stopping materials shall consist of commercially manufactured products capable of passing ASTM E-814 (UL 1479) Standard Method of Fire Test for Through Penetration Fire Stops.
2. Fire stopping materials shall maintain the rating of the wall, partition, ceiling or floor opening where penetration is made. Comply with NEC 300-21.
3. All fire-stopping materials shall be third-party classified.
4. Where sleeves are to be installed, the sleeve shall be heavy wall steel pipe sleeves, anchored to building construction and finished plumb with wall, ceiling, or floor lines.
5. Manufacturers:

    a. Chase Technology – CTC, PR-855.
    b. Dow Corning – Silicone RTV Foam 3-6548.
    c. Nelson – Flameseal.
    d. Thomas & Betts – Flame Safe.
    e. 3M – Fire Barrier.

6. Where applicable for the respective wall and its fire rating, smoke and fire stop fittings may be used in lieu of sealant as manufactured by OZ/Gedney, Series CFS.

B. Thermal Seal:

1. Seal penetrations of thermally insulated equipment or rooms top prevent heat transfer.

C. Moisture Seal:

1. When electrical conduits are installed in sleeves, core-drilled holes or box outs, seal between conduit and penetration of perimeter walls, ceilings or floors to prevent entry of water.
2. Seal conduit penetrations of roof with flashings compatible with roof design and approved by Roofing System Manufacturer and Engineer.
3. Seal annular space between conductors and conduit wall of all conduit terminations where conduit enters a building from below grade in order to block moisture migration into electrical equipment. In addition seal conduits entering electrical equipment located either interior or exterior that once installed condensation is created in the electrical equipment due the electrical system being connected to areas with a different temperature. Conduit moisture barrier material shall not harden and be compatible with both wire insulation and conduit materials. Installed product shall be easily removed for maintenance or modifications,

regardless of the length of time material has been installed. Conduit moisture seal material shall be:

a. "Hydroblock" by WaterGuard Technology Products
16023 East Freeway
Channelview, Texas 77530-4365
Phone: (281) 862-0300
Fax: (281) 862-0314

b. American Polywater Corporation
Polywater Duct Sealant FST-250 Series
P.O. Box 53
Stillwater, MN 55082
Phone: (651) 430-2270
Fax: (651) 430-3634

c. O-Z/Gedney
Type DUX Water Sealing Compound

D. Class I, Division 1, Group D Conduit Seals

1. Explosion proof conduit seals shall be suitable for use in Class I, Division 1, Group D classified location. Explosion proof conduit seals shall be Crouse-Hinds EYS or EZS Series, Appleton EYS, ESU, or EY Series, Killark ENY, EYS or EY Series, or O-Z Gedney EYA, EY, EZS Series explosion proof sealing fitting. Conduit seal shall include Packing Fibers and Epoxy Sealing Compound to provide an explosion-proof seal. See also note in Part 3 regarding identification of "poured" conduit seals.

E. Class I, Division 2 Conduit Seals

1. Conduit seals shall be Crouse-Hinds EYS or EZS Series, Appleton EYS, ESU, or EY Series, Killark ENY, EYS or EY Series, or O-Z Gedney EYA, EY, EZS Series. See also note in Part 3 regarding identification of "poured" conduit seals.
2. Per NEC 501.15.B.1, conduit connections to enclosures required to be explosion-proof shall have a conduit seal in accordance with NEC 501.15.A.1.1 and A.3, this is, a Class 1, Division 1, Group D Conduit Seal. There shall be no unions, couplings, boxes or fittings between conduit seal and enclosure.
3. Per NEC 501.15.B.2, in each conduit run passing from a Class I, Division 2 location into an unclassified location, the sealing fitting shall be permitted on either side of the boundary of such location within 10 ft of the boundary. There shall be no unions, couplings, boxes or fittings between conduit seal and the defined wall. Conduits shall be sealed to minimize the amount of gas or vapor within the Division 2 portion of the conduit from being communicated to the conduit beyond the seal. Such seals shall not be required to be explosion-proof but shall be identified for the purpose of minimizing passage of gases under normal operating conditions and shall be accessible.

PART 3 EXECUTION

3.01 INSPECTION

A. All conduits shall be inspected for proper fit and finish, for out-of-round and for proper thickness. All burrs and flashing shall be removed. Conduit and fittings shall be clean and free of obstructions.

3.02 INSTALLATION

A. Unless otherwise shown on the project drawings, minimum conduit trade-size shall be 3/4". Larger sizes shall be installed where noted or where required by NEC.

B. In general, no aluminum conduit shall be cast in concrete or in direct contact with earth. Where such contact is found necessary or where specifically noted on project drawings, either coat all aluminum contact surfaces with a protective bituminous coating (such as Carboline Bitumastic 50 or 300M) or alternately substitute galvanized rigid steel conduit for the sections which are in contact with concrete or earth.

C. Interior Conduit Applications:

1. Above Grade or Floor:
   Rigid aluminum type unless otherwise noted on the project drawings.
   Exception: Conduit in Chlorine Room and Chlorine Storage Room shall be non-metallic (schedule 40 PVC).
2. Below Grade or Floor:
   Schedule 40 PVC or galvanized rigid steel at the Contractor's option. Where interior conduits exit from below floor or grade to above grade furnish conduit transition between types no more than 6" above finish floor.

D. Exterior Conduit Applications

1. Above Grade:
   Rigid aluminum type unless otherwise noted on the project drawings.
   Where conduits exit to above grade transition to conduit type shall be no more than 6" from penetration.
2. Below Grade:

   a. Conduits within exterior Duct Bank shall comply with Section 16118 – Exterior Underground Duct Bank. See Standard Detail Drawings for method of transition from underground duct bank to above grade.

E. Moisture Seal of Below-Grade Conduits

1. Seal annular space between conductors and conduit wall of all conduit terminations where conduit enters from below grade in order to block moisture migration into electrical equipment. Install product only after conductors have been installed, terminated and commissioned for service. Install moisture seal products per all manufacturer's instructions and requirements.

F. Conduit Sealing For Fireproofing

1. Sleeves:

a. Install rigid metallic sleeves where exposed raceways pass through floors, walls (except exterior walls below grade) and ceilings.
b. Sleeve Diameter: Size sleeves to accommodate their through penetrating items and allow a minimum of a one (1") inch void between the sleeve and the item of penetration.

2. Seal openings in fire rated floors, ceilings and roofs:

a. Pack void with backing material and ends of the sleeve sealed with a minimum of one (1") inch of a listed fire-resistive silicone compound to a depth required to meet the fire rating of the structure penetrated.
b. Install firestopping to meet the requirements of ASTM E-814
c. Install product in accordance with the manufacturer's instructions.

G. Conduit size and fill requirements shall comply with appropriate conduit fill tables in Annex C of NEC. It should be noted these are minimum requirements and larger conduit sizes or smaller fill requirements shall be used whenever specified or detailed on drawings.

H. Flexible conduit shall be provided as a connection between each motor junction box (or any other piece of equipment subject to movement or vibration) and rigid conduit system. <u>Liquid-tight and explosion-proof flexible conduit shall not exceed 3' in length.</u>

I. Ream conduits only after threads are cut. Cut joints square to butt solidly into couplings. Where necessary to join two pieces of conduit and it is impossible to use standard coupling, use three piece conduit coupling. Use of running thread is prohibited. This applies to all rigid conduit installations, underground or otherwise. In order to comply with NEC Article 300.6(A), all rigid steel conduit shall have field-cut threads re-coated using an electrically conductive, corrosion-resistant compound, Thomas & Betts/Shamrock "Kopr-Shield" (a product of Jet Lube, Inc.), or equivalent.

J. Make all joints in underground conduit watertight with approved joint compound. Temporarily plug conduit openings to exclude water, concrete or any foreign materials during construction. Clean conduit runs before pulling in conductors.

K. Hickey hand-bends will not be acceptable for conduits one inch (1") and larger.

L. Use pre-manufactured factory elbows or bends fabricated with hydraulic bending machine. Field bending of all PVC conduit shall be accomplished with use of equipment approved by conduit manufacturer. Open flame bending equipment will not be acceptable. A run of conduit between outlet and outlet, between fitting and fitting or between outlet and fitting shall not contain more than the equivalent of four quarter turn bends (360°), including bends immediately at an outlet or fitting.

M. At all conduit terminations furnish locknuts on both sides of enclosure plus an insulated bushing unless conduit termination is into a factory-threaded conduit opening or watertight (Myers-type) hub.

N. All conduit terminations at NEMA 4 or 4X enclosures shall be made with watertight (Myers-type) hubs listed for the application.

O. Do not run conduit below or adjacent to water piping, except where permitted by Owner's representative.

P. Run exposed conduits parallel with walls and at right angles to building lines, not diagonally.

Q. Support exposed PVC conduit runs on walls or ceiling every three feet (3') and support exposed rigid metal conduit runs on walls or ceiling every five feet (5') with stainless steel or PVC coated galvanized cast one hole straps, clamp backs and anchors. Provide lead shield insert anchors, with stainless steel round head machine screws, for concrete and brick construction. In wood construction, use stainless steel round head wood screws. Where steel members occur, drill and tap and use stainless steel round head machine screws.

R. In brick construction, drill hole for insert near center of brick, not near edge or in mortar joint.

S. Support two or more PVC exposed hanging parallel conduit runs every three feet (3') and support exposed rigid metal hanging parallel conduit runs every five feet (5') with trapeze hangers. Hanger assembly to consist of concrete inserts, threaded solid rod, washers, nuts and cross members nominally one and five-eighths inch (1-5/8") by one and five-eighths inch (1-5/8") non-metallic framing, as specified in Section 16190 - Supporting Devices. Anchor each conduit individually to cross members of every other hanger with cast one hole straps, clamps backs and proper sized stainless steel or non-metallic machine bolts and nuts.

T. Perforated metal strapping of any kind is prohibited. Provide expansion and deflection fittings in all conduits which pass through or over building expansion joints. All expansion and deflection fittings shall be designed for, and compatible with, the conduit types on which they are installed.

U. Grounding Electrode Conductors shall be installed in non-metallic PVC conduit or bonded to both ends of metallic conduit to comply with NEC 250.64.

V. All conduit and fittings installed in Classified Areas shall be third part listed for the applicable Hazardous Location.

W. Install explosion-proof conduit sealing fittings in conformance with the manufacturer's instructions. Per Article 501 Paragraph 501-5(c)(6) of the NEC, cross-sectional area for conductors installed in a conduit sealing fitting shall not exceed 25%, unless conduit sealing fitting has been specifically approved for a higher percentage of fill.

X. Identification of "poured" conduit seals: Conduit seal fill plugs shall be neatly spray painted red immediately following installation of fill material. Excess spray paint on surrounding surfaces shall be removed at the Contractor's expense. The Engineer will use this means of identification to certify that the Contractor has installed conduit-seal fill materials and plugs in compliance with all U.L., F.M. and manufacturer's requirements. Do not spray paint fill plugs of any spare or future conduit seals.

Y. PVC coated galvanized rigid steel conduit shall be installed per manufacturer's requirements, using tools specifically designed for installation of PVC coated galvanized rigid steel conduit. Any tools, hardware or installation methods which cause damage the PVC coating shall not be utilized. Do not install any material found damaged from shipping or handling. Any PVC coated conduit damaged during installation shall be immediately repaired to the satisfaction of the Owner's authorized representative using patching materials and methods per manufacturer's instructions. If, in the opinion of the Owner's authorized representative, PVC coated galvanized rigid steel conduit is damaged beyond repair, the damaged portion(s) shall be removed and replaced at the contractor's expense.

END OF SECTION 16111

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is duct bank, concrete encasement, reinforcing, pre-cast or cast in place handholes, trenching and backfilling required for operation and maintenance of facility.

B. This Specifications Section includes all exterior direct-buried conduit and concrete-encased duct bank. Unless otherwise specified on drawings, all underground conduit and duct-bank shall be concrete encased.

1.02 RELATED SECTIONS

A. Section 03200 - Concrete Reinforcement.
B. Section 03300 - Cast-In-Place Concrete.
C. Section 16010 - General Electrical Requirements.
D. Section 16111 - Conduit and Raceway.
E. Section 16123 - Building Wire and Cable.

1.03 REFERENCE TO STANDARDS

A. Federal Specifications WW-C-581d
B. ANSI C80.1
C. ANSI/SCTE 77
D. UL Standard #6
E. NEMA RN1-1980
F. NEC (Chapter 9 Tables 4, 5, 5A, 8 and Appendix C)
G. NEMA TC-2
H. NEMA TC-3
I. UL-651
J. A.A.S.H.T.O.
K. ASTM A615

1.04 DELIVERY, STORAGE AND HANDLING

A. Reinforcing steel and conduit supports shall be stored on pallets, covered to protect them from weather.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Conduit Spacers / Supports

1.06 MAINTENANCE SERVICE (WARRANTY)

A. Material and workmanship shall be warranted to be free from defects in materials and workmanship for a period of one year from date of substantial completion established by Owner.

PART 2 PRODUCTS

2.01 POLYMER CONCRETE HANDHOLES

A. Handholes shall be constructed of polymer concrete consisting of sand and aggregate bound together with a polymer resin. Internal reinforcement may be provided by means of steel, fiberglass, or a combination of the two.

B. The use of chopped fiberglass strands, high density polyethylene or high density polystyrene is unacceptable. Plastic and/or fiberglass boxes will not be considered as acceptable alternates for polymer concrete handholes.

C. Boxes and covers shall be concrete gray in color. All boxes and covers 30”W x 48”L and less shall be U.L. Listed and meet or exceed TIER 22 loading requirements of ANSI/SCTE 77-2007. U.L. Certification labels shall be attached to both box and lid. Shop Drawing submittals shall clearly note that the loading and U.L. listing requirements are met by the proposed equipment.

D. All metal hardware shall be stainless steel.

E. Logo “ELECTRIC” (Code #17) shall be factory molded into cover at time of production

F. Handhole covers, and frames shall meet equivalent handhole requirements of NEC Article 314.30(D) including the bonding of all exposed metal components.

G. All covers will have a minimum coefficient of friction of 0.5 in accordance with ASTM C1028 and be labeled to indicate the corresponding Tier level rating.

H. Polymer concrete handholes shall open-bottom design and shall be Quazite/Hubbell #PG-2436-DA-42 with #PG-xxyy-HH-00-17 Cover, or equivalent where “xx” = width in inches, “yy” = length in inches, and “zz” = depth in inches. Handholes shall be 24”W x 36”L x 42” deep unless otherwise noted on project drawings.

I. Where divided boxes are noted on project drawings or where physical cable isolation is required between compartments, furnish units similar to Quazite/Hubbell Model #PG-xxyy-BC-zz.

J. Cable racks shall be provided per Section 16190 – Supporting Devices.

K. Furnish 6” thick minimum base of CA-6 below all handholes extending 6” beyond each exterior sidewall.

2.02 DUCT SPACERS / SUPPORTS

A. Duct line spacers / supports shall provide stability and consistent separation and relieve direct stress for duct materials to be encased in concrete. Units shall incorporate a dovetail or other interlocking means to allow side-by-side interchangeablilty of conduit spacer sizes while maintaining horizontal stability. Units shall be of non-metallic construction and include integral base flanges and re-bar slots. Duct Spacers / Supports shall be Underground Devices "Wunpeece", Carlon/Lamson & Sessions Snap-Loc series or equivalent.

2.03 LINE MARKING TAPE
(To be provided only if specifically indicated on drawings)

A. Electrical line marking tape shall be installed only if specifically noted on project drawings. Tape shall be minimum 5 mils thick constructed of aluminum foil encased in an impervious Mylar plastic coating. The minimum tensile strength determined in accordance with ASTM D882 is 15,000 PSI. The tape shall contain sufficient metal mass to provide detectability at depths up to 3 feet with a radio type metal locator. Tape shall be acid, alkali and corrosion resistant. Color shall be "RED", corresponding to the standard color for electrical lines, and shall additionally be printed with "WARNING-ELECTRICAL LINE BELOW" or similar text. Line marking tape shall be as manufactured by Pro-Line Safety Products of West Chicago, Illinois or equivalent. Unless otherwise indicated on the drawings, burial depth of tape shall be approximately 18" below finish grade.

2.04 MISCELLANEOUS FITTINGS

A. Fittings and conduit supports shall be suitable for use with conduits and ducts supplied.

PART 3 EXECUTION

3.01 DUCT BANK

A. Security

Contractor is responsible for providing all safety barricades, safety materials, man-lift devices, and posting safety watches at all manholes and raceway vaults as required to construct this project in a safe manner.

B. Concrete Encased Schedule 40 PVC

Unless otherwise specified on drawings, all underground conduit and duct-bank shall be Schedule 40 PVC concrete-encased. Reinforced concrete-encased duct-bank shall be provided where duct-bank is installed under vehicular-traveled surfaces or whenever ductbank crosses underground piping. Reinforcing shall extend minimum of 5'-0" beyond the edge of all pavement surfaces. Transitions from below-grade Schedule 40 PVC conduit to galvanized rigid steel conduit shall be as detailed on project drawings. All field threaded galvanized rigid steel conduit shall have field threads re-coated using an electrically conductive, corrosion-resistant compound as specified in Section 16111.

C. Excavation for Duct Bank

The ground shall be excavated in open trenches to width, depth and in direction necessary for proper installation of underground duct work and any manholes, handholes, etc., and connections as may be shown on drawings.

Any necessary sheathing to prevent cave-ins, etc. shall be provided by this Contractor.

Where muck or unstable ground is encountered in bottom of trench, it shall be excavated to a depth of at least 12 inches below line of duct or slab. Where bottom of trench is excavated below necessary elevation, it shall be brought to proper grade by use of torpedo sand or three-eighth inch (3/8") gravel, well compacted.

Where excavation for its entire depth is in water or wet sand, Contractor shall furnish a temporary pumping system connected with well points so as to drain same effectively during construction.

Excavations shall be deeper than minimum wherever required in order that ducts or conduits may be installed so as to avoid new or existing piping, etc., as directed by site conditions or Owner's representative.

Should conduits, ducts, etc. pass under sidewalks, roads, or curbs, Contractor shall take up same in order to install conduit or ducts. All sidewalks, roads or curbs shall be replaced with material equal to that removed and shall be as approved by Owner's representative.

CONTRACTOR SHALL PROCEED WITH CAUTION IN EXCAVATION AND PREPARATION OF TRENCH SO THAT EXACT LOCATION OF UNDERGROUND STRUCTURES, UTILITIES AND PIPING, BOTH KNOWN AND UNKNOWN, MAY BE DETERMINED, AND CONTRACTOR SHALL BE HELD RESPONSIBLE FOR REPAIR OF SUCH STRUCTURES, UTILITIES AND PIPING WHEN BROKEN OR OTHERWISE DAMAGED BY CONTRACTOR.

D. Installation of Duct Bank

Unless otherwise noted on project drawings, all underground duct bank shall be a minimum of 1'-6" and a maximum of 2'-6" below finished grade to top of top duct in bank.

Extend concrete encasement for ductbank to all manholes and handholes. Unless otherwise indicated on the drawings, enter and exit all manholes and handholes utilizing PVC conduit with end bells or non-metallic bushings to prevent cable damage during installation.

Where possible, install conduit with typical pitch of 4 inches per 100 ft length.

Where duct comprised of plastic (PVC) conduit must transition from underground to above ground, conduits shall transition from PVC conduit to rigid steel conduit by means of factory manufactured couplings. All transitions from plastic (PVC)

conduit to galvanized rigid steel conduit shall be made within concrete encasement as detailed on drawings.

Any rigid metal conduit ends extending into manholes or handholes shall be electrically bonded to the largest ground conductor passing thru the structure by use of threaded lay-in type insulated grounding bushings such as O/Z Gedney IBC-L-AC.

All duct runs shall be separated and supported before backfilling or pouring concrete. Conduit spacing shall be minimum of 7-1/2” center-to-center.

All angle bends in conduit of 45° or greater shall be made with PVC-coated rigid galvanized steel conduit. Provide factory manufactured couplings between conduit types.

Materials for concreting shall be thoroughly mixed and immediately placed in trench around rigid conduits and ducts. No concrete that has been allowed to partially set shall be used. After duct runs are completed and concrete is set, Contractor shall backfill trenches and tamp thoroughly so as to settle the fill.

Before Contractor pulls any cables into ducts he shall have a mandrel one-fourth inch (1/4") smaller than duct inside diameter and approximately twenty inches (20") long pulled through each duct, and if any concrete or obstructions are found, Contractor shall remove them and clear ducts.

E. Duct Bank Under Vehicular-Traveled Surfaces and Pipe Intersections

Unless otherwise detailed on project drawings, all duct runs passing under roadways, traveled surfaces, or where ductbank intersects or crosses underground piping utilities shall be Schedule 40 PVC conduit encased on all sides with a two inch (2") concrete envelope and reinforced as specified herein.

Reinforcing shall consist of one-half inch (1/2") round bars spaced six inches (6") on center, paralleling ducts on top, bottom and sides, with one-half inch (1/2") formed tie bars spaced twelve inches (12") on centers. Bars shall overlap forty (40) diameters and shall extend five feet (5') beyond roads or drives on each side.

F. Concreting and Forms

All concreting and form work necessary in connection with construction and concreting around plastic and metal duct runs underground shall be provided by this Contractor.

G. Ready-Mixed Concrete

Ready-mixed concrete shall be used for all electrical duct runs to be encased. Ready-mixed concrete shall comply with requirements set forth in "Standard Specifications for Ready-Mixed Concrete," (ASTM Designation C-94).

The top of all concrete-encased duct runs shall be dyed “red” in color. At the Contractor’s option, this requirement may be met by either providing concrete

that has been dyed red by the supplier, or by field applying red dye to the top of the duct-bank while still wet.

H. Removal of Water

New construction:
Contractor shall at all times during construction provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering excavations or other parts of work and shall keep said excavations dry until all work to be performed therein has been completed.

Existing facilities:
Where project requirements involve existing ductbank, manholes and handholes, Contractor should assume same are full of water and field pumping will be necessary. Contractor shall furnish all temporary pumping equipment and labor in order to work on the existing duct-system and this equipment and effort shall be considered incidental to the project cost.

I. Backfill in Open Areas

Backfill for conduit and duct runs in continuous open areas away from roadways, paved areas and structures shall be backfilled as described below.

Unless otherwise noted, clean material obtained from the excavation which, in opinion of Owner's representative, does not contain excessive moisture, shall be suitable in constructing backfill. Excavated material which is considered unsuitable by Owner's representative due to excessive moisture may be allowed to dry before being used as backfill. Approved backfill material shall be placed in 6 to 8 inch lifts (layers) and then compacted as necessary to prevent settlement.

J. Backfill Under Roadways and Paved Areas

Unless otherwise ordered by Owner's representative, CA-6 granular backfill shall be used in locations where conduit and duct runs cross roadways and paved surfaces. Granular backfill shall be used from top of concrete encasement to bottom of roadway base and shall be compacted to 95% Standard Proctor of material to be used, as tested.

K. Pavement Restoration

If duct bank installation requires pavement removal, pavement shall be saw cut prior to removal. As directed by the Owner's authorized representative, pavement removed shall be replaced with concrete pavement or bituminous concrete surface material (Class I, minimum of 1700 pound Marshall stability) and compacted to satisfaction of Owner's representative.

L. Jacking Conduit

With approval of Owner's representative, Contractor shall be permitted to jack conduit under roadways.

3.02 SEPARATION OF CABLES IN HANDHOLES (WHERE INSTALLED)

A. Contractor shall maintain maximum separation possible of telephone cables and 4-20 madc signal cables from 120V, 208V and 480V wiring in handholes to minimize electromagnetic affects from this wiring.

3.03 WIRE AND CABLE INSTALLATION

A. All wire and cable passing thru manholes, handholes or vaults shall be supported on non-metallic racks or supports. No wire or cable will be permitted to lie directly on the floor of manholes, handholes or vaults.

B. Install and support all cables passing thru manholes and handholes such that sump-pump depression in floor is not obstructed. Train and tie all cables to racks such that a portable sump pump may be dropped into sump depression without entering manholes and handholes.

END OF SECTION 16118

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is supply of wire and cable to provide a complete and operational electrical system.

B. Any bid submitted to the Owner which contains cost adjustments for the current price of metals (copper and/or aluminum) will be rejected. Qualified bids in any form will not be considered.

C. Unless otherwise specified or detailed on drawings, all wire and cable on this project shall be copper construction only.

1.02 RELATED SECTIONS

A. Division 11 - Equipment
B. Division 13 - Special Construction
C. Division 15 - Mechanical
D. Section 16010 - General Electrical Requirements
E. Section 16111 - Conduit and Raceway
F. Section 16170 - Grounding and Bonding

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code

B. U.L Standard No. 44 - Thermoset-Insulated Wires and Cables.

C. IPCEA Publication No. S-66-524.

D. Federal Specification J-C-30B

E. ASTM Specification B-8.

1.04 DELIVERY, STORAGE AND HANDLING

A. Wire and cable shall be delivered on reels or coiled in boxes. Wire and cables shall be stored and handled to prevent damage to conductor and insulation.

1.05 SUBMITTAL REQUIREMENTS

A. Submit under provisions of Division 1.

B. Contractor shall submit for all cable types and sizes used on this project.

1.06 QUALIFICATIONS

A. Wire and cable shall be manufactured and supplied by a company regularly engaged in business of furnishing wire and cable. If required by Owner's

representative, manufacturer shall submit a certification to a minimum experience of five years in manufacture of wire and cable.

1.07 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

1.08 EQUIPMENT SPECIFICATION

A. THHN/THWN

Unless otherwise noted on the plans or specifications, all power wiring installed under this project shall be dual rated type THHN/THWN.

Cable shall be 600 Volt rated, sized as indicated on the drawings. Cable shall comply with Underwriters Laboratories Standard U.L. 83. Cables shall be rated 90°C in dry locations 75°C in wet locations.

B. INSTRUMENTATION SHIELDED CABLE
(For use in Conduit)

Shielded instrumentation cable shall be used where required or shown on plans. Cable construction shall be #16 AWG tinned copper, polyethylene insulated, have #18 AWG stranded tinned copper drain wire and aluminum-polyester shield with 100% coverage. Overall jacket shall be polyvinyl Chloride (PVC). Cables shall be 60°C, 600 V rated and U.L. recognized.

1. 2-Conductor shielded instrumentation cable for use in conduit shall be Belden #8719, or equivalent.
2. 3-Conductor shielded instrumentation cable for use in conduit shall be Belden #8618, or equivalent.

C. CATEGORY 6 CABLE

1. UTP Cable to be 23 AWG copper construction and Certified to TIA/EIA-568-B.2-1 requirements.
2. Cable shall be accommodate transmission speeds up to 4.8 Gb/s.

   a. Riser cable shall be ITS/ETL Certified as CMP and listed as NEC type CMR per UL Standard 444. Riser cable shall be Belden DataTwist 4812 or equivalent.
   b. Plenum cable shall be ITS/ETL Certified as CMP and listed as NEC type CMP per UL Standard 444. Plenum cable shall be Belden DataTwist 4813 or equivalent.

D. FIBER OPTIC CABLES (FO)

1. Multi-mode Breakout Riser Rated - ONFR
2. Nominal Operating Temperature –40°C to +85°C
3. 12 Fiber Construction around center strength member
4. Elastomeric PVC Black outer jacket suitable for indoor or outdoor use
5. 62.5/125 micron core/cladding
6. Attenuation: At 850 nm; 3.5 dB/km 220 MHz-km
   At 1310 nm; 1.0 dB/km 500 MHz-km
7. Optical Cable Corporation Part Number BX***-D-WLS-9KR or equivalent (where "***" indicates the number of individual fibers as noted on project drawings within each cable).

E. Furnish and install fiber optic terminators (connectors) style SC or ST as required to match equipment. Connectors shall be designed for field assembly and be self-aligning and self-centering. Comply with manufacturers requirements. Include terminators on all fibers, including spares.

F. Splice Closures: Splice closures shall protect the spliced fibers from moisture and to prevent physical damage. The splice closure shall provide strain relief for the cable and the fibers at the splice points.

2.02 COLOR CODING

A. Color code conductor insulation for #10 AWG or smaller conductors. Color code conductors #8 AWG or larger with colored tape or colored insulation. Standard colors:

	120/240V 1 Phase 3W	240 V or 208/120V 3 Phase 3 or 4W	480V 3 Phase 3 or 4W	240/120V 3 Phase 4W,)
Phase A	Black	Black	Brown	Black
Phase B	Red	Red	Orange	Orange (high leg)
Phase C	N/A	Blue	Yellow	Blue
Neutral	White	White	Gray	White
Ground	Green	Green	Green	Green

B. Intrinsically safe wiring shall be light blue color insulation per ANSI/ISA RP12.6 and NEC 504 or per respective equipment manufacturer's recommendations.

C. Control wiring insulation color shall be red.

D. 120 VAC control wiring from a separate source (for example, 120 V control wiring from a control panel that supplies a remote located starter) shall be with yellow color insulation.

E. 24 VDC wiring shall be Blue for Positive and White with Blue Stripe for Negative.

2.03 WIRE PULLING LUBRICANT

A. Pulling lubricant shall be UL listed, water based, polymer solution. Lubricants containing waxes, soaps or combustible materials are not acceptable. Contractor shall verify the compatibility of the selected cable pulling lubricant and cable jacket materials proposed. Manufacturers/Lubricants shall be as follows, or equivalent:

1. American Polywater - Polywater J
2. Ideal Industries - ClearGlide
3. American Colloid - Poly-X
4. Buchanan - Quick Slip
5. ARNCO – HydraLube

2.04 SPLICES AND JOINTS

A. Splices and joints shall be as described below, or approved equivalent.

B. Interior applications:

1. #8 and smaller conductors:

   a. Ideal “sing nut” type insulated connectors.
   b. Scotchlok R, B, and Y type insulated connectors.

2. #6 and larger conductors:

   a. New construction: For straight line connections, use compression connector with rubber insulating cover or boot.
   b. New construction: For “Tee” cable taps, use compression connector with rubber insulating cover or boot.
   c. Existing construction: For taps in cabinets, gutters and other close locations, use O-Z/Gedney type XW & XWC, XTP & XTPC or, PMX &PMXC, or equivalent.

C. Exterior applications

Note that below grade splices in manholes, handholes and vaults **<u>will not</u>** be allowed on this project unless specifically shown on drawings. Conductors are to be pulled continuous end-to-end unless otherwise noted or directed by the Engineer in writing.

1. #8 and smaller conductors:

   a. Twist-on connectors pre-filled with silicone-based sealant to protect against moisture and corrosion. Units shall be UL 486D listed as weatherproof, waterproof and suitable for direct burial. Units shall be Ideal Industries “Underground” #64 or King Innovation “Dryconn King 6 Blue” Filled Waterproof Connectors, or equivalent.

2. #6 and larger conductors:

a. NSI/Polaris ISRW Series “Blue”
b. Ilsco Series USPA, DBK, SSK or PDSS

2.05 LINE MARKING TAPE

A. Where required or noted on the drawings, line marking tape shall be installed as specified in Section 16118 - Duct Bank.

PART 3 EXECUTION

3.01 INSTALLATION (WIRE CONDUCTORS)

A. Wire and cable shall be installed using accepted industry methods to prevent damage to conductors and insulation. Installation shall comply with all applicable sections of NEC regarding conduit fill.

B. No splices shall be permitted in conduit bodies. All splices shall be made in junction boxes, control panels and cabinets provided for that purpose as detailed or required by need.

C. Neatly train and lace wiring inside boxes, equipment and panelboards.

D. Drawings are diagramatic in showing circuitry routing between devices and equipment. Provide all phase conductors, neutrals, switched and unswitched legs, grounds, etc., as required for a complete and operational electrical system.

E. All 120V circuits shall have individual neutral conductors. 120V circuits with “shared” neutral conductor shall not be permitted.

F. Minimum wire size shall be #12 unless otherwise noted. Where protected by 15A fuses, control wiring may be #14 AWG.

G. All conductors shall be continuous without splices except at locations approved for the purposes of splicing.

H. All wire sizes shall be stranded except where specifically approved otherwise.

I. Intrinsically safe wiring shall be separated from non-intrinsically safe wiring in compliance with Article 504 of the NEC and ANSI/ISA Standard RP12.6. Intrinsically safe wiring insulation color shall be blue.

J. All circuits shall be labeled in compliance with Section 16195 - Electrical Identification.

K. Pulling eyes on conductors or a basket weave grip shall be used for pulling cable. Woven wire cable grips shall be used to pull all single conductor cable where pulling eyes are not available. Preferred method for pulling conductors is factory-installed eyes attached to conductors. All sharp points and edges on the hardware attaching the pulling rope to the cable shall be taped to prevent snagging or damaging the raceway.

L. When a cable grip or pulling eye is used for pulling, the area of the cable covered by the grip or seal plus 6 inches shall be cut off, and discarded when the pull is completed. When pulling loops are used, the entire loop shall be cut off and discarded when the pull is completed.

M. A non-binding type of swivel, or swivel connection shall be inserted between the pulling rope and the cable pulling eye, grip or loop to prevent twisting under strain and allow for free rotation of the cable during pulling.

N. The pulling tension of any cable shall not exceed the maximum tension recommended by the cable manufacturer. Pulling mechanisms of both the manual and power types shall have the rated capacity clearly marked on the equipment. Cable shall be installed using either hand-tension or by use of specially-designed “cable-tuggers”. Any cable pulled through conduit using trucks, back-hoe’s, earthmoving equipment or similar apparatus will be rejected and will be replaced with new cable at the Contractor’s expense.

O. Break-away shear-pins or other acceptable method of tension limitation shall be utilized on mechanical pulling equipment to prevent over-stressing cable during installation. To avoid insulation damage from excessive sidewall pressure at bends, the pulling tension, in pounds at a bend, shall not exceed 300 times the radius of the bend in feet.

P. As soon as the cable is pulled into place, the pulling eyes, cable grips, or pulling loops shall be removed. On exterior pulls, the remaining cable ends shall be temporarily resealed with either a minimum of three (3) wraps of 2" Scotch #23 rubber splicing tape or heat-shrink caps. Exposed cable ends shall be wrapped in such a manner to prevent unintentional water entry. Cable ends or seals shall be installed prior to the end of the workday.

Q. Cable shall not be bent to a radius of less than 4 times the overall diameter, including installation apparatus.

R. Cable supports and securing devices shall be installed to provide adequate support without deformation of the cable jackets or insulation.

S Cables shall be routed within manholes and vaults such that adequate working space is provided within the structure for cable splicing and for the installation of future cables.

T. All damaged or rejected cable shall be removed from the project site and replaced at no additional expense to the project.

3.02 CONNECTIONS AND TERMINATIONS (WIRE CONDUCTORS)

A. Identify each conductor in panelboards, junction or pull boxes, or troughs with a permanent pressure sensitive label with suitable numbers or letters for easy recognition. Identify control wiring at each end and in junction boxes with numeric wire number corresponding to control wiring diagram.

B. Thoroughly clean wire before installing lugs and connectors.

C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

D. Terminate spare conductors with electrical tape, identify as “spares” and roll up in box.

3.03 TESTING (WIRE CONDUCTORS)

A. Inspect wiring for physical damage and proper connection.

B. All wire and cable shall be tested for continuity and short circuits prior to energizing circuits. Verify proper phasing, adjust as required.

C. Comply with all applicable items in Section 16010 and 16950.

3.04 INSTALLATION (FIBER OPTIC CABLE)

A. Unless noted otherwise, all conduits, ducts, and manholes for FO cable systems shall be installed as shown on drawings.

1. No splices shall be permitted unless the length of cable being installed exceeds the maximum standard cable length available from manufacturer.
2. Splices shall be made using the method recommended by the cable manufacturer. Splices shall be housed in a splice enclosure and shall be encapsulated with an epoxy or ultraviolet light cured splice encapsulant. All FO splices shall be field tested at the time of splicing. Fusion splices shall have less than 0.2 dB loss, and mechanical splices shall not be used. There shall be no more than one (1) splice per kilometer in any of the FO cables excluding terminations. All field splices shall be located in cable boxes. Sufficient cable shall be provided in each splicing location to properly splice the cables, and to provide extra cable for additional splices. All cable ends shall be protected at all times with end caps except during actual splicing. During the splicing operations, means shall be provided to protect the unspliced portions of the cable from the intrusion of moisture and other foreign matter. All splices shall be done in hand holes provided and installed by the Contractor as required.
3. For cable installed in ducts and conduit a cable lubricant compatible with the cable sheathing material shall be used on all cables pulled. Pulling fixtures shall be attached to the cable strength members. If indirect attachments are used, the grip diameter and length shall be matched to the cable diameter and characteristics. If indirect attachment is used on cables having only central strength members, the pulling forces shall be reduced to ensure that the fibers are not damaged from forces being transmitted to the strength member. DURING PULLING THE CABLE

PULL LINE TENSION SHALL BE CONTINUOUSLY MONITORED, AND SHALL NOT EXCEED THE MAXIMUM TENSION AS GIVEN BY THE CABLE MANUFACTURER. The mechanical stress placed upon a cable during installation shall be such that the cable is not twisted or stretched. A cable feeder guide shall be used between the cable reel and the face of the duct or conduit to protect the cable and guide it into the duct or conduit as it is played off the reel. As the cable is played off the reel, it shall be carefully inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed and that the minimum bend radius of the cable is not exceeded at any time. Cable shall be hand fed and guided through each manhole and additional lubricant shall be applied at all intermediate manholes. When practicable, the center pulling technique shall be used to lower pulling tension. That is, the cable shall be pulled from the center point of the cable run towards the end termination points. The method may require the cable to be pulled in successive pulls. If the cable is pulled out of a junction box or manhole the cable shall be protected from dirt and moisture by laying the cable on a ground covering. Dynamometers or load-cell instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress place upon a cable during installation shall be such that the cable is not twisted or stretched.

3.05 CONNECTIONS AND TERMINATIONS (FIBER OPTIC CABLE)

A. Connectors: All fibers at each end of the cable shall have jumpers or pigtails installed of not less than 1 meter in length. All fibers at both ends of the cable shall have connectors installed on the jumpers. The mated pair loss, without rotational optimization shall not exceed 1.5 dB. The pull strength between the connector and the attached fiber shall not be less than 50 pounds.

B. Identification and Labeling: The Contractor shall supply identification tags or labels for each cable. The labeling format shall be identified and complete record shall be provided to the Owner with the final documentation. Each cable shall be identified with type of signal being carried and termination points.

3.06 TESTING (FIBER OPTIC CABLE)

A. An optical time domain reflectometer (TDR) test at 820 nanometers, of the FO cable on the reel prior to installation. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. Test data shall be recorded and furnished to the Engineer. Cable tested with losses exceeding manufacturer's acceptable levels for new cable shall be rejected.

B. A second time domain reflectometer test at 820 nanometers shall be performed on the FO cable after it is installed. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum. If the optical time domain reflectometer test results are unsatisfactory, the FO cable segment is unacceptable.

C. The unsatisfactory segments of cable shall be replaced with a new segment of cable at no cost to the Owner. The new segment of cable shall then be tested to

demonstrate acceptability.

END OF SECTION 16123

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is supply and installation of all junction and pull boxes to provide a complete and operational electrical system.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16111 - Conduit and Raceways
C. Section 16123 - Building Wire and Cable
D. Section 16170 - Grounding and Bonding
E. Section 16190 - Supporting Devices

1.03 REFERENCE TO STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. U.L. 50 - Enclosures for Electrical Equipment

C. ANSI/NEMA OS-1 - Sheet Steel Outlet boxes, Device Boxes, Covers and Box Supports

D. NEMA 250 - Enclosures for Electrical Equipment

1.04 DELIVERY, STORAGE AND HANDLING

A. Junction and pull boxes shall not be shipped loose, but shall be in boxes with labels indicating size and type. These boxes shall be stored away from contact with earth and protected from weather and abuse.

1.05 SUBMITTAL REQUIREMENTS

A. Submit under provisions of Division 1.

B. Junction and pull boxes.

1.06 QUALIFICATIONS

A. Junction and pull boxes shall be manufactured and supplied by a company regularly engaged in business of furnishing junction and pull boxes. If required by Owner's representative, manufacturer shall submit a certification to a minimum experience of five years in manufacture of junction and pull boxes. Junction and pull boxes shall be U.L. listed.

1.07 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION

A. Dimensions of all boxes shall meet or exceed NEC Article 370 requirements. Boxes larger than 12 inches in any dimension shall be hinged type.

B. Flush mounted exterior boxes in floors, walkways and walls shall be NEMA 4, cast aluminum, Crouse Hinds, Killark, or equal. For supplemental corrosion protection, boxes encased in poured concrete shall have an asphalt paint coating applied to surfaces in contact with concrete prior to installation. Note that an asphalt paint coating is not required on boxes installed in masonry brick or block walls.

C. Surface mounted interior junction and pull boxes used with Schedule 40 PVC conduit shall be nonmetallic and shall be as manufactured by Carlon, or equal.

D. Surface mounted interior junction and pull boxes used with GRS or EMT conduit shall be NEMA OS-1, stamped galvanized steel.

E. Flush mounted interior boxes in concrete floors and concrete walls shall be NEMA 4, cast aluminum, Crouse Hinds, Killark, or equal, and shall be supplied with asphalt paint applied to all surfaces in contact with concrete.

F. Boxes used to support light fixtures shall be of metallic construction and capable of supporting installed fixtures.

G. Exterior junction and pull boxes located in non-hazardous, non-classified areas shall be NEMA 4X stainless steel or aluminum. Provide waterproof conduit hubs, Meyers or equivalent, for all conduit terminations at enclosures. Gasketed lock-nuts will not meet this requirement.

H. Junction boxes located in classified hazardous areas (Class I, Division 1 or 2, Group D) and/or junction boxes detailed on the drawings with an EP (Explosion Proof rating) shall be NEMA 7 explosion proof U.L. listed suitable for use in Class I, Division 1, Group D hazardous locations. Exterior mounted NEMA 7 junction boxes shall also meet NEMA 4 requirements. All NEMA 7 explosion proof junction boxes shall be of aluminum material. All junction and pull boxes installed in Class I, Division 1 and Division 2 areas (hazardous) shall comply with the applicable provisions of the NEC Articles 500 and 501.

I. Exterior junction and pull boxes for intrinsically safe wiring ONLY located in classified hazardous areas (Class I, Division 1 or 2, Group D) or non-hazardous areas shall be NEMA 4X and NEMA 13 stainless steel or aluminum.

J. Acceptable manufacturers:

1. Appleton Electric Co.
2. Crouse-Hinds Co.
3. Hennessy Outdoor Enclosures.
4. Hoffman Co.
5. Hubbell-Killark Electric Mfg. Co.
6. O.Z./Gedney Co.
7. Square D.
8. Hammond.
9. Carlon

PART 3 EXECUTION

3.01 INSTALLATION

A. Junction or pull boxes required by code or need which are not detailed on drawings shall be considered incidental to proposal price and will not be paid for separately.

B. Any damage to equipment enclosures, pull or junction boxes shall be immediately repaired or replaced to satisfaction of Owner's representative.

C. Junction and pull boxes containing intrinsically safe wiring shall be labeled "Intrinsically Safe".

D. All pull or junction boxes surface mounted in any interior damp location shall be "standoff" mounted 1/2" from the wall in a manner to promote air circulation completely around the box.

E. The contractor shall coordinate the installation of flush mounted junction boxes with the general and mechanical work as required at each structure.

F. Flush mounted junction boxes to be installed in precast top slabs shall be furnished by the contractor for installation, and shall be furnished completely assembled, including conduit nipples and stub-outs with ends covered by protective caps.

G. Provide knockout closures to cap unused knockout holes where blanks have been removed (for non-hazardous location boxes).

H. Explosion proof junction boxes requiring drilling and taping for conduits shall be U.L. listed to permit field drilling and taping or shall be drilled and tapped at the factory. Installations that void the U.L. listing, void the explosion proof rating, or void the warranty of a device shall NOT be permitted. Provide plugs (suitable for Class I, Division 1, Group D location and manufacturers requirements) to plug unused conduit entrances in explosion proof boxes.

I. All mounting hardware shall be corrosion resistant.

J. All metal junction boxes shall be bonded to ground with a ground wire connection.

END OF SECTION 16130

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work in this section is supply and installation of receptacles and toggle switches.

B. Work shall also include supply and installation of device boxes for receptacles and toggle switches.

C. Work shall also include supply and installation of remote control pushbutton stations.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16111 - Conduit and Raceway
C. Section 16123 - Building Wire and Cable
D. Section 16195 - Electrical Identification

1.03 REFERENCE TO STANDARDS

A. UL Standard 943 Class A

B. Federal Specification W-C-596F

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEC Article 410-57

E. NEMA WD-1

F. NEMA WD-6

G. ANSI/NEMA OS-1 - Sheet Steel Outlet boxes, Device Boxes, Covers and Box Supports

H. U.L. 514A - Metallic Outlet Boxes

1.04 DELIVERY, STORAGE AND HANDLING

A. Supplied items shall not be shipped loose but shall be in boxes, labeled with material and equipment enclosed. Boxes shall be stored away from contact with earth and shall be protected from weather.

1.05 SUBMITTAL REQUIREMENTS

A. Submit under provisions of Division 1

1. Receptacles
2. Toggle switches
3. Weatherproof covers and device boxes

4. Remote control stations
5. Multi-outlet raceway (if used)

B. Where applicable, color of wiring devices to be identified during submittal review.

1.06 QUALIFICATIONS

A. Wiring devices shall be manufactured and supplied by companies regularly engaged in business of furnishing wiring devices. If required by Owner's representative, manufacturers shall submit certification to a minimum experience of five years in manufacture of respective wiring devices.

1.07 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION

A. Receptacles:

Receptacles shall be installed under this item where shown on drawings.

1. General Purpose Receptacles (Non-GFCI)

General purpose receptacles for all wall type convenience outlets in non-hazardous areas shall be of 20 amp, 125 volt, 3 wire grounding type, NEMA 5-20R, back and side wire compatible, heavy duty industrial specification grade.

a. Leviton 5362A
b. Pass & Seymour 5362-A
c. Hubbell HBL5362
d. Equivalent

2. Ground Fault Circuit Interrupting (GFCI) Duplex Receptacles

Duplex receptacles with ground fault circuit interrupters (GFCI) shall be provided and installed where noted on drawings. All units shall be rendered permanently inoperative at its "end of useful life" (EOL) as defined in UL 943. All receptacles shall be rated 20 Amp with NEMA 5-20R receptacle configuration. To simplify locating the proper "reset" button after tripping, unless specifically noted on project drawings, DO NOT utilize "feed-thru" feature to protect downstream GFCI outlets. Provide self-protected GFCI receptacles at each required location. Receptacles shall be back and side wire compatible, feed-thru type (whether or not feed-thru feature is utilized on project). GFCI Receptacles shall be of the following types:

a. Interior GFCI Applications (Non-Hazardous)

i. Leviton “SmartLockPRO” 7899
ii. Pass & Seymour 2095
iii. Hubbell GF-20L
iv. Equivalent, meeting requirements noted.

b. Exterior, Hose-Down and Corrosion-Resistant GFCI Applications (Non-Hazardous). Duplex GFCI receptacles used outdoors, where indicated indoors in hose-down areas, and GFCI receptacles used in corrosive environments shall comply with the following:

i. GFCI Receptacles shall meet National Electrical Code Weather-Resistant requirements, shall be listed to the Weather-Resistant supplement of UL498, and shall exceed UL corrosion requirements. Rubber curtains shall let plug blades in, keep dust, water and insects out. Provide integral gasket to seal receptacle. Receptacles shall be of high-impact-resistant thermoplastic construction with matching Nylon wall plate. GFCI Receptacles shall be Pass & Seymour Cat. # 2095DSWRBK, or equivalent meeting requirements noted.
ii. “WP”, where noted, indicates that receptacles are to be used with Weatherproof Receptacle Covers, specified elsewhere.

3. Special Purpose Receptacles (Where Required)

Special purpose receptacles shall have amperage, voltage, number of poles, number of wires as required or as shown on drawings. Contractor shall verify compatibility between proposed special purpose receptacles and plugs of proposed equipment prior to ordering. Contractor shall also provide labels for special purpose receptacles.

B. Toggle Switches

Toggle switches shall be installed under this item.

1. General Purpose Toggle Switches

Units for use in non-hazardous, toggle-type applications shall be 20A, 120/277 VAC rated, back and side wired type, industrial specification grade. Switches shall be duty rated for 1 HP at 120 VAC.

a. Single Pole

Leviton 1221-2
Pass & Seymour CSB20AC1
Hubbell HBL1221
Equivalent

b. Two Pole

Leviton 1222-2
Pass & Seymour 20AC2
Hubbell HBL1222
Equivalent

c. Three-Way

Leviton 1223-2
Pass & Seymour 20AC3
Hubbell HBL1223
Equivalent

d. Four-Way

Leviton 1224-2
Pass & Seymour 20AC4
Hubbell HBL1224
Equivalent

e. Single Pole; Double Throw; Center-Off

Leviton 1257
Pass & Seymour 1251
Hubbell HBL1557
Equivalent

2. Explosion-Proof Toggle Switches

Hazardous area 120 VAC toggle switches shall be suitable for use in a Class I, Division I, Group D environment. Toggle switches shall be “factory sealed” (such that no external conduit seals are required) snap switches, 20A rated at 120V and shall be Crouse-Hinds EDS series, or equivalent.

C. Unless noted otherwise on the drawings, wall plates shall be of nylon construction for resistance to impact, abrasion and mechanical stress fracture. Wall plate color shall match receptacle or switch at each location.

D. Weatherproof Receptacle Covers

All receptacle covers noted as "weatherproof" with the letters “WP” or installed outdoors shall comply with NEC Article 406.9B1. Units shall remain raintight whether or not a plug and cord is inserted. Covers shall be extra-deep, padlockable, cast aluminum construction, listed and identified as “extra duty” as manufactured by Intermatic WP1010HMXD, Hubbell, WP26MH, or equivalent, horizontal, for use with GFCI receptacles.

E. Device Boxes

1. Where PVC conduit is used, associated device boxes shall be of FS design, non-metallic PVC, as manufactured by Carlon, or equivalent.
2. Where galvanized rigid metal conduit is used, associated device boxes shall be FS or FD design, metallic, as manufactured by Crouse-Hinds, or equivalent.

F. CONTROL STATIONS

Pushbutton type control stations used to control motors, solenoids and selected lights and heaters, etc., shall be furnished and installed under this item and located where indicated on drawings.

1. General Purpose Control Statins (Non-Hazardous Locations)

Interior and exterior general purpose control stations shall be NEMA 4X rated, with NEMA 4X enclosures. Selector switches, pushbuttons and transformer type, push-to-test indicating lights shall be Square D Type SK, or equivalent.

2. Explosion Proof Control Stations

Control stations in hazardous areas shall be suitable for Class I, Division I and II, Group D (NEMA 7D) as well as NEMA 3, 4X and 12. Units shall be of non-metallic construction with an internal metal imbedded grounding grid. Enclosure openings shall be designed to accept 3/4" threaded rigid metal conduit. All external components shall be coated with epoxy, Teflon or Mylar or be constructed of corrosion proof material. Enclosure shall be gasketed to prevent entrance of moisture without interfering with venting of cooled hazardous gases and vapors. Enclosure shall exceed UL pull-out and bending resistance tests resulting in no effect on conduit connections. Stainless steel pushbutton shafts shall be utilized with stainless steel bushings for long life in corrosive atmospheres. Pushbutton and selector switch contacts shall be silver cadmium oxide sealed in interior chamber to assure resistance to corrosion. Springs shall be stainless steel.

Control stations shall be “factory sealed” (such that no external conduit seals are required) and shall comply with UL Standard 698. Maintained stop stations shall be Appleton Electric N2D75 Series, or equivalent. Momentary start pushbutton stations with pilot light shall be Appleton Electric N2DC75 Series, or equivalent. If complete station of maintained stop, momentary start and pilot light are required, both units are to be utilized.

PART 3 EXECUTION

3.01 INSTALLATION

A. Unless otherwise specified on the drawings, use the following as a guide for mounting of device boxes and control operator (pushbutton) stations:

	Device	Height above finished floor to bottom of box
1.	Receptacles in offices and finished areas.	16 inches
2.	Toggle wall switches	48 inches
3.	Receptacles in all other or non-finished areas.	48 inches
4.	Receptacles on walkways	Attach to handrail crossbar
5.	Control Operator (P.B.) Stations	48 inches

B. Unless otherwise noted on the drawings, boxes for wiring devices shall be flush mount construction such that device cover plates are flush with wall after installation.

C. Legend plates shall be securely attached using weatherproof adhesives in accordance with Section 16195.

D. All receptacles and toggles switches shall be grounded with a ground conductor connected to their respective grounding terminal or screw.

E. Grounded conductors (neutrals) shall be continuous between outlets, boxes, devices, and so forth per NEC Article 300.13. Wiring device neutral connections shall not be utilized as splice points. Neutral path shall not be broken with wiring devices removed from boxes.

F. Test all receptacles, toggle switches and control stations for proper operation, including GFCI operation where applicable.

G. Ground device enclosure or box with a ground conductor connected to the respective grounding lug or screw.

H. Unless specifically shown otherwise on the drawings, all device boxes are to be flush mounted. This includes masonry construction.

I. Where boxes are to be installed in finished masonry walls, adjust position of outlets to suit masonry course lines.

J. Do not install boxes back-to-back in the same wall. Provide minimum 4 inches separation.

K. Provide insulation behind boxes mounted in exterior walls.

L. For boxes, outlets or multi-outlet raceway installed above counters or backsplashes, coordinate location and mounting height to agree with other trades and equipment.

M. Unless otherwise specified, install wall switches with “OFF” position down.

N. Unless otherwise specified, install duplex outlets with ground blade on the bottom if mounted vertically or to the right if mounted horizontally. Install GFCI receptacles in such that “Test” and “Reset” wording are oriented correctly.

O. Each duplex outlet cover shall be furnished with a 3/8”-1/2” adhesive label strip identifying its respective source of supply (e.g. LP1-15 for Lighting Panelboard LP-1 circuit #15). All labels shall be affixed to the exterior (outside) of each respective cover plate. All duplex outlet labels shall be installed in the same general location on each cover plate throughout the project.

P. Each toggle wall switch shall be furnished with a 3/8”-1/2” adhesive label strip identifying its respective source of supply (e.g. LP1-16 for Lighting Panelboard LP-1 circuit #16). All toggle switch labels shall be affixed to the rear (inside) of the respective cover plate.

Q. Exterior receptacles shall be mounted horizontal.

END OF SECTION 16141

PART 1 GENERAL

1.01 WORK INCLUDES

A. Enclosures used to house electrical equipment.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16170 - Grounding and Bonding
C. Section 16190 - Supporting Devices
D. Section 16195 - Electrical Identification
E. Section 16902 - Electric Controls and Relays

1.03 REFERENCE TO STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. ANSI/NFPA 70 - National Electrical Code.

1.04 DELIVERY, STORAGE AND HANDLING

A. Cabinets and enclosures shall be delivered to jobsite in original shipping containers and shall be stored in a clean, dry location until ready for installation.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide manufacturer’s standard data for enclosures and cabinets.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.06 QUALIFICATIONS

A. Cabinet and Enclosure manufacturer shall be regularly engaged in construction of Product and shall have at least five years’ experience.

1.07 QUALITY ASSURANCE (RESERVED)

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 COORDINATION (RESERVED)

1.10 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS)

A. Provide individual containers of touch up paint for each painted cabinet and enclosure.

B. For each cabinet and enclosure with a locking mechanism, provide two spare keys.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 EQUIPMENT SPECIFICATION

A. NEMA 1

Enclosures shall be NEMA 1 rated, hinged, single or double door with slotted flush latch and white interior mounting panel, similar to Hoffman A-xxN Series (where xx is size subseries), or equivalent. Materials of construction shall be 14 or 16 gauge steel, depending on enclosure size, with polyester powder coating. Large enclosures shall have continuous hinge on door. Where noted, large enclosures shall include door operated light kits. Enclosure shall include grounding device kit or other means of positively grounding door to enclosure body.

B. NEMA 3R

Enclosures shall be NEMA 3R rated, hinged with stainless steel hinge pin, with drip shield, single door, white interior mounting panel and easily released door clamps. Materials of construction shall be 16 or 14 gauge steel, depending on enclosure size, with polyester powder coating. Furnish all exterior-mounted NEMA 3R enclosures with a NEMA 4X Drain-Vent (specified below) to remove interior moisture and condensation.

C. NEMA 4X

Enclosures shall be NEMA 4/ NEMA 4X/ NEMA 12 rated, hinged, gasketed, single or double door, with easily released fast-operating clamp assemblies or quarter turn slotted latch kits replacing conventional screw clamps, white interior mounting panel and stainless steel hinge pin. Materials of construction shall be 16 or 14 gauge (depending on size) Type 304 stainless steel, Type 5052 H-32 aluminum, molded fiberglass polyester or corrosion resistant nonmetallic composite material. Interior mounting panel shall be steel, finish shall be white enamel. Where noted, enclosures shall include door operated light kits. Metallic enclosures shall include grounding device kit or other means of positively grounding door to enclosure body. Furnish all exterior-mounted NEMA 4X

enclosures with a NEMA 4X Drain-Vent (specified below) to remove interior moisture and condensation.

D. NEMA 7

Enclosures shall be NEMA 7 rated suitable for Class 1, Division 1, Group D hazardous locations. Materials of construction shall be copper-free aluminum and shall be either U.L. or F.M. listed and labeled for the application. Covers for small enclosures shall be threaded construction with minimum of 5 threads fully engaged after installation. Larger enclosures shall utilize bolted covers with all bolts torqued per manufacturer's requirements after installation.

E. NEMA 12

Enclosures shall be NEMA 12 rated, continuous hinge, gasketed, single or double door, with white interior mounting panel. Materials of construction shall be 16 or 14 gauge steel, depending on enclosure size, with polyester powder coating. Small enclosures shall be similar to Hoffman "CHQR" Series, or equivalent. Medium size enclosures shall include 1-point latch kits or quarter turn slotted latch kits replacing conventional external screw clamps. Large size enclosures shall include 3-point latch kits. Where noted, large enclosures shall include door operated light kits. Enclosure shall include grounding device kit or other means of positively grounding door to enclosure body.

F. Drain-Vents

Where noted or specified, enclosure Drain-Vents shall be furnished and installed in the bottom of enclosures in order to remove unwanted condensation and moisture from within enclosure. Units shall be NEMA 4X rated and shall maintain the NEMA 4X rating of enclosures when installed. Drain-Vents shall be as manufactured by Stahlin Enclosures Model DV4XKIT, or equivalent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect cabinets, enclosures and mounting panels for damage or rust. Inspect gasketing for proper sealing. Inspect hinges and clamps for proper operation.

3.02 PREPARATION

A. Thoroughly clean interior and exterior of cabinets and enclosures. Sand and apply touch up paint where needed. Install mounting panels after equipment is mounted to it.

3.03 INSTALLATION

A. Install cabinets and enclosures at locations shown on drawings and as directed by Owner's representative. Cabinets and enclosures shall be "standoff" mounted 1/2" from wall to provide free air flow behind cabinets and enclosures.

B. To maintain NEMA 4X enclosure ratings, watertight hubs which are UL listed NEMA 4X shall be installed as necessary at conduit entrances to enclosure.

C. At both interior and exterior locations, where enclosure or cabinet knockouts consist of tangental knockouts, the Contractor shall install weatherproof hubs sized for largest knockout, with a reducing bushing sized for the incoming conduit.

END OF SECTION 16160

PART 1 GENERAL

1.01 Work under this item includes the electrical grounding and bonding of the service entrance gear, electrical distribution equipment, metallic raceways, metallic enclosures, utilization equipment and other appurtenances for the work or equipment to be furnished under this project. In general, all work shall meet or exceed that defined in article 250 of the national electrical code NEC/NFPA 70.

1.02 This specifications section neither replaces any NEC requirements, nor are any NEC requirements not specifically identified considered deleted from the scope of work. Items listed in this section are furnished to either augment, or exceed those established by NEC.

1.03 WORK INCLUDES

A. Equipment grounding conductors

B. Grounding Electrodes

C. Grounding Electrode Conductors

D. Bonding

1.04 RELATED SECTIONS

A. Section 16010 – General Electrical Requirements
B. Section 16671 – Surge Protective Devices (SPD)

1.05 REFERNCE TO STANDARDS

A. Article 250; ANSI/NFPA 70 - National Electrical Code (NEC)

B. NFPA 780 – Standard for the Installation of Lightning Protection Systems

1.06 DELIVERY, STORAGE AND HANDLING

A. Ground rods shall be tie-wrapped together and stored away from contact with the earth.

B. Exothermic welds and hardware items shall not be shipped loose but shall be in boxes, labeled with material and equipment enclosed. Boxes shall be stored away from contact with earth and shall be protected from weather.

1.07 SUBMITTALS

A. Submit under provisions of Division 1

1. Ground rods
2. Exothermic welding components

1.08 QUALIFICATIONS (RESERVED)

1.09 QUALITY ASSURANCE (RESERVED)

1.10 REGULATORY REQUIREMENTS (RESERVED)

1.11 COORDINATION

A. Installation of all Grounding and Bonding shall be coordinated with other trades and Sub-Contractors. Special attention is required for installation of Concrete-Encased Electrodes within structural footings.

1.12 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.13 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (RESERVED)

2.02 EQUIPMENT SPECIFICATION

A. Ground rods shall be UL listed, single-piece, 3/4" diameter by 10' long copper-clad steel with minimum 10 mil copper cladding.

All buried connections of grounding and bonding components shall be via exothermic weld only. Clamp or compression grounding connections below grade will be rejected and replaced at Contractor's expense.

B. Exothermic Welding Equipment Manufacturers

1. Erico – Cadweld
2. Continental Industries – Therm-O-Weld
3. Hagar – Ultraweld

C. Grounding conductors shall be 600 volt, same insulation type as used for phase conductors, green in color unless otherwise noted.

D. Grounding electrode conductors in contact to earth shall be bare, stranded, annealed copper. Grounding Electrode Conductors shall be the larger of that detailed on the project drawings, specified herein or as required by NEC.

PART 3 EXECUTION

3.01 EXAMINATION (RESERVED)

3.02 PREPARATION (RESERVED)

3.03 INSTALLATION

A. A continuous grounding system shall be provided throughout the facility. The Contractor shall furnish and install all grounding and bonding as required per NEC and all Local Codes, whether or not specifically shown on the project drawings.

B. Except for separately derived systems, a single-point ground system is intended throughout the facility. So-called “Multi-point”, “independent”, “clean” or “separate” grounding systems that are not inter-bonded to the single-point facility system do not comply with NEC, are unsafe, and will be rejected.

   1. On occasion, supplemental driven ground rods may be required on the project drawings. All such supplemental ground rods are to be bonded to the equipment grounding conductor and are NOT intended to indicate any separation of, or isolation from, the facility grounding system.

C. Equipment ground conductors (green insulated) shall be used solely for grounding and bonding purposes and be kept entirely separate from grounded neutral conductors (white insulation), except where bonded at the Service Entrance equipment.

   1. The system Neutral and Ground conductors shall be bonded together through the Main Bonding Jumper in the Service Entrance Equipment only.
   2. Unless otherwise directed on the project drawings, Grounding Electrode Conductors shall terminate on the Neutral Bus within the Service Entrance equipment.
   3. The Main Bonding Jumper within the Service Entrance equipment shall be accessible for visual inspection.

D. Bond the system Neutral and Ground within Utility-owned KWH metering or Current-Transformer (C.T.) Cabinets ONLY if specifically required by the serving Utility. Otherwise, bond the system neutral and the ground in Service Entrance Equipment as described below.

E. Service Entrance Equipment Grounding and Bonding

   1. Furnish grounding bushings on all metallic service conduits entering Service Entrance Equipment. Bond each bushing to Neutral bus in the Service Entrance Equipment as required by NEC Article 250.92 and 250.102C.
   2. The System (Main) Bonding Jumper shall be installed within the Service Entrance Equipment and shall connect the Neutral Bus to the Ground Bus.

a. The Main Bonding Jumper shall consist of either a U.L. Listed bonding link furnished by the Service Equipment manufacturer or a copper bonding conductor sized to requirements in NEC Article 250.28D.

b. Do not re-bond Neutral and Ground downstream unless required by special conditions, such as those described in NEC Article 250.32.

F. Grounding Electrode System

1. As a minimum, the Grounding Electrodes shall comply with NEC Articles 250.52 and 250.53. Where present at each new building or structure, all available Grounding Electrodes defined in NEC Article 250.52A1 thru A4 shall be interconnected to form the Grounding Electrode System.

2. Per NEC Article 250.68A, the Grounding Electrode System shall be installed in such a manner that each connection point may be visually inspected, unless encased by concrete or earth.

3. Per NEC Article 250.64, Grounding Electrode Conductors shall be installed without splice between Service Entrance Equipment Neutral bar and Grounding Electrodes. Where required due to distance or construction, splicing shall be permitted by means of exothermic welding only. Irreversible “H” and “C” type compression connectors shall NOT be utilized for Grounding Electrode Conductors.

   a. Where exposed or visible, all Grounding Electrode Conductors (regardless of size) shall be protected from physical damage using non-metallic conduit, such as Schedule 40 PVC. Extend protective conduit as close as practical to the Grounding Electrode. Any metallic conduits installed by the Contractor for grounding electrodes must be bonded at both ends per NEC Article 250.64E.

   b. Where a copper Grounding Electrode System Bus-Bar is indicated on the project drawings, it shall sized as noted but no less than ¼”T x 2”W x 24”L.. Size of the single copper Grounding Electrode Conductor between the Service Entrance Neutral Bus and the Grounding Electrode System Bus-Bar shall be the larger of that shown in NEC Table T250.66 or as noted on the project drawings. Connection of Grounding Electrode Conductors to a Grounding Electrode System Bus-Bar shall be through the use of listed compression-type lugs bolted to the Bus-Bar.

4. Grounding Electrode Conductors shall be individually installed from the Service Entrance Neutral Bus (or Grounding Electrode System Bus-Bar) to the respective Grounding Electrode. “Looping” of Grounding Electrode conductors (extending a suitably-sized single grounding electrode conductor from electrode-to-electrode) shall NOT be utilized without written approval from the Engineer.

5. Connection of Grounding Electrode Conductors to individual Grounding Electrodes shall comply with NEC Article 250.70.

a. Connection at all Grounding Electrodes shall be by use of exothermic welding, Listed clamp or compression connection connections shall NOT be utilized without written approval from the Engineer.

b. Below-grade ground rod and associated ground wire shall be clean and dry before performing the exothermic weld. Verify that the proper size and type of exothermic weld kit is used before beginning work

c. Exothermic welds shall be left exposed for inspection and approval before backfilling or otherwise concealing. Any unacceptable exothermic welds shall be redone, including any necessary replacement material (ground rods, ground wires, etc.) as needed to provide an accepted exothermic weld.

6. Non-Metallic conduits containing grounding electrode conductors shall not be supported with metal clamps that completely encircle the conduit. Use nylon nuts, bolts, straps and/or reinforced fiberglass or premium grade plastic resin strut support with non-metallic hardware as manufactured by Aickinstrut, or equivalent.

7. All of the following shall be interconnected, where available:

a. Bond metallic underground water piping in direct contact with earth for no less than 10 feet per NEC Article 250.52A1. Size of the copper bonding jumper shall be the larger of that shown in NEC Table T250.66, or as noted on the project drawings. Installation shall comply with NEC Article 250.53. Connection shall be made at a point less than 5 feet from where the metallic water piping enters the facility. Furnish bonding around removable equipment (water meters, etc.) per NEC Article 250.68B.

i. Note that NEC Article 250.53D2 requires a Supplemental Grounding Electrode when a metallic underground water pipe is the sole Grounding Electrode. The Supplemental Grounding Electrode shall be one of those described in NEC Articles 250.52A2 through 250.52A7. See also paragraph 16170-3.03F8 below.

b. Metal frames of building or structure shall be bonded per NEC Article 250.52A2. Size of the copper bonding jumper shall be the larger of that shown in NEC Table T250.66, or as noted on the project drawings. Installation shall comply with NEC Article 250.53.

c. Furnish concrete-encased electrodes (commonly called “Ufer” ground) per NEC Article 250.52A3 and install per NEC Article 250.53.

i. The size of the copper conductor which is the sole connection to the concrete-encased electrode shall be the larger of that shown on the project drawings or #4 AWG.

ii. The Concrete-Encased Electrode (CEE) shall be no less than #4 rebar (½" diameter) with a minimum length of 20 feet long placed in bottom of concrete footing encased by no less than 2" of concrete in direct contact with earth.

iii. Within the concrete encasement, connect the grounding electrode conductor to the re-bar by means of exothermic weld, Cadweld, or equivalent. Compression connections will not be accepted as an alternate termination method of connection within the concrete envelope.

iv. The Contractor shall provide all necessary coordination between the Sub-Contractors and trades for the implementation of this item before concrete is placed.

v. Do not use Insulated (plastic or epoxy coated) re-bar for concrete-encased electrodes. If the structural construction requires insulated or plastic-coated re-bar, add a minimum of 20 feet bare, non-coated re-bar to create the Grounding Electrode.

vi. For installations that may structurally utilize re-bar smaller than #4, tie-wrap a minimum of 20' length of no smaller than #4 AWG bare copper Grounding Electrode to the re-bar in the bottom of the footing prior to installation of concrete.

d. Furnish a Grounding Electrode Ground-Ring only where specifically noted on the project drawings. Ground-Ring shall comply with NEC Article 250.52A4 requirements and be installed per NEC Article 250.53. Where utilized, all Ground-Rings must encircle the entire facility (form a closed-loop). Size of the copper Grounding Electrode Conductor which is the sole connection to the ground-loop shall be the larger of that shown on the project drawings or #2 AWG.

8. On projects where the only Grounding Electrode listed in NEC Article 250.52A through 250.52D is a metallic underground water pipe, it must be supplemented by another grounding electrode per NEC Article 250.53D2. Unless directed otherwise, the supplemental grounding electrode shall be a driven ground field.

a. Ground field shall consist of a triangle 10 feet on each side, with a driven ground rod at each vertex of the triangle. Size of the copper Grounding Electrode Conductor, and the bonding jumpers between all ground rods, shall be the larger of that shown on the project drawings or #6 AWG.

b. If required due to space constraints, furnish two (2) ground rods a minimum of 10 feet apart. Deviations from the triangular-shaped ground field shall require written approval by the Engineer prior to installation.

G. All metallic raceways, boxes, enclosures, etc. shall include an insulated equipment ground conductor. Due to corrosion, metallic raceway and conduit connectors alone WILL NOT be considered as meeting this requirement. The Equipment Grounding Conductor shall positively bond all electrical components and utilization equipment to the facility ground system.

H. All metallic boxes used for electrical equipment shall include listed grounding screws or lugs. No more than one grounding conductor shall be installed per lug location unless lug is listed for multiple conductors.

I. The largest factory-scored concentric conduit knockouts shall be used to provide conduit bonding to NEMA 1 & 3R enclosures.

1. If required, provide a conduit reducing hub for the specific conduit size terminated.

J. Equipment Grounding Conductors shall be sizes as shown in NEC T250.122, but no less than #12 AWG.

K. Where “isolated” ground receptacles are shown on the project drawings, furnish a separate, insulated, equipment grounding conductor directly between the supply panelboard ground bus and the “isolated” ground outlet. Equipment grounding conductors for “isolated” ground outlets shall not be extended or looped from other outlets or equipment.

L. Isolated, exposed metal conduit segments (e.g. within manhole or handhole) shall be bonded with a bare copper conductor sized from NEC T250.122. Bonding jumper size shall be based upon the largest ampacity circuit contained within.

M. Bonding of metallic components of manhole and handhole frames and lids as well as all exposed metal conduit sections of underground duct bank is covered under Specifications 16118 “Exterior Underground Duct Bank”.

N. All other exposed metal piping (e.g. air, fire-protection, natural gas, metallic process piping etc.) and exposed structural steel not used as a Grounding Electrode shall be bonded to the Grounding Electrode System per NEC Article 250.104. Size of the copper bonding jumper shall be no smaller than that shown in NEC Table T250.66.

O. All communications systems described in NEC Chapter 8 shall be bonded to system ground. Installation shall comply with NEC Article 250.94 and Articles 800, 810, 820 and 830. Size of the copper bonding jumper shall be #6 AWG unless otherwise noted on the project drawings.

P. General Requirements for Separately Derived Systems (e.g. Two-Winding Transformers)

Solidly-Grounded Separately-Derived Systems shall be installed per NEC Article 250.30 requirements. In general, the following shall apply for solidly-grounded two-winding transformers unless specifically directed otherwise on the project drawings.

1. Primary Equipment Ground conductor shall terminate on transformer ground lug “G”.
2. Install the transformer “X0-G” link, or system bonding jumper, within the transformer housing only. Where the System Bonding Jumper consists of a field-installed copper conductor, it shall be sized to NEC Table 250.66 but not less than 12½% of the total cross-sectional area of the secondary phase conductors.
3. Secondary Neutral conductors shall be terminated on transformer “X0” Lug.
4. Secondary Equipment Ground conductors shall be terminated on transformer ground lug “G”.
5. Bond the transformer Neutral “XO” to the nearest grounding electrode in accordance with Article 250.30A7 of the NEC. The grounding electrode conductor shall be sized per Table 250.66, "Grounding Electrode Conductor for Alternating-Current Systems of the latest edition of NEC. Grounding Electrode conductor shall be installed in either non-metallic conduit (Schedule 40 PVC) or bonded at both ends of metallic conduit per NEC Article 250.64E.
6. Neutral and Ground Bus in all downstream equipment shall be kept isolated. Do not re-bond downstream unless required by special conditions, such as those described in NEC Article 250.32.

Q. On-Site Generation (e.g. Standby or Emergency Engine-Generators)

Unless otherwise noted on the project drawings, on-site generators are NOT to be installed as a separately derived system. Unless specifically shown otherwise on the project drawings, DO NOT bond Neutral and Ground at the generator.

1. Separate Neutral conductors plus separate Equipment Ground conductors shall be extended between distribution equipment (typically a 3-Pole Transfer Switch) and engine-generator system.
2. Generator Equipment Ground conductor shall be terminated on generator ground lug “G”.
3. Generator Neutral Conductors shall be terminated on generator Neutral lug “X0”.
4. DO NOT install “X0-G” bonding strap at generator. Contractor shall field-inspect generator and remove the “X0-G” jumper if found installed by factory prior to shipping.
5. Unless otherwise shown on the project drawings, the Transfer Switch will be a 3-Pole device switching the phase-conductors only. Unless the Transfer Switch the Service Entrance Equipment, the isolated Generator Neutral is to pass un-switched through the 3-Pole ATS and terminate on the Service Entrance “XO” Neutral Bus.
6. The Generator Ground conductor shall be terminated on the Service Entrance system Ground bus or Ground lug “G”.
7. The system Neutral-Ground bond is to be installed at one location at the Service Equipment ONLY. All downstream equipment shell keep Neutral and Ground conductors isolated and insulated from each other.

3.04 INTERFACE WITH OTHER SYSTEMS

(Where used on the project)

A. Interface with Surge Protective Devices installed under section 16671.

B. Lightning Protection Systems shall be bonded per NEC Article 250.106. All Lightning Protection Systems shall be bonded to facility Grounding Electrode system on facility exterior. Isolated grounding for Lightning Protection Systems will not be allowed.

3.05 MANUFACTURER'S FIELD SERVICES (RESERVED)

3.06 TESTING

A. As described in Specifications Section 16950.

B. All grounded metal cases and parts associated with electrical equipment shall be tested for continuity with ground system.

C. If requested, testing shall be performed in the presence of the Owner's representative.

D. Provide a copy of all testing reports to Engineer for record purposes.

END OF SECTION 16170

PART 1 GENERAL

1.01 WORK INCLUDES

A. Line-voltage power wiring and final electrical connections necessary to complete mechanical systems furnished by others, in particular but not limited to, Division 15 tasks. Note that equipment being furnished under other Specification Sections may, or may not be completely shown on project drawings, or may differ from that indicated due to differences between equipment from various manufacturers. Provide coordination as required in order furnish a complete and operational system. No additional payment will be issued for this item.

1.02 RELATED SECTIONS

A. Division 15 - Mechanical.
B. Section 16010 - General Electrical Requirements
C. Section 16111 - Conduit and Raceway.
D. Section 16123 - Building Wire and Cable.
E. Section 16130 - Boxes
F. Section 16141 - Wiring Devices
G. Section 16160 - Cabinets and Enclosures
H. Section 16170 - Grounding and Bonding
I. Section 16190 - Supporting Devices
J. Section 16195 - Electrical Identification
K. Section 16220 - Motors (600 Volts and Below)
L. Section 16441 - Enclosed Switches
M. Section 16950 - Testing Electrical Systems

1.03 REFERENCE TO STANDARDS

A. NFPA 70 - NATIONAL ELECTRICAL CODE

B. NEMA - National Electrical Manufacturer's Association.

C. UL - Underwriter's Laboratories, Inc.

D. ANSI - American National Standards Institute.

E. NECA - National Electrical Contractors Association.

1.04 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be delivered to jobsite in original shipping containers and shall be stored in a clean, dry location until ready for installation.

1.05 SUBMITTALS

A. In accord with Section 01300

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide all necessary material to complete final power wiring connections to all mechanical equipment items.

PART 3 EXECUTION

3.01 INSTALLATION

A. Furnish and install all motor starters and disconnect switches.

B. All integral packaged control panels shall be provided by the Contractor furnishing the equipment. Install power control panels and complete all power wiring. For equipment and motors requiring a direct fixed connection, install liquid tight flexible conduit.

C. Provide all necessary assistance during start-up and installation to the contractors furnishing the various equipment.

D. Verify with mechanical contractors as to what electrical equipment is furnished with mechanical equipment. Provide starters unless otherwise noted as such on the Drawings.

E. Test all motors for proper rotation and phase connection. Verify with ampere meter that motor is running under normal conditions and is not drawing excessive amperage. All motors shall have proper fuse and thermal overload protection.

END OF SECTION 16185

PART 1 GENERAL

1.01 WORK INCLUDES

A. Strut-type framing for conduit and equipment supports

B. Cable Rack saddle-type supports

C. Anchors and Fasteners

1.02 RELATED SECTIONS

A. Section 16010 – General Electrical Requirements

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code.

B. NECA - National Electrical Contractors Association.

C. ASTM No. A570 G33

D. ASTM No. A-123

E. ASTM No. A-525

1.04 DELIVERY, STORAGE AND HANDLING

A. Stored conduit and equipment supports shall not be in contact with earth, but shall be on pallets or other above-grade supports. Conduit and equipment supports shall be covered to minimize exposure to weather.

B. Anchors and fasteners shall be stored in their original containers in a clean, dry place. They shall not be exposed to weather.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300

B. Product Data: Provide manufacturer's catalog data for fastening systems and supports.

C. Manufacturer's instructions: Include application conditions and limitations for use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination and installation of Product.

1.06 QUALIFICATIONS (RESERVED)

1.07 QUALITY ASSURANCE (RESERVED)

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 COORDINATION (RESERVED)

1.10 MAINTENANCE SERBICE (WARRANTY) (RESERVED)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MOUNTING STRUT

A. Where utilized, strut-type metal framing shall be provided to mount and support electrical equipment and enclosures as indicated on the drawings.

B. Strut-type supports shall be either aluminum or stainless steel construction. Unless specifically identified for use on the drawings, painted or factory coated steel, galvanized steel or non-metallic strut are not acceptable alternates to this requirement. Use stainless steel on all project locations where strut is in direct physical contact with earth.

C. Unless specifically noted to be Type 316 Stainless Steel only, Stainless Steel strut-type metal framing may be Type 304 or Type 316 Stainless Steel.

D. Aluminum strut-type metal framing shall be Type 6063-T6 Aluminum.

E. All mounting hardware shall be stainless steel.

F. Manufacturers:

1. Unistrut: P-1000 EA (Aluminum), P-1000 SS (Stainless Steel)
2. B-Line: B22AL (Aluminum), B24SS (Stainless Steel)
3. Equivalent meeting specifications

2.02 CABLE RACKS

A. Cable racks within manholes, handholes and vaults shall be non-metallic saddle type construction as manufactured by Underground Devices, Inc.; Northbrook, IL, or equivalent. All mounting hardware shall be stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine all supports and fasteners for straightness, rust and corrosion. Do not use any equipment that is not straight or is rusted or corroded.

3.02 PREPARATION

A. All equipment shall be clean at time of installation. Remove all burs.

3.03 INSTALLATION

A. Install products in conformance with manufacturer's instructions and as detailed in drawings.

B. Provide anchors, fasteners and supports in accordance with NECA Standard of Installation. Do not use spring steel clips or clamps except as noted in Section 16190-3.03H.

C. Do not fasten supports to pipes (except where detailed on drawings), ducts, mechanical equipment (except where detailed on drawings), or conduit.

D. Install surface mounted cabinets, enclosures and panelboards with a minimum of four anchors.

E. Provide materials, sizes and types of anchors, fasteners, and supports necessary to carry loads of equipment and conduits. Consider weights of equipment and conduit when selecting products.

F. Provide all necessary hardware, such as floor flanges, in order to install equipment as specified or as shown on the drawings.

G. Include knee-braces and stiffeners as necessary to provide rigid support such that equipment does not bounce or sway.

H. Use spring-lock washers under all nuts.

3.04 INTERFACE WITH OTHER PRODUCTS (RESERVED)

3.05 MANUFACTURER'S FIELD SERVICES (RESERVED)

END OF SECTION 16190

PART 1 GENERAL

1.01 WORK INCLUDES

A. This section includes field-installed nameplates, labeling and identification methods for electrical equipment, components and wiring.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements\

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code

1.04 DELIVERY, STORAGE AND HANDLING

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide catalog data for nameplates, labels and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

D. During course of construction, Contractor shall submit Wiring Identification Tables, listing wire marker identification schedules of all proposed wiring and terminations.

1.06 QUALIFICATIONS (RESERVED)

1.07 QUALITY ASSURANCE (RESERVED)

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

1.09 COORDINATION (RESERVED)

1.10 MAINTENANCE SERVICE (WARRANTY) (RESERVED)

1.11 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (RESERVED)

2.02 EQUIPMENT SPECIFICATION

A. Nameplates and legend plates shall be engraved three-layer laminated plastic, black letters on white background. Legends (wording) shall be as detailed on drawings or as directed by Owner's representative.

B. All wire markers installed on electrical equipment above grade shall be weatherproof and water resistant. Wire identification labeling, whether factory applied or written in the field, shall utilize an adhesive that does not soften or weaken over time. Sleeve or tubing type labels may be utilized as an alternate. Paper adhesive-backed wire markers will be rejected and replaced at the Contractor's expense. Wire marker labels shall be as manufactured by Brady, or equivalent.

C. All wire markers installed below grade in manholes, handholes or vaults shall be waterproof. Markers shall be non-corroding plastic clip-on sleeve type construction. Markers shall be permanently factory-printed such that label identification will not deteriorate due to time or contact with water. Wire markers used below grade shall be Brady Clip-Sleeve, or equivalent.

D. Provide and install Safety Stripe Tapes on finished floors around electrical gear noting clearances required per NEC Article 110.26. Tape shall be minimum 2" in width with alternating black/yellow striping. Tape shall be Scotch/3M #5702 or equivalent.

PART 3 EXECUTION

3.01 EXAMINATION (RESERVED)

3.02 PREPARATION

A. Degrease and clean surfaces to receive nameplates, legend plates and markers.

3.03 INSTALLATION

A. Secure nameplates and legend plates to equipment using screws or adhesive.

B. Nameplates or legend plates shall be provided for all disconnects, enclosed starters, control panels, transformers, level meters, flow meters and recorders.

C. Wiring Device identification labels shall be furnished and installed on all wiring device cover plates per Specifications Sections 16141-3.01O and 16141-3.01P.

D. Contractor shall develop the Wiring Identification Tables to be used for ALL wiring terminations on this project, and shall submit Tables for review and comment by Owner's Representative prior to installation of any conductors or cables.

E. Provide wire markers for ALL wires and terminations. By “all”, this is intended to include, but not be limited to, all terminations at distribution panelboards, motors, valves, heaters, fan coils, heat pumps, fans, dampers, all MCC terminations, instrumentation & controls, terminal blocks and strips, etc. Wire identification shall be unique to wire that is marked or to terminal that wire lands upon. Identification of a run of wire from termination to termination shall be same throughout run.

F. Provide wire markers in all manholes, handholes and vaults.

G. Include markers labeled “SP” on all spare conductors.

3.04 INTERFACE WITH OTHER PRODUCTS (RESERVED)

3.05 MANUFACTURER’S FIELD SERVICES (RESERVED)

3.06 AS-BUILT WIRING IDENTIFICATION TABLE

A. Upon completion of project, Contractor shall provide five copies of as-built Wiring Identification Table. This table shall list ALL circuits installed as part of this work and shall give identification of ALL wires and terminations as installed and marked.

Table shall include routing of ALL conductors installed in the project from end-to-end including each conduit, manhole, handhole and vault through which each conductor passes. Include and identify all spare conductors.

END OF SECTION 16195

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for squirrel cage motors

B. No motors are to be furnished or mounted by the Electrical Contractor.

The motors specified herein are included as Section 16220 in order to maintain compliance with current CSI specification numbering and format. However, all motors to be furnished on this project shall comply with this specification section and shall be furnished by the respective equipment supplier, as specified elsewhere.

C. Electrical Contractor work under this item is limited to providing conduit, wire and motor terminations.

1.02 RELATED SECTIONS

A. Division 11 – Equipment
B. Division 13 – Special Construction
C. Division 15 – Mechanical

1.03 REFERANCE TO STANDARDS

A. Motors shall be constructed in strict conformance with the applicable publications, standards and specifications of the following:

1. Institute of Electrical and Electronic Engineers (IEEE)
2. National Electrical Manufacturers Association (NEMA)
3. American National Standards Institute (ANSI)
4. National Fire Protection Association (NFPA)

B. Motors shall be manufactured in compliance with the most recent edition and all revisions of the following as a minimum:

1. NEMA Publications MG 1 "Motors and Generators"
2. IEEE Standard 112 "Standard Test Procedure for Polyphase Induction Motors and Generators".
3. IEEE-841 “Standard for petroleum and chemical industry - severe duty totally enclosed fan cooled (TEFC) squirrel cage induction motors – up to and including 370 kW (500 hp)”

1.04 SYSTEM DESCRIPTION

A. It is not the intent to completely specify details of design and construction. This section shall be considered a General Specification for all motors which are a part of this project. Motors shall be constructed and equipped with accessories

as specified and where they do not conflict with these specifications, in accordance with the motor manufacturer's practices.

1.05 SUBMITTALS

A. Submit under the provisions of Section 01300.

B. As a minimum, for each motor the following information shall be furnished for review:

1. Manufacturer’s Name including motor model or catalog numbers.
2. Horsepower output
3. Time rating
4. Maximum ambient temperature for which the motor is designed.
5. Insulation system designation.
6. RPM at rated load.
7. Frequency
8. Number of Phases
9. Rated-load amperes
10. Voltage
11. Locked-rotor amperes or code letter for locked-rotor kVA per horsepower for motors ½ HP or greater.
12. NEMA Frame size/ Design letter for motors greater than 1 horsepower.
13. NEMA nominal efficiency as calculated by NEMA MG-1 12.58.
14. Service Factor.
15. Service factor amperes when service factor exceeds 1.15.
16. For motors equipped with thermal protectors, indicate “thermally protected.”
17. For motors rated above 1 horsepower equipped with over-temperature devices or systems, indicate “OVER TE<P PROT” followed by the type as defined by NEMA MG-1 12.57.
18. Motor weight, if exceeding 66lbs (30kg).
19. Internal winding connection of the motor
20. Data for all options as specified herein and on the project drawings.

1.06 QUALIFICATIONS

A. Motors shall be supplied by manufacturers that can demonstrate a minimum of five (5) years’ experience in design and manufacture of the type of motor supplied.

1.07 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS (MOTORS 5 HP AND GREATER)

A. Base Bid

1. Emerson / U.S. Electric Motors
2. Reliance Electric/ Baldor/ Of the ABB Group
3. Siemens
4. Toshiba

B. Alternates

1. None

2.02 MANUFACTURERS (MOTORS LESS THAN 5 HP)

A. Standard product as selected by equipment manufacturer

2.03 RATINGS

A. Alternating current motors shall be squirrel cage induction type, unless otherwise specified, mounted horizontally or vertically, with horsepower and RPM rating as required by the driven equipment. Motors shall be designed for continuous operation in a 40°C ambient temperature.

B. Unless otherwise specified motors shall be for use on 60 Hertz system and three phase motors shall be rated 460 VAC for use on 480 VAC system, 230 VAC for use on 240 VAC system and 200 VAC for use on 208 VAC system. Where fractional horsepower single phase motors are supplied they shall be rated 230 VAC for use on 240 VAC system, 200 VAC for use on 208 VAC system and 115 VAC for use on 120 VAC system.

C. Motors rated for A-C service shall withstand stresses and shall perform without damage when started with driven equipment connected and with supply voltage sustained at rated frequency and 110% rated motor terminal voltage applied. Motors shall be suitable for operation at rated load with a combined variation of 10 percent above or below rated voltage and frequency provided that the frequency variation does not exceed 5 percent. Motors shall not be damaged when subjected to an over speed of 125 percent of rated R.P.M.

D. For motors intended for outdoor service the effects of solar heat shall be considered in the determination of the design ambient temperature. Calculation of the solar heat contribution shall be in accordance with referenced standards.

E. Motors driving non-overloading pumps and fans shall be sized to supply maximum pump or fan brake horsepower at motor full load speed without exceeding nameplate full load current. Motors driving overloading type pumps or fans shall be sized for a reasonable run-out of the operating point on the head vs. capacity curve.

2.04 EFFICIENCY

A. All motors 1 HP and greater shall be furnished with “NEMA Premium” efficient design. Motor efficiencies shall meet, or exceed, that shown in NEMA MG-1 Table 12-12. All motors shall additionally meet, or exceed, EPAct 1992 requirements.

B. Motor efficiency shall be determined in accordance with NEMA MG-1 Section 12.58 and full load efficiency labeled on motor nameplate in accordance with NEMA MG-1 Section 12.58.2. The full load efficiency, when operating at rated voltage and frequency, shall be not less than the minimum value associated with the nominal value per NEMA MG-1 Table 12-10.

2.05 APPLICATION

A. Motors shall be rated for continuous operation in an ambient temperature not exceeding 40°C at an altitude not exceeding 3300 feet above mean sea level.

B. Unless otherwise specified, motors 1.0 HP through 200 HP shall have a service factor of 1.15 minimum. Fractional HP motors shall have a service factor per NEMA standards.

C. The Service Factor rating on motors to be furnished for VFD applications shall be 1.15 on sine wave power and 1.0 Service Factor on VFD power in a 40°C ambient.

2.06 TERMINAL BOXES AND LEADS

A. Motor terminal boxes shall be sized equal to, or larger than, that required by NEC or UL standards. Boxes shall be drilled and tapped for conduit entry. Cover shall be installed with corrosion resistant cap screws. Terminal box shall be furnished with NEMA F1 mounting arrangement, but may be rotated as required for conduit clearance. Increased terminal box space shall be provided for additional motor features such as space heaters, thermal-switch contacts, etc. Alternately, an additional motor terminal box may be provided for these features if desired by supplier.

B. Motor leads in the conduit box shall be sized in accordance with NEC minimum ampacity values using a minimum of 125°C insulated lead wire. Conductors shall be clearly identified in accordance with ANSI C6.1.

C. Motor stator leads shall be brought out to the conduit box through an insulating gasket of neoprene, or equal, that holds each lead individually and forms a positive seal between the conduit box and frame.

D. Motor stator leads shall be connected to field power cables with Thomas & Betts “MD”, or equal, motor pigtail connections and matching insulated boots. Termination of motor leads using split-bolts and tape will be rejected.

E. Motors shall be provided with a grounding lug mounted within the conduit box by drilling and tapping into the motor frame or by a double-ended cap screw of silicon bronze.

2.07 INSULATION

A. Unless otherwise specified, motors shall be supplied with NEMA Class F insulated windings with maximum Class B operational temperature rise when the motor is operated continuously at rated nameplate horsepower, voltage and frequency and an ambient temperature not exceeding 40°C, and a service factor of 1.0.

B. The maximum temperature rise shall not exceed 90°C at the service factor load.

C. The insulation resistance of the stator winding shall be greater than 100 megohms when measured at 25°C with a megohm bridge having 1000-volt direct current.

D. Insulation shall utilize non-hygroscopic varnish.

2.08 ENCLOSURES

A. Unless otherwise specified, motors shall be supplied with totally enclosed fan cooled (TEFC) enclosures and shall be suitable for service conditions specified.

B. All motors used on VFD applications shall be furnished with TEFC enclosures.

C. Totally enclosed fan cooled (TEFC) applications shall comply with NEMA MG1 Part 1.26.

D. Where Open Drip Proof (ODP) enclosures are specifically specified, machines shall comply with NEMA MG1 Part 1.25.

2.09 TORQUE CHARACTERISTICS

A. Squirrel cage induction motors, unless otherwise specified or special requirements indicate, shall be NEMA Design B construction, designed to withstand full-voltage starting, developing locked-rotor, breakdown and pull-up torques adequate for general applications.

B. The locked rotor current of polyphase induction motors shall be the lowest value consistent with good performance, economic design and related requirements of this specification. Motors requiring NEMA Locked Rotor Code Letters exceeding code letter H (maximum 7.09 KVA per HP) shall require the Engineer's concurrence for each request.

2.10 STARTING AND RUNNING

A. Motors shall be designed to start, accelerate and run the driven load without exceeding the specified temperature rise of the motor per NEMA MG1-12.43 variations from rated voltage and frequency.

B. Limitations on the number of repetitive hot and cold starts, with driven load connected, shall be clearly identified on shop drawing submittal.

2.11 VIBRATION

A. Vibration peak-to-peak amplitudes shall be limited to values defined by NEMA Standards.

2.12 BEARINGS AND LUBRICATION

A. The motor shall be equipped with two end shield supported bearings of the rolling element (anti-friction) type. Grease fittings and reliefs shall be supplied for external lubrication while machine is in operation. Fittings and reliefs shall be plugged.

B. Bearings shall have a rated fatigue life of L-10 (B-10) of 26,280 hours minimum for belted applications, 100,000 hours minimum for flexible direct coupled applications. Calculations shall be based on external loads using NEMA belted applications limits per MG-1 Section 14.42 and typical sheave weights and internal loads defined by the manufacturer including magnetic pull and rotating assembly weight.

C. The motor shall have tight mechanical bearing housing fits. Either the D.E. O.D.E. bearing must be locked to limit axial shaft movement.

D. For motors applied to VFD's, see Paragraph 16220-2.14 for additional information.

2.13 ROTATION

A. Motors shall be designed for rotation in either direction without damage to motor.

2.14 VARIABLE FREQUENCY DRIVE (VFD) APPLICATIONS

A. Motors noted for operation on variable frequency drives (VFD) shall be "Inverter-Duty" and designed for the additional insulation stresses applied to motor windings by Pulse-Width Mode (PWM) VFD power sources.

B. Motor insulation shall be "voltage spike-resistant", "Inverter-Duty" or similar and comply with all requirements in NEMA MG-1 Part 31.4.4. which requires motors to be designed to withstand an upper limit of 3.1 times the motor's rated line-to-line voltage (or an upper limit of 1,426 peak volts at the motor terminals for a motor rated at 460V).

C. All motors shall be suitable for the intended application, without further de-rating or additional equipment, including consideration of the following:

1. Motor lead conductors and conduit as noted on project drawings up to 500 feet in length.
2. VFD carrier frequency of 4 kHz or less.

D. Motors applied on VFD applications shall be selected based upon available motor torque de-rating per NEMA MG-1 Part 30.2.2.2.

E. All Motors 10 HP and greater utilized on VFD applications shall be furnished with Normally Closed (N.C.) stator winding thermal switches ("Klixon"). Thermal switch conductors shall be series-connected and brought to motor terminal box. Switches shall be wired to stop the VFD in the event the driven motor overheats. Motor winding thermal switches shall be auto-reset type.

F. Motors shall operate successfully under running conditions at rated load with variation of +/- 10% rated voltage at rated constant volts/hertz ratio.

G. Motors shall operate successfully under running conditions at rated load and volts/hertz ratio when the voltage unbalance at the motor terminals does not exceed 1%.

H. See Section 16220-2.08B regarding enclosures on VFD applied motors.

I. To prevent induced-current bearing damage, all motors applied to VFD's which are 20 HP or greater (excluding submersible pump applications) shall be furnished with one of the following:

1. Insulated outboard (front) bearings (bearing opposite the driven load)
2. Shaft grounding provisions similar to AEGIS-SCR Shaft Grounding Rings as manufactured Electro Static Technology; Mechanic Falls, ME. Install shaft-grounding equipment per manufacturer's requirements.

2.15 NAMEPLATES

A. Nameplates shall be constructed from non-corroding metal and be fastened with stainless steel screws or pins. Nameplate motor data shall be stamped or engraved into nameplate surface; printed nameplates will not be allowed.

B. Nameplates shall include the following information as a minimum:

1. Manufacturer's type and frame designation
2. Horsepower Output
3. Time Rating
4. Maximum ambient temperature for which motor is designed
5. Insulation system designation
6. RPM at rated load
7. Frequency
8. Number of phases
9. Rated load amperes
10. Voltage
11. Locked-rotor amperes or code letter for locked-rotor kVA per horsepower for motors ½ HP or greater.
12. Design letter for 1 HP or greater motors
13. NEMA nominal efficiency per MG 1-12.58; Table 12-12
14. Service Factor
15. For Motors equipped with thermal protectors, the words "thermally protected" if the motor provides all the protection described in MG 1-12.56. This shall be permitted to be shown on a separate plate or decalcomania.
16. For motors rated above 1 horsepower equipped with over-temperature devices or systems, the words "OVER TEMP. PROTE" followed by type number as described in MG 1-12.57. This shall be permitted to be shown on a separate plate or decalcomania.

2.16 COUPLINGS

A. Motor drive couplings shall be supplied by the driven equipment manufacturer. The driven equipment manufacturer shall finish bore and mount the motor half of the couplings or other drive accessories on the motor.

2.17 HOSTILE DUTY MOTOR APPLICATIONS

A. Where motors are noted to be furnished as hostile-duty (Mill & Chemical duty), the additional features shall be provided as a minimum:

1. Motors shall meet or exceed IEEE-841 requirements.
2. Motors shall be manufactured as suitable for continuous duty operation without de-rating in wet, corrosive and hostile environments. These areas shall include those normally encountered in mills and chemical plants. Applications may be indoors and outdoors involving high humidity, as well as chemical laden, corrosive or salty atmospheres.
3. Enclosures shall be Totally-Enclosed Fan Cooled (TEFC) construction only.
4. Motor frames and endplates shall be cast iron.
5. Motor windings shall be copper.
6. Insulation shall be non-hygroscopic and be chemical and humidity resistant.
7. Stators shall be dipped in high-solids varnish and baked. Stators and rotors shall be protected by a resin and hardener treatment.
8. Leads shall be non-braided and non-wicking. Conduit box shall be threaded and capable of being rotated in 90° increments. Lead positioning gaskets shall be provided between the conduit box and frame. Provide additional gasket between conduit box and cover.
9. Condensation drain holes shall be provided at the low points in the end brackets and supplied with corrosion resistant, breather drain plugs.
10. Ventilating fans shall be of a non-sparking, non-corroding material.
11. All nameplates and fastening hardware shall be stainless steel and capable of meeting 720 hour salt spray test per ASTM B117-90.
12. Paint shall be either two-part epoxy or vinyl-phenoloc over oxide prime. Coating shall be chemical solvent, salt water and acid resistant and shall surpass 96 hour salt spray test per ASTM B117-90.
13. Motor bearings shall provide for an L-10 life of 30,000 hours per ANSI/AFBMA 9 – 1990.

2.18 ACCESSORY EQUIPMENT AND MISCELLANEOUS REQUIREMENTS

A. All motors utilizing frames 215 and above shall be provided with lifting eye bolts.

B. Motors shall be equipped with suitable sole plates where required. Hold down bolts between the motor and the sole plates shall be furnished. Foundation bolts will be supplied by others; however, the motor manufacturer shall state foundation size and projection above the foundation.

C. Motors shall have drain plugs or holes to prevent accumulation of water.

D. Horizontal motors shall be foot-mounted and vertical motors shall be base mounted unless otherwise specified.

E. Grounding provisions shall be supplied in accordance with NEMA and suitable lugs for field ground cable shall be furnished with each motor. The ground cable sizes will be defined by the Engineer. Motors shall have provisions for a ground connection inside the terminal housing in addition to the provisions for grounding the motor frame.

F. Bolts, screws and other hardware shall be treated for resistance to corrosion. Exposed parts of the motor shall be protected against corrosion.

G. On all motors 100 hp or greater, or where specifically noted, motor space heaters shall be provided for condensation control. Space heaters shall operate at 120 Volts, single phase, 60 Hertz, and wired to a motor terminal box.

2.19 TESTS

A. Motors meeting ratings shown in Table 12-5 of NEMA MG 1-Part 12 classifications (Small and Medium Motors) shall be each tested per MG 1 Part 12.55 “Routine Tests for Polyphase Medium Induction Motors” as a minimum. Further Factory testing is not required unless specifically specified herein. Routine Factory Testing Data shall be furnished to the Engineer upon request.

B. Motors meeting ratings of NEMA MG 1-Part 20 (Large Motors) classification shall be each tested per MG1 Part 20.16 “Tests” as a minimum. Copies of these performance characteristics and test results shall be provided to the Engineer. Additional tests, when specified, shall become a part of this requirement.

C. Format of test reports shall be per IEEE Standard 112.

2.20 SPARE PARTS

A. The motor manufacturer shall furnish for each motor, a list of recommended spare parts. Each list shall contain part numbers, part name, quantity used in each motor sub-assembly, where applicable, and the unit price for each part.

2.21 O & M MANUALS

A. The motor manufacturer shall furnish a total of six (6) copies of an O & M Manual covering installation, operation and maintenance of each motor horsepower size furnished. Installation instructions shall include procedure for checking alignment of motor shaft, coupling and base. Instructions shall also cover lubricating details, including recommended lubrication inspection and replacement periods, recommended quantity of lubricant and specification for replacement lubricant. O & M Manuals shall be specific for equipment actually supplied.

B. One (1) additional copy of instructions shall be shipped with each motor.

PART 3 EXECUTION

3.01 INSTALLATION, START-UP, COMMISSIONING

A. For each motor 1 HP and greater, provide an individual certification and testing report included at the end of this section.

3.02 Refer to equipment specification that required motor furnished under this section.

(Motor Data sheets follow)

MOTOR START UP CERTIFICATION AND TESTING REPORT

(One form is to be provided for **each** motor, copy as required)

Crawford, Murphy & Tilly, Inc.
Consulting Engineers
Springfield, Illinois
Phone (217) 787-8050

Project Location:_____ CMT Project Number: _____

Client (End User):_____

Client Site Location: _____

Temperature (EF): _____

Humidity: _____

Time of Day: _____

Weather (if outdoors): _____

Motor Function / Number / Location: _____

Motor Nameplate Data

1. Manufacturer's Name: _____
2. Motor Serial Number: _____
3. Manufacturer's type and frame designation _____
4. Horsepower _____
5. Time Rating (5, 15, 30, 60 minutes, or Continuous) _____
6. Maximum ambient temperature for which motor is designed _____
7. NEMA Insulation Class Designation _____
8. NEMA Torque Design Class _____
9. RPM at rated load _____
10. Frequency _____
11. Number of Phases _____
12. Rated Full-Load-Amperes _____
13. Voltage _____
14. Code letter for Locked-Rotor KVA _____
15. Service Factor _____
16. Efficiency (NEMA Nominal) _____
17. Internal motor thermal protected (if required)? (Yes / No) _____

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Motor Start-Up & Commissioning Data

(One form is to be provided for **each** motor, copy as required)

Insulation Resistance Test

Megohms measured to ground @ 500 VDC (60 Second continuous test)

Motor Lead T1 measured to Ground _____ Megohms

Motor Lead T2 measured to Ground _____ Megohms

Motor Lead T3 measured to Ground _____ Megohms

T1-T2-T3 (Tied) measured to Ground _____ Megohms

Voltage (at motor)

	Phase A-B	Phase B-C	Phase C-A
No-Load	_____	_____	_____
Full Load	_____	_____	_____

Motor Current (field measured data)

No Load

Phase A _____ Amps

Phase B _____ Amps

Phase C _____ Amps

Full Load

Phase A _____ Amps

Phase B _____ Amps

Phase C _____ Amps

DATA CERTIFIED BY:

Firm: _____

Name: _____

Date: _____

END OF SECTION 16220

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work included in this section is labor, equipment and materials necessary to provide a complete and operational service entrance as detailed on drawings and specified herein. All work shall be as shown on project drawings and coordinated with serving utility requirements.

B. The work described in this Specification Section is for information only. The Contractor shall comply with all requirements of the Serving Utility effective at the time of the installation of the Service Entrance. This may result in different installation methods and different equipment supply and installation by the Contractor than shown on the plans or specified herein. All material, equipment and labor required to furnish and install a complete and operational Service Entrance in compliance with Serving Utility requirements shall be considered incidental to the contract work.

C. Serving Utility shall furnish and install:

1. Medium-Voltage primary cable, installation and terminations.
2. Service transformer
3. All metering transformers (C.T.'s and P.T.'s as appropriate). (Note, Contractor shall furnish and install metering transformer cabinet if not furnished by serving Utility.)
4. Termination of secondary conductors on secondary lugs of pad-mount transformer. Conductors to be provided and pulled by Contractor.
5. KWH Meter instrument. (Note, Contractor shall furnish and install kWH Meter Base if not furnished by serving Utility.)
6. Installation of secondary metering conductors between metering transformer enclosure and KWH meter equipment. Conduit and pull string meeting utility requirements is to be provided and installed by Contractor.

D. Contractor shall furnish and install:

1. Concrete transformer pad with frost-legs meeting utility requirements and as detailed on project drawings.
2. Secondary service conductors and concrete-encased ductbank between pad-mount transformer and Metering Transformer Cabinet.
3. Termination of service conductors at Metering Transformer Cabinet. Service conductors will be terminated at utility pad-mount transformer by serving utility.
4. If not furnished by serving Utility, KWH Meter Base meeting electric utility requirements
5. If not furnished by serving Utility, Metering Transformer Cabinet meeting electric utility requirements.

6. Conduit and pull-string meeting utility requirements between Metering Transformer Cabinet and KWH Meter base. Electric utility will furnish and install metering conductors.
7. Installation of conduit and service conductors between Metering Transformer Cabinet and Service Entrance Main Circuit Breaker.
8. Any additional work as required by serving utility but not specifically noted herein shall be considered incidental to this section.
9. Grounding and Bonding for Service Entrance is covered under Section 16170.

1.02 UTILITY NAME: AMEREN
Contact Individual: QUINTON COMBS
Street Address: 711 South 9th Street
City, State, Zip: Mattoon, IL 61938
Phone No.: (217) 234-0439
Email: qcombs@ameren.com

1.03 COSTS FROM SERVING UTILITY THAT MAY BE CHARGED FOR PROVIDING NEW PERMANENT ELECTRICAL SERVICE TO THE WATER TREATMENT PLANT WILL BE PAID BY THE OWNER. CONTRACTOR SHOULD NOT INCLUDE THESE IN HIS BASE-BID COST.

1.04 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16111 - Conduit and Raceway
C. Section 16118 - Ductbank
D. Section 16170 - Grounding and Bonding
E. Section 16496 - Enclosed Transfer Switch
F. Section 16671 - Surge Protective Devices (SPD)
G. Section 16950 - Testing Electrical Systems

1.05 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code

1.06 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be stored in original cartons, where applicable, and away from contact with earth and protected from weather and abuse.

1.07 SUBMITTALS (RESERVED)

1.08 QUALIFICATIONS (RESERVED)

1.09 QUALITY ASSURANCE (RESERVED)

1.10 REGULATORY REQUIREMENTS

A. Contractor shall comply with all requirements of serving utility.

1.11 COORDINATION

A. Contractor shall coordinate service installation with serving utility.

1.12 MAINTENANCE SERVICE (WARRANTY)

A. Cable and appurtenances shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion.

1.13 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Contractor shall comply with all requirements of serving utility.

PART 3 EXECUTION

3.01 INSTALLATION

A. Pad-mounted transformer shall be installed on concrete pad as detailed in drawings and as required by serving utility. Concrete pad shall be level. Surrounding earth shall be thoroughly tamped, graded, fertilized and seeded. If erosion appears to be a problem, Contractor shall install rock to control erosion.

B. Install service entrance conductors between the utility transformer and the Automatic Transfer Switch in the Electrical Building. Conductors shall conform to the requirements as noted in Section 16123 - Building Wire and Cable.

C. Conduit shall be installed as specified in Section 16111 - Conduit and Raceway and Section 16118 - Duct Bank.

D. Contractor shall furnish and install utility metering equipment as required by serving utility and shall coordinate the location of this metering with serving utility and owner's authorized representative.

E. Power coordination during construction at an existing facility (if applicable)

In order to minimize down-time to the existing facility, an existing service shall remain in service as long as possible until new service or modifications are in place and ready for switch-over. Any shutdown or disruption of the existing facility power distribution shall be coordinated with the owner and engineer. A minimum of 72 hours written notice of any such shutdown shall be furnished by contractor before commencing with any such work. Before disconnection of any existing service entrance or power, new improvements shall be fully installed, checked out and ready for commission. Any existing utility equipment to be de-commissioned or removed shall be done only after new improvements have been thoroughly tested and accepted for permanent operation.

3.02 TESTING

A. Entire service entrance system shall be tested. Perform testing in accordance with serving utility's recommendations.

B. Comply with all applicable items in Section 16950 – Testing Electrical Systems.

END OF SECITON 16421

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is supply of temporary electrical power as required to complete work as indicated on drawings and specified herein.

B. All energy costs, demand costs and applicable one-time charges billed by serving utility for Temporary Power shall be paid for by the Contractor and included in base-bid price. They will not be paid for separately.

C. It shall remain solely the Contractor's responsibility to ensure proper system voltage and adequate electrical construction power capacity are available for his work. If construction site is at an operational facility, the Contractor's temporary construction power shall not impact Owner's operations in any manner.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements.
B. Section 16111 - Conduit and Raceway.
C. Section 16123 - Building Wire and Cable.
D. Section 16170 - Grounding and Bonding.
E. Section 16190 - Supporting Devices.
F. Section 16441 - Enclosed Switches.

1.03 REFERENCE TO STANDARDS

A. NFPA 70 – National Electric Code (most current issue)

B. Requirements and standards as noted by serving utility

PART 2 PRODUCTS

2.01 MATERIALS

A. May be new or used, but shall be adequate for purposes used, shall not create unsafe conditions, nor violate specified codes. Comply with Federal, State and local regulations.

B. Any and all additional work as required by serving electrical utility shall be considered incidental to this specification.

C. Utility Name: Ameren
Contact Individual: Quinton Combs
Street Address: 711 South 9th Street
City, State, Zip: Mattoon, IL 61938
Phone No.: (217) 234-0439
Email: qcombs@ameren.com

PART 3 EXECUTION

3.01 TEMPORARY ELECTRICITY DURING CONSTRUCTION

A. Contractor shall be solely responsible to make necessary arrangements and provide temporary electric service for construction equipment and lighting required during the entire construction period including all utility fees, service charges, and permits.

B. Electric services shall be of sufficient capacity and characteristics to supply proper current for various types of construction tools, motors, welding machines, lights, heating plant, air conditioning system, pumps and other work required. All necessary temporary wiring, panelboards, outlets, switches, lamps, fuses, controls and accessories shall be provided by Contractor. A sufficient number of electric outlets shall be provided along with adequate lighting. Materials used for temporary service shall not be used in permanent system unless specific approval is given by Owner’s representative. Temporary service shall be so constructed and arranged as not to interfere with progress of other trades. This system shall be erected and maintained strictly in accordance with all ordinances and requirements for temporary service pertaining thereto inclusive of OSHA and NEC.

C. All 15A and 20A receptacles used for temporary power shall be ground fault circuit interrupter type, per NEC Article 590.

3.02 TEMPORARY POWER FOR CONTINUITY OF SERVICE TO FACILITY

A. If the work to be performed under this contract is to be performed at an existing complex, it is imperative that these facilities remain operational during the performance of work under this contract. There shall be no power outages of any duration whatsoever without the express written consent of the owner. Failure to comply with this requirement could result in substantial penalty charges being assessed the Contractor.

B. Maximum duration of any single power outage, whether partial or complete, shall be eight (8) hours - however this maximum duration shall apply only when convenient to the owner and, again, only with the written approval of the owner's authorized representative.

3.03 TEMPORARY POWER REMOVAL

A. Any Contractor who has installed a temporary utility connection as herein specified, shall, prior to final acceptance, remove temporary connections and installations and leave premises restored to condition in which it was found.

END OF SECTION 16422

PART 1 GENERAL

1.01 WORK INCLUDES

A. This section includes enclosed safety switches for use as service disconnects, feeder and branch circuit switching and disconnect switches for motors and equipment.

B. This section shall also include double-throw safety switches used as manual transfer switches.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements.
B. Section 16170 - Grounding and Bonding.
C. Section 16190 - Supporting Devices.
D. Section 16195 - Electrical Identification.

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code.

B. NEMA KS 1 - Enclosed Switches.

C. NECA - National Electrical Contractors Association.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.04 DELIVERY, STORAGE AND HANDLING

A. Single-Throw and Double-Throw Safety Switches shall be stored in original containers as delivered to jobsite. Safety switches shall be stored on pallets or other supports to prevent contact with earth. Safety switches shall be covered to protect them from weather.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide catalog data for switch ratings and enclosure dimensions.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.06 QUALIFICATIONS (RESERVED)

1.07 QUALITY ASSURANCE

A. Perform work in accordance with NECA Standard of Installation.

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 COORDINATION (RESERVED)

1.10 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Square D
B. Cutler-Hammer
C. Siemens
D. General Electric

2.02 EQUIPMENT SPECIFICATION

A. Safety switches (disconnects) shall be rated for use at 480 Volts, 3 phase and shall be Heavy Duty, NEMA KS 1 load interrupter enclosed knife switch with externally operated handle interlocked to prevent opening front cover with switch in ON position. Disconnect handle shall be lockable in OFF position.

B. Safety switch enclosures shall be NEMA 4X, unless otherwise indicated on drawings.

C. Where noted on project drawings, disconnects shall be fusible-type and shall include high-interrupting capacity, U.L. Class “R” time-delay (slow-blow) fuses, Buss, or equivalent. Fuse ampacities shall be as noted on the project drawings. Three spare fuses of each ampacity used on the project drawings shall be provided with each fusible disconnect.

D. Where noted, disconnects shall be U.L. Listed as suitable for use as Service Entrance Disconnect Equipment. Provide Ground Kit and Neutral Kit where required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect safety switches for proper operation. Disconnect switch movement shall not bind at any point in its travel. Inspect enclosures for corrosion and water tightness.

3.02 PREPARATION (RESERVED)

3.03 INSTALLATION

A. Install safety switches (disconnects) where detailed on drawings. All switches shall be mounted to strut-type framing.

B. All safety switches shall be bonded to equipment grounding system.

C. Provide nameplate for each safety switch as detailed on drawings or as directed by Owner's representative.

D. Inspect all disconnects for proper operation, tight and secure connections, and correctness. Adjust as necessary to assure proper operation.

3.04 INTERFACE WITH OTHER PRODUCTS (RESERVED)

3.05 MANUFACTURER'S FIELD SERVICES (RESERVED)

3.06 TESTING

A. Test all disconnects for proper operation and continuity on all poles when in the closed (ON) position.

END OF SECTION 16441

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is supply and installation of enclosed dry type transformers to provide a complete and operational electrical system.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16111 - Conduit and Raceways
C. Section 16123 - Building Wire and Cable
D. Section 16170 - Grounding and Bonding

1.03 REFERENCE TO STANDARDS

A. NEMA ST20 - Dry Type Transformers for General Applications

1.04 DELIVERY, STORAGE AND HANDLING

A. Dry type transformers shall be stored indoors from time of delivery to jobsite, protected from weather and construction.

1.05 SUBMITTAL REQUIREMENTS

A. Submit under provisions of Section 01300

B. Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, rated temperature rise and sound level.

QUALIFICATIONS

C. Dry type transformers shall be manufactured and supplied by a company regularly engaged in business of furnishing dry type transformers. If required by Owner's representative, manufacturer shall submit a certification to a minimum experience of ten years in manufacture of dry type transformers.

1.06 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Square D
B. Cutler-Hammer
C. General Electric
D. Siemens

2.02 CONSTRUCTION

A. Insulation System

1. 2 KVA and below: 150° C insulation based upon 80° C rise.
2. 3.0 to 15 KVA: 185° C insulation based upon 115° C rise
3. 15 KVA and above: 220° C insulation based upon 150° C rise

B. Performance shall be obtained without exceeding the specified temperature rise in a 40° C maximum ambient. Units shall be designed for continuous operation, with normal life expectancy as defined in ANSI C57.96.

C. Insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

D. Core and Coil Assemblies

Transformer core shall be constructed with high-grade, nonaging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. Transformer windings may be either copper or aluminum using continuous wound construction.

E. Where noted on project drawings, provide “K-Factor” rated transformers specifically designed as suitable for use with Nonlinear loads having increased harmonic currents. Minimum transformer “K” factor shall be as noted on project drawings.

F. Efficiency

Per Federal Requirements described in 10CFR Part 431 “Energy Efficiency Program for Certain Commercial and Industrial Equipment”, all Dry-Type transformers 15 kVA and larger shall comply with NEMA Standard TP-1.

G. Sound Levels

Transformer maximum audible sound levels shall not exceed the following per IEEE C57.12.01 and NEMA ST-20 for 600-Volt Class, self-cooled units:

0	to	9 kVA	40db
10	to	50 kVA	45db
51	to	150 kVA	50db
151	to	300 kVA	55db

301 to 500 kVA	60db
501 to 700 kVA	62db
701 to 1000 kVA	64db
1001 to 1500 kVA	65db

H. Wiring Terminations

Terminals shall be provided for external cables rated 90°C applied at 75°C ampacity.

I. Enclosure

The enclosure shall be made of heavy-gauge steel with minimum NEMA 2 rating unless otherwise specified. Unit shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90°C. The core of the transformer shall be grounded to the enclosure.

J. Mounting

Transformers, 75 KVA and below, shall be suitable for wall or floor mounting. Transformers over 75 KVA shall be floor mounted.

K. Unless otherwise noted or specified for environmental reasons, enclosures shall be ventilated. Provide lifting brackets or lifting eyes.

L. Taps

2 ea 2-½% FCAN (Full Capacity Above Normal)
2 ea 2-½% FCBN (Full Capacity Below Normal)

PART 3 EXECUTION

3.01 INSPECTION

A. Dry type transformers shall be inspected for physical damage. Touch up paint matching transformer shall be used as needed.

3.02 INSTALLATION

A. Install transformers in accordance with manufacturer's instructions.

B. Set transformer plumb and level.

C. Use flexible conduit, under provisions of Section 16011, 2 ft. (0.6 M) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

D. Mount transformers on vibration isolating pads suitable for isolating transformer noise from building structure.

3.03 TESTING

A. Check for damage and tight connections prior to energizing transformer.

B. Adjust primary taps so that secondary voltage is within 2% of rated voltage.

END OF SECTION 16461

PART 1 GENERAL

1.01 WORK INCLUDES

A. The work on this section is the supply and installation of packaged power supplies, including transformer, panelboard section and circuit breakers in a weatherproof enclosure.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16170 - Grounding and Bonding
C. Section 16190 - Supporting Devices
D. Section 16195 - Electrical Identification
E. Section 16461 - Dry Type Transformers
F. Section 16470 - Panelboards
G. Section 16671 - Surge Protective Devices
H. Section 16950 - Testing Electrical Systems

1.03 REFERENCE TO STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. U.L. Listed.

C. U.L. Standard 489.

D. U.L. Standard 67 Panelboards.

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

F. NFPA 70 - National Electrical Code.

G. NECA (National Electrical Contractors Association) "Standard of Installation".

H. NEMA AB 1 - Molded Case Circuit Breakers.

I. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

J. NEMA KS 1 - Enclosed Switches.

K. NEMA PB 1 - Panelboards.

L. Federal Specification W-P-115b, Type I, Class I.

M. Federal Specification W-G-375B (Circuit Breakers).

N. U.L. 50 Cabinets and Boxes.

1.04 DELIVERY, STORAGE AND HANDLING

A. Mini power centers shall be stored indoors from time of delivery to jobsite, protected from weather and construction.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submittals for Mini-Power Distribution Center shall include transformer rating, voltage, bus ampacity, circuit breaker switch arrangement and sizes, unit weight, outline and support point dimensions of enclosures and accessories, and manufacturer name and catalog number. Submittals shall also include manufacturer's installation instructions; indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting the product.

1.06 QUALIFICATIONS

A. The mini power centers shall be manufactured and supplied by a company regularly engaged in the business of furnishing dry type transformers. If required by the Construction Manager, the manufacturer shall submit a certification to a minimum experience of five years in the manufacture of mini power centers.

1.07 WARRANTY

A. Mini power centers shall be warranted to be free from defects in material and workmanship for one year from date of substantial completion.

PART 2 PRODUCTS

2.01 MINI POWER CENTERS

A. The mini power center shall be built according to the latest revision of ANSI C89.2 (ST-20). It shall feature a self-contained indoor outdoor non-ventilated enclosure that incorporates a primary breaker, dry type transformer, secondary main breaker and a secondary distribution section. Units shall be designed for continuous operation at rated KVA, for 24 hours a day, 365 days a year operation with normal life expectancy as defined in ANSI C57.96.

B. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

0 to 9 KVA - no more than 40db
10 to 30 KVA - no more than 45db

C. Insulating Systems

1. Transformers shall be insulated with a 185° C insulation system minimum.

2. Required performance shall be obtained without exceeding the above-indicated temperature rise in a 40° C maximum ambient, with a 30° C average over 24 hours.
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

D. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, nonaging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction.
2. The core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.
3. The core of the transformer shall be grounded to the enclosure.
4. Provide minimum two (2) FCBN taps.

E. Bus

1. Secondary bus shall be aluminum.

F. Wiring / Terminations

1. All interconnecting wiring between the primary circuit breaker and transformer, secondary main circuit breaker and transformer and distribution section shall be factory installed and terminated.
2. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring.

G. Main Devices

1. Each mini-power center shall include a Main primary circuit breaker with an interrupting rating of 14 KA at 480 volts; and a secondary panelboard with a main circuit breaker rated 10 KA at 120/240; or 208Y/120 as applicable.

H. Feeder Devices

1. The secondary distribution section shall accommodate standard panelboard circuit breakers with 10KA interrupting capacity.

I. Enclosure

1. The enclosure shall be made of heavy-gauge steel and the maximum temperature of the enclosure exterior shall not exceed 90 □C.
2. The enclosure shall be totally enclosed, nonventilated, with lifting eyes.

3. Unless specified otherwise on the drawings, enclosure rating shall be NEMA 3R. Enclosure door shall accept padlock.

J. The mini power center shall be listed by Underwriters' Laboratories. Mini-Power Distribution center shall be Square D, Class 7400 or equivalent.

PART 3 EXECUTION

3.01 INSPECTION

A. Mini power centers shall be inspected for physical damage. Matching touch up paint shall be used as needed.

3.02 INSTALLATION

A. Mini-Power Distribution Center

1. Install Mini-Power Distribution Center in accordance with manufacturer's instructions and as detailed on the drawings. Provide typed circuit directory for the secondary distribution section. Revise directory to reflect circuiting changes as required.
2. The Contractor shall ground the secondary circuit of the Mini-Power Distribution Center by means of a 3/4" diameter by 10 foot long copper clad ground rod. Furnish and install ground rod as detailed on the drawings. Ground rod shall be connected to secondary neutral with a #6 copper bare stranded conductor minimum or as detailed on the drawings installed in a 1" Schedule 40 PVC Conduit. Conductor shall be Exothermic Welded to top of ground rod minimum of 1'-0" below finish grade.
3. Provide Legend Plates for all mini-power distribution centers to identify the area and/or equipment controlled by the panelboard. Legend plates shall comply with Section 16195 - Electrical Identification.
4. Install grounding bushings with ground wire connections between the bushing and the ground bus at all metal conduit terminations that enter or leave the Mini-Power Distribution Center.
5. Verify all future/spare circuit breakers shown on drawings are provided as indicated
6. Install surge arrestors per requirements in Section 16671 on panelboard of mini-power center in conformance with manufacturer’s requirements.

3.03 TESTING

A. Check for damage and tight connections prior to energizing mini power centers.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

C. Phase loads shall be within 20% of each other. Rearrange circuits as required to maintain proper phase balance to meet this requirement.

END OF SECTION 16462

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is supply and installation of power and lighting panelboards to provide a complete and operational electrical system.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16111 - Conduit and Raceway
C. Section 16120 - Building Wire and Cable
D. Section 16170 - Grounding and Bonding
E. Section 16190 - Supporting Devices
F. Section 16195 - Electrical Identification
G. Section 16671 - Surge Protective Devices

1.03 QUALITY ASSURANCE

A. Panelboards shall be manufactured and supplied by a company regularly engaged in business of furnishing panelboards. If required by Owner's representative, manufacturer shall submit a certification to a minimum experience of five years in manufacture of panelboards.

1.04 REFERENCE TO STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

B. U.L. Standard 489 - Molded Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

C. U.L. Standard 67 - Panelboards

D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

E. NFPA 70 - National Electrical Code

F. NECA (National Electrical Contractors Association) "Standard of Installation"

G. NEMA AB 1 - Molded Case Circuit Breakers

H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies

I. NEMA KS 1 - Enclosed Switches

J. NEMA PB 1 – Panelboards

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submittals shall include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes. Submittals shall also include manufacturer's installation instructions; indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting the product.

1.06 DEVLIVERY, STORAGE AND HANDLING

A. Panelboards shall be stored indoors from time of delivery to jobsite, protected from weather and damage.

1.07 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cutler-Hammer/Westinghouse
B. Square D
C. General Electric
D. Siemens
E. Equivalent

2.02 EQUIPMENT

A. Panelboard shall be provided with bolt-on circuit breakers of size and rating as detailed in panel schedule on plans. Breakers shall be 1, 2 or 3-pole with an integral crossbar to assure simultaneous opening of all poles in multipole circuit breakers. Breakers shall have an overcenter, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have "ON", "OFF" and "TRIPPED" positions. Circuit breakers shall be UL listed in accordance with UL Standard 489.

B. Panelboards bus structure and main lugs or main circuit breakers shall have current ratings as shown on panelboard schedule. Bus material shall be copper with either silver or tin plating. Bus ratings shall be in accordance with UL Standard 67. Bus bar connections to branch circuit breakers shall be the "distributed phase" or phase sequence type.

C. Panelboard bus assembly shall be enclosed in a steel cabinet rated NEMA 1 (unless otherwise noted on the drawings). Box front shall include a door and have a flush, cylinder tumbler-type lock and catch and spring-loaded stainless steel door pull. Door shall have completely concealed hinges when closed and shall not be removable when locked. A circuit directory frame and card with a clear plastic cover shall be provided on door interior.

D. Panelboards shall be nominal 20” in width unless otherwise noted.

E. Panelboards rated 240 VAC or less shall have short-circuit ratings as shown on the drawings, or as herein scheduled, but not less than an integrated equipment rating of 10,000 amps RMS symmetrical. All units shall bear UL label.

F. Panelboards rated 480 VAC shall have short-circuit ratings as shown on the drawings, or as herein scheduled, but not less than an integrated equipment rating of 65,000 amps RMS symmetrical. All units shall bear UL label.

G. Except where noted otherwise on the drawings, all panelboards shall have neutral bar and ground bar bonded together. Where neutral bar and ground bar are noted to be isolated, the contractor shall verify during wiring installation that neutral and ground conductors are terminated on the correct bar.

H. Where schedule on drawings indicates “SPARE”, a complete circuit breaker of the ampacity and number of poles indicated is to be provided. Where schedule on drawings does not indicate a specific size circuit breaker provide a 20 AMP single pole circuit breaker for each of the remaining unused poles. Therefore, panelboard shall be filled with feeder circuit breakers.

I. All circuit breakers feeding HVAC equipment shall be HACR rated.

J. Multi-pole circuit breakers with removable tie-links are not acceptable.

K. Tandem circuit breakers (two circuit breakers on single pole frame) are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards where shown on the plans, in accordance with manufacturer’s directions and in accordance with NEMA PB1.1. Install panelboards plumb. Provide filler plates for unused spaces in panelboards. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes as required.

B. Provide legend plates for all panelboards to identify panelboard as well as voltage, phase and number of wires (example”LP-1, 208Y/120 VAC, 3 PHASE, 4 WIRE”). Legend plates shall comply with Section 16195 - Electrical Identification.

C. Panelboard Surge Protective Device shall be installed in compliance with Section 16671.

3.02 TESTING

A. Panelboards and load centers shall be thoroughly tested after installation and connection to respective loads. Lighting panelboard phases shall be measured with all major items operating. Phase loads shall be within 20 percent of each other. Rearrange circuits if required maintaining proper phasing for multi-wire branch circuits.

B. Test for shorts and high resistance grounds. Check for faulty operation of circuit breakers and correct as needed.

END OF SECTION 16470

PART 1 GENERAL

1.01 WORK INCLUDES

A. Fractional Horsepower Manual Starter: Enclosed manually operated full voltage non-reversing switch equipped with thermal overloads and rated for operation of AC motors of 1.0 HP or less and 600 volts maximum.

B. Magnetic Starter: Enclosed electrically operated full voltage non-reversing contactor equipped with a holding coil and thermal overloads and rated for operation of AC motors in accordance with NEMA Standards for horsepower and voltage utilized.

C. Combination Motor Circuit Protector Magnetic Starter: Enclosed electrically operated full voltage non-reversing contactor equipped with a holding coil, thermal overloads, externally operable integral horsepower rated adjustable magnetic only trip circuit protectors, and rated for operation of AC motors in accordance with NEMA Standards for horsepower and voltage utilized.

D. Solid-State Reduced Voltage Motor Starters: Enclosed electrically operated Solid-State adjustable "Soft Start" starter with run-rated bypass contactor, thermal overloads, externally operable integral horsepower rated adjustable magnetic only trip circuit protectors, and rated for operation of AC motors in accordance with NEMA Standards for horsepower and voltage utilized.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements.
B. Section 16160 - Cabinets and Enclosures.
C. Section 16170 - Grounding and Bonding.
D. Section 16190 - Supporting Devices.
E. Section 16195 - Electrical Identification

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code.

B. NECA - National Electrical Contractors Association.

C. NEMA AB 1 - Molded Case Circuit Breakers.

D. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.

E. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.04 DELIVERY, STORAGE AND HANDLING

A. Motor starters shall be stored in containers as delivered to jobsite, in a clean and dry location, protected from construction.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide catalog data showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions and enclosure details.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.06 QUALIFICATIONS

A. Motor starters shall be furnished by a manufacturer regularly engaged in construction of motor starters, with at least five years' experience in furnishing motor starters.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with NECA Standard of Installation.

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 COORDINATION (RESERVED)

1.10 MAINTENANCE SERVICE (WARARNTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Enclosed fractional horsepower motor starters, Type F, shall be as manufactured by:

1. Square D series 2510/2512
2. Cutler Hammer series 9101
3. Allen Bradley bulletin 600
4. GE series CR101H/Y

B. Enclosed Magnetic Starters shall be as manufactured by:

1. Square D series 8536
2. Cutler Hammer series A10
3. Allen Bradley bulletin 509

C. Enclosed Full Voltage Combination magnetic motor starters shall be motor circuit protector type as manufactured by:

1. Cutler-Hammer/Westinghouse AN16 Freedom Series
2. Square D Class 8539 Series
3. Allen-Bradley 509 Series

D. Enclosed Solid-State Reduced Voltage motor starters shall be motor circuit protector type as manufactured by:

1. Cutler-Hammer: S801 Series
2. Square D: Altivar 48
3. Allen-Bradley: SMC

2.02 EQUIPMENT SPECIFICATION

A. Fractional HP Motor Starters

1. Quick make and break toggle action with double break silver alloy contacts.
2. Shall be inoperative unless one-piece, interchangeable, melting alloy thermal unit is in position, shall have trip-free mechanism.
3. Shall include red pilot light.
4. Enclosures shall be NEMA 1 or standard gang box and suitable switchplate covers for general purpose indoor applications, flush mounted in finished indoor areas, NEMA 4 for exterior applications or where otherwise noted on the plans, and NEMA 7-9 for Class I Group B. C. & D. and Class I Groups E, F, & G areas.

B. Magnetic Starter

1. Straight-through wiring, double-break silver alloy contacts through size 6, electrically operated coil, interchangeable melting alloy thermal units, one for each phase conductor.
2. Shall be inoperative if any thermal unit is removed.
3. Shall include fused control circuit transformer of sufficient VA capacity to power all control circuit elements fed from the control circuit transformer plus 50 VA minimum spare capacity.
4. Control circuit transformer secondary voltage shall be 120 volts unless otherwise listed on drawings.
5. Have provisions for four additional electrical interlocks in addition to holding circuit interlock. A minimum of 1 N.O. additional interlock is required on all starters.
6. Hand-Off-Auto selector switches, and pilot lights shall be provided. All Control Operators shall be NEMA 4X “full size” 30 mm type.
7. Enclosures shall be NEMA 1 for general purpose indoor applications, NEMA 4 for exterior applications or where otherwise noted on the plans, NEMA 4X for corrosive areas or where otherwise noted on the plans, and

NEMA 7-9 for Class I Group B. C. & D. and Class I Groups E, F, & G areas.

8. Entire unit shall be UL Labeled.

C. Full Voltage Combination Motor Starters

1. Enclosed magnetic motor starters shall be NEMA Rated, sized as indicated on the drawings and be furnished with 120 VAC coils and enclosures as specified herein and indicated on the drawings. Furnish suitably sized control power transformer with primary and secondary fusing, 120 VAC secondary windings and grounded neutral (X2). Pilot relays, control operators and pilot lights shall be furnished as indicated on the control schematics with all pilot lights being transformer push-to-test type. All Control Operators shall be NEMA 4X "full size" 30 mm type. All overload elements shall be 3 phase, ambient compensated, NEMA Class 20 devices except submersible pump applications which shall utilize NEMA Class 10 overloads. All overload blocks shall be provided with external reset button on starter door. Provide overload blocks with individual normally closed (N.C.) and isolated normally open (N.O.) alarm contacts. For future use, provide one spare normally open (N.O.) and one spare normally closed (N.C.) contacts in addition to all contacts noted on schematics shown on project drawings. Combination motor starters shall be motor circuit protector type (MCP), utilizing adjustable magnetic only trip circuit protectors. Provide running time meters for all pump motors utilizing 5 digits plus tenths hours (99,999.9 hours). Motor starters shall be integral NEMA sizes shown on the drawings. IEC or horsepower rated devices are NOT acceptable and will be rejected.
2. Enclosures shall be NEMA 1 for general purpose indoor applications, NEMA 4 for exterior applications or where otherwise noted on the plans, NEMA 4X for corrosive areas or where otherwise noted on the plans, and NEMA 7-9 for Class I Group B. C. & D. and Class I Groups E, F, & G areas.

D. Solid-State Reduced-Voltage (SSRV)

1. Starters shall be combination motor circuit protector type, utilizing adjustable magnetic only trip motor circuit protectors, control power supply, and all control operators as detailed in schematics. SSRV frame size shall be based upon 1.15 Service Factor, and applied motor nameplate FLA and RPM, NOT manufacturers' standard HP tables. SSRV starters shall include the following features as a minimum:

   a. "Severe-Duty" Rating
   b. Built-in 3-phase overload protection
   c. Adjustable ramp times (independent start and stop)
   d. Adjustable torque control
   e. Adjustable kick-start control
   f. Field Adjustable overload settings
   h. Run bypass contactor to shunt around SSRV power module during "run" operation.
   i. Kick-Start (Supply multiples of full load current for several seconds

in order to provide additional starting torque.)

j. Ramp Start (Provide a constant increase in torque to the motor)

k. Current Limit Start (Limit the maximum current available to the motor during the startup phase.)

l. Multiple trip class settings (minimum NEMA Class 10, 20 and 30). Unless otherwise specified, set for NEMA Class 20

m. Integral Over-temperature Protection

n. Protection against, Jam, Stall, Phase Loss, Phase Reversal and Shorted Power Device Detection

o. Minimum Ambient Operating Temperature Range Capability -30°C to +50°C.

p. As a minimum, “dry contacts” shall be provided at the SSRV Starters for the following outputs for use by others:
   - Starter selector switch in “Auto”
   - “Pump Running”
   - “Starter Fail”

   Any “interposing relays” in the starters which may be required to provide these “dry contacts” shall be provided.

2. Enclosures shall be NEMA 1 for general purpose indoor applications, NEMA 4 for exterior applications or where otherwise noted on the plans, NEMA 4X for corrosive areas or where otherwise noted on the plans, and NEMA 7-9 for Class I Group B. C. & D. and Class I Groups E, F, & G areas.

2.03 SUBMERSIBLE PUMP GROUND FAULT PROTECTION (WHERE REQUIRED)

A. Per Illinois Recommended Standards for Sewage Works “Illinois Environmental Protection Agency (IEPA) Title 35; Subtitle C, Chapter II; Part 370.430c3” all submersible pumps and power cables shall additionally be furnished with motor ground fault protection. Equipment shall consist of either motor starters with integral ground fault protection or a separate ground fault sensing relay and matching C.T. sensor. Should a separate ground fault sensor arrangement be utilized, the “zero-sequence” Current Transformer opening shall be suitably sized to permit installing all three motor conductors thru the C.T. window for “zero-sequence” type sensing. Unless otherwise specified on drawings, sensing C.T. shall be 100:5 CT combined with Crouzet-USA Current Sensing Relay Model DIRT-110A. Utilize medium sensitivity A.C. input (Terminal E2) on current sensing relay. Ground fault control output contact shall be interlocked with motor control circuit and shall stop and lock-out motor operation should a ground fault condition occur. Visual indication of “tripped” condition shall be provided by means of pilot light on control panel and require manual reset in order to restart motor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect motor starters for damage, rust or corrosion, broken or loose wiring. Motor starter operators shall operate smoothly without binding or sticking.

3.02 PREPARATION (RESERVED)

3.03 INSTALLATION

A. Install motor starters in accordance with manufacturer's instructions.

B. Install combination motor starters plumb. Provide supports in accordance with Section 16190. Top of motor starter enclosure shall be five feet (5'- 0") above finished grade or walkway or as detailed on drawings.

C. Select and install overload heater elements to match installed motor characteristics. Overloads shall be sized based on actual motor nameplate amperage draw, not NEC tables.

D. Provide nameplates under provisions of Section 16195.

E. Adjust MCP magnetic trip settings for each motor application per manufacturer’s recommendations.

F. At combination motor starters, provide neatly typed label inside the door of starter, identifying motor served, nameplate horsepower, nameplate full load amperes, code letter, service factor and voltage/phase rating.

G. Bond motor starters to ground with ground lug and ground wire.

3.04 TESTING

A. Inspect and test motor starters to NEMA ICS 2, as recommended by manufacturer and as specified herein.

END OF SECTION 16481

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is supply and installation of new motor control centers and related equipment as specified herein.

B. Unless specifically noted on project drawings, VFD's shall not be installed or furnished as part of Motor Control Centers. All VFD's shall be furnished as individual units as specified in Section 16483.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16170 - Grounding and Bonding
C. Section 16195 - Electrical Identification
D. Section 16671 - Surge Protective Devices (SPD)
E. Section 16496 - Enclosed Transfer Switch
F. Section 16950 - Testing Electrical Systems

1.03 REFERENCE TO STANDARDS

A. NEMA 1A (Enclosure)

B. U.L. 845 - Motor Control Centers

C. U.L. 869A - Reference Standard for Service Equipment (where applicable)

D. ANSI/NFPA 70 - National Electrical Code

E. ANSI C37.81 - IEEE Guide for Seismic Qualification of Class 1E Metal-Enclosed Power Switchgear Assemblies

1.04 DELIVERY, STORAGE AND HANDLING

A. Motor control centers shall be stored indoors from time of delivery to jobsite, protected from weather and construction. Contractor shall note that failure to comply with this requirement could be grounds for rejection of MCC as no longer suitable for use.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submittal shall include electrical ratings, motor control center layout, components, wiring diagrams and schematics, shipping splits, legend plates, U.L. listing and shipping weights.

C. Submittal shall include list of legends for all MCC compartment legend plates.

1.06 QUALIFICATIONS

A. Motor control center shall be manufactured and supplied by a company regularly engaged in business of furnishing motor control centers. If required by Owner's representative, manufacturer shall submit a certification to a minimum experience of ten years in manufacture of motor control centers.

1.07 QUALITY ASSURANCE (RESERVED)

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 MANUFACATURERS

A. Proposed motor control centers shall be:

1. Cutler-Hammer/Westinghouse
2. Allen-Bradley
3. Square D
4. Approved equivalent

Note that layout dimensions have generally been performed utilizing Cutler-Hammer/Westinghouse Series equipment.

2.02 MCC GENERAL STANDARDS

A. These general specifications apply to all motor control centers to be installed on this project:

1. Proposed motor control center (MCC) equipment shall be suitable for operation at:
   480 Volts
   3 Phase
   600 Amps
   Parallel 350KCMIL Wire
   No Neutral
   65 kA Equipment Short Circuit Rating Amps RMS Sym.
2. Incoming feeder cable size and quantity shall be as shown on drawings. Ground bus shall be provided for connection to incoming equipment grounding conductor.

3. MCC shall consist of independent vertical sections, free standing on 3” or 4" field-removable channel sills with sections bolted together to make up motor control center. Unless otherwise noted on project drawings, nominal dimensions shall be approximately 90" x 20" x 20" per section (HxWxD). Contractor shall be responsible for coordination with manufacturer for maximum shipping split dimensions in order to coordinate with building construction and other trades.
4. MCC shall be "front mount" only design unless otherwise shown on project drawings.
5. Pan type doors shall be used for all units and future spaces. Doors shall be hinged to structure with a concealed hinge. All door openings shall be gasketed.
6. All MCC bucket doors shall be held by quarter turn latches requiring only a screwdriver for operation.
7. Where applicable, the top of each section shall have removable plates for access to horizontal feeder bus.
8. A minimum of 12 gauge steel shall be used throughout structure, except that door, side and top sheets may be minimum of 14 gauge steel.
9. All enclosure parts shall be thoroughly cleaned and given a phosphatizing treatment to inhibit rust and to prime the metal for the finish coating. A minimum 2-mil thick electrostatic powder paint coat shall be applied to all surfaces. The paint type and process shall meet UL1332 for electrical equipment steel enclosures. No field painting will be required except for "touching up" of damaged areas as a result of shipping and installation.
10. All bus shall be silver or tin plated copper (minimum 65°C rise in 40°C ambient) with ampacity as noted on drawings. Provisions shall be made for addition and connection to adjacent / future sections.
11. Each section shall contain three vertical copper bus bars running full working height of section and connected to horizontal feeder bus bars. Vertical bus shall be 300 Amp rated unless otherwise noted or as required by devices detailed in that section. Adjust as required and identify on shop drawing submittals. Bus supports shall be formed of high dielectric strength, low moisture absorbing, high impact material with ample creepage distance between bus bars.
12. In either engaged or starter removed positions, latching mechanisms on unit must be capable of being padlocked to prevent unauthorized operation of unit.
13. Individual MCC buckets shall have complete steel top and bottom plates to provide maximum isolation between units.
14. Vertical bus isolation shall be provided utilizing shutter-type mechanism. The shutter shall automatically move to cover the stab openings when a unit is removed. As a unit is reinserted into a compartment, the shutter shall move sideways to uncover the stab opening in the vertical bus barrier.
15. Provide vertical bus fish-tape barrier at the bottom of each vertical section to prevent inadvertent contact of fish-tape with vertical bus during installation and maintenance.
16. Units shall be of modular dimensions so that it is possible to readily interchange units of same size without modifications to structure.

17. Control Operators (Indicating lights, pushbuttons and selector switches) for motor starters shall be unit mounted and shall be full size (30mm) NEMA Type 4X. All pilot lights shall be LED type.
18. Unless otherwise noted, enclosure rating shall be NEMA-1G (formerly called NEMA-1A designating NEMA 1 with gasketed doors). Bottom plates are not required.
19. Interior wiring shall be NEMA Class 1 Type B wiring. Provide pull-apart terminal blocks on all control wiring field terminations.
20. Vertical wireway shall run the full working height of each section. This vertical wiring trough shall be designed as to allow installation of wiring to units with unit doors open but with units in place.
21. As a minimum requirement, each motor starter unit shall have one spare N.O. and one spare N.C. starter auxiliary contact in addition to contacts shown in schematics or specified elsewhere or required for starter operation and control.
22. Motor starter thermal overloads shall be sized based on actual supplied motor FLA. <u>NEC Table 430-150 shall NOT be utilized for selection of thermal overloads.</u>
23. Provide individual strip heater for each MCC section and a control thermostat for each shipping split. Power wiring shall terminate at separate terminal strip for independent power. Terminal strip shall be labeled and located in wireway and reasonably accessible with MCC in as-shipped condition. Prior to energization, whenever MCC is to be stored in an ambient temperature below 65°F. strip heaters shall be field wired to a 120 VAC power source to prevent condensate formation in MCC interior. <u>Contractor shall note that failure to comply with this requirement could be grounds for rejection of MCC as no longer suitable for use.</u>
24. Motor control center shall be completely factory wired as detailed on drawings. Buses shall be braced for fault current specified in paragraph 2.02A1. Provide horizontal ground bus with minimum of 50% capacity of main horizontal bus.
25. Seismic Rating:

    a. All Motor Control Centers shall be manufactured for Seismic Level Zone 4 requirements.
    b. Seismic Installations shall be required only where specifically noted on project drawings

26. Nameplates and legend plates shall comply with Section 16195 - Electrical Identification.

2.03 MOTOR CONTROL CENTER SPECIFIC SPECIFICATIONS

A. MCC Main Circuit Breaker

1. None.

B. Current Transformers:
ANSI C57.13; CT Ratios shall have primary ratio equal to main bus rating. C.T. secondary shall be 5 Amp and be provided with secondary winding shorting

device. Accuracy and burden capability shall be consistent with connected metering and relaying devices

C. Digital/Graphical Metering Equipment: Digital door mounted.

1. Cutler-Hammer PXM 2290 or equivalent with the following features as a minimum:

   a. RMS Phase-to-Phase and Phase-to-Neutral Voltages
   b. Phase, Neutral and Ground Currents
   c. Power: Real, Reactive and Apparent (system and per phase)
   d. Frequency
   e. Power Factor
   f. Energy and Demand
   g. Individual current and voltage harmonics (thru 50th) : magnitude and phase angle
   h. Percent THD: current and voltage
   i. Sub-cycle transient capture: Waveform Capture
   j. Minimum and Maximum Values
   k. Event Logging/Disturbance Recording

2. Provide 10-Base-T Ethernet network interface module for each digital door-mounded display. Ethernet interface shall utilize standard RJ-45 jack. Ethernet interface shall be Cutler-Hammer EPONI, or equivalent.
3. Provide one (1) Windows-based software package capable of displaying and monitoring all digital door-mounted metering units on the main facility computer over the Ethernet network backbone. Software shall display the same parameters available on the face-plate of the field units. Software shall monitor only, control functions are not required. Software shall be Cutler-Hammer PowerNet PNED20N, or equivalent. Software license and all documentation shall be recorded in the name of the Owner.

D. Surge Protective Devices (SPD)

Surge protection shall be as detailed on drawings and as specified in Section 16671, or equivalent. Include breaker or fusing as required by U.L. listing.

E. Motor Starters (FVNR)

Starters shall be combination motor circuit protector breaker type, utilizing adjustable magnetic only trip motor circuit protectors, Full Voltage Non-Reversing (FVNR) unless detailed otherwise on project drawings. Include the following additional features on each unit.

1. Control power transformer (CPT) with 120 Volt secondary. Furnish two (2) NEC-sized fuses on CPT primary and one (1) fuse on CPT secondary in “X1” leg. Ground each CPT “X2” winding within each transformer bucket.
2. Wire color for all power wiring within each bucket shall be black, all 120 Volt control wiring shall be red and all neutral conductors shall be white.

Provide wire number labels matching shop-drawing wiring schematics on each starter.

3. Motor Starter overloads shall be three-phase, ambient-compensated type, NEMA Class 20 trip curve unless otherwise specified.
4. Isolated normally closed (N.O.) “bell alarm” contacts on overload block.
5. Thru-Door overload RESET pushbutton
6. One spare, normally open (N.O.) and one normally closed (NC) spare auxiliary contacts, wired to starter unit terminal blocks. Note that these are spare unused units and are in addition to all contacts required on project schematics or control function.
7. All pilot lights to be Push-to-Test transformer type. LED type lamps are preferred. Units shall be “full-size” (nominal 30.5 mm) NEMA 4X construction.
8. All pushbutton and selector switches shall be “full-size” (nominal 30.5 mm) NEMA 4X construction.
9. Non-reset type running time meters (10,000 hours w/tenths) for each starter, mounted in bucket door.
10. Motor starters shall be NEMA size shown on drawings. IEC rated or horsepower rated devices are NOT acceptable.
11. Where required or shown on project schematics, control relays shall be plug-in “ice-cube” type, having 10-Amp 3-Pole Form-C (DPDT) contacts and matching 11-pin plug-in socket. Each relay shall be furnished with factory-wired internal pilot light or lamp across coil to visually indicate energized condition. Coil operating voltage shall be 120 VAC unless specified otherwise. Control relays shall be similar to Potter & Brumfield KRPA-14AN-120VAC.
12. Control and timing relays as indicated in the schematics on the drawings shall be installed in respective starter bucket and additional bucket space shall be provided as necessary to install these devices.
13. Individual combination starters shall be rated for system fault current specified in paragraph 16482-2.02A1.

F. Per Illinois EPA “Recommended Standards for Sewage Works” (Title 35, Subtitle C, Chapter II, Part 370.430c3), all motor controls utilized for submersible pump applications shall be furnished with motor ground fault protection. This may be provided by means of motor starters with integral ground fault protection (such as Cutler-Hammer Advantage series) or separate fully-programmable electronic overload relay, SymCom Model 777, or functional equivalent. Ground fault sensing shall be interlocked with motor control circuit. Sensor shall stop and lock-out motor operation should a ground fault condition occur. Visual indication of “tripped” condition shall be provided by means of either a pilot light or handle position and require manual reset in order to restart motor.

G. Feeder Circuit Breakers

Feeder circuit breakers shall be molded case thermal-magnetic type, 3-pole unless otherwise specified, with minimum of fault rating as specified in paragraph 2.02A1. Trip ratings shall be as indicated on project drawings.

PART 3 EXECUTION

3.01 INSPECTION

A. Motor control center shall be thoroughly inspected upon delivery to jobsite. Exterior finish shall be inspected for blemishes, nicks and bare spots and touched up as required using touch-up paint provided. Sections shall be examined for plumbness and misalignment. All doors and operators shall be checked for smooth operation and proper fit and finish. Draw-out compartments shall also be checked for smooth operation and alignment of bus bars with compartment stabs. Bolted connections shall be checked for tightness. Internal wiring shall be examined for proper connection and routing. All internal wiring shall be neatly trained and tie-wrapped.

3.02 INSTALLATION

A. Motor control center shall be installed on 4" housekeeping pad unless otherwise directed. Housekeeping pad shall extend 2" beyond front and sides of MCC and edges shall be chamfered. Shipping splits shall be bolted together and busbars torqued per manufacturer's instructions.

B. Field wiring shall be labeled, neatly trained and tie-wrapped and attached to terminals, lugs, starters and circuit breakers.

C. Where applicable, motor control center shall be mated to automatic transfer switch. MCC manufacturer shall coordinate this connection with transfer switch manufacturer.

D. All metal conduit terminations in motor control centers that are not electrically continuous with the MCC housing shall have grounding bushings with ground wire connections to bond the respective conduits to ground.

E. Adjust MCP magnetic trip settings for each motor application per manufacturer’s recommendations.

3.03 TESTING

A. Motor control center shall be thoroughly tested after installation and connection to field equipment. All operations shall be tested, either in actual use or by simulation (i.e., alarm conditions). Motor full load amps shall be measured on each phase conductor at respective starter. Horizontal bus bar connections and connections of cables to circuit breakers and starters shall be checked for excessive heat under full load using an infra-red type heat gun. All tests shall be recorded in presence of Owner’s representative.

B. Comply with all applicable items in Section 16950 - Testing Electrical Systems.

END OF SECTION 16482

PART 1 GENERAL

1.01 WORK INCLUDES

A. The work in this section is the supply and installation of variable frequency drives (VFD's) to provide a complete and operational electrical system.

B. The VFD table furnished herein shall be considered as a guideline only. All VFD's shall be fully compatible with specific driven equipment at all operating conditions. Contractor shall be solely responsible to coordinate the proposed VFD chassis rating with the driven equipment Horsepower, Service Factor, RPM, operating voltage and full load amps.

C. Unless specifically noted on project drawings, VFD's shall not be installed within Motor Control Centers (MCC's). VFD's shall be furnished and installed as individual units, either wall-mount or floor-mount depending upon chassis size and installed separate from Motor Control Centers.

D. All VFD's that are not furnished as an integral part of a pre-wired factory-assembled control panel shall be from a single manufacturer throughout this project.

E. The following equipment shall require VFD's under this specification section.

Equipment Name	Qty.	HP	Input Volts / Phase – Output Volts / Phase	Conduit Entry Line/Load	VFD Encl. NEMA Rating	Main Disc. & Fusing Req'd Y/N	Bypass Req'd Y/N
Blower No. 1	1	75	480/3-480/3		1	Y	N
Blower No. 2	1	75	480/3-490/3		1	Y	N

1.02 RELATED SECTIONS

A. Section 16010 – General Electrical Requirements.
B. Section 16111 – Conduit and Raceway.
C. Section 16123 – Building Wire and Cable.
D. Section 16170 – Grounding and Bonding.
E. Section 16190 – Supporting Devices.
F. Section 16195 – Electrical Identification.
G. Section 16671 – Surge Protective Devices.
H. Section 16902 – Electric Controls and Relays.
I. Section 16950 – Testing Electrical Systems.

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code.

B. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA ICS 3.303 - General Purpose Inverters.

E. IEC 146A - Semiconductor Converters.

F. IEEE Std 444 (ANSI C34.8) - Thyristor Converters.

G. IEEE Std 519 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters

1.04 DELIVERY, STORAGE AND HANDLING

A. Variable frequency drives shall be stored indoors from time of delivery to jobsite, protected from weather and construction. The contractor shall note that failure to comply with this requirement could be grounds for rejection of the variable frequency drive as no longer suitable for use.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.05 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures.

B. Submittals will be required on all VFD equipment

C. The manufacturer shall submit storage and installation instructions detailing how equipment is to be stored and installed and connected to source power and necessary control wiring and pump wiring.

D. If applicable, supplemental distortion analysis as specified in 16483 Article 2.01B.

E. Motors applied to VFD's 25 HP and greater will have supplemental Normally-Closed (N.C.) stator thermal switches. In order to assist Contractor in field wiring, clearly indicate proper VFD terminal numbers where stator thermal switches are to be connected on shop drawings.

F. Line and Load Lug capacity (in AWG, not mm2) and the number of cables per phase for each VFD.

1.06 QUALIFICATIONS

A. The variable frequency drives shall be manufactured and supplied by companies regularly engaged in the business of furnishing variable frequency drives. If required, the manufacturers shall submit certification to a minimum experience of ten (10) years in the manufacture of respective variable frequency drives.

B. The drives shall be manufactured in the United States.

C. Manufacturer shall have factory authorized service facility within 200 miles of the project site.

D. The drives shall be U.L. Listed.

1.07 QUALITY ASSURANCE (RESERVED)

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 COORDINATION

A. The motor horsepower and VFD sizes shown on the project drawings shall be used as guidelines only. Variations in the mechanical equipment proposed by the Contractor may require adjustments in VFD capacity from that shown on the project drawings or specified herein. (Example: Motors with operating speeds below 1200 RPM typically have increased full-load current and decreased operating Power-Factor. Use of these motors often requires the use of a larger VFD to adequately handle the increased operating current.) Any and all such adjustments to VFD ratings shall be considered incidental to this item and included in the base-bid cost. No additional compensation for this requirement will be considered. No part of this requirement relieves or modifies other features as specified herein.

1.10 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS)

A. One box (minimum 5) each type of field-replaceable fuse utilized within VFD and furnished equipment, including power fast-acting fuses on VFD's specified with line-side fuses in Table 1.01E.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Design Documents have been based on:

1. ABB; ACS-800

B. Other acceptable base-bid manufacturers:

1. Allen-Bradley; 1336 Plus II or PowerFlex
2. Cutler-Hammer; SV-9000
3. Square D: Altivar 71
4. Toshiba: G-9

C. Alternates

1. None

2.02 EQUIPMENT SPECIFICATION

A. Drives shall be Pulse Width Modulated (PWM) type, to convert 480 volt, 3 phase, 60 hertz, 3 wire input power into a variable voltage and frequency (0-60 Hz nominal) output.

B. All VFD's shall be capable of operating the specified load in either Constant Torque (CT) or Variable Torque (VT) modes of operation. Drives limited only to variable torque loads will be rejected.

C. All VFD's shall include the capability for either Vector Mode (Sensorless or Open-Loop) or Scalar (Volts/Hz) Modes of operation.

D. Drives shall be heavy-duty rated and capable of 150% overload for one-minute in specified ambient temperature.

E. The VFD's are to be fully microprocessor based utilizing Insulated Gate Bipolar Transistor (IGBT) power devices. Input power factor shall be 0.95 or higher. Unless otherwise specified, VFD's shall be 6-Pulse rectifier design.

F. All VFD's shall include either D.C. Bus Chokes or 3-phase A.C Input Line Reactors. Where such units are external to VFD enclosure, Contractor shall coordinate adequate mounting space, rigid mounting, and all interconnecting cable and conduit. All applications with external D.C. Bus Chokes or Input Line Reactors shall be clearly indicated on shop drawing submittals. All external D.C. Bus Chokes or Input Line Reactors shall be provided in ventilated NEMA 1 enclosures suitable for wall mounting. Units shall be self-cooled without the use of additional fans or blowers and shall be U.L. listed.

G. VFD's shall be suitable for use with NEMA Design B, 460V, 3-phase squirrel cage induction motors regardless of manufacturer. Note: Motors requirements are located in Specifications in Section 16220. New motors driven by VFD's are specified to comply with NEMA MG-1 Part 31 requirements.

H. Additional harmonic mitigation shall be furnished where compliance with IEEE-519 is noted in Part 1 of this Section. Where required, harmonic mitigation shall comply with Specifications Section 16484, or a similar unit determined to be fully compatible by VFD manufacturer. For purposes of this project, the Point of Common Coupling (PCC) shall be the Secondary Lugs of the utility Service Entrance Transformer. VFD's with integral harmonic-mitigation hardware will be considered as meeting this requirement providing manufacturer furnishes adequate information for evaluation and Certifies that equipment will meet all IEEE-519 requirements.

I. VFD Low-Pass Output Filters shall be furnished where cable and conduit distances between the VFD and driven motor exceed 100 feet. VFD Low-Pass Output Filters shall be as specified in Section 16486, or equivalent.

J. VFD's shall be factory rated for installation in enclosures with NEMA ratings as noted in table above without overheating in project environment. Enclosures shall be sized to provide for proper clearances as required by VFD manufacturer, including all accessories and components necessary for a complete and operational VFD as specified herein.

K. The VFD's shall be designed to operate under the following conditions:

1. Indoor Location
2. Ambient Temperature Range …….0 to 40°C (not frozen)
3. Storage Temperature Range …….20 to 60°C
4. Relative Humidity……..0 to 90% non-condensing
5. Vibration……..0.5G max at 20 to 50 Hz
6. Altitude……Up to 3300 ft. without de-rating
7. Voltage tolerance……..+/- 10%
8. Frequency tolerance……+/- 5%

L. The VFD's shall have the following protective functions as a minimum:

1. Motor Overload Protection……....Electronic thermal overload relay plus provisions for connection of motor winding thermostats
2. Overload……100% continuous
   150% for 1 minute (heavy-duty rated)
   200% instantaneous
3. Overvoltage……...Drive shut down if output over-voltage is detected
4. Heatsink Protection……..Thermostat
5. Stall Prevention……...Stall prevention at acceleration, deceleration, and constant speed operation
6. Phase Fault……...Drive shut down if phase-to phase or phase-to-ground fault is detected

M. The VFD's shall be designed to start into a spinning motor without failure or damage. The VFD's shall be able to determine the motor speed in any direction and resume operation without tripping.

N. Adjacent to each VFD, provide a 2-hole, 30.5 mm, NEMA 4X pushbutton station for use with each VFD. Pushbutton station shall house a 3-position Hand-Off-Auto selector switch and local manual speed potentiometer. Both control operators shall be NEMA 4X rated. Coordinate proper speed potentiometer resistance with VFD manufacturer. Speed potentiometer shall manually control VFD speed while in the “Hand” mode. The Hand-Off-Auto Selector switch shall include an additional set of dry contacts that close only in the “Auto” position (OOX) for remote monitoring or PLC use. These operators may be VFD door mounted as an alternate to this requirement provided this is a factory-installed option and enclosures are not field-cut during installation. VFD “programmable” output relays may be substituted to meet this requirement, if the relay contact is closed only when the VFD is in “Auto” mode.

O. Each VFD shall include a local front mounted operator station or digital display with output frequency meter.

P. It shall be possible to remotely control the VFD by means of a 4-20 madc process follower input while in the “Auto” mode. In the event the process signal input is lost, the drive shall go to a field adjustable pre-set speed and close a “process signal-lost” dry-contact alarm.

Q. VFD shall be furnished with 4-20 madc output signal proportional to VFD output frequency (speed), for remote monitoring and/or control.

R. Whether or not required for specific project, VFD shall have integral PI controller suitable for use with external 4-20 ma process signal input. PI parameter settings (Proportional/Gain, Integral/Reset) shall be field adjustable without the use of supplemental instruments or calibrators.

S. VFD shall be capable of programming a minimum of two frequency “jumps” for avoidance of resonant or critical frequency points in driven mechanical equipment.

T. VFD shall be capable of motor speed up to 200% of motor base rating. Normal calibration range shall be set to 0-100% of driven motor nameplate RPM. Only where specifically specified to operate above base speed, the drive shall be set to operate in a constant voltage extended frequency mode.

U. PWM carrier frequency shall be either manually selectable or automatically adjusted by the drive in order to enhance performance.

V. Both upper and lower frequency (speed) settings shall be adjustable.

W. Acceleration and deceleration times shall be independently adjustable.

X. The drive shall have a “torque-boost” function for increased operating torque while operating motor at low RPM.

Y. The drive shall be able to start and stop from either a two-wire control (dry-contact), three wire momentary or maintained contact closure.

Z. The drive shall have adjustable volts/hertz calibration. VFD shall be capable of operating in either a linear volts/hertz (Constant-Torque) mode or a volts/hertz squared (Variable-Torque) mode. Initially configure all drives for linear volts/hertz (Constant-Torque) unless otherwise directed.

AA. The drive programming shall permit capability to auto-restart after momentary power loss, overvoltage, undervoltage. Restart from motor winding overtemp and overcurrent shall be manual (or field programmed to provide).

BB. All drive reversing programming functions shall be disabled unless otherwise specified.

CC. The VFD shall have a diagnostic readout to indicate the following faults as a minimum:

1. Overcurrent
2. Overload
3. Overvoltage
4. Undervoltage
5. Overtemperature

Where fault codes are not specifically identified in English on drive face, a plastic or laminated chart shall be provided for each drive. Chart shall be attached where clearly visible by maintenance personnel in order to assist in identifying the most common causes of drive tripping without referring to printed VFD instruction manual.

DD. Where indicated on the table in 16483-1.01E, VFD's shall be furnished complete with main fusible disconnect. Disconnect mechanisms utilizing molded-case switches are acceptable. Power fuses shall be <u>current-limiting, very fast-acting semi-conductor type</u>.

EE. Line and load cables indicated on the drawings have been initially selected by the engineer as typical for most equipment manufacturers. The Contractor and supplier shall verify that the cable sizes and quantities are compatible with the proposed VFD hardware. Data shall be furnished with VFD shop drawings clearly indicating the gauge of both line and load cables, as well as line and load lug capacity including the required number of cables per phase. Contractor shall adjust cable and conduit sizes for both line and load of VFD, in order to coordinate with the VFD equipment he is proposing. VFD manufacturer shall furnish all line and load lugs with VFD equipment.

FF. VFD's shall include all necessary options and additional control equipment as necessary to provide the VFD control, monitoring and alarm functions described herein.

GG. Where noted in table 16483-1.01E only, VFD bypass starter and overload block shall be furnished by the VFD equipment manufacturer for the purpose of allowing motor operation in a Full Voltage Non-Reversing (FVNR) mode should VFD fail or otherwise be non-operational. Note that since this bypass starter will be used to replace VFD operation, it must be Full Horsepower Rated, Not reduced capacity or bypass rated. Manufacturer shall furnish selector switch for bypass operation where this feature is required.

HH. VFD supplier shall be solely responsible for verification of proper operation of VFD's in the ambient temperature conditions specified and required by the VFD enclosure or housing. Any supplemental cooling equipment or measures required shall be furnished at no additional contract cost. Should VFD's be installed as a part of a control panel system, this requirement shall be verified by the control panel supplier for his equipment.

PART 3 EXECUTION

3.01 INSPECTION

A. Contractor shall inspect all VFD's for physical damage, corrosion and loose parts.

3.02 INSTALLATION

A. Installation of all equipment furnished under this section shall be installed in accordance with manufacturer's written instructions and NEMA ICS 3.1.

B. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

C. If line reactors are required they shall be wall mounted above respective VFD and connected to VFD's input power wiring.

D. Contractor shall coordinate any wiring and control functions to and from any remote control panels with control panels manufacturer to provide I/O and control functions necessary to provide a complete and operational electrical system. This work shall be considered incidental to the contract work.

3.03 MANUFACTURER'S SERVICE

A. Manufacturer's Field Service Technician: The Contractor shall include with his bid the special services of the equipment manufacturer's factory field service technician for a minimum period of two (2) trips and three (3) 8 hour days for the VFD's, travel time excluded. This service shall be for the purpose of equipment checkout, calibration and installation certification. A written report covering the technician's findings and installation certification shall be submitted to the Engineer for each trip covering all inspections and outlining in detail any deficiencies noted.

3.04 TESTING AND START-UP SERVICES

A. The VFD manufacturer shall provide on-site testing and start-up services for all VFD's. As a minimum the following services shall be provided:

1. Inspect and test the completed VFD installations.
2. Perform field adjustments to installed VFD's. Configure VFD's utilizing specific driven motor nameplate parameters, not "typical" NEC data.
3. Where applicable, VFD carrier frequency shall initially be set at the lowest standard setting, nominally 3kHz, unless otherwise directed by Engineer.

4. If required by mechanical field conditions, program appropriate “jump” frequencies to prevent equipment resonance during operation.
5. Test VFD's under load.
6. Provide systems demonstration, showing operation of controllers in automatic and manual modes.
7. Describe and list maintenance and troubleshooting of equipment.
8. Furnish seven (7) complete Operations and Maintenance Manuals, including complete schematics and interconnection drawings covering the equipment provided.

END OF SECTION 16483

PART 1 GENERAL

1.01 WORK INCLUDES

A. Supply and install the enclosed transfer switch to provide a complete and operational electrical system.

1.02 RELATED SECTIONS

A. Specified Elsewhere:

1. Section 16010 - General Electrical Requirements
2. Section 16111 - Conduit and Raceway
3. Section 16123 - Building Wire and Cable
4. Section 16170 - Grounding and Bonding
5. Section 16195 - Electrical Identification
6. Section 16421 - Service Entrance
7. Section 16620 - Packaged Engine Generator Systems
8. Section 16950 - Testing Electrical Systems

1.03 REFERENCE TO STANDARDS

A. UL 1008 - Transfer Switches

B. U.L. 869A - Reference Standard for Service Equipment (where applicable)

C. NFPA 70 - National Electrical Code.

D. NEMA ICS 1 - General Standards for Industrial Control and Systems.

E. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

F. NEMA ICS 6 - Enclosures for Industrial Control and Systems.

1.04 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 internal components, enclosure and finish.

1.05 SUBMITTALS

A. In accord with Section 01300 - Shop Drawings, Product Data & Samples.

B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.06 QUALIFICATIONS

A. The enclosed transfer switch shall be manufactured and supplied by a company regularly engaged in the business of furnishing enclosed transfer switches. If required by the Engineer, the manufacturer shall submit certification to a minimum experience of ten years in the manufacture of enclosed transfer switches.

1.07 GUARANTEE

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

A. Design Documents have been based on:

1. Eaton/Cutler-Hammer – ATVI

B. Other acceptable base-bid manufacturers

1. ASCO – Series 7000
2. General Electric / Zenith – Series ZTSD

C. Alternates

1. None

2.02 TRANSFER SWITCH SCHEDULE:

ATS-1						
Voltage	# Switched Poles	Solid Neutral Y / N	Open, Delayed or Closed Transition	Amps	Manual Bypass Req'd Y / N	Service Entrance Rated Y / N
480	3	Y	Delayed	1200	N	Y

2.03 CONSTRUCTION

A. Features

1. The automatic transfer switch shall be furnished with the necessary potential and frequency relays for sensing each phase of the commercial power source, control relays, time delays, contact to initiate engine starting and voltage and frequency relays for generator shall be provided and installed as shown on the plans.
2. The switch shall be rated as shown on the Transfer Switch Schedule for both normal and emergency sources. Frequency of operation shall be 60Hz. Insulation rating shall be 600 volts on all main contacts and current carrying parts. Where utilized, bus shall be silver or tin plated copper construction. The withstand capacity of the main contacts shall not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data.
3. Enclosure shall be NEMA 1 unless otherwise specified.
4. The current rating shall be a 24 hour continuous rating when the switch is enclosed in non-ventilated enclosure. The switch shall be unaffected by accumulative operations and shall conform to NEMA Temperature Rise Standards.
5. The current rating shall be suitable for all classes of loads, i.e. resistance, tungsten, ballast and inductive loads as defined by U.L.
6. The switch shall be certified to meet the latest adopted transfer switch standards as defined by U.L.
7. All pilot devices and relays shall be of the industrial type with self-cleaning contacts and rated 10 amperes.
8. The automatic transfer switch shall be arranged to close a pilot contact for remote starting of an engine-generator three seconds (adjustable) after loss of normal source or three seconds (adjustable) after a drop in voltage on any phase to 80 percent or less. The load circuits shall not be disconnected from the normal source during the three second time delay period. When the standby generator is delivering not less than 90 percent of rated voltage and 95 percent of rated frequency, the load circuits shall be transferred to the emergency power source.

9. Upon restoration of the normal source to not less than 90 percent of rated voltage on and 95 percent of rated frequency on all phases, the load shall be re-transferred to the normal source after a time delay of from 2 to 25 minutes (adjustable). After retransfer to the normal source, the engine shall run unloaded for a cool-down period of 15 minutes (adjustable) and then automatically shut down and be ready to start upon the next failure of the normal source. If the standby plant should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of the normal source.
10. The transfer switch shall consist of completely enclosed contact assemblies and a separate control logic panel. The contact assemblies shall be operated by a non-fused motor operator or stored energy mechanism and be energized only momentarily during transfer, providing inherently double throw switching action. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
11. Transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under all operating conditions. Main contacts shall be mechanically locked in position in both normal and emergency positions.
12. Where noted in the Transfer Switch Schedule, three-phase four-wire transfer switches shall be true four-pole switched neutral type with all four poles for each source being fully rated and connected to a common shaft. The fourth (neutral) pole contacts shall be of identical construction as, and operate simultaneously with, the main power contacts. Add-on or overlapping neutral contacts are not acceptable.
13. Inspection and replacement of all separate arcing contacts (moving and stationary) shall be possible from the front of the transfer switch.
14. An electronic sensing and control logic panel shall be separately mounted from the power switching portion of the transfer switch. The two sections shall be connected by control cables with plug-in connectors. The control section shall be capable of being disconnected from the power section for maintenance purposes.
15. The logic circuits shall utilize electronic components mounted on printed circuit boards to accomplish functions such as timing, time delays, and voltage and frequency monitoring. LED's shall be furnished to indicate the operation of each solid-state function. Modifications shall be available for field installation without voiding the UL label.
16. (Reserved)
17. Automatic Transfer Switch feature requirements shall include as a minimum:

    a. Time delay: Normal to emergency, adjustable.
    b. Time delay: emergency to normal, adjustable.
    c. Pilot light to indicate switch in normal position.
    d. Pilot light to indicate switch in emergency position.
    e. Pilot lights marked "Normal Source" and "Emergency Source" to indicate that respective source voltages are available.
    f. Relay auxiliary contacts (2 NO and 2 NC) to indicate transfer switch position and the availability of each source.
    g. Time delay engine start, adjustable.

h. Time delay engine cool off, adjustable.
i. Engine start (crank) contact.
j. Delayed transition time delay, adjustable, to allow disconnection of load during transfer in either direction to prevent inrush currents due to out-of-phase switching of large inductive loads.
k. As a minimum, field adjustable three-phase under-voltage and under-frequency sensing shall be provided on Normal Source. Field adjustable single-phase under-voltage and under-frequency sensing shall be provided on Emergency Source.
l. Three-position selector switch with the following functions: “Stop” / “Test (or Reset)” / “Automatic.”
m. Automatic plant exercise timer, selectable Load/No-Load.
n. Compression or Mechanical lugs shall be furnished by the switch manufacturer for termination of all Normal, Emergency and Load cables by the Contractor unless Enclosed Transfer Switch is hard-bussed to adjacent equipment. Contractor shall coordinate all lug capacity and quantity for phase conductors, neutral conductors and ground conductors as indicated on the project drawings. All two-hole lugs shall utilize standard NEMA hole spacing.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspection and operational tests shall be conducted in the presence of the Engineer, to indicate the switch satisfactorily meets all conditions required by the specifications.

B. Inspection of the automatic transfer switch may also be required by the serving utility. The Contractor shall arrange for this inspection if so required.

3.02 INSTALLATION

A. Provide housekeeping pad as detailed in plans and install transfer switches in accordance with manufacturer's instructions.

3.03 START-UP SERVICES

A. Transfer switch manufacturer shall provide testing and start-up services. As a minimum the following services shall be provided:

1. Inspect and test the completed transfer switch installation.
2. Perform field adjustments to installed transfer switch.
3. Test transfer switch under load.
4. Provide systems demonstration showing operation in automatic and manual modes.
5. Describe and list maintenance and troubleshooting methods and equipment.
6. Furnish complete Operations and Maintenance Manuals, including complete schematics and interconnection drawings covering the equipment provided.

3.04 TESTING

A. Comply with applicable items in Section 16950 – Testing Electrical Systems.

END OF SECTION 16496

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is interior lighting fixtures, lamps, accessories and installation and connection to wiring and ducts required for a complete and operational interior lighting system at facility.

B. This work shall also include lighting fixtures mounted to building exterior walls and structures, including lamps, accessories and installation and connection to wiring and ducts required for a complete and operational lighting system at facility.

C. This work shall also include pole mounted light fixtures, including, poles, concrete foundations (where required), including lamps, accessories and installation and connection to wiring and ducts required for a complete and operational lighting system at facility.

1.02 RELATED SECTIONS

A. Section 03200 - Concrete Reinforcement
B. Section 03300 - Cast-in-Place Concrete
C. Section 16010 - General Electrical Requirements.
D. Section 16111 - Conduit and Raceway
E. Section 16118 - Duct Bank
F. Section 16123 - Building Wire and Cable
G. Section 16130 - Boxes
H. Section 16170 - Grounding and Bonding

1.03 REFERENCE TO STANDARDS

A. NEC Article 410 - Light Fixtures, Lampholders, Lamps and Receptacles.

B. U.L. listing as "Suitable for Wet Locations".

C. Illuminating Engineering Society (IES) of North America.

1.04 DELIVERY, STORAGE AND HANDLING

A. All fixtures, ballasts and lamps shall be delivered in manufacturer's cartons and shall be stored inside, away from construction until just prior to installation. Under no circumstances shall they be stored outdoors or subject to weather.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300

B. Submittals will be required on all lighting fixtures, poles and accessories to be used at this facility.

1.06 QUALIFICATIONS

A. Manufacturer, catalog number, type, wattage, and lamp data for each fixture as listed in Light Fixture Schedule on drawings establish acceptable minimum standard of quality, type of construction, and size of respective item.

1.07 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION

A. Fluorescent Fixtures:

Fluorescent fixtures shall be as shown in Light Fixture Schedule on drawings, or equal. Light fixtures and lamps shall conform to latest Federal Agency Policy requirements for efficiency. Ballasts shall be NEC Class P with automatic resetting thermal protection adjacent to coil and non-resetting protection for capacitor. Ballasts shall be UL labeled, CBM certified by ETL, HPF, and shall have an "A" sound rating. Ballasts shall be Advance, General Electric, Jefferson, Universal, or equal. All fixtures shall be listed as suitable for use in wet areas, except for lay-in style for installation in drop ceiling grids.

All fluorescent fixtures shall be furnished with an integral power disconnecting means which complies with NEC Article 410.73(G). Disconnecting means shall be Thomas & Betts LD2 or LD3, or equivalent.

Sealed Fluorescent Fixtures specified with emergency battery packs for application in wet or damp locations listing shall utilize battery systems which do not void any certifications or listings on the equipment. All submittals on emergency fluorescent fixtures with wet or damp listings shall clearly indicate equipment remains sealed (not vented) and maintains UL approval and listing with battery packs installed.

B. Fluorescent Lamps:

All fluorescent lamps shall be furnished and installed by electrical contractor. Fluorescent lamps shall be as shown in Light Fixture Schedule on drawings.

C. H.I.D. Fixtures:

H.I.D. fixtures shall be as shown in Light Fixture Schedule on drawings, or equal. Ballasts shall have Class H insulation and shall be high power factor with minimum of 90% power factor for high pressure sodium or metal halide units. Capacitors shall be of non-PCB type. H.I.D. lamp socket shall be of mogul base type. Internal wiring shall be suitable for 150˚C minimum. All fixtures shall be listed as suitable for use in wet areas.

D. H.I.D. Lamps:

All H.I.D. lamps shall be furnished and installed by electrical contractor.

E. LED Fixtures:

Light Engine configurations shall consist of high-efficiency LED's mounted to metal-core circuit boards with a pf greater than 90% and THD less than 20%. Provide 6kV minimum surge protection.

F. Metal Poles:

Metal poles shall be furnished and installed by electrical contractor. Metal poles shall be as shown in Light Fixture Schedule on drawings, or equivalent. Contractor and supplier are responsible for compatibility between light fixtures and pole hardware. Where poles are to be installed on metal platforms, contractor shall provide suitable mounting plate to be used in anchoring poles. <u>All metal poles over 20 feet in overall length shall be furnished with factory installed vibration dampeners, whether or not specifically called out on the Fixture & Pole schedule on the drawings.</u> All metal poles 20 feet and longer installed without vibration dampeners will be replaced with the proper units at the Contractor's expense. Approved shop drawings shall be submitted detailing the proposed mounting methods and hardware. Contractor shall coordinate all such installation with the General Contractor and supplier of equipment or apparatus on which the pole is to be installed.

G. Unless otherwise noted on the drawings, furnish exterior wall mounted fixtures with individual integral photocell control.

H. Light fixtures noted to be "explosion-proof" shall be "Factory Sealed" and shall <u>not</u> require conduit seals within 18" of fixture.

I. Light fixtures shall include all mounting hardware and appurtenant materials and equipment as required to provide a complete and operational lighting system.

PART 3 EXECUTION

3.01 INSPECTION

A. All light fixtures, poles and hardware shall be inspected for physical damage and corrected as required prior to installation. Gasketing shall be inspected for proper fit and sealing. Any defective or broken lamps, poles and hardware shall be replaced at no cost to contract.

3.02 INSTALLATION

A. Light fixtures shall be installed at locations shown on drawings or as directed by Owner's representative. All fixtures shall be cleaned inside and out just prior to installation. All fixtures shall be located such that they may be easily maintained.

B. Install concrete foundations for light poles as detailed on the drawings and in conformance with Sections 03200 and 03300.

C. Where indicated, a smooth rubbed finish shall be applied to the exposed concrete foundation no later than the day after form removal. The wetted surface shall be rubbed with Carborundum brick or other abrasive until uniform color and texture are achieved. No grout is used, other than cement paste that is drawn from the concrete by the rubbing process.

D. Where indicated, the exposed concrete foundation shall be painted yellow with a minimum of two coats of yellow epoxy paint. Epoxy paint shall be two-component catalyzed or pre-catalyzed water-based paint, and shall be resistant to water, including salt water, most cleaners, mild acids, solvents, shop chemicals, and most fuels - including gasoline and diesel.

E. Per NEC 300.11(A)(2), when independent electrical equipment support wires are installed within dropped-ceiling areas, they shall be distinguished by color, tagging, or other permanent effective means.

3.03 TESTING

A. All luminaries shall be tested for proper operation after installation and defective equipment shall be replaced at no cost to contract.

END OF SECTION 16510

PART 1 GENERAL

1.01 WORK INCLUDES

A. Provide, install, and acceptance test a complete and operable electric generating system, including all devices and equipment specified herein, as shown on the drawings, or required for the service. Equipment shall be new, factory tested, and delivered ready for installation.

B. As a minimum, the work shall include the following:

1. Engine/Generator/Main Circuit Breaker/Controls
2. Fuel Tank/Containment Facilities
3. Exhaust Silencer and Exhaust Piping
4. Batteries/Battery Charger
5. Radiator and all cooling system components
6. Vibration Isolators
7. Remote NFPA 110 Alarm Module
8. Coordination, Start Up and Training

C. Note that the Automatic Transfer Switches are not part of the work under this item. If required they are specified under Section 16496 - Enclosed Transfer Switch.

D. In the State of Illinois, all engine-driven generator systems having rated engine power output of 1118 kW (1500 horsepower) or greater require the Owner to obtain an Air Permit per *Administrative Code Title 35, Subtitle B, Chapter I, Subchapter a, Part 201, Section 201.146*. As part of this Section, the equipment manufacturer or supplier shall prepare all necessary paperwork on the Owner's behalf, requiring only signature from the Owner. Costs for preparing permit applications shall be included with equipment and will be considered incidental to this Section. Revise accordingly for all Air Permits required in other States.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements
B. Section 16141 - Wiring Devices
C. Section 16170 - Grounding and Bonding
D. Section 16195 - Electrical Identification
E. Section 16496 - Enclosed Transfer Switch
F. Section 16671 - Electrical Surge protection Systems
G. Section 16950 - Testing Electrical Systems

1.03 QUALITY ASSURANCE

A. The packaged engine generator systems shall be manufactured and supplied by a company regularly engaged in the business of furnishing packaged engine generator systems. If required by the Engineer, the manufacturer shall submit a certification to a minimum experience of ten years in the manufacture of packaged engine generator systems.

1.04 REFERENCE STANDARDS

A. ANSI/NFPA 70 - National Electrical Code

B. NEMA MG1 - Motors and Generators

C. NFPA 30 - Flammable and Combustible Liquids Code

D. NFPA 31 - Installation of Oil-Burning Equipment

E. NFPA 37 - Stationary Combustion Engines and Gas Turbines

F. NFPA 110 - Emergency and Standby Power Systems

G. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids

H. UL 2200 – Stationary Engine Generator Assemblies

1.05 SUBMITTAL REQUIREMENTS

A. Submit under provisions of Section 01300.

B. Provide as a minimum for all equipment specified:

1. Specification and data sheets.
2. Manufacturer's certification of prototype testing.
3. Manufacturer's certification that the proposed unit is rated at full nameplate HP and kW at the site conditions specified.
4. Manufacturer's published warranty documents.
5. U.L. 2200 Compliance certification
6. Shop drawings showing plan and elevation views with certified overall and interconnection point dimensions.
7. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
8. Manufacturer's installation instructions.

C. Engine/Generator/Main Circuit Breaker/Electronic Control Panel

D. Fuel Tank/Containment Facilities/Platform & Handrail (where required)

E. Exhaust Silencer and Exhaust Piping

F. Batteries/Battery Charger

G. Vibration Isolators

H. Cooling System / Radiator

I. Remote NFPA 110 Alarm Module

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.07 WARRANTY

A. A no deductible warranty shall be provided for all products against defects in materials and workmanship for a five year to 1500 hour period from the start-up date, per the manufacturer's Basic Extended Coverage Limited Warranty.

1.08 MAINTENANCE SERVICES

A. Service facilities shall be provided within 150 miles of project location of City of Mattoon, Illinois

B. Furnish service and maintenance agreement of packaged engine generator systems for minimum of two years from date of substantial completion, not date of delivery to contractor or jobsite.

1.09 SINGLE SOURCE RESPONSIBILITY

A. Each packaged engine generator system, including, but not limited to, engine, alternator, main circuit breaker, controls, fuel tank/containment facilities, exhaust piping, exhaust silencer, batteries, battery charger, etc., and miscellaneous items needed to provide a complete operational system shall be furnished by engine generator supplier.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Caterpillar/Olympian
B. Cummins/Onan
C. Kohler

2.02 DIESEL ENGINE GENERATOR SET

A. Electric power generating system shall have a minimum site capability of:

800 KW/1000 KVA @ 0.8 power factor; 60 Hz
480 Volts
3 Phase
4 Wire.
Standby Rated

Unless otherwise noted, all motors are to be Full Voltage Non-Reversing Started, NEMA Code Letter F and VFD's shall be 6-Pulse design. Load list and start sequence shall be as indicated on the following table (next page):

GENERATOR LOAD SEQUENCE START TABLE

Load Step	Load HP Or KVA	Load Name	Start Method	Max. Voltage Dip (%)
1	500 KVA	Existing Pump Station		35
1	12.5 KVA	Chlor Storage Room Unit Heater		35
1	12.5 KVA	Screen Building Unit Heater		35
1	12.5 KVA	Blower Room Unit Heater		35
1	3.75 KVA	Blower Room Water Heater		35
1	6.25 KVA	Dechlor Room Unit Heater		35
1	6.25 KVA	Chlor Room Unit Heater		35
1	3.75 KVA	Chlor Room MPC		35
1	18.75KVA	Chlor Room Water Heater		35
2	25 HP	Influent Pump 1	FVNR	35
2	25 HP	Influent Pump 2	FVNR	35
2	25 HP	Influent Pump 3	FVNR	35
3	43A	Tank Mixer 1	FVNR	35
3	43A	Tank Mixer 2	FVNR	35
3	43A	Tank Mixer 3	FVNR	35
3	43A	Tank Mixer 4	FVNR	35
3	15 HP	Foul Sewer Pump 1	FVNR	35
3	1HP	Screen No. 1	FVNR	35
3	1HP	Screen No. 2	FVNR	35
3	10HP	Plant Water 1	VFD	20
3	75 HP	Blower No. 1	VFD	20
3	75 HP	Blower No. 2	VFD	20

B. System shall consist of a single generator set and include all controls, protection, wiring and accessories for automatic start-stop operation.

C. Generator set shall include the capability of automatically controlling generator set operation. After starting, the unit will attain rated speed and voltage, and accept rated load. Generator set speed shall be controlled by the engine governor, while generator output voltage regulation shall be a function of the generator automatic voltage regulator. Manual adjustment of generator speed and voltage shall be provided.

D. Generator set start-stop sequence shall be initiated manually or automatically by closing or opening of a contact. The control system shall automatically engage the cranking motor, sense engine starting speed, disengage the motor, arm the engine protection circuit, and accept load.

E. Generator set shall immediately shut down in the event of over-speed, low oil pressure, and high water temperature. Cause of shutdown shall be indicated by a light annunciator. System logic shall prevent restart until fault is cleared.

F. There shall be a provision for manual shutdown in the event of an emergency.

G. Fuel shall be #2 diesel. Contractor shall provide all fuel to be used for generator load bank test, generator startup services and miscellaneous generator testing prior to final acceptance. Contractor shall provide a full fuel tank for final acceptance.

H. All components shall have been designed to achieve optimum physical and performance compatibility and prototype tested to prove integrated design capability. Prototype testing shall comply with the requirements of NFPA 110 for Level 1 systems. Each complete system shall have been factory fabricated, assembled, and production tested as performed by generator manufacturer.

I. Each generator set shall be a complete unit, including, but not limited to, engine, generator, controls, exhaust, generator mounted main circuit breaker, fuel containment facilities, platform & handrail (where required), and radiator. All crankcase lubricant, coolant, full tank of fuel and other consumables are to be included with the unit before final acceptance.

J. Generator set shall meet all U.L. 2200 requirements.

2.03 ENGINE

A. The engine shall be a stationary, liquid cooled, four-cycle design. Units utilizing two-cycle engines will not be considered. Manufacturer shall maintain a nationwide support organization for parts and service.

B. While installed within the housing specified in paragraph 16220-2.12, unit shall be capable of providing full rated nameplate horsepower and kW under the following conditions simultaneously without derating:

1. Altitude 685 ft above sea level.
2. External ambient temperature of 110°F minimum

C. The engine shall be equipped with air filters, fuel filters and pressure gauge, lubricating oil cooler, filters and pressure gauge, water pump and temperature gauge, service hour meter, flywheel and flywheel housing.

D. The fuel system shall be integral with the engine. It shall consist of fuel filter, transfer pump, injection pumps, lines, and nozzles. The transfer pump shall deliver fuel under low pressure to individual injection pumps - one for each cylinder. The injection pumps shall be driven from the camshaft and simultaneously controlled by a rack and pinion assembly that is hydraulically actuated by signals from the engine governor. The pumps shall be of a variable displacement type to alter the volume of fuel delivered to the spray nozzles according to load demand. The nozzles shall inject fuel directly into the cylinder in the optimum spray pattern for efficient combustion.

E. Furnish an in-line fuel filter on all units. On units 400 KW and above, furnish an oil/water separator in addition to the standard fuel filter.

F. The engine jacket water cooling system shall be a closed circuit design with provision for filling, expansion and de-aeration. The cooling pump shall be driven by the engine. Auxiliary coolant pumps required for separate circuit after cooling shall also be engine driven. The cooling system shall tolerate at least 172.4 kPa (25 PSI) static head.

G. Governor: The engine governor shall be of the electronic type. Speed “droop” shall be adjustable form 0 (isochronous) to 10%, from no load to full rated load. Steady State frequency regulation shall be +/- 0.25%, or better. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustments shall be included. The unit shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

H. Engine Jacket Heater: Thermal tank-type water heater with integral thermostatic control, 3KW minimum, or as sized to maintain engine jacket water at 90°F (32°C), and suitable for operation on 120/240/480 Volts AC.

I. Provide glow plugs as a starting aid only if required. Note that generator set will be installed outdoors in weatherproof housing. Minimum exposed temperature could be as low as –25°F.

2.04 EXHAUST

A. The engine exhaust system shall be installed to discharge combustion gases quickly and silently with minimum restriction. System back pressure shall in no case exceed 6.7kPa (27" of water). Heavy walled piping such as Schedule 40 is preferred with radii of 90° bends at least 1 ½ times the pipe diameter. Piping shall be installed with 229 mm (9 in) minimum clearance from combustible material or incorporate appropriate insulation and shielding. Piping shall be supported and braced to prevent weight or thermal growth being transferred to the engine and flexible expansion fittings provided to accommodate thermal growth. Support dampers and springs shall be included where necessary to isolate vibration. Long runs of pipe shall be pitched away from the engine and water traps installed at the lowest point. Exhaust stacks shall be extended to avoid nuisance fumes and odors, and outlets cut at 45° to minimize noise.

B. Provide critical grade silencer, Maxim M-41 series, or equivalent. Inlet and outlet pipe shall be sized as required by engine generator manufacturer.

2.05 STARTING SYSTEM

A. The engine starting system shall include 24 volt DC starting motor(s), starter relay, and automatic reset circuit breaker to protect against butt engagement. Batteries shall be low maintenance, high output, lead acid type mounted near the starting motor. A corrosion resistant or coated steel battery rack shall be provided for mounting. Copper battery cables shall be furnished with the equipment and sized to satisfy circuit requirements. The system shall be capable of starting a properly equipped engine within 10 seconds at ambient temperatures greater than 22°C (70°F).

B. Battery charger shall be current limiting type suitably sized for generator system and batteries furnished, but in no case less than 10 Amp continuous rated. Unit voltage shall match that used for by generator batteries and shall include both “float” and”equalize” features. Battery Charger shall be EnerGenius NRG by Stored Energy Systems (SENS), Longmont, CO, or equivalent. Battery Charger shall be furnished loose for installation and wiring by Contractor in nearby structure as shown on project drawings.

2.06 ALTERNATOR

A. The alternator shall utilize permanent magnet excitation system capable of withstanding a three-phase load of 300% rated current for 10 seconds during a fault condition.

B. Generator shall be per ANSI/NEMA MG 1. Unit to be three phase, four pole design.

C. Alternator Enclosure: ANSI/NEMA MG 1; open drip roof.

D. Voltage Regulation: Digital type, microprocessor based with fully programmable operating and protection characteristics. The regulator shall be capable of sensing true RMS in three phases of the alternator output voltage, or operate in single-phase mode.

E. Alternator Protection: The generator Main Circuit Breaker shall not be utilized solely for alternator protection. The manufacturer shall include a dedicated protection controller system such as Cummins/Onan AmpSentry or Caterpillar EMCP-II+ specifically designed to protect equipment against all fault and overload conditions.

F. Provide condensation space heaters for generator alternator windings.

G. Insulation shall be NEMA MG-1, Class H (150°C rise) minimum.

H. Motor starting capability shall be a minimum of 460 SkVA. The generator set shall be capable of sustaining a minimum of 90% of rated no-load voltage with the specified kVA load at near zero power factor applied to the unit.

2.07 FUEL TANK/STEPS/PLATFORM/HANDRAIL

A. The generator supplier shall provide a double wall base-mounted fuel tank/containment facilities of sufficient capacity to operate generator for a minimum of 24 hours at 3/4 load. The fuel tank shall include containment facilities to capture any leakage of diesel fuel from the tank. The double wall steel tank shall provide 100% secondary containment. The fuel tank/containment facilities shall comply with all applicable provisions of NFPA30, NFPA31 and appropriate state and all local fire codes. Tank outside dimensions shall nominally be the same as that of the weatherproof housing in order to provide a uniform appearance.

B. Fuel tank shall include float and alarm horn with silence pushbutton to alert the operator when tank is full. Float shall activate and deactivate the sounding of the horn.

C. The Contractor shall note that detailed shop drawings and certification of compliance with applicable safety and environmental regulations are to be submitted for review and approval.

D. Fuel tank shall be UL 142 listed and shall include UL label on tank.

E. The fuel tank shall be painted in accordance with respective manufacturer's recommendations.

F. Provide anchoring as required by generator set and fuel tank manufacturers.

G. Fuel tank shall include access way through the bottom for conduits to stub up from below grade into the generator set housing.

H. The following additional fuel tank equipment shall be provided:

1. Vent and piping sized to allow for proper venting of the size of tank provided.
2. Annular space emergency pressure relief vent, set at 8 oz./in^2, minimum.
3. Tank interior emergency pressure relief vent, set at 8 oz./in^2, minimum.
4. Provide locking gas cap for tank fill.
5. Liquid level indicator calibrated for tank capacity to provide direct reading of fuel volume. Dry contacts for low level fuel supply shall be provided for Owner's use.
6. Foot valve/Check valve as recommended by generator set manufacturer to ensure that the fuel supply line remains primed.
7. Provide flex connector where recommended by the generator set manufacturer. Flex connectors shall be UL listed as suitable for intended application.
8. Provide additional equipment (unions, shut-off valves, etc.) as required for complete and operational system.

I. If the Fuel Tank raises the generator set more than 24” then a maintenance platform, stairs and handrail are to be furnished. Provide components manufactured of aluminum with stainless steel hardware. Platform shall 36 inches wide minimum and be of the open-grating type in order to maximize drainage and minimize accumulation of water and debris. All handrail shall be field removable for maintenance purposes.

2.08 GENERATOR SET MAIN CIRCUIT BREAKER

A. Generator set main circuit breaker shall be:

1200 Amps Frame
1200 Amps Trip (100% Rated)
Solid State Trip Type
3 Pole
65 kAmps Interrupting Capacity (AIC) at operating voltage.

1. Include 24 VDC Shunt-Trip Coil
2. Circuit breaker lugs shall be provided to accommodate the number and size of load cables as detailed on the drawings. Contractor shall coordinate with supplier to meet this requirement.

2.09 VIBRATION/ISOLATORS

A. Spring type vibration isolators, Korfund Series LK or equivalent, shall be provided in suitable size and quantity for the equipment.

2.10 ENGINE GENERATOR CONTROLS

A. The engine generator controls shall include the following features as a minimum:

1. Digital Display Indication of:

a. AC voltage (L-L)
b. AC amps
c. System Diagnostics
d. Frequency
e. DC voltage
f. Coolant temperature
g. Oil pressure
h. Revolutions per minute (RPM)
i. Hours Run

2. Operator Controls

   a. Auto Start/Stop
   b. Emergency Stop
   c. Lamp Test
   d. Cycle Crank
   e. Voltage Control
   f. Cool-down Timer
   g. Phase Selector Switch

3. Enclosure Rating: NEMA 1, IP22 with vandal resistant door
4. Indicating Lights for the following as a minimum:

   a. Low Oil Pressure
   b. Low Oil Pressure
   c. High Coolant Temperature
   d. Overspeed
   e. Overcrank
   f. Emergency Stop
   g. Fault Shutdown
   h. Fault Alarm

5. Additional Features Required

   a. Common alarm/shutdown volt free contact. Contact shall close upon all generator failure conditions. Contact to be extended to facility SCADA System. Contact shall not require external power source for operation and shall function with generator DC battery supply only.

B. NFPA 110 REQUIREMENTS: Each packaged engine generator set shall include annunciator panel and pre-alarm module complying with NFPA 110 requirements. The annunciator panels shall be provided with a surface mount enclosure to be remotely installed where shown on the drawings or as directed by the Owner's authorized representative. Indication points shall be provided as a minimum:

1. High Coolant Temperature: Alarm and Shutdown
2. Low Coolant Temperature: Alarm
3. Low Oil Pressure: Alarm and Shutdown
4. Low Fuel Level: Alarm
5. Not in Auto: Alarm
6. Over-crank: Shutdown
7. Over-speed: Shutdown
8. Spare Faults: 4 Red, 3 Amber/Switch Inputs

2.11 COOLING & COMBUSTION AIR SYSTEMS

A. Engine; Self-contained liquid/radiator type, complete with pusher type fan maintaining safe operating temperature for unit full-load operation conditions.

B. Coolant;. 50% Solution of ethylene glycol.

C. Engine Air Cleaners; Dry element type to be furnished with unit.

2.12 WEATHERPROOF HOUSING

A. The enclosure shall offer protection as specified by OSHA from all moving and hot parts of the engine, generator and radiator. It shall be constructed to allow full access to the engine for maintenance without exposing personnel to any moving machinery. Radiator and radiator fan assembly shall be totally enclosed with lockable door over the radiator cap. The radiator shall be sized to accommodate any resulting air flow restrictions without further derating. Provision shall be made for a duct flange or perforated metal grill to protect the radiator core. Doors shall be the lift-off hingeless type with lockable stainless steel security latches.

B. Louvers shall allow sufficient airflow to allow full load operation of the generator set. The louvers shall be twisted to deflect water and direct noise downward. The enclosure shall be of drip-proof construction acceptable for exterior installations when doors are in place.

C. The enclosure shall be fitted to the generator set base and isolated from engine vibration. Corners shall be formed and welded to assure strength and rigidity, while the roof shall be sloped to encourage runoff. Sheet metal with minimum thickness of 1.9 mm for the enclosure and doors shall have no burrs or sharp edges. Inside and outside surfaces shall be finished with a baked electrostatically applied powder coat paint. Exposed fasteners shall be zinc plated with door hinges and latches either painted or stainless steel.

D. Paint shall be manufacturer's standard color.

E. In order to minimize rodent damage, housing shall be constructed such that no exterior openings exceed ½".

2.13 LABELING

A. An engraved three-layer laminated plastic nameplate shall be provided by the generator manufacturer to indicate whether or not the generator neutral is bonded to the generator frame. Where the bonding is modified in the field, the nameplate shall be replaced to indicate whether or not the neutral is bonded to the generator frame. Nameplate to be located in the proximity of the generator set control panel.

2.14 HOUSE POWER

A. The generator shall be set up to receive a single 480VAC, single Phase power feed for all the ancillary power requirements such as block heaters, housing lighting fixtures, battery charging system, convenience outlet,…etc. This should include but not be limited to an appropriately sized transformer and load center for all of the required 120VAC circuits.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Equipment shall be provided and installed in conformance with all applicable State, County and Local requirements, rules and regulations.

C. Fuel tank fabricator and installer shall be registered/licensed with all applicable governing agencies.

D. Contractor shall be responsible to obtain and pay for all permits required for the above ground storage tank installation.

E. Contractor shall pay for all consumables (oil, anti-freeze, fuel, etc.) for start-up and load-bank testing as well as topping off same after commissioning of equipment prior to acceptance by owner.

3.02 TESTING AND STARTUP SERVICES

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Factory performed load-bank testing of generator set prior to shipment <u>will not</u> be considered as an alternative in meeting on-site load bank testing requirements. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. Engine generator manufacturer/supplier shall provide testing and startup services and shall provide load bank for testing of generator under load.

B. Inspection

1. Carefully inspect wiring, fuel system, exhaust system, duct and ventilation openings prior to operating generator set.

   a. Ensure completeness of installation and that all connections are sound and leak free.

C. Cleaning

1. Prior to starting generator set thoroughly clean the following as a minimum:

   a. Housing of dust and debris to prevent pick up by air intake.
   b. Generator set of all dirt, dust and debris.
   c. Fuel oil, lubricating oil, or coolant spills and residues.
   d. All associated equipment in housing.

D. Preparation

1. Verify fuel levels in tanks, ensure that adequate supply of fuel is available.
2. Inspect battery condition, verify full charge.
3. Prime engine fuel intake manifold.

E. Acceptance Test

1. Make all specified submittals.
2. Demonstrate functional capability at site under manual and automatic modes of operation.

    a. Verify that all controls work and that interfaces with fuel system and transfer switches are properly operating.

3. Demonstrate ability of unit to automatically start and accept load by transfer switch command within 10 seconds.

    a. Record all delay times.

4. Perform full-load test using load bank sufficient to provide 100% specified KW rating (1.0 Power Factor) for 2-hour test period.

    a. Start generator system and, upon reaching rated speed, pick up 100% load on single step.
    b. Record voltage, amperage, frequency, oil pressure and engine temperature at beginning of test and each ½ hour thereafter.
    c. Furnish test report to Engineer.

5. Apply manufacturer's touch-up paint to any surfaces scratched or otherwise blemished during shipment or installation.
6. Refill fuel tank.
7. Correct any deficiencies found during retest if required.
8. Verify that system is operating as specified before concluding tests.
9. Top-off any liquids (fuel, oil, coolant) before acceptance.
10. Instruct user personnel on the operation and maintenance of unit.

END OF SECTION 16620

PART 1 GENERAL

1.01 WORK INCLUDES

A. This specification describes the requirements for Surge Protective Devices (formerly called "Transient Voltage Surge Suppression" or "TVSS"). Surge Protective Device equipment shall be furnished for all locations where noted on project Drawings, referenced in other equipment specifications or as described herein.

B. Unless noted otherwise on the drawings, new surge protection equipment shall be furnished with the following new equipment:

1. Switchboards
2. Motor Control Centers
3. Other Service-Entrance Equipment
4. Panelboards
5. Fabricated Control Panels
6. Other equipment where specifically noted on project drawings or specified herein.

C. Additionally, where drawings note to add surge protection to existing equipment, provide equipment as specified herein or as noted on the project drawings.

D. Provide supplemental Surge Suppressors on each end of all 4-20 madc signal lines which originate at, or terminate on, devices located on exterior of building. Typical equipment would include, but not be limited to, magmeters located in exterior meter pits and wet-well transmitters. Where 4-20 madc signals both originate and terminate within a single building, no supplemental surge protection is required.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements.
B. Section 16170 - Grounding and Bonding.
C. Section 16421 - Service Entrance
D. Section 16426 - Distribution Switchboards
E. Section 16462 - Mini Power Centers
F. Section 16470 – Panelboards
G. Section 16482 - Motor Control Centers
H. Section 16483 - Variable Frequency Drive
I. Section 16496 - Enclosed Transfer Switches
J. Section 16901 - Level Sensing and Measurement
K. Section 16902 - Electric Controls and Relays
L. Section 16903 - Programmable Logic Control Panels
M. Section 16904 - Supporting Instrumentation Items and Equipment
N. Section 16906 - Pump Control Panels

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code (most current issue).

B. U.L. 1449/ANSI “3nd Edition” - Surge Protective Devices

C. U.L. 1283 – Electromagnetic Interference Filters.

D. IEEE C62.41– Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

E. IEEE C62.45 – Guide on Surge Testing for Equipment Connected to Low-Voltage Power Circuits

F. NEMA LS-1 – Low Voltage Surge Protection Devices

1.04 DELIVERY, STORAGE AND HANDLING

A. Electrical surge protection equipment shall be stored in a clean dry place, away from construction.

1.05 SUBMITTALS

A. Submit under the provisions of Division 1.

B. Product Data: Provide catalog data for electrical surge protection equipment.

C. Provide information to verify 3rd party testing certification on assembled equipment ratings. Ratings on individual components will not meet this requirement and will not be considered.

D. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Intertek (ETL), Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratorys (NRTL). Compliance may be in the form of a file number that can be verified on ETL’s or UL’s website or on any other NRTL’s website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n). Language similar to “Manufactured in accordance with . . .” will not meet the intent of this specification requirement.

E. Manufacturer’s Instructions:

Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.06 QUALIFICATIONS

A. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

B. Third party tested for compliance.

1.07 QUALITY ASSURANCE (RESERVED)

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 COORDINATION (RESERVED)

1.10 MAINTENANCE SERVICE (WARRANTY)

A. As a minimum, all equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 EQUIPMENT SPECIFICATION

A. UL Category Code VZCA = UL 1449 3rd Edition Surge Protective Devices.

B. All Electrical Surge Protection hardware shall be U.L. Listed and labeled as "Surge Protective Devices" under the latest edition of UL 1449 "3rd Edition".

C. Visual indication that surge suppressors are functioning properly shall be furnished in the form of display, pilot light or LED for each device. If manufacturer utilizes LED's or pilot lights, one indicator shall be provided for each leg of a multi-phase device.

D. Where Surge Protective hardware is not an integral part of a factory-assembled piece of equipment (such as factory installed in a switchboard or MCC), manufacturer or Contractor shall furnish all equipment, brackets and appurtenances necessary in order to properly install suppressors to manufacturer's requirements.

E. Electrical Requirements – Power Distribution Equipment

1. Unit operating voltage and configuration – Refer to Drawings
2. SPD Types:

Type 1: Can be installed before service disconnect overcurrent device. (Old equivalent: Secondary surge arrestor, lightning arrester.) Nominal Discharge Current Rating - 10kA or 20kA.

Type 2: Can only be installed after service disconnect overcurrent

device. (Old equivalent: TVSS) Nominal Discharge Current Rating - 3kA, 5kA, 10kA or 20kA.

Type 3: Point of Utilization SPD. Installed a minimum 10m (30ft) of conductor between service disconnect overcurrent device and surge protective device. (Old equivalent: Plug-In surge strips, surge receptacles).

Type 4: Component SPD. Does not have full enclosure; intended solely for installation in another listed device. Must pass all tests relevant to installation location (Type 1 or Type 2). (Old equivalent: UR recognized component.)

3. The suppression system shall incorporate thermally protected metal oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps, etc.
4. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 125% of the nominal system operating voltage.
5. Protection Modes: The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

LN = Line to Neutral
LL = Line to Line
LG = Line to Ground
NG = Neutral to Ground

Wye System: LN-A Phase, LN-B Phase, LN-C Phase, LG-A Phase, LG-B Phase, LG-C Phase, NG

Delta System: LL-A Phase, LL-B Phase, LL-C Phase, LG-A Phase, LG-B Phase, LG-C Phase

Single Phase System: LN-A Phase, LN-B Phase, LG-A Phase, LG-B Phase, NG

High Leg Delta: LN-A Phase, LN-B Phase, LN-C Phase, LG-A Phase, LG-B Phase, LG-C Phase, NG

6. Voltage Protection Ratings (VPR) shall not exceed the following per UL-1449:

Modes	208Y/120	480Y/277
L-N; L-G; N-G	600 V	1000 V
L-L	900 V	1800 V

7. ANSI/IEEE Cat. C3 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:

Modes	208Y/120	480Y/277
L-L	1240V	2060V
L-G	1000V	1580V
L-N, N-G	890 V	1370 V

8. ANSI/IEEE Cat. B3/C1 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ringwave (6000V, 3000A) shall be less than:

Modes	208Y/120	480Y/277
L-L	900V	1640V
L-G	550V	1050V
L-N, N-G	520 V	980 V

9. Each unit shall include an EMI/RFI filter. Filter shall comply with UL-1283.
10. Where practical, and to aid in keeping power lead/bus length short, Surge Protective Devices may be integrated into electrical distribution equipment enclosures.
11. In order to isolate the Surge Protective Devices under fault conditions, the assembly shall be U.L. rated for the same short circuit fault duty rating as the equipment to which it is connected. Provide supplemental fusing, if required, in order to meet this requirement. All overcurrent protection components shall be tested in compliance with UL 1449 – Limited Current Test and AIC Ratings.
12. Devices shall be provided with integral thermal protection to disconnect the suppression components during an overheated MOV condition.
13. Minimum Repetitive Surge Current Capability: The device shall be repetitive surge tested in every mode utilizing Category C3 waveshapes at minimum of one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 shall be:

    a. Service Entrance: 12,000 impulses per mode.
    b. Branch Location (MCC's & Switchboards): 500 impulses per mode.
    c. Branch Location Panelboard: 100 impulses per mode.

14. Voltage Protection Rating: The residual (limiting) voltage for a 6000V, 3000A, 8x20µs surge waveform that the Surge Protective Device is capable of withstanding shall be no less than that shown in the following table:

Minimum total Surge Current and Withstand Capability with Compliance to ANSI/IEEE C62.41 and NEMA LS-1			
Application	Per Phase	Per Mode	Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA)
All Service Entrance Equipment (Switchgear, Switchboards, MCC's, and other S.E. listed equipment)	240 kA	120kA	12,000 events
Branch Locations (Non-S.E. MCC's & Switchboards)	120 kA	60 kA	500 events
Branch Locations (Non-S.E. Panelboards)	40 kA	20 kA	100 events

15. Lighting and Distribution Panelboard Requirements. The following additional requirements shall apply when drawings indicate that the Surge Protective equipment is to be integral to the panelboard and mounted within the enclosure housing.

    a. The Surge Protection units shall be tested to demonstrate suitability for ANSI/IEEE C62.41 Category C1 environments.
    b. The Surge Protective Device shall not limit the use of Through-feed lugs, Sub-feed lugs and Sub-feed breaker features, where applicable.
    c. The Surge Protective Device shall be immediately installed on the load side of the main breaker.
    d. The panelboard shall be capable of re-energizing upon removal of the Surge Protective Device.
    e. A direct bus bar connection shall be used to mount the Surge Protective component to the panelboard bus bar to reduce the impedance of the shunt path.
    f. The Surge Protected panelboard shall be constructed using a direct bus bar connection.
    g. The surge Protective Device shall be included and mounted within the panelboard by the manufacturer of the panelboard.
    h. The complete panelboard, including the Surge Protection Device shall be UL-67 listed.

16. Switchgear, Switchboard, MCC and other Service Entrance equipment:

    a. The Surge Protection Devices covered under this section shall be 3rd party tested and suitable for ANSI/IEEE C62.41 Category C3 environments.
    b. Surge Protection Device Nominal Discharge Current Rating: 20kA.
    c. Then Surge Protection Device shall be located on the load side of the main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

d. Provide a 30-amp disconnect (or manufacturers recommended size). The disconnect shall be directly integrated to the suppressor assembly.
e. Provide factory installed digital surge counter and form C dry-contact alarm that changes state if any of the three phases detect a faulted, open or other reduced protection condition.
f. All monitoring diagnostic features shall be visible from the front of the equipment.

F. Control Panels (120 VAC Supply): All fabricated control panels utilizing 120 VAC power which house relays, timers or other electrical and electronic equipment shall be provided with Surge Protective Devices on the 120 VAC supply. This 120 VAC Surge Protective Device is in addition to any upstream three-phase Surge Protection units required elsewhere. Each 120 VAC Surge Protective Device unit shall include an isolated dry-contact "failure-alarm" for remote monitoring. Control Panel Surge Protective Devices units shall be Transtector ACP Model 100-BW3R, or equivalent. To permit remote monitoring, connect the "Alarm" dry-contact to a Programmable Logic Controller (PLC) Digital Input, if applicable on project.

G. Instrumentation Signal Protection. All analog instrumentation 4-20 ma signal cables which originate or terminate on an instrument installed on building exterior shall be individually protected with surge suppression at both ends of cable.

1. All Instrumentation Signal Surge Suppressors mounted within control panels shall be Transtector Model DRDC-24 (DIN Rail mount), or equivalent.
2. All Instrumentation Signal Surge Suppressors mounted at field mounted equipment shall be ½" pipe nipple mount Transtector Model PDS-1 (dead-ended) or PDS-2 (thru-design), or equivalent.

H. Surge Protection for DeviceNet Network:
On projects involving DeviceNet, or where shown on the drawings, provide UL-497B DeviceNet surge protection devices. Surge protection may be installed within DeviceNet equipment where practical. Where other enclosures are unavailable, provide suitably sized NEMA 4X Non-Metallic enclosure to house Surge Protection equipment. DeviceNet Surge Protection devices shall be Leviton Model #3863-DEV.

I. Surge Protection for Ethernet Network:
On projects involving metallic-wire Ethernet which extends to building exterior, or where shown on the drawings, provide UL-497B Ethernet surge protection devices. Surge protection may be installed within other Ethernet equipment, Local Control Panels or PLC enclosures, whichever best suits particular project networking architecture and equipment. Where other enclosures are unavailable, provide suitably sized NEMA 4X Non-Metallic enclosure to house Surge Protection equipment. Ethernet Surge Protection devices shall be furnished with standard RJ-45 Input and Output jacks. Ethernet Surge Protection devices shall be Leviton Model #3861-ETH.

PART 3 EXECUTION

3.01 EXAMINATION (RESERVED)

3.02 PREPARATION (RESERVED)

3.03 INSTALLATION

A. Control panel surge protection shall be installed per manufacturer's instructions by panel builder prior to shipment.

B. Surge protection equipment for all other locations shall be installed per manufacturer's instructions and requirements.

END OF SECTION 16671

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work included in this section is supply of electrical controls and control panels not specified elsewhere, including switches, pushbuttons, relays, time delays, indicating lights, and miscellaneous equipment as shown on plans or specified herein.

1.02 RELATED SECTIONS

A. Section 16010 - General Electrical Requirements.
B. Section 16111 - Conduit and Raceway.
C. Section 16123 - Building Wire and Cable.
D. Section 16141 - Wiring Devices.
E. Section 16160 - Cabinets and Enclosures.
F. Section 16170 - Grounding and Bonding.
G. Section 16190 - Supporting Devices.
H. Section 16195 - Electrical Identification.
I. Section 16671 – Surge Protective Devices (SPD).
J. Section 16901 - Electrical Sensing and Measurement.
K. Section 16903 - Programmable Logic Controllers

1.03 REFERENCE TO STANDARDS

A. ANSI/NFPA 70 - National Electrical Code (most current issue).

B. NFPA 79 – Electrical Standard for Industrial Machinery

C. NECA - National Electrical Contractors Association.

D. NEMA ICS 1 - General Standards for Industrial Control Systems.

E. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

F. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

G. U.L. 508 - Industrial Control Panels

H. U.L. 698A - Industrial Control Panels Relating Hazardous (Classified) Locations.

I. U.L. 913 - Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1 Hazardous (Classified) Locations.

J. ANSI/ISA RP-12.06.01 – Wiring Methods for Hazardous (Classified) Locations Instrumentation

1.04 DELIVERY, STORAGE AND HANDLING

A. Items shall be stored in original containers and shall be stored indoors, protected from weather and construction.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide catalog data for all control panels.

Data submittals shall include complete, detailed, annotated schematics, product data on all components, product layout and dimensions, mounting details, including supports.

C. Manufacturer's Instruction Information

Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.06 QUALIFICATIONS (RESERVED)

1.07 QUALITY ASSURANCE

A. Control Stations with Control Operators only (selector-switches, pilot-lights and pushbuttons) may be field fabricated or assembled by Contractor.

B. Fabricated Control Panels shall be assembled, Listed and Labeled by a UL 508 listed panel manufacturer, requiring only installation and connection to external wiring in field.

C. Control panels having field devices located within a Hazardous (Classified) location shall additionally comply with U.L. 698A requirements. Intrinsically Safe Barriers shall comply with U.L. 913.

D. Control panel shall be thoroughly tested prior to delivery to jobsite.

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.09 COORDINATION (RESERVED)

1.10 MAINTENANCE SERVICE (WARRANTY)

A. All equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS) (RESERVED)

PART 2 PRODUCTS

2.01 CONTROL PANEL EQUIPMENT SPECIFICATIONS (GENERAL)

The following items shall apply, as necessary, for each control panel. Note that all devices listed will not be required for every panel.

A. Unless specified otherwise on the drawings, control operators (pushbuttons, selector switches, indicating lights, etc.), shall be heavy duty, non-metallic, Full-Size (30 mm) NEMA 4X/13 and shall be Allen-Bradley 800H, Square D type SK, or equivalent. Pilot lights shall be 120 VAC transformer-type. To ensure long lamp life, all pilot lights shall utilize LED type lamps only.

B. Unless specified otherwise on the drawings, control relays shall be heavy duty, “ice-cube” style, 11-pin (3PDT) socket mount, 120VAC operation with integral pilot light, contact rating of 10 Amps minimum, IDEC RR3PA-UL-AC120V, or equivalent. Provide all relays complete with matching plug-in socket IDEC #SR3P-05, or equivalent. Include DIN-style mounting rail as required. Provide a minimum of 10% additional panel space for future relays and sockets.

C. Unless specified otherwise on the drawings, time delay relays shall be heavy duty, socket mount. 120VAC operation with contact rating of 10 Amps minimum. Include DIN-style mounting rail as required. Provide a minimum of 10% additional future time delay relay panel space. Time Delay Relays shall be the following, or equivalent:

1. On-Delay (Delay on Make) and Interval
   IDEC #RTE-P1AF20 & SR2P-05 (DIN-Rail Mount Socket)
2. Off-Delay (Delay on Break)
   IDEC #RTE-P2AF20 & SR3P-05 Socket (DIN-Rail Mount Socket)

D. Enclosures shall comply with applicable portions of Section 16141 - Wiring Devices or Section 16160 - Cabinets and Enclosures.

E. Unless otherwise indicated on project drawings, control panel wire color coding shall comply with NFPA 79.

F. Run Time Meters / Elapsed Time Meters (RTM/ETM). Unless otherwise noted, the terms RTM & ETM may be used interchangeably on project drawings for the same device. Units shall be 120 VAC, non-reset type, round-style, with six digit LCD display. Meters shall display cumulative elapsed hours (5 digits) plus tenths of hours of operation. Meters shall be designed for flush door mounting unless otherwise noted on project drawings. The exposed face of all Run-Time Meters shall be NEMA 4X rated. Include gasket kit, if required to meet the NEMA 4X watertight requirements. Run Time (Elapsed Time) Meters shall be Redington Model 3311-1000/5003-005S, or equivalent.

G. Isolate all intrinsically-safe wiring within control panels from other wiring using grounded metal barriers. Do not combine any intrinsically-safe wiring with any other conductors. Intrinsically-safe wiring insulation shall be light-blue in color.

H. Unless specified otherwise on the drawings, intrinsically-safe isolated switches shall be Diversified Electronics, Model ISO-120-AFA with matching socket PF083A, or equivalent. Note: In order to maintain the U.L. Classified Listing of

this device, it MUST be used with the specified socket only. Do not substitute a standard 8-pin octal socket on this device.

I. Intrinsically-safe barriers for analog 4-20 ma signals shall be third-party certified for use with proposed field transmitters or instruments. Coordinate as required with other project instrument manufacturers and suppliers in order to meet this requirements.

J. Control panel terminal blocks shall be DIN-Rail mount tubular compression type, rated 300 Volts, 30 Amp capacity. Include minimum of 10% spare, unused terminal blocks in all custom-fabricated control panels. Include end-blocks and mounting rail as required. Do not install more than two conductors per terminal block point (i.e. 2 conductors each side).

K. Both ends of each control panel conductors shall be numbered. Numbering scheme to be selected by Contractor or Panel Fabricator. Wire labels shall be machine-printed type with clear plastic self-laminating over-wrap. Pre-printed paper-type wire labels (i.e. “Brady-Card” labels) will NOT meet the requirements specified herein. Paper-type wire labels will be rejected and require replacement in the field at the Contractor’s expense.

L. All conductor bundles within control panels shall be neatly grouped and plastic tie-wrapped, or installed within slotted plastic wireway with matching covers. All cable ties shall be pulled tight and tail sheared off using tool specifically designed to prevent sharp burrs or exposed sharp edges. Cable ties cut with other methods will be rejected and require replacement in the field at the Contractor’s expense. Conductor bundles extending between control panel interior and door shall be mounted using a screw-type anchor base on each side of the door hinge. Adhesive-anchors without supplemental screw anchors will not be accepted.

M. Bond all control panel exterior metallic doors to control panel ground lug using a green insulated copper conductor or braided copper jumper.

N. Furnish printed identification labels for all control panel interior components. Embossed-type labels (old-style “Dymo”) will be rejected and will require replacement at the Contractor’s expense.

O. Include a label placed on the inside of the panel door with the name, address, phone number and emergency phone number of the service representative for the pumps and control panel.

2.02 CONTROL DEVICES NOT SPECIFIED ELSEWHERE

A. Capacitance Door Limit Switches

Where indicated on the drawings for automatic ventilation system control, limit switches on man-doors shall be capacitance type suitable for use on either metallic or non-metallic sensing with field-adjustable sensitivity of 0-30 mm. Materials of switch construction shall be non-metallic such as Crastin. Device output shall be field programmable as either normally-open or normally-closed. Switches shall be 2-wire type suitable for use on 120 VAC. Capacitance type limit switches shall Pepperl+Fuchs Model # CJ15-40-W/BF-40 or equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Items shall be installed per manufacturer's recommendations and as detailed on plans.

B. Install panel enclosures as detailed on plans and as specified in Section 16160 - Cabinets and Enclosures.

3.02 TESTING

A. All equipment shall be thoroughly tested for proper operation. Defective or malfunctioning equipment shall be immediately replaced at no charge to Contract.

3.03 MANUFACTURERS SERVICE

A. Under provisions of Section 01435 - Manufacturer’s Service

B. Under provisions of Section 01820 - Demonstration and Training

END OF SECTION 16902

PART 1 GENERAL

1.01 WORK INCLUDES

A. Work under this section is to provide the PLC control panels including the fiber-optic network as described herein and/or as detailed on project drawings.

1.02 DESCRIPTION

A. All PLC control panels shall be furnished complete; including but not limited to, fabrication, testing, field installation, debugging, start-up, commissioning, cable, conduit and terminations in order to provide a fully functional system to the satisfaction of the Engineer and Owner.

B. To ensure sole-source responsibility, a single Systems Integrator shall furnish all PLC control panels, networking, programming, start-up and commissioning.

C. Following are the PLC's:

1. PLC-100 Electrical Building
2. PLC-101 Screen Building
3. PLC-102 Chemical Feed Building
4. PLC-103 Riley Creek Pump Station

1.03 RELATED SECTIONS

A. Section 01300 - Submittal Procedures.
B. Section 16123 – Building Wire and Cable.
C. Section 16160 - Cabinets and Enclosures.
D. Section 16170 - Grounding and Bonding.
E. Section 16195 - Electrical Identification.
F. Section 16671 – Surge Protective Devices
G. Section 16902 - Electric Controls and Relays
H. Section 16905 – Systems Integration
I. Section 16950 – Testing Electrical Systems

1.04 REFERENCE

A. ANSI/NFPA 70 - National Electrical Code (most current issue).

B. NECA - National Electrical Contractors Association.

C. NEMA ICS 1 - General Standards for Industrial Control Systems.

D. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers & Assemblies.

E. NEMA ICS 3 - Industrial Systems.

F. NEMA ICS 6 - Enclosures for Industrial Controls and Systems

G. U.L. 508 – Industrial Control Equipment

H. U.L. 913 – Intrinsically Safe Apparatus and Associated Apparatus for Use Class I, II III, Division 1, Hazardous (Classified) Locations

I. Illinois EPA Title 35; Subtitle C; Chapter II; Part 370 - Illinois Recommended Standards for Sewage Works

J. Recommended Standards for Wastewater Facilities; Great Lakes Upper Mississippi River - 10 State Standards

K. ANSI/ISA - RP12.6 Recommended Practice - Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations.

L. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

M. ANSI/NEMA 250 - Enclosures for Electrical Equipment.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Accept products on site in factory containers. Inspect for damage.

C. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

1.06 SUBMITTALS

A. Submit product data under provisions of General Requirements - Section 01300.

B. Product Data: Provide catalog data for all control panel components and modules.

1. Data submittals shall include complete, detailed, annotated schematics, product data on all components, product layout and dimensions, mounting details, including supports.
2. PLC logic printouts are not required as submittal information. However, Contractor shall be solely responsible for providing a functional system meeting all the requirements and sequence of operation as specified herein. As part of the Record Drawings, the Contractor shall furnish “as-built” PLC logic as required in Part 2 of this specification.

C. U.L. Identification Number for Control panel manufacturing facility

D. Manufacturer's Instructions: Indicate applicable conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation and operation of Product.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section. If required by the Owner's representative, manufacturer shall submit a certification to a minimum experience of five (5) years in manufacture of equipment similar to that specified.

B. System Integrator: Company specializing in and experienced in integrating PLC's, instrumentation, control valves, pumps, chemical feeders, supervisory SCADA computers, radio telemetry and related equipment into a fully functional control system.

1.08 QUALITY ASSURANCE

A. To assist in quality assurance, PLC control panels shall be assembled and wired by a UL 508 listed panel manufacturer, requiring only installation and connection to external wiring in field. Each individual control panel shall bear a uniquely serial-numbered U.L. listing label.

1.09 MAINTENANCE SERVICE (WARRANTY)

A. Furnish manufacturer's authorized service and maintenance of PLC system for a minimum period of one (1) year from date of substantial completion established by the Owner.

B. Supplied equipment shall be warranted to be free from defects in material and workmanship for a period of one year from date of substantial completion established by the Owner.

1.11 EXTRA MATERIALS (SPARE PARTS) Note that spare unit quantities specified are for the entire PLC system. Quantities indicated are NOT required for each individual PLC control panel.

A. Provide one (1) spare PLC (1756 ControlLogix & 1766 MicroLogix 1400) module including original manufacturer's packaging and instructions. These units are to be retained by the owner for future repair purposes. On projects with multiple networked PLC's, the spare unit shall be furnished with memory capacity equal to, or greater than, the largest unit utilized on the PLC system.

B. Provide one (1) spare I/O module of each type (For both the 1756 ControlLogix & 1766 MicroLogix 1400) and function used in the system including original manufacturer's packaging and instructions. These are to be retained by the owner for future repair purposes. These modules are over and above any modules utilized by the start-up technician during commissioning of the equipment.

C. On systems with fiber-optic networking, furnish one (1) spare fiber-optic network interface unit including original manufacturer's packaging and instructions. This unit is to be retained by the owner for future repair purposes.

D. Provide one (1) box of fuses (minimum of (5) five) of each type and ampacity used in the control panels.

PART 2 PRODUCTS

2.01 For standardization, the Owner has selected the Allen-Bradley PLC product line for all PLC-based control panels to be installed at the facility. A fiber-optic network backbone will be installed to interconnect all PLC control panels.

A. Each PLC control panel shall include an EtherNet network interface and a fiber-optic network module as specified herein.

B. Programmable Logic Controllers (PLC's)

1. PLC shall be the following:

a. Allen-Bradley 1756 ControlLogix controller for PLC-100.

i. Memory capacity as required for all application logic plus minimum 25% future capacity.
ii. Furnish 1756-EN2T EtherNet/IP communication module for integration into Owner's SCADA system.
iii. Furnish sufficient PLC I/O space for all project requirements plus minimum 10% space for future I/O.

b. Allen-Bradley 1766 MicroLogix 1400 Controller for PLC-101, PLC-102, PLC-103

i. Memory capacity as required for all application logic plus minimum 25% future memory capacity.
ii. Controller shall have embedded EtherNet/IP communications protocol. Include 1763-NC01 cable.
iii. Furnish sufficient PLC I/O space for all project requirements plus minimum 10% space for future I/O.
iv. Provide 1760 MicroLogix Expansion I/O cards as required.

2.02 Equipment Specification

A. Description: Programmable Logic Controller (PLC) manufactured to NEMA ICS 3.

B. Service Conditions:

1.	Temperature (operating)	0 to 60°C
2.	Temperature (non-operating)	-40 to 85°C
3.	Humidity	5 to 95 %, non-condensing

4.	Altitude	up to 6600 feet (2000 meters)
5.	Supply Voltage	120 VAC, 60 Hz
6.	Electrical Noise Immunity	NEMA ICS 2-30

C. Each PLC Assembly: Include enclosure, wire duct, terminal blocks, fuses or circuit breakers, surge suppressors, PLC processor, HMI, power supply, Input/Output modules, backplane or rack, communication port(s), programming port, fiber-optic interface, interconnecting wiring and all programming for a complete & operational system.

D. Input/Output Modules

Provide sufficient unused I/O rack space to allow for future installation of 10% (minimum) additional I/O modules. If required, increase rack and enclosure sizes in order to accommodate.

E. Fiber-Optic Ethernet Network Module for Allen-Bradley PLC's

1. Industrial Managed Ethernet Switch 4TX/2FX-E Phoenix Contact 2832658

F. HMI

1. HMI shall be Allen Bradley Panelview+ 6 1500

G. Terminal Blocks

1. Terminal blocks for control wiring shall be Heavy Duty 600 volt, tubular clamp style, with accessories as required, as manufactured by Buchanan, Allen-Bradley, Cutler-Hammer, or Square D. Control panel interior wiring shall be MTW or THW sized as required per NEC minimum #14 AWG. All connections shall be checked for tightness and secured as required.

H. Secondary 120 VAC Surge Arrester

1. Secondary surge arrester shall be provided by the control panel manufacturer and be as specified under Section 16671. Install per manufacturer's directions, include mounting bracket or plate as required.

I. Uninterruptible Power Supply (UPS)

1. Provide each PLC panel with an internal Off-Line UPS to power all components within each panel in the event of power outage or disruption. Both Input and Output of the UPS shall be 120 VAC, 60 Hz. UPS capacity shall be no less than 850VA/510W.

J. Ethernet Surge Protection

1. Where copper Ethernet is utilized on the project, provide Ethernet Surge Protection as shown on Project Drawings and as specified in Section 16671.

K. Analog Loop Surge Protection

1. Provide DIN-rail mounted supplemental Surge Suppressors on all 4-20 madc Analog Inputs and Outputs which originate at, or terminate on, devices located on exterior of building. Typical equipment would include mag-meters located in exterior meter-pits and wet-well level transmitters. These devices are to limit electrical surges which might be transmitted from exterior wiring back into the PLC hardware over the 4-20 madc signal cables. Supplemental analog surge protection shall be as specified in Section 16671-2.01F1. Analog I/O which both originates and terminates within a single building do not require supplemental Surge Suppressors.

L. Enclosure Light

1. Provide each LCP/PLC control panel with interior door-activated fluorescent light. Unit shall be Hoffman A-LTDB1 or X-LF16D18 as applicable for enclosure size.

M. Power Supply

1. Provide each of the Programmable Logic Control Panels with a 24 VDC, 2 Amp power supply for 2-wire Analog Loop Excitation. A supply is to be furnished in each of the Local Control Panels, whether or not required for initial project I/O. Wire the D.C. output to panel terminal blocks and appropriately label for easy identification. D.C. power supply shall be DIN-Rail mounted type, as indicated on drawings.

N. Receptacle

1. Provide 120 VAC convenience duplex outlet installed in device box on control panel interior as specified in section 16141.

O. Where required or specified, control operators and pilot relays shall be as specified in Section 16902 unless otherwise noted.

P. Grounding Bar

1. Provide a copper grounding bar mounted and bonded inside the panel enclosure, adequately sized to accommodate all ground conductors to or from the pump control panel.

Q. Enclosure Heater

1. For all exterior applications and interior locations where noted on the drawings, provide a condensation heater sized as required for the control panel enclosure to minimize moisture that may accumulate inside the equipment. Include integral thermostat and circulating fan for heater. Circulating fan shall be 4" to 6" nominal diameter axial type fan with wire guards, 115 VAC, 60 Hz. Thermostat shall be line voltage thermostat, 120 VAC, 5 Amp minimum current rating, SPST, with adjustable control knob. Enclosure heater shall be as manufactured by Honeywell, White-Rogers, Hammond, Hoffman, or Chromalox.

R. Enclosure

1. Enclosures shall be of the type and material specified below. Items designated NEMA 4X shall be constructed from 304SS. Items designated NEMA 1 shall be constructed from painted steel.
2. Include a label placed on the inside of the panel door with the name, address, phone number and emergency phone number of the service representative.

ITEM		TYPE
a.	Blower and Electrical Building (PLC-100)	NEMA 4X
b.	Screen Building (PLC-101)	NEMA 4X
c.	Chlorine Feed Building (PLC-102)	NEMA 4X
d.	Riley Creek Pump Station (PLC-103) (PLC-103 shall be field installed in existing enclosure)	NA

S. Documentation

1. Final Program

a. Provide (1) copy of the final program logic complete with annotation (Applicable to OEM's Only) to the Owner after start up and all de-bugging and commissioning has been completed. The PLC data image shall be as provided by the programming software specified above. PLC logic shall be furnished on either USB flash drive or CD-ROM and also provide one copy of hard copy printout on bound 8.5"x 11" paper.

PART 3 EXECUTION

3.01 INSTALLATION

A. Control panel shall be installed per manufacturer's recommendations as detailed on the drawings and as specified herein.

B. All conduit entries into the panel enclosure shall have watertight threaded hubs, Meyers or equivalent in order to maintain the NEMA 4X rating of the enclosure.

C. Seal all underground conduit openings that terminate within control panel enclosure as specified in Section 16111-2.02C.

D. Conduits with intrinsically safe wiring, including float switch cables, shall terminate in the control panel at the intrinsically safe wiring section. Non-intrinsically wiring including, but not limited to, power feeder conductors from the service entrance circuit breaker, branch circuit conductors, and pump motor cables shall not enter the control panel at the intrinsically safe wiring section and shall maintain a minimum separation distance inside the control panel from the intrinsically safe conductors as required by NEC 504 and ANSI/ISA RP12.6.

E. Install explosion proof conduit seals as detailed on the drawings and in conformance with Manufacturer's requirements. Contact the respective conduit seal off manufacturer if assistance is required for direction of installing the packing fiber to form a dam and pouring the sealing compound.

F. Contractor and supplier shall furnish any other items not specifically noted or detailed in order to provide for a functional system as described in these specifications.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01435.

B. Perform operational testing on control systems to verify proper operation and field wiring connections.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01435.

3.04 DEMONSTRATION

A. Under provisions of Section 01611 - Manufacturer's Service.

B. Demonstrate operation and programming of controller.

C. Under provisions of Section 01820 - Demonstration and Training. Provide minimum of (8) hours of instruction each for up to five (5) people, to be conducted at project site by manufacturer's representative technician familiar with this specific project, equipment and functionality requirements.

PART 4 PLC CONTROL DESCRIPTION

4.01 GENERAL

A. This description below is to be utilized for the programming of the specific PLC for automatic operations of the facility. See Specification Section 16905 for further information on what an operator will be able to view such as status of equipment and/or alarms and what the operator will be able to control.

4.02 PLC-100 ELECTRICAL BUILDING

A. First Flush Tank

1. Level: The PLC shall monitor the level via LIT-201.
2. Blowers: Upon reaching a specified water level Blower 1 shall turn on. Upon a rising water level Blower 2 shall turn on. When each Blower turns on the respective enclosure fan shall also turn on. Each Blower shall

operate in a lead lag situation. Upon the water lowering to a level the lag blower shall turn off and upon a lower water level the lead blower shall turn off. After a blower has shut off the enclosure fan shall be timed to shut off in 30 minutes.

3. Mixer: Upon reaching a specified water level all of the mixers shall turn on with an adjustable (15 seconds) delayed start. Upon a receding water level (if not currently shut off) the mixers shall shut off.

B. Influent Pumping Station

1. Level: The PLC shall monitor the level via LIT-301.
2. Pumps: The 4 pumps shall operate in a lead, lag, lag type of control operation where upon rising water level the lead pump shall turn on, if the water keeps rising, then the lag pump will start, if water still continues to rise then the second lag pump shall start. Upon a lowering water level then each pump shall shut off at specified levels in the opposite order of when they turned on. After all the pumps are off the pumps shall rotate which pump will then be the lead pump.
3. Control Valve: The control valve will be monitored and controlled by the SCADA system for draining of the pumping station.

C. Foul Sewer Drain Pump

1. Level: The PLC shall monitor the level via LIT-801.
2. Pumps: The 2 pumps shall operate in an alternate basis with the lead pump to turn on upon a set rising water level. Upon a falling specified level the lead pump shall turn off.

   a. If either pump is called to run automatically or manually and the Head Box Valve to RCPS (CV-801) is not in a closed position and the RCPS wet well is at a high water level, both pumps shall not operate. If both valves of the head box (CV-801 to the RCPS and CV-802 to the First Flush Tank) are in the closed position, then both pumps shall be disabled.

4. Control Valve: The control valves will be monitored and controlled by the SCADA system for draining of the pumping station.

D. Plant Water - The plant water skid shall operate independently with the skids control panel. The Panel shall provide the PLC with a general alarm notification.

4.03 PLC-101 SCREEN BUILDING

A. Screen Channel

1. Level: The PLC shall monitor the level via LIT-101.
2. Screen: Upon a rising set water level in the channel both screens shall be called to start. Upon a lowering set water level the screens shall stop.

a. Upon the start of the first event the First Flush Tank gate (G-101) shall be open and the Pump Station Gate (G-102) shall be closed. Upon a rising set level in the First Flush Tank as indicated by LIT-201 gate G-102 shall first open and then gate G-101 shall close.

4.04 PLC-102 CHEMICAL FEED BUILDING

A. Chlorine Contact Tank

1. Level: The PLC shall monitor the level via LIT-501
2. Outfall Level: The PLC shall monitor the outfall level via LIT-502. When water starts overflow of the weir, the PLC shall calculate the number of gallons that goes over the weir by use of elevation.
3. Control Valves: The control valves will be monitored and controlled by the SCADA system for draining of the chlorine contact tank.

B. Chlorine Feed Building

1. Chlorination: Upon indication of water in the Chlorine Contact Tank from LIT-501 the PLC shall start the Chlorination by opening the plant water solenoid valve CV-602. The PLC will control the dosing rate by sending a 4-20mA signal to the Chlorinator. The signal produced will be three rates with the first rate indicating that one of the influent pump station pumps is running, second rate indicating that two of the influent pump station pumps are running and a third rate indicating that three of the influent pump station pumps are running. Two chlorinators will be present and wired with power and control signals. One will operate and the other will be shut off and used as a back-up. If the operator chooses to switch Chlorinators then he must shut off the power to the one in use and turn on power to the one selected to use. Then the operator needs to manually switch the process piping to utilize the desired Chlorinator.
2. Vacuum Switch: The vacuum switch shall provide the PLC with High Vacuum and Low Vacuum alarm.
3. Scales: The PLC will monitor the weights of the Chlorine Cylinders.
4. Chlorine Leak: The Chlorine Leak Detector (A-601) shall provide an alarm signal to the PLC.
5. Chlorine Analyzer: The Chlorine Analyzer shall continuously run. When the Chlorine Tank is not in use, the Analyzer shall be fed by the plant water system. Upon the start of the Chlorination, the PLC shall switch the three way solenoid valve CV-601 of plant water and shall start the Sample Pump.
6. Dechlorination: Upon a water level (height of the Dechlorination chamber) indicated by LIT-501 that water is now entering such section, the PLC shall start the Dechlorination pump. A 4-20mA signal (as a result from the Chlorine Analyzer) from the PLC shall control the pump rate. The skid includes two pumps, one to operate and the other to be a back-up. Power and control wiring shall be connected to both pumps and the operator will manually switch which pump shall operate by shutting off the original pump, turning power on to the desired pump and manually switch valves for the desired pump.
7. Scale: The PLC will monitor the weight of the tote.

4.05 PLC-103 RILEY CREEK PUMP STATION

A. Level: The PLC shall monitor the level via LIT-901.
Back up to LIT-901 shall be two floats (LS-901 and LS-902)

B. Flow: Indicate the flow rate from the Existing Flow meter and totalize.

C. Bar Screen Channel Level: The PLC shall monitor the level via new float LS-901.

1. The control of the existing pump station shall consist of utilizing the existing Inputs and Outputs and relocating to new PLC.

D. Pump Station control Logic: The Station is equipped with 1 small pump (100HP) and 3 large pumps (150 HP). The PLC will alternate the 3 large pumps between starts. The wet well depth is 22'-5". The PLC will cycle pumps based on the wet well level.

Wet Well Level	Action
2.0'	Small Pump On
4.0'	Small Pump Off, 1st Large Pump On.
10.0'	2nd Large Pump On concurrent with 1st.
16.0'	3rd Large Pump On concurrent with 1st and 2nd.
11.0'	3rd Large Pump Off
6.0'	2ND Large Pump Off
1.5'	1st Large Pump Off
1.5'	Small Pump Off

1. The pump speed input is to be a fixed speed set by the operator on the SCADA Screen for each VFD. The PLC will then operate the pumps in an ON/OFF mode.

E. Discharge Valve Control Logic: Each pump is equipped with a pneumatic actuated, DeZurik discharge valve. Each discharge valve is equipped with 1 pressure switch, 1 normal solenoid valve, 1 valve position indicator and 1 emergency solenoid valve.

F. Starting Valve Position – Prior to starting a pump, the PLC confirms that the valve is in the closed position. An alarm is generated if the valve in not in the closed position. The PLC will not start the pump until the alarm condition is corrected.

G. Normal Opening Operation – The PLC will signal the VFD to start the pump at 30HZ. When the PLC receives a signal from the pressure switch that the pressure has reached its mechanical set point, the PLC will energize the Normal Solenoid to open. When the PLC receives a signal that the valve has reached full open position, the PLC will restore the VFD run speed to its SCADA set point. The normal solenoid will remain energized while the pump is running.

H. Normal Closing Operation – The PLC will signal the VFD to set the pump speed at 30HZ. After a 5 second delay, the PLC will de-energize the normal solenoid valve causing the discharge valve to close. When the valve position reaches 95% closed, the PLC will send a stop command to the VFD.

I. Emergency Solenoid Operation – The emergency solenoid is normally energized in the closed position. IN the event of a power outage the emergency solenoid opens, allowing the valve to close faster.

J. Emergency Stop Procedure #1 – The PLC will stop the pump, de-energize the normal solenoid, and send a Valve Fail alarm when the following conditions occur during the Normal Open Operation:

1. The pressure switch fails to signal after a certain time limit.
2. The discharge valve fails to open after a certain time limit.
3. The PLC will use the remaining pumps until the alarm condition is corrected.

K. Emergency Stop Procedure #2 – The PLC will stop the pump, de-energize the emergency solenoid and send an alarm when the following conditions occur:

1. The discharge valve fails to close in an adjustable time limit.
2. The PLC will use the remaining pumps until the alarm condition is corrected.

4.06 INPUT/OUTPUT LIST

A. See the Attachment to this specification for the I/O List for further information.

END OF SECTION 16903

CONTROL SYSTEM INPUT/OUTPUT DATABASE
CITY OF MATTOON RILEY CREEK PUMP STATION CSO FACILITY

No.	INSTR Tag No.	Device	Signal Name	Loop No.	Discrete In	Discrete Out	Analog In	Analog Out	Remarks
		PLC-100 ELECTRICAL BUILDING							
		FIRST FLUSH TANK							
100	LE-201	TANK LEVEL	LEVEL	LIT-201			1		4-20mA FROM PRESSURE TRANSMITTOR
100	M-201	FFT MIXER NO. 1	IN AUTO	HS-201A	1				FROM MIXER STARTER IN MCC
100	M-201	FFT MIXER NO. 1	IN HAND	HS-201B	1				FROM MIXER STARTER IN MCC
100	M-201	FFT MIXER NO. 1	RUNNING	JIS-201	1				FROM MIXER STARTER IN MCC
100	M-201	FFT MIXER NO. 1	OVLD	YA-201	1				FROM MIXER STARTER IN MCC
100	M-201	FFT MIXER NO. 1	ON/OFF	YC-201		1			TO MIXER STARTER IN MCC
100	M-202	FFT MIXER NO. 2	IN AUTO	HS-202A	1				FROM MIXER STARTER IN MCC
100	M-202	FFT MIXER NO. 2	IN HAND	HS-202B	1				FROM MIXER STARTER IN MCC
100	M-202	FFT MIXER NO. 2	RUNNING	JIS-202	1				FROM MIXER STARTER IN MCC
100	M-202	FFT MIXER NO. 2	OVLD	YA-202	1				FROM MIXER STARTER IN MCC
100	M-202	FFT MIXER NO. 2	ON/OFF	YC-202		1			TO MIXER STARTER IN MCC
100	M-203	FFT MIXER NO. 3	IN AUTO	HS-203A	1				FROM MIXER STARTER IN MCC
100	M-203	FFT MIXER NO. 3	IN HAND	HS-203B	1				FROM MIXER STARTER IN MCC
100	M-203	FFT MIXER NO. 3	RUNNING	JIS-203	1				FROM MIXER STARTER IN MCC
100	M-203	FFT MIXER NO. 3	OVLD	YA-203	1				FROM MIXER STARTER IN MCC
100	M-203	FFT MIXER NO. 3	ON/OFF	YC-203		1			TO MIXER STARTER IN MCC
100	M-204	FFT MIXER NO. 4	IN AUTO	HS-204A	1				FROM MIXER STARTER IN MCC
100	M-204	FFT MIXER NO. 4	IN HAND	HS-204B	1				FROM MIXER STARTER IN MCC
100	M-204	FFT MIXER NO. 4	RUNNING	JIS-204	1				FROM MIXER STARTER IN MCC
100	M-204	FFT MIXER NO. 4	OVLD	YA-204	1				FROM MIXER STARTER IN MCC
100	M-204	FFT MIXER NO. 4	ON/OFF	YC-204		1			TO MIXER STARTER IN MCC
		INFLUENT PUMP STATION							
100	P-301	PUMP NO. 1	IN AUTO	HS-301A	1				FROM PUMP STARTER IN MCC
100	P-301	PUMP NO. 1	IN HAND	HS-301B	1				FROM PUMP STARTER IN MCC
100	P-301	PUMP NO. 1	RUNNING	JIS-301	1				FROM PUMP STARTER IN MCC
100	P-301	PUMP NO. 1	OVLD	YA-301A	1				FROM PUMP STARTER IN MCC
100	P-301	PUMP NO. 1	ON/OFF	YC-301		1			TO PUMP STARTER IN MCC
100	P-301	PUMP NO. 1	SEAL LEAK	YA-301B	1				FROM PUMP STARTER IN MCC
100	P-301	PUMP NO. 1	PUMP THERMAL	YL-301	1				FROM PUMP STARTER IN MCC
100	P-302	PUMP NO. 2	IN AUTO	HS-302A	1				FROM PUMP STARTER IN MCC
100	P-302	PUMP NO. 2	IN HAND	HS-302B	1				FROM PUMP STARTER IN MCC
100	P-302	PUMP NO. 2	RUNNING	JIS-302	1				FROM PUMP STARTER IN MCC
100	P-302	PUMP NO. 2	OVLD	YA-302A	1				FROM PUMP STARTER IN MCC
100	P-302	PUMP NO. 2	ON/OFF	YC-302		1			TO PUMP STARTER IN MCC
100	P-302	PUMP NO. 2	SEAL LEAK	YA-302B	1				FROM PUMP STARTER IN MCC
100	P-302	PUMP NO. 2	PUMP THERMAL	YL-302	1				FROM PUMP STARTER IN MCC
100	P-303	PUMP NO. 3	IN AUTO	HS-303A	1				FROM PUMP STARTER IN MCC
100	P-303	PUMP NO. 3	IN HAND	HS-303B	1				FROM PUMP STARTER IN MCC
100	P-303	PUMP NO. 3	RUNNING	JIS-303	1				FROM PUMP STARTER IN MCC
100	P-303	PUMP NO. 3	OVLD	YA-303A	1				FROM PUMP STARTER IN MCC
100	P-303	PUMP NO. 3	ON/OFF	YC-303		1			TO PUMP STARTER IN MCC
100	P-303	PUMP NO. 3	SEAL LEAK	YA-303B	1				FROM PUMP STARTER IN MCC
100	P-303	PUMP NO. 3	PUMP THERMAL	YL-303	1				FROM PUMP STARTER IN MCC
100	P-304	PUMP NO. 4	IN AUTO	HS-304A	1				FROM PUMP STARTER IN MCC
100	P-304	PUMP NO. 4	IN HAND	HS-304B	1				FROM PUMP STARTER IN MCC
100	P-304	PUMP NO. 4	RUNNING	JIS-304	1				FROM PUMP STARTER IN MCC
100	P-304	PUMP NO. 4	OVLD	YA-304A	1				FROM PUMP STARTER IN MCC
100	P-304	PUMP NO. 4	ON/OFF	YC-304		1			TO PUMP STARTER IN MCC
100	P-304	PUMP NO. 4	SEAL LEAK	YA-304B	1				FROM PUMP STARTER IN MCC
100	P-304	PUMP NO. 4	PUMP THERMAL	YL-304	1				FROM PUMP STARTER IN MCC
100	LE-301	WET WELL LEVEL	LEVEL	LIT-301			1		4-20mA FROM PRESSURE TRANSMITTOR
		FOUL SEWER-DRAIN PUMP STATION							
100	LE-801	WET WELL LEVEL	LEVEL	LIT-801			1		4-20mA FROM PRESSURE TRANSMITTOR
100	P-801	PUMP NO. 1	IN AUTO	HS-801A	1				FROM PUMP STARTER IN MCC
100	P-801	PUMP NO. 1	IN HAND	HS-801B	1				FROM PUMP STARTER IN MCC
100	P-801	PUMP NO. 1	RUNNING	JIS-801	1				FROM PUMP STARTER IN MCC
100	P-801	PUMP NO. 1	OVLD	YA-801A	1				FROM PUMP STARTER IN MCC
100	P-801	PUMP NO. 1	ON/OFF	YC-801		1			TO PUMP STARTER IN MCC
100	P-801	PUMP NO. 1	SEAL LEAK	YA-801B	1				FROM PUMP STARTER IN MCC
100	P-801	PUMP NO. 1	HIGH TEMP	YL-801	1				FROM PUMP STARTER IN MCC
100	P-802	PUMP NO. 2	IN AUTO	HS-802A	1				FROM PUMP STARTER IN MCC
100	P-802	PUMP NO. 2	IN HAND	HS-802B	1				FROM PUMP STARTER IN MCC
100	P-802	PUMP NO. 2	RUNNING	JIS-802	1				FROM PUMP STARTER IN MCC
100	P-802	PUMP NO. 2	OVLD	YA-802A	1				FROM PUMP STARTER IN MCC
100	P-802	PUMP NO. 2	ON/OFF	YC-802		1			TO PUMP STARTER IN MCC
100	P-802	PUMP NO. 2	SEAL LEAK	YA-802B	1				FROM PUMP STARTER IN MCC
100	P-802	PUMP NO. 2	HIGH TEMP	YL-802	1				FROM PUMP STARTER IN MCC
100	G-801	FFT GATE INFLUENT	MONITOR RELAY	YT-803	1				FROM GATE OPERATOR
100	G-801	FFT GATE INFLUENT	OPEN	ZO-803		1			TO GATE OPERATOR
100	G-801	FFT GATE INFLUENT	CLOSE	ZC-803		1			TO GATE OPERATOR
100	G-801	FFT GATE INFLUENT	OPENED	YIO-803	1				FROM GATE OPERATOR
100	G-801	FFT GATE INFLUENT	CLOSED	YIC-803	1				FROM GATE OPERATOR

CONTROL SYSTEM INPUT/OUTPUT DATABASE
CITY OF MATTOON RILEY CREEK PUMP STATION CSO FACILITY

No.	INSTR Tag No.	Device	Signal Name	Loop No.	Discrete In	Discrete Out	Analog In	Analog Out	Remarks
100	G-801	FFT GATE INFLUENT	ALARM	YA-803	1				FROM GATE OPERATOR
100	CV-801	HEAD BOX TO RCPS	MONITOR RELAY	YT-804	1				FROM VALVE OPERATOR
100	CV-801	HEAD BOX TO RCPS	OPEN	ZO-804		1			TO VALVE OPERATOR
100	CV-801	HEAD BOX TO RCPS	CLOSE	ZC-804		1			TO VALVE OPERATOR
100	CV-801	HEAD BOX TO RCPS	OPENED	YIO-804	1				FROM VALVE OPERATOR
100	CV-801	HEAD BOX TO RCPS	CLOSED	YIC-804	1				FROM VALVE OPERATOR
100	CV-801	HEAD BOX TO RCPS	ALARM	YA-804	1				FROM VALVE OPERATOR
100	G-802	HEAD BOX TO FFT	MONITOR RELAY	YT-805	1				FROM VALVE OPERATOR
100	G-802	HEAD BOX TO FFT	OPEN	ZO-805		1			TO VALVE OPERATOR
100	G-802	HEAD BOX TO FFT	CLOSE	ZC-805		1			TO VALVE OPERATOR
100	G-802	HEAD BOX TO FFT	OPENED	YIO-805	1				FROM VALVE OPERATOR
100	G-802	HEAD BOX TO FFT	CLOSED	YIC-805	1				FROM VALVE OPERATOR
100	G-802	HEAD BOX TO FFT	ALARM	YA-805	1				FROM VALVE OPERATOR
		BLOWER AND ELECTRICAL BUILDING							
100	PW-701	PLANT WATER BOOSTER STA	ALARM	YA-701	1				
100	B-701	BLOWER NO 1 - VFD	HAND	HS-701A	1				FROM VFD SELECTOR SWITCH "HAND" SELECTED
100	B-701	BLOWER NO 1 - VFD	AUTO	HS-701B	1				FROM VFD SELECTOR SWITCH "AUTO" SELECTED
100	B-701	BLOWER NO 1 - VFD	RUNNING	JIS-701	1				FROM VFD "RUNNING" CONTACT
100	B-701	BLOWER NO 1 - VFD	FAULT	JAS-701	1				FROM VFD COMMON "FAULT" CONTACT
100	B-701	BLOWER NO 1 - VFD	START/RUN	JC-701		1			TO VFD "START / RUN" CONTROL INPUT
100	B-701	BLOWER NO 1 - VFD	RUNNING SPEED.	SI-701			1		4-20 ma FROM VFD (VFD ACTUAL RUNNING SPEED)
100	B-701	BLOWER NO 1 - VFD	MODULATE	SC-701				1	4-20 ma TO VFD (VFD SPEED CONTROL INPUT)
100	B-701	BLOWER NO 1 - VFD	ESTOP	HSS-701	1				
100	B-702	BLOWER NO 2 - VFD	HAND	HS-702A	1				FROM VFD SELECTOR SWITCH "HAND" SELECTED
100	B-702	BLOWER NO 2 - VFD	AUTO	HS-702B	1				FROM VFD SELECTOR SWITCH "AUTO" SELECTED
100	B-702	BLOWER NO 2 - VFD	RUNNING	JIS-702	1				FROM VFD "RUNNING" CONTACT
100	B-702	BLOWER NO 2 - VFD	FAULT	JAS-702	1				FROM VFD COMMON "FAULT" CONTACT
100	B-702	BLOWER NO 2 - VFD	START/RUN	JC-702		1			TO VFD "START / RUN" CONTROL INPUT
100	B-702	BLOWER NO 2 - VFD	RUNNING SPEED.	SI-702			1		4-20 ma FROM VFD (VFD ACTUAL RUNNING SPEED)
100	B-702	BLOWER NO 2 - VFD	MODULATE	SC-702				1	4-20 ma TO VFD (VFD SPEED CONTROL INPUT)
100	B-702	BLOWER NO 2 - VFD	ESTOP	HSS-702	1				
100	B-703	BLOWER 1 ENCLOSURE FAN	START/RUN	JC-703		1			TO FAN IN ENCLOSURE
100	B-704	BLOWER 2 ENCLOSURE FAN	START/RUN	JC-704		1			TO FAN IN ENCLOSURE
100		ATS IN "NORMAL" POWER	STATUS	ZS-701	1				AUTOMATIC TRASFER SWITCH
100		ATS IN "EMERGENCY" POWER	STATUS	ZSH-701	1				AUTOMATIC TRASFER SWITCH
		PLC-100 SUB-TOTAL I/O POINTS			**77**	**20**	**5**	**2**	

PLC-101 SCREEN BUILDING

		SCREEN BUILDING							
101	LE-101	CHANNEL LEVEL	LEVEL	LIT-101			1		4-20mA FROM PRESSURE TRANSMITTOR
101	M-101	SCREEN NO 1	SHEER PIN TRIP	ZS1-101	1				FROM SCREEN CONTROL PANEL
101	M-101	SCREEN NO 1	ESTOP	YI-101	1				FROM SCREEN CONTROL PANEL
101	M-101	SCREEN NO 1	OVLD	YA-101	1				FROM SCREEN CONTROL PANEL
101	M-101	SCREEN NO 1	RUNNING	JIS-101	1				FROM SCREEN CONTROL PANEL
101	M-102	SCREEN NO 2	SHEER PIN TRIP	ZS1-102	1				FROM SCREEN CONTROL PANEL
101	M-102	SCREEN NO 2	ESTOP	YI-102	1				FROM SCREEN CONTROL PANEL
101	M-102	SCREEN NO 2	OVLD	YA-102	1				FROM SCREEN CONTROL PANEL
101	M-102	SCREEN NO 2	RUNNING	JIS-102	1				FROM SCREEN CONTROL PANEL
101	G-101	FFT GATE	OPENED POS	YIO-101	1				FROM GATE OPERATOR
101	G-101	FFT GATE	CLOSED POS	YIC-101	1				FROM GATE OPERATOR
101	G-101	FFT GATE	MODULATE	ZC-101				1	TO GATE OPERATOR
101	G-101	FFT GATE	POSITION	ZI-101			1		FROM GATE OPERATOR
101	G-101	FFT GATE	ALARM	YA-101	1				FROM GATE OPERATOR
101	G-101	FFT GATE	MONITOR RELAY	YT-101	1				FROM GATE OPERATOR
101	G-102	PUMP STATION GATE	OPENED POS	YIO-102	1				FROM GATE OPERATOR
101	G-102	PUMP STATION GATE	CLOSED POS	YIC-102	1				FROM GATE OPERATOR
101	G-102	PUMP STATION GATE	MODULATE	ZC-102				1	TO GATE OPERATOR
101	G-102	PUMP STATION GATE	POSITION	ZI-102			1		FROM GATE OPERATOR
101	G-102	PUMP STATION GATE	ALARM	YA-102	1				FROM GATE OPERATOR
101	G-102	PUMP STATION GATE	MONITOR RELAY	YT-102	1				FROM GATE OPERATOR
101	CV-301	WET WELL DRAIN VALVE	MONITOR RELAY	YT-301	1				FROM VALVE OPERATOR
101	CV-301	WET WELL DRAIN VALVE	OPEN	ZO-301		1			TO VALVE OPERATOR
101	CV-301	WET WELL DRAIN VALVE	CLOSE	ZC-301		1			TO VALVE OPERATOR
101	CV-301	WET WELL DRAIN VALVE	OPENED	YIO-301	1				FROM VALVE OPERATOR
101	CV-301	WET WELL DRAIN VALVE	CLOSED	YIC-301	1				FROM VALVE OPERATOR
101	CV-301	WET WELL DRAIN VALVE	ALARM	YA-301	1				FROM VALVE OPERATOR
		PLC-101 SUB-TOTAL I/O POINTS			**20**	**2**	**3**	**2**	

CONTROL SYSTEM INPUT/OUTPUT DATABASE
CITY OF MATTOON RILEY CREEK PUMP STATION CSO FACILITY

No.	INSTR Tag No.	Device	Signal Name	Loop No.	Discrete In	Discrete Out	Analog In	Analog Out	Remarks
		PLC-102 CHEMICAL FEED BUILDING							
		CHLORINE CONTACT TANK							
102	CV-501	CHANNEL 1 DRAIN VALVE	MONITOR RELAY	YT-501	1				FROM VALVE OPERATOR
102	CV-501	CHANNEL 1 DRAIN VALVE	OPEN	ZO-501		1			TO VALVE OPERATOR
102	CV-501	CHANNEL 1 DRAIN VALVE	CLOSE	ZC-501		1			TO VALVE OPERATOR
102	CV-501	CHANNEL 1 DRAIN VALVE	OPENED	YIO-501	1				FROM VALVE OPERATOR
102	CV-501	CHANNEL 1 DRAIN VALVE	CLOSED	YIC-501	1				FROM VALVE OPERATOR
102	CV-501	CHANNEL 1 DRAIN VALVE	ALARM	YA-501	1				FROM VALVE OPERATOR
102	CV-502	CHANNEL 2 DRAIN VALVE	MONITOR RELAY	YT-502	1				FROM VALVE OPERATOR
102	CV-502	CHANNEL 2 DRAIN VALVE	OPEN	ZO-502		1			TO VALVE OPERATOR
102	CV-502	CHANNEL 2 DRAIN VALVE	CLOSE	ZC-502		1			TO VALVE OPERATOR
102	CV-502	CHANNEL 2 DRAIN VALVE	OPENED	YIO-502	1				FROM VALVE OPERATOR
102	CV-502	CHANNEL 2 DRAIN VALVE	CLOSED	YIC-502	1				FROM VALVE OPERATOR
102	CV-502	CHANNEL 2 DRAIN VALVE	ALARM	YA-502	1				FROM VALVE OPERATOR
102	CV-503	CHANNEL 3 DRAIN VALVE	MONITOR RELAY	YT-503	1				FROM VALVE OPERATOR
102	CV-503	CHANNEL 3 DRAIN VALVE	OPEN	ZO-503		1			TO VALVE OPERATOR
102	CV-503	CHANNEL 3 DRAIN VALVE	CLOSE	ZC-503		1			TO VALVE OPERATOR
102	CV-503	CHANNEL 3 DRAIN VALVE	OPENED	YIO-503	1				FROM VALVE OPERATOR
102	CV-503	CHANNEL 3 DRAIN VALVE	CLOSED	YIC-503	1				FROM VALVE OPERATOR
102	CV-503	CHANNEL 3 DRAIN VALVE	ALARM	YA-503	1				FROM VALVE OPERATOR
102	CV-504	CHANNEL 4 DRAIN VALVE	MONITOR RELAY	YT-504	1				FROM VALVE OPERATOR
102	CV-504	CHANNEL 4 DRAIN VALVE	OPEN	ZO-504		1			TO VALVE OPERATOR
102	CV-504	CHANNEL 4 DRAIN VALVE	CLOSE	ZC-504		1			TO VALVE OPERATOR
102	CV-504	CHANNEL 4 DRAIN VALVE	OPENED	YIO-504	1				FROM VALVE OPERATOR
102	CV-504	CHANNEL 4 DRAIN VALVE	CLOSED	YIC-504	1				FROM VALVE OPERATOR
102	CV-504	CHANNEL 4 DRAIN VALVE	ALARM	YA-504	1				FROM VALVE OPERATOR
102	CV-505	DECHLOR AREA DRAIN VALVE	MONITOR RELAY	YT-505	1				FROM VALVE OPERATOR
102	CV-505	DECHLOR AREA DRAIN VALVE	OPEN	ZO-505		1			TO VALVE OPERATOR
102	CV-505	DECHLOR AREA DRAIN VALVE	CLOSE	ZC-505		1			TO VALVE OPERATOR
102	CV-505	DECHLOR AREA DRAIN VALVE	OPENED	YIO-505	1				FROM VALVE OPERATOR
102	CV-505	DECHLOR AREA DRAIN VALVE	CLOSED	YIC-505	1				FROM VALVE OPERATOR
102	CV-505	DECHLOR AREA DRAIN VALVE	ALARM	YA-505	1				FROM VALVE OPERATOR
102	LE-501	TANK LEVEL	LEVEL	LIT-501			1		4-20mA FROM LEVEL TRANSMITTER
102	LE-502	OUTFALL WEIR LEVEL	LEVEL	LIT-502			1		4-20mA FROM LEVEL TRANSMITTER
		CHLORINATION STORAGE ROOM							
102	WT-601	CHLOR CYLINDER NO 1	WEIGHT	WI-601			1		4-20mA FROM SCALE TRANSMITTER
102	WT-602	CHLOR CYLINDER NO 2	WEIGHT	WI-602			1		4-20mA FROM SCALE TRANSMITTER
102	WT-603	CHLOR CYLINDER NO 3	WEIGHT	WI-603			1		4-20mA FROM SCALE TRANSMITTER
		CHLORINATION ROOM							
102	A-601	CHLOR LEAK DETECTOR	ALARM	YA-601	1				DI FROM CHLORINE LEAK CONTROL PANEL
102	CV-601	PLANT WATER VS DECHLOR TANK	POSITION	ZC-601		1			OPEN TO DECHLOR TANK
102	CV-602	PLANT WATER	OPEN	ZO-602		1			START CHLORINE PROSSESS
102	U-601	CHLORINATOR NO 1	MODULATE	SC-601				1	4-20 mA FEED RATE
102	U-602	CHLORINATOR NO 2	MODULATE	SC-602				1	4-20 mA FEED RATE
102	U-604	VACUUM SWITCH	ALARM	YA-604A	1				HIGH VACUUM ALARM
102	U-604	VACUUM SWITCH	ALARM	YA-604B	1				LOW VACUUM ALARM
102	U-603	CHLORINE ANALYZER	DENSITY INDICATOR	AI-603			1		4-20 mA RISUDUAL RESULT
102	P-603	SAMPLE PUMP FOR ANALYZER	ON/OFF	JC-603	1				START FROM PLC
102	P-603	SAMPLE PUMP FOR ANALYZER	MODULATE	SC-603			1		4-20MA FROM PLC
102	P-603	SAMPLE PUMP FOR ANALYZER	SPEED	SI-603				1	4-20MA FROM PUMP
102	P-603	SAMPLE PUMP FOR ANALYZER	FLOW FAIL	FI-603	1				FROM PUMP
102	P-603	SAMPLE PUMP FOR ANALYZER	TUBE FAIL	FA-603	1				FROM PUMP
		BISULFATE FEED ROOM							
102	WT-604	BISULFATE TOTE	WEIGHT	WI-604			1		4-20mA FROM SCALE TRANSMITTER
102	P-601	BISUFATE FEED PUMP 1	ON/OFF	JC-601	1				START FROM PLC
102	P-601	BISUFATE FEED PUMP 1	MODULATE	SC-601			1		4-20MA FROM PLC
102	P-601	BISUFATE FEED PUMP 1	SPEED	SI-601				1	4-20MA FROM PUMP
102	P-601	BISUFATE FEED PUMP 1	FLOW FAIL	FI-601	1				FROM PUMP
102	P-601	BISUFATE FEED PUMP 1	TUBE FAIL	FA-601	1				FROM PUMP
102	P-602	BISUFATE FEED PUMP 2	ON/OFF	JC-602	1				START FROM PLC
102	P-602	BISUFATE FEED PUMP 2	MODULATE	SC-602			1		4-20MA FROM PLC
102	P-602	BISUFATE FEED PUMP 2	SPEED	SI-602				1	4-20MA FROM PUMP
102	P-602	BISUFATE FEED PUMP 2	FLOW FAIL	FI-602	1				FROM PUMP
102	P-602	BISUFATE FEED PUMP 2	TUBE FAIL	FA-602	1				FROM PUMP
102	S-601	DRAIN VALVLE TAMPER SWITCH	ALARM	YA-605	1				FROM TAMPER SWITCH
102	S-602	FLOW SWITCH	ALARM	YA-606	1				FROM FLOW SWITCH
102	S-603	RPZ-1 TAMPER SWITCH	ALARM	YA-607	1				FROM TAMPER SWITCH
102	S-604	RPZ-2 TAMPER SWITCH	ALARM	YA-608	1				FROM TAMPER SWITCH

CONTROL SYSTEM INPUT/OUTPUT DATABASE
CITY OF MATTOON RILEY CREEK PUMP STATION CSO FACILITY

No.	INSTR Tag No.	Device	Signal Name	Loop No.	Discrete In	Discrete Out	Analog In	Analog Out	Remarks
102	S-605	CONTAINMENT FLOAT SWITCH	ALARM	YA-608	1				FROM FLOAT SWITCH IN CONTAINMENT
		PLC-102 SUB-TOTAL I/O POINTS			**37**	**12**	**10**	**5**	
		PLC-103 RILEY CREEK PUMP STATION							
		RILEY CREEK PUMP STATION							
103	LS-901	SCREEN CHANNEL HIGH LEVEL			1				FROM SCREEN CHANNEL FLOAT
		SCREEN RUNNING			1				FROM SCREEN CONTROL PANEL
		SCREEN SHEER PIN			1				FROM SCREEN CONTROL PANEL
103	FIT-901	FORCE MAIN FLOW METER	FLOW	FI-901			1		4-20mA FROM EXISTING FLOW METER
103	LIT-901	WET WELL LEVEL	LEVEL	LI-901			1		4-20mA FROM PRESSURE TRANSDUCER
103	LS-902	WET WELL HIGH LEVEL		LS-901	1				HIGH WET WELL LEVEL SWITCH
103	LS-903	WET WELL LOW LEVEL		LS-902	1				LOW WET WELL LEVEL SWITCH
		EXISTING TO BE RECONNECTED TO NEW PLC							
		IN EXISTING PUMP CONTROL PANEL							
103	P-901	PUMP 1 - VFD	START/RUN	JC-901		1			TO VFD "START/RUN" CONTROL INPUT
103	P-901	PUMP 1 - VFD	FAULT	JAS-901A	1				FROM VFD COMMON "FAULT" CONTACT
103	P-901	PUMP 1 - VFD	RUNNING SPEED	SI-901			1		4-20 ma FROM VFD (VFD ACTUAL RUNNING SPEED)
103	P-901	PUMP 1 - VFD	MODULATE	SC-901				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	P-901	PUMP 1 - VFD	OVERTEMP	JAS-901B				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	P-902	PUMP 2 - VFD	START/RUN	JC-902		1			TO VFD "START/RUN" CONTROL INPUT
103	P-902	PUMP 2 - VFD	FAULT	JAS-902A	1				FROM VFD COMMON "FAULT" CONTACT
103	P-902	PUMP 2 - VFD	RUNNING SPEED	SI-902			1		4-20 ma FROM VFD (VFD ACTUAL RUNNING SPEED)
103	P-902	PUMP 2 - VFD	MODULATE	SC-902				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	P-902	PUMP 2 - VFD	MODULATE	JAS-902B				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	P-903	PUMP 3 - VFD	START/RUN	JC-903		1			TO VFD "START/RUN" CONTROL INPUT
103	P-903	PUMP 3 - VFD	FAULT	JAS-903A	1				FROM VFD COMMON "FAULT" CONTACT
103	P-903	PUMP 3 - VFD	RUNNING SPEED	SI-903			1		4-20 ma FROM VFD (VFD ACTUAL RUNNING SPEED)
103	P-903	PUMP 3 - VFD	MODULATE	SC-903				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	P-903	PUMP 3 - VFD	MODULATE	JAS-903B				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	P-904	PUMP 4 - VFD	START/RUN	JC-904		1			TO VFD "START/RUN" CONTROL INPUT
103	P-904	PUMP 4 - VFD	FAULT	JAS-904A	1				FROM VFD COMMON "FAULT" CONTACT
103	P-904	PUMP 4 - VFD	RUNNING SPEED	SI-904			1		4-20 ma FROM VFD (VFD ACTUAL RUNNING SPEED)
103	P-904	PUMP 4 - VFD	MODULATE	SC-904				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	P-904	PUMP 4 - VFD	MODULATE	JAS-904B				1	4/20 ma TO VFD (VFD SPEED CONTROL INPUT)
103	CV-901	DISCHARGE VALVE 1	POSITION	ZI-901			1		FROM VALVE OPERATOR
103	CV-901	NORMAL SOLENOID 1	OPEN	ZO-901		1			TO NORMAL SOLENOID
103	CV-901	EMERGENCY SOLENOID 1	CLOSE	ZC-901		1			TO EMERGENCY SOLENOID
103	CV-901	PRESSURE SWITCH 1	ALARM	PS-901	1				FROM PRESSURE SWITCH
103	CV-902	DISCHARGE VALVE 2	POSITION	ZI-902			1		FROM VALVE OPERATOR
103	CV-902	NORMAL SOLENOID 2	OPEN	ZO-902		1			TO NORMAL SOLENOID
103	CV-902	EMERGENCY SOLENOID 2	CLOSE	ZC-902		1			TO EMERGENCY SOLENOID
103	CV-902	PRESSURE SWITCH 2	ALARM	PS-902	1				FROM PRESSURE SWITCH
103	CV-903	DISCHARGE VALVE 3	POSITION	ZI-903			1		FROM VALVE OPERATOR
103	CV-903	NORMAL SOLENOID 3	OPEN	ZO-903		1			TO NORMAL SOLENOID
103	CV-903	EMERGENCY SOLENOID 3	CLOSE	ZC-903		1			TO EMERGENCY SOLENOID
103	CV-903	PRESSURE SWITCH 3	ALARM	PS-903	1				FROM PRESSURE SWITCH
103	CV-904	DISCHARGE VALVE 4	POSITION	ZI-904			1		FROM VALVE OPERATOR
103	CV-904	NORMAL SOLENOID 4	OPEN	ZO-904		1			TO NORMAL SOLENOID
103	CV-904	EMERGENCY SOLENOID 4	CLOSE	ZC-904		1			TO EMERGENCY SOLENOID
103	CV-904	PRESSURE SWITCH 4	ALARM	PS-904	1				FROM PRESSURE SWITCH
		PLC-103 SUB-TOTAL I/O POINTS			**13**	**12**	**10**	**8**	
		PLC-100 SUB-TOTAL I/O POINTS			**77**	**20**	**5**	**2**	
		PLC-101 SUB-TOTAL I/O POINTS			**20**	**2**	**3**	**2**	
		PLC-102 SUB-TOTAL I/O POINTS			**37**	**12**	**10**	**5**	
		PLC-103 SUB-TOTAL I/O POINTS			**13**	**12**	**10**	**8**	
		TOTAL I/O POINTS			**147**	**46**	**28**	**17**	**238**

PART 1 GENERAL

A. To ensure sole-source responsibility, a single Systems Integrator shall furnish all computer hardware, software, programming and commissioning specified herein, as well as the PLC control panels specified under Section 16903.

1.01 SECTION INCLUDES

A. Supervisory Control and Data Acquisition (SCADA) computers.

B. Supervisory Control and Data Acquisition (SCADA) software.

C. Operating System and General Software.

D. SCADA Computer Uninterruptible Power Supplies (UPS)

1.02 RELATED SECTIONS

A. Section 01300 - Submittal Procedures.
B. Section 01450 - Quality Control & Testing Services.
C. Section 01560 - Temporary Environmental Controls.
D. Section 01750 - Starting & Adjusting.
E. Section 16010 - General Electrical Requirements.
F. Section 16111 - Conduit and Raceway.
G. Section 16123 - Building Wire and Cable.
H. Section 16141 - Wiring Devices.
I. Section 16170 - Grounding and Bonding.
J. Section 16195 - Electrical Identification.
K. Section 16671 - Surge Protective Devices (SPD).
L. Section 16903 - Programmable Logic Controllers

1.03 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code (most current issue).

B. FCC - Federal Communications Commission.

1.04 SUBMITTALS

A. Submit under provisions of Submittal Procedures listed in paragraph 1.02.

B. Product Data: Provide catalog data for all products. Include product layout and dimensions and mounting details.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years' experience.

B. Supplier: Authorized distributor of specified manufacturer with minimum 3 years' experience.

C. System Integrator: Company specializing in integrating PLC's, instrumentation, control valves, pumps, chemical feeders, supervisory computers, SCADA software and related equipment into a fully functional control system with minimum 5 years' experience.

1.06 QUALITY ASSURANCE

A. SCADA computers shall be assembled and tested prior to delivery to the job site.

B. Software shall be installed on the SCADA computers and tested prior to delivery to jobsite.

1.07 REGUALTORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Conform to requirements of FCC 47 CFR, part 15.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of "Temporary Environmental Controls" listed in paragraph 1.02.

B. Accept products on site in factory containers. Inspect for damage.

C. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

D. All software licenses are to be registered in the name of the Owner.

1.09 MAINTENANCE SERVICE (WARRANTY)

A. Furnish manufacturer's authorized service and maintenance of SCADA system hardware for a minimum period of one year from date of substantial completion established by Owner.

B. Furnish replacements for all defective SCADA system hardware components for a minimum period of one year from date of substantial completion established by Owner.

PART 2 PRODUCTS

2.01 SYSTEMS INTEGRATION

A. As part of this item, the Contractor shall obtain the services of a Systems Integrator. The Systems Integrator shall provide all services under the direction of the Contractor. As a minimum, System's Integrator tasks shall include the following:

1. Provide coordination services to interconnect the specific instrumentation devices, power devices, controllers, etc. furnished under this project. As part of this task, the Systems Integrator shall review the Contract Documents, Shop Drawings and manufacturer's literature and generate any supplemental sketches, drawings and interconnection diagrams found necessary for the installation, routing and termination of conduit and wire between various project devices.
2. Computer hardware, software and programming of both SCADA Computer and Programmable Logic Controllers as described in this section.

2.02 HARDWARE & SOFTWARE MANUFACTURERS

A. SCADA Computers

1. Design Documents have been based on:

   a. Asus
   b. Dell
   c. Hewlett-Packard

2. Other acceptable base-bid manufacturers

   a. None

3. Alternates

   a. None

B. MMI software

1. Design Documents have been based on:

   a. GE/Fanuc; Proficy HMI/SCADA iFix
   b. Invensys/Wonderware; InTouch

2. Other acceptable base-bid manufacturers:

   a. None

3. Alternates

a. None

C. Operating System Software: Furnish one licensed copy per computer

1. Design Documents have been based on:

a. Microsoft: Windows 8.1 Professional

2. Other acceptable base-bid manufacturers

a. None

3. Alternates

a. None

D. Office Suite Software: Furnish one licensed copy per computer

1. Design Documents have been based on:

a. Microsoft: Office Home & Business 2013

2. Other acceptable base-bid manufacturers:

a. None

3. Alternates:

a. None

E. Waste-Water Treatment Data Management

1. Design Documents have been based on:

a. OPS 32/Single User (Including interface for MMI Software)
OPS Systems
4020 Peggy Road SE; Suite K
Rio Rancho, NM 87124
Phone (800) 677-0067
Fax (505) 994-3574
Internet: www.opssys.com

2. Other acceptable base-bid manufacturers:

a. None

3. Alternates

a. None

F. Operations & Maintenance Management Software

a. Job Plus by OPS Systems (see contact information above)

2. Other acceptable base-bid manufacturers

a. None

3. Alternates

a. None

G. AutoDial Alarm Software

1. Design Documents have been based on:

a. Win 911/TEP
Specter Instruments
4020 S. Industrial Drive
Suite 120
Austin, TX 78744
Phone (800) 331-8740
Fax (512) 326-1019
Internet: www.specterinstruments.com

2. Other acceptable base-bid manufacturers

a. Invensys/Wonderware: SCADAlarm

3. Alternates

a. None

H. Loop Tuning Software: One licensed copy of either of the following

1. Design Documents have been based on:

a. RSTune-Rockwell Software
b. ExperTune-ExperTune, Inc.
4734 Sonseeahray Drive
Hubertus, WI 53033-9728
Phone (262) 628-0088
Fax (262) 628-0087
Internet: www.expertune.com

2. Other acceptable base-bid manufacturers

a. None

3. Alternates

a. None

I. Uninterruptible Power Supply (for SCADA Computer, Display & Printer)

1. Input Power: 120 VAC; Single Phase; NEMA 5-15 or 5-20 Plug
2. Run Time: 15 Minutes (minimum) at rated capacity
3. Surge Protection: ANSI/IEEE C62.41 Category A & B; U.L. 1449 2nd ed.
4. Battery Source: Self-contained, sealed, field replaceable
5. Load Receptacles: 2 (minimum)
6. Manufacturers

a. Design Documents have been based on:

i. American Power Conversion (APC)
ii. Best Power Technology

b. Other acceptable base-bid manufacturers:

i. None

c. Alternates

i. None

2.03 SCADA COMPUTERS

A. SCADA computer minimum configuration. One (1) computer required

1. Processor …….Intel 4th Generation Core i5 (minimum)
2. Processor Speed…….3.2GHz (minimum)
3. CPU Cache……..…….6 Mb (minimum)
4. System Memory……..……12 GB (minimum)
5. Graphics Board ……Intel HD Graphics 4600 (minimum)
6. Recordable DVD Drive…….DVD+-RW/CD-RW
7. Ports……2-Serial, 1-Bidirectional parallel, 2-USB 2.0 minimum, 1-Firewire
8. Operating System…….....……Windows8.1 (64-bit version)
9. LED Display…….……..Dell S2415H, or equivalent
10. Number of LCD Displays per Computer…….One (1)
11. Display size, diagonal measure (nominal)……24” (minimum)
12. Mouse……..3-Button; scroll-type; wireless design
13. Keyboard……...Wireless Chiclet-style (minimum)
14. Printer, Scanner, Fax, Copy……HP Envy 5660 Wireless, or equivalent

15. Printer Ink Cartridges…….One of each color.

2.04 FIBER OPTIC NETWORK INTERFACE MODLUE

A. Furnish DIN rail mount fiber-optic network interface module for SCADA computer. Unit shall be Phoenix Digital Model OCX-ETF-85-R-D-ST-ACV-4A1 or equivalent. Installation shall include all Fiber-Optic cable terminations, Ethernet patch-cables, and all appurtenances in order to provide a fully functional interface between the SCADA computer and fiber-optic network. Supply power shall be 120 VAC. Include suitably sized metal or non-metallic housing.

2.05 SECURITY

A. The Mattoon CSO facility SCADA system shall be able to be viewed and manipulated by the existing Mattoon Waste Water Treatment Facility SCADA system. This will be accomplished by both facilities having internet services (provided by the owner) that will allow the WWTP SCADA computer to VPN to the CSO SCADA computer. In order to provide a secure connection, provide and program a Firewall or any other devices that will not allow unwanted users access to the SCADA systems.

2.06 SCADA SOFTWARE

A. One (1) SCADA software packages required. See Section 16903 Programmable Logic Controllers for PLC control descriptions. SCADA software functions are to include the following:

1. Communicate with the PLC's provided under "Programmable Logic Controllers", over the respective Network.
2. Read status of PLC discrete Inputs & Outputs and display on graphic screens. Show changes of state, on equipment such as pumps & valves, as a graphic symbol color change. Provide graphic symbols, for pushbuttons and selector switches, to operate discrete devices from the computer screen.
3. Read PLC analog input values and convert to engineering units. Display value changes, such as tank levels, in dynamic graphic & numeric format.
4. Write set point values entered on the SCADA computer to the PLC. Display bar graphs showing actual and set point values. Provide slider symbols to adjust set points from the computer screens.
5. Log values from the PLC as described in "Programmable Logic Controllers".
6. Log, display, annunciate and print alarms with date & time of occurrence. Display active, acknowledged and corrected alarms in different colors.
7. Print reports every 24 hours (daily), on the first of each month (monthly) or on command.
8. Provide graphic screens representing different parts of the treatment system, such as, pumps, chemical feeds, analysis instruments, generator, chemical storage, etc.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Do not install products until major construction is complete, building interior is enclosed and heated, and workstation area in control room is completed.

C. Connect input and output devices as indicated on the drawings.

D. Configure SCADA software as described in "Programmable Logic Controllers" and listed in Part 4 of this section.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of "Quality Control and Testing", listed under paragraph 1.02.

B. Perform operational testing on control systems to verify proper operation and field wiring connections.

3.03 MANUFACUTERER'S FIELD SERVICES

A. Prepare and start systems under provisions of "Starting and Adjusting", listed under paragraph 1.02.

3.04 DEMONSTRATION

A. Provide systems demonstration under provisions of "Starting and Adjusting" listed under paragraph 1.02.

B. Demonstrate operation and configuration of SCADA hardware and software.

C. Provide eight (8) hours of instruction each for up to six (6) people, to be conducted at project site by the manufacturer's representative.

PART 4 SCADA SOFTWARE CONFIGURATION

4.01 GRAPHICS SCREENS - CONFIGURE GRAPHICS SCREENS TO REPRESENT THE CSO FACILITY AS FOLLOWS:

A. Overview (Map)

1. Create Overview screen to be used as the home or main screen. This would be a map of the area showing the on-site CSO Facility generally in plan view.
2. The operator shall be able to go into further areas of the facility by clicking the mouse on an area representing the treatment plant on the map.

B. Power Distribution (may be included on Overview Screen)

Create a screen showing a plan view of the facilities with respective areas labeled and links to other screens. Include the following as a minimum:

1. Automatic Transfer Switch

   a. On Utility Supply-“Normal” (ZSL-100)
   b. On Generator Supply-“Emergency” (ZSH-100)

C. Plant Water (May be included on Overview Screen)
Create a screen showing a representation of the plant water system.

1. Indicate a General Alarm

D. CSO Screening Facilities: Create a screen showing a plan view of the facilities with the respective areas labeled and links to other screens. Include as a minimum:

1. Include the following numeric displays

   a. Channel Water Level (LIT-101)

      i. Water Level in feet
      ii. Level of Screens both Starting (Adjustable)
      iii. Level of Screens both Stopping (Adjustable)
      iv. Gallons of Effluent (calculated) per level and duration over Overflow Weir.

2. Screen Drive (Typical of two)

   a. Screen “Sheer Pin Tripped” (ZS1-101, ZS1-102)
   b. Screen “E-STOP” (YI-101, YI-102)
   c. Screen “Overload” (YA-101, YA-102)
   d. Screen “Running” (JIS-101, JIS-102)

3. Gates: First Flush Tank and Pump Station
(See I/O List for Loop Numbers indicated by “***”)

   a. Gate in “Opened Position” (YIO-***)
   b. Gate in “Closed Position” (YIC-***)
   c. Gate control “Modulate” (ZC-***)
   d. Gate “Position” (ZI-***)
   e. Gate in “Alarm” (YA-***)

   The operator shall be able to open and close gate to a percent open from the SCADA system.

E. First Flush Tank: Create a screen showing a plan view of the facilities with the respective areas labeled and links to other screens. Include the following information for each of the Influent Pumps as a minimum:

1. Include the following numeric display:

a. Tank Water Level in feet (LIT-201)
b. Level of Mixers Start (Adjustable)
c. Level of Lead Blower Start (Adjustable)
d. Level of Lag Blower Start (Adjustable)
e. Level of Pump Sta. Gate Open/FFT Gate Close (Adjustable)

2. Mixer #1, 2, 3, 4
(See I/O List for Loop Numbers indicated by ***)

a. In “Auto” Mode Selected (HS-***)
b. In “Hand” Mode Selected (HS-***)
c. “Running” (JIS-***)
d. Motor “Overload” (YA-***)
e. “ON/OFF” Control (YC-***)
f. Indicate the water level in feet as to when the mixers will turn on and allow the height to be operator adjustable.

3. Blower #1,#2
(See I/O List for Loop Numbers Indicated by ***)

a. “ON/OFF Control” (JC-***)
b. “Running” (JIS-***)
c. VFD “Fail” (JAS-***)
d. VFD “AUTO” Mode Selected (HS-***)
e. VFD “HAND” Mode Selected (HS-***)
f. Speed Control “Modulate” (SC-***)
g. Running “Speed” Feedback (SI-***)
h. E-STOP (HSS-701)
i. Indicate the water level in feet as to when the mixers will turn on and allow the height to be operator adjustable.

F. Influent Pump Station: Create a screen showing a plan view of the facilities with the respective areas labeled and links to other screens. Include the following information for each of the Influent Pumps as a minimum:

1. Influent Pumps #1, 2, 3, 4
(See I/O List for Loop Numbers indicated by “***”)

a. “ON/OFF Control” (YC-***)
b. “Running” (JIS-***)
c. In “Auto” (HS-***)
d. In “Hand” (HS***)
e. Motor “Overload” (YA-***)
f. Seal Leak (YA-***)
g. High Temp (YL-***)

2. Include the following numeric displays:

a. Influent Wet Well Level (LIT-301)

i. Water Level
ii. Level of Lead Pump Start (Adjustable)
iii. Level of Lag Pump Start (Adjustable)
iv. Level of Lag Pump Start (Adjustable)
v. High Level Alarm (Adjustable)
vi. Low Level Alarm (Adjustable)

3. Control Valve for Draining

a. Call to “Open” (ZO-301)
b. Call to “Close” (ZC-301)
c. In “Open” Position (YIO-301)
d. In “Closed” Position (YIC-301)
e. Valve “Fail/Alarm” (YA-301)

G. Foul Sewer-Drain Pump Station

1. Include the following numeric displays:

a. Influent Wet Well Level (LIT-301)

i. Water Level
iii. Level of Lead Pump Start (Adjustable)
iv. Level of Lead Pump Stop (Adjustable)
v. High Level Alarm (Adjustable)

2. Foul Pumps #1, #2,
(See I/O List for Loop Numbers indicated by “***”)

a. “ON/OFF Control” (YC-***)
b. “Running” (JIS-***)
c. In “Auto” (HS-***)
d. In “Hand” (HS***)
e. Motor “Overload” (YA-***)
f. Seal Leak (YA-***)
g. High Temp (YL-***)

3. Gate to Drain First Flush Tank (G-801)

a. Call to “Open” (ZO-801)
b. Call to “Close” (ZC-801)
c. In “Open” Position (YIO-801)
d. In “Closed” Position (YIC-801)
e. Valve “Fail/Alarm” (YA-801)

4. Control Valve to Drain to Riley Creek PS Wet Well (CV-801)

a. Call to “Open” (ZO-801)
b. Call to “Close” (ZC-801)
c. In “Open” Position (YIO-801)
d. In “Closed” Position (YIC-801)
e. Valve “Fail/Alarm” (YA-801)

5. Gate to Send to First Flush Tank (G-802)

a. Call to “Open” (ZO-802)
b. Call to “Close” (ZC-802)
c. In “Open” Position (YIO-802)
d. In “Closed” Position (YIC-802)
e. Valve “Fail/Alarm” (YA-802)

H. Chemical Feed

1. Control Valve for Draining (CV-501, CV-502, CV-503, CV-504, CV-505) (See I/O List for Loop Numbers indicated by “***”)

a. Call to “Open” (ZO-***)
b. Call to “Close” (ZC-***)
c. In “Open” Position (YIO-***)
d. In “Closed” Position (YIC-***)
e. Valve “Fail/Alarm” (YA-***)

2. Include the following numeric displays:

a. Influent Tank Level (LIT-501)

i. Water Level
ii. Level of Chlorinator On (Adjustable)

b. Effluent Weir Level (LIT-502)

i. Water Level
ii. Gallons of Effluent per level and duration over Weir.
iii.

c. Chlorine Tank Weight (Tank1, Tank 2 and Tank 3) (See I/O List for Loop Numbers indicated by “***”

i. Weight in pounds (WI-***)
ii. Low Level Alarms Each

3. Chlorine Leak Detector

a. Alarm of leak detection (YA-601)

4. Plant Water Valve (CV-602)

a. Indicate open or closed.

5. Chlorinator (U-601 and U-602)

   a. Indicate feed rate for 3 levels (Adjustable)

6. Vacuum Switch

   a. Indicate “High Vacuum” (YA-604A)
   b. Indicate “Low Vacuum” (YA-604B)

7. Chlorine Analyzer

   a. Indicate Residual of Chlorine (SC-603)

8. Control Valve Switching between Plant Water and Dechlor Chamber

   a. Valve in Plant Water Position
   b. Valve in Dechlor Position

9. Sample Pump

   a. “START/STOP” Control (JC-603)
   b. Speed Control “Modulate” (SC-603)
   c. Running “Speed” Feedback (SI-603)
   d. Flow Fail Alarm (FI-603)
   e. Tube Fail Alarm (FA-603)

10. Dechlorination Pumps (P-602, P-603)
    (See I/O List for Loop Numbers indicated by “***”)

    a. “START/STOP” Control (JC-603)
    b. Speed Control “Modulate” (SC-603)
    c. Running “Speed” Feedback (SI-603)
    d. Flow Fail Alarm (FI-603)
    e. Tube Fail Alarm (FA-603)

11. Bisulfate Tote

    a. Weight in Pounds
    b. Low Level Alarm

12. Fire Sprinkler Piping

    a. Drain Valve Tamper Switch Alarm
    b. Flow Switch Alarm

c. RPZ-1 Tamper Switch Alarm
d. RPZ-2 Tamper Switch Alarm

13. Liquid Containment Area

a. Float Switch Alarm

I. Existing Riley Creek Pump Station: Create a screen showing a plan view of the facilities with the respective areas labeled and links to other screens. Include as a minimum:

1. Riley Creek Screen
   a. Indicate Screen Channel High Level (LS-901)
   b. Indicate Screen Running
   c. Indicate Screen Sheer Pin Fail

2. Indicate the following numeric displays

   a. Wet Well Level
   b. Small Pump On (Adjustable)
   c. Small Pump Off, 1st Large Pump On (Adjustable)
   d. 2nd Large Pump On (Adjustable)
   e. 3rd Large Pump On (Adjustable)
   f. 3rd Large Pump Off (Adjustable)
   g. 2nd Large Pump Off (Adjustable)
   h. 1st Large Pump Off (Adjustable)
   I Small Pump Off
   j. Low Level Alarm (Float LS-901)
   k. High Level Alarm (Float LS-902)

3. Riley Creek Pump #1,#2, #3, #4
   (See I/O List for Loop Numbers Indicated by ***)

   a. “ON/OFF Control” (JC-***)
   b. “Running” (JIS-***)
   c. VFD “Fail” (JAS-***)
   d. Speed Control “Modulate” (SC-***)
   e. Running “Speed” Feedback (SI-***)
   f. “Overtemp” (JAS-***)

4. Discharge Valve #1, #2, #3, #4
   (See I/O List for Loop Numbers Indicated by ***)

   a. Indicate Position (ZI-***)

5. Normal Solenoid #1, #2, #3, #4
   (See I/O List for Loop Numbers Indicated by ***)

a. Indicate Open Position (ZO-***)

6. Emergency Solenoid #1, #2, #3, #4
(See I/O List for Loop Numbers Indicated by ***)

a. Indicate Closed Position (ZC-***)

7. Pressure Switch #1, #2, #3, #4
(See I/O List for Loop Numbers Indicated by ***)

a. Indicate High Pressure Alarm (PS-***)

8. Force Main
a. Indicate Gallon per Hour (FIT-901)

9. Provide the following additional Alarms

a. Discharge Valve Fail (from PLC)
b. Control Panel Power Fail from UPS
c. Phase Failure from (Control Panel)
d. Control Panel Low Temp from Control Panel
e. Pump Station Flooding from Existing Float
f. Seal Water Tank Low from Existing Float
g. Air Compressor Fail from Control Panel

4.02 SCREEN DEVELOPMENT GENERAL GUIDELINES

A. Motors shall change color when in operation (Red – Stopped; Green – Running; Grey when taken out of service as indicated by local H-O-A switch in any other position other than “Auto”. Display cumulative runtime in hours and tenths.

B. For all motors with VFD’s, near each motor symbol, display the running speed in percent (0-100%). Include a graphical selector switch, or other graphical to show if the remote H-O-A switch is in the “Auto” position. Indicate if the speed is in “Manual” or “Automatic” mode of operation. Include a pop-up box for the operator to enter a speed set point (0-100%) when in “Manual” mode.

C. Show dynamic level in tanks as well as numeric value (0-100%, or 0-“x feet”, as applicable).

D. Indicate the status of power source (“on-utility” or “on-generator”), generator run-time. Log the running and on-line hours for both utility and generator once every 24 hours.

4.03 HISTORICAL DATA COLLECTION & TRENDING

A. Log Influent Channel Level (LIT-101) once every 10 min. Trend

B. With (LIT-101) Trend number of gallons (as calculated by the duration and height of water above the Screen Overflow Level) that goes out the overflow weir.

C. Log First Flush Tank Level (LIT-201) once every 10 min. Trend

D. Log Influent Pump Station Level (LIT-301) once every 10 min. Trend

E. Log Foul Sewer Pump Station Level (LIT-801) once every 10 min. Trend

F. Log Chlorine Tank Influent Level (LIT-501) once every 10 min. Trend

G. Log Outfall Weir Level (LIT-502) once every 10 min. Trend

H. Log Chlorine Analyzer (SC-603) once every 10 min. Trend

I. Log Riley Creek Pump Station Wet Well Level (LIT-901) once every 10 min. Trend

J. Log Riley Creek Force Main Flowrate once every 10 min. Trend

4.04 REPORTS

A. Generate the following reports:

1. Create EPA required reports and Operation & Maintenance reports using the “OPS WIN 32” & “Job Cal” Software.

4.05 ALARM SOFTWARE

A. Configure the Alarm Annunciation Software

1. Coordinate with the Owner & Engineer for specific alarms and individuals to contact when alarms occur during off-hours. Configure the alarming software to dial out, page, beep, e-mail, fax, etc. as appropriate for facility operations.

END OF SECTION 16905

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Contractor shall note that this section shall be considered a Supplement to testing requirements outlined or described in other sections of these specifications.

1.02 WORK INCLUDES

A. Extent of Work as required by the Drawings and these Specifications

1.03 RELATED WORK

A. Specified elsewhere:

1. Section 16010 - General Electrical Requirements
2. Section 16123 - Building Wire and Cable
3. Section 16160 - Cabinets and Enclosures
4. Section 16170 - Grounding and Bonding
5. Section 16185 - Mechanical Equipment Wiring
6. Section 16220 - Motors (600 Volts and below)
7. Section 16441 - Enclosed Switches
8. Section 16481 - Enclosed Motor Controllers

1.04 QUALITY ASSURANCE

A. Regulatory Requirements

1. Governing Codes:

a. NFPA 70 – National Electrical Code (most current issue)

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

1. Test Reports:

a. Test of entire electrical system as noted herein. Submit to the Engineer in triplicate.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish all equipment, tools, manpower, and labor to perform specified testing.

PART 3 EXECUTION

3.01 TESTING

A. After wires and cables are in place and connected to devices and equipment, the system shall be tested for short circuits, improper grounds, and other faults. When fault condition is present, the trouble shall be rectified, then re-tested. Where cable is found defective or damaged, it shall be removed and replaced in entirety; do not field repair. Cost for correction shall be considered incidental to the project.

B. All wiring devices and electrical apparatus furnished under this contract, when ground or shorted on any integral “live” part, shall be removed and the trouble rectified by replacing all defective parts and materials. Cost of correction is considered incidental to the project.

C. All feeder cables and other power distribution apparatus shall have a Megger resistance test conducted to determine that insulation resistance is not less than that recommended by the manufacturer, or as noted below.

Unless otherwise recommended by the manufacturer, insulation resistance testing shall meet or exceed the following on 600 Volt equipment utilizing 500 Volt resistance test instrument:

Conductors .....50 Meg-Ohms
Motors……5 Meg-Ohms
Switchboards, MCC’s and Panelboards.....25 Meg-Ohms
Power Transformers .....5 Meg-Ohms

D. Contractor shall furnish all tests and shall provide all test equipment, meters, instruments, cable connections or apparatus necessary for performing tests as specified herein. All costs for testing shall be considered incidental to this item and will not be paid for separately.

E. Examine connections to equipment for proper phase relationships. Rotate phase conductors as necessary in order to correct.

F. All motors shall be tested under Article 16220. All motors shall be tested for correct direction of rotation. Run tests on all motors shall be tested for correct direction of rotation. Run tests on all motors and verify that proper overload devices have been installed. Coordinate this task with motor supplier.

G. Testing of Ground System

1. Each and all grounded cases and metal parts associated with electrical equipment shall be tested for continuity of connection with the ground bus system by the Contractor in the presence of the Engineer or his representative.
2. All grounding electrode conductors brought in from the ground field shall be tested for satisfactory continuity and by resistance measurement between the electrical equipment ground bus and the ground field. The grounding path shall not exceed 0.010 ohms.
3. Each Ground Field shall be tested for resistance to earth a “three-terminal” or “fall-of-potential” test as described in IEEE Standard #81. As an alternate, a specially designed clamp-on instrument such as AEMC Model 3710 or 3730 may be used if found acceptable to the engineer. Based upon measured field data, the Contractor shall calculate the ground field resistance and furnish record copies to the Engineer and Owner for record. In no case shall the ground field resistance exceed 25 ohms. If the resistance is found to be higher than 25 ohms, one additional rod shall be driven with a minimum separation equal to the length of the ground rod used and connected in parallel with the rod under test.
4. Exterior ground field resistance testing shall not be measured during unusually wet weather and should be performed during normal weather and soil conditions. Any tests incorrectly performed or not performed to the satisfaction of the engineer will be repeated. Costs for all such re-testing shall be considered incidental to the project.
5. All specified maximums and minimums of this specifications must be met. Complete test records of all tests shall be made and shall show resistance values obtained and calculations of same, showing method of test and calculation.

3.02 CORRECTION OF DEFECTS

A. When tests disclose any unsatisfactory workmanship or equipment furnished under this contract, correct defects and retest. Repeat tests until satisfactory results are obtained.

B. When any wiring or equipment is damaged by tests, repair or replace such wiring or equipment. Test repaired items to ensure satisfactory operation.

END OF SECTION 16950