SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work to be performed under this Division shall include all labor, materials, equipment, transportation, construction plant and facilities necessary to provide a complete and satisfactory system ready to use. Examine all drawings and all sections of specifications to ascertain to what extent other contracts affect work.

1.02 QUALITY ASSURANCE

A. Qualifications of contractor: All materials and equipment shall be new and all work shall be executed with maximum speed consistent with current accepted trade practices. Furnish materials and equipment promptly after authorization to proceed, and proceed with work in progress with contractor on project. Perform all work included in contract in a manner that will not cause interferences or delays to, or interfere with, progress of contractor.

B. Requirements of regulatory agencies:
   1. Permits: Arrange and pay for all permits, inspections and utility connections required.
   2. Referenced standards:
      a. Comply with specified codes and standards. If conflict exists between codes or standards and drawings, project manual or addenda requirements, request clarification from Architect/Engineer.
      b. Conform to installation rules and regulations of standards listed including all subsequently published amendments thereto issued prior to date of bidding documents.
      c. Conform to requirements of all local, state and federal agencies, which have authority over this project. Include all items of labor and material required to meet such requirements regardless of failure to specify in project manual or indicate on drawings each individual item.
      d. All equipment, apparatus and systems shall be rated, tested, fabricated and installed with applicable industry standards.
      e. Applicable portions of latest editions of following standards form a part of this project manual to same force and effect as if repeated herein.
         1) American Society for Testing Materials (ASTM)
         2) American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
         3) American Society of Mechanical Engineers (ASME)
         4) American Water Works Association (AWWA)
         5) National Electrical Code (NEC)
         6) National Electric Manufacturers Association (NEMA)
         7) National Fire Protection Association (NFPA)
         8) Underwriters Laboratories, Inc. (UL)
         9) Environmental Protection Agency (EPA)
         10) Department of Public Health (DPH)
         11) Iowa Plumbing Code, Current Edition

1.03 COORDINATION & SUBMITTALS

A. Contractor shall resolve all conflicts before actual installation begins. Order of space preference throughout building shall be:
   1. Recessed light fixtures
   2. Duct work
   3. Soil, waste, vent and storm piping
   4. Domestic water piping
   5. Sprinkler piping
   6. Electrical conduit
   7. Exception: Plumbing lines below or behind plumbing fixtures shall have precedence over all other work. Electrical conduit above or below switchgear, panel boards and control panels shall have precedence over all other work. Do not install any fluid conveying piping over electrical or elevator equipment.
   8. Submit following Certifications:
      a. Medical Air and Vacuum (Brazing).

1.04 WARRANTY

A. Guarantee all work including labor, material and equipment for this project for a period of one (1) year from date of acceptance by Owner.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

A. In order to become familiar with scope of work involved, visit existing site, before submitting bid, and carefully examine existing condition in order to have full knowledge and understanding of conditions and restrictions affecting performance of work required. Include in bid all work which is reasonably inferred by contract drawings and specifications, whether specifically shown or not, as a result of existing conditions, construction, irregularities and interferences which may affect work. No additional compensation will be considered for misunderstanding conditions to be met.

B. Layout shown on drawings is necessarily diagrammatic but shall be followed as closely as other work will permit. Changes from these drawings required to make this work conform to building construction shall be made only with prior written approval of Architect/Engineer. All proposed changes shall be shown on shop drawings. All measurements shall be verified by actual observation and all work shall fit in place meeting approval of Architect/Engineer.

C. Contractor shall provide openings required in new and existing construction that may be necessary for installation of mechanical work and all patching and workmen competent in trade required, at expense of contractor shall do repairing. Contractor shall be responsible for arranging work so that minimum cutting will be required. All rubbish and excess materials involved in such cutting shall be promptly removed from site and disposed of by contractor. Cutting through floor or roof systems or load bearing walls shall be done only with prior written approval of Architect/Engineer so as to avoid damaging structural system.

D. Sequencing, scheduling:
   1. Confer with contractor regarding location and size of pipes, equipment, ducts, openings and special architectural treatments in order that there may be no interferences between installation or progress of work of contractor on project. Order of space preference shall be as listed above.

2. In case of interconnection of work of two or more contractors, verify at site or on shop drawings all dimensions relating to such work. All errors due to failure to so verify any such dimensions shall be promptly rectified.
3. All line voltage wiring and final connections to complete mechanical systems shall be provided by Electrical Contractor. All electrical conduit, wire, and connections relating to mechanical equipment controls and all wiring associated with starter holding coils, shall be responsibility of contractor installing mechanical equipment unless otherwise indicated on drawings. Contractor installing mechanical equipment shall be responsible for magnetic motor starters where such starters are part of control package of equipment supplied. All other starters shall be furnished and installed by Electrical Contractor. Contractor installing starters that are part of a control package shall coordinate starter requirements with Division 26 of specifications.
4. Access panels, in walls or ceilings, required for access and maintenance (i.e., valve or control instrument mounted in a pipe) shall be provided by respective contractor. Access panels are not required in areas where ceiling system is lay-in tile; however, sufficient space must be available in and through ceiling system to allow maintenance and adjustment of dampers, and cleaning of coils as necessary, or a suitable access panel shall be provided for that purpose. Access panels shall be approximately 15 inches by 18 inches wherever possible and shall be provided with flush trim and an allenkey operated camlock fastener. Karp, Milcor, or Bilco shall manufacture panels.
5. Items of equipment may be specified in singular however, provide and install number of items of equipment as indicated on drawings and as required for a complete system.
6. Equipment and devices furnished and installed by contractors, which have factory prime coat, or final surface finish shall be replaced, repaired or refinished if defective or damaged during installation.
7. Arrange all work so a minimum period of interruption or outages will occur in temporary or permanent transfer of services as required for all mechanical revisions. Not less than 48 hours notification to Owner shall be required before approval will be granted for any disruption of gas, water, or sanitary services. Outage request shall include extent of work to be done, length of outage time required, and time at which outage is to begin. No allowance will be made for extra payment as a result of scheduling “overtime” work necessary to perform before or after normal or regular working hours to accomplish work intended.
8. Submit a “Sequence of Work Schedule” in respect to all temporary and permanent utility and service cutovers after final determination. This schedule shall be submitted for approval to Architect/Engineer. Submittal shall designate priority order, service or utility affected, date of cutover, and time of day to start and finish.

3.02 CLEANING

A. Upon completion of contract all remaining materials and rubbish shall be removed from building and premises and work areas shall be left clean and free from stains, mortar, paint spots, etc.

B. All switches, 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 presence of Owner's designated representative to insure that their function and purpose is understood.

C. Upon completion of work, put systems into service maintaining responsibility for equipment during all testing operations including lubricating and turning on and off of such apparatus.

END OF SECTION

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SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tags.

B. Pipe Markers.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.03 SUBMITTALS

A. Product Data: Valve tags.

B. Product Data (Pipe Markers): Provide manufacturers catalog literature.
1. Domestic Cold Water.
2. Domestic Hot Water.
3. Drains.

PART 2 PRODUCTS

2.01 TAGS

A. Acceptable Products:
1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Brady Corporation: www.bradycorp.com.
3. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
4. Seton Identification Products: www.seton.com.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color.
1. Tag Size: 1½" square, minimum.

C. Metal Tags: 304 Stainless Steel with smooth edges.
1. Tag size: 2-1/8 inch x 3-3/8 inch.
2. Embossed letters: 3/16 inch.
3. Justified text.

2.02 PIPE MARKERS

A. Acceptable Products:
1. Brady Corporation: www.bradycorp.com.
2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
3. MIFAB, Inc.: www.mifab.com.
4. Seton Identification Products: www.seton.com.

B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

C. Color: Conform to ASME A13.1.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with 0.032 inch diameter stainless steel aircraft lockwire.
   1. Cut length of lockwire and fold in half.
   2. Thread wire through label and form small loop capturing label at center of wire.
   3. 3Thread wire ends around component so label can be easily read from walkway.
   4. Mate tag ends of wire and clamp with pliers.
   5. Twist lockwire, cut off excess wire, and bend wire end over to prevent exposed sharp edges.

C. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

D. Install plastic pipe markers in accordance with manufacturer's instructions. At a minimum: install adjacent to valves and major pieces of equipment and once every 50 ft of pipe runs.

3.03 IDENTIFICATION

A. Valve Tags: Provide valve tags for all valves.

B. Pipe Markers: Provide pipe markers at access panels and above ceiling.
   1. Domestic Cold Water.
   2. Domestic Hot Water.
   3. Drains.

END OF SECTION

SECTION 22 07 19
PIPE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

1.02 REFERENCE STANDARDS

A. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2004.

B. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2004.

C. ASTM C 533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2009.

D. ASTM C 534/C 534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2008.

E. ASTM C 795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008.

F. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.

G. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. Product Data: Provide product description including thermal characteristics.
   1. Insulation.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver material to site in factory fabricated containers with manufacturer's stamp or label, showing fire and smoke hazard ratings of products.

B. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

C. Store material in original wrappings and protect from weather and construction traffic.

D. Protect against sun, dirt, water, chemical and mechanical damage.

E. Remove damaged insulation from project site. Do not install.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.

2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Armacell International: www.armacell.com.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 1; use molded tubular material wherever possible.
   1. 'K' value: 0.25 at 75 °F.
   2. Minimum Service Temperature: -40°F.
   3. Maximum Service Temperature: 220°F.
   4. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Remove existing damaged insulation as required to install new insulation.

B. Verify that surfaces are clean and dry, with foreign material removed

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. For hot piping conveying fluids 140°F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

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: Hydrous calcium silicate insulation or phenolic, rigid premolded insulating material (ASTM C1126 Type III) suitable for the planned temperature range.

F. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

3.03 INSULATION THICKNESSES

A. Domestic Cold and Hot Water: 1".

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SECTION 22 10 05
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.

1.02 REFERENCE STANDARDS

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2005.

B. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

C. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005) (ANSI B16.18).

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers; 2006.

G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2001.

H. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2004 (ANSI/ASME B31.9).

I. ASTM A 53/A 53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2007.

J. ASTM A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2007.

K. ASTM B 32 - Standard Specification for Solder Metal; 2004.

L. ASTM B 42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2002.

M. ASTM B 88 - Standard Specification for Seamless Copper Water Tube; 2003.

N. ASTM B 306 - Standard Specification for Copper Drainage Tube (DWV); 2002.

O. ASTM C 564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2003a.

P. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2004 and errata.

Q. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2007 (ANSI/AWWA C111/A21.11).

R. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2002 (ANSI/AWWA C151/A21.51).

S. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).

T. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2005.

U. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2004.

V. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2005.

W. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1996.

1.03 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

B. Project Record Documents: Record actual locations of valves.

1.04 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Valves shall be manufactured in the United States of America

B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of Iowa plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPING, ABOVE GRADE

Contractor Option – PVC is allowed

A. Cast Iron Pipe: ASTM A 74, service weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C 564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. Copper Tube: ASTM B 306, DWV.
   1. Fittings: ASME B16.29, wrought copper, or ASME B16.32, sovent.
   2. Joints: ASTM B 32, alloy Sn50 solder.

D. Steel Pipe: ASTM A 53/A 53M Schedule 40, galvanized.
   1. Cast Iron Fittings: ASME B16.1, flanges and fittings; ASME B16.4, threaded fittings.
   2. Malleable Iron Fittings: ASME B16.3, screwed type.
   3. Mechanical Grooved Couplings: Malleable iron, galvanized.

2.02 DOMESTIC WATER PIPING, ABOVE GRADE

Contractor Option – PEX is allowed

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B 32, alloy Sn95 solder.

2.03 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3" and Over:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.04 VALVES IN WATER LINES

A. Check Valves (2.5 Inches Diameter and Smaller): Class 125 # SWP, 200 # WOG, horizontal swing check, body and cap shall be of ASTM B62 cast bronze, TFE disc, integral bronze seats, MSS SP-80.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. 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. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.

H. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

I. Provide support for utility meters in accordance with requirements of utility companies.

J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

K. Install valves with stems upright or horizontal, not inverted.

L. Install water piping to ASME B31.9.

3.03 EXECUTION

A. Workmanship
1. Piping shown on Drawings shall be installed complete and shall be of size shown on Drawings. When a size is not indicated, request pipe size from Engineer.
2. All vertical offsets shall have a drip leg full size of pipe and a minimum of 6 inches long.
3. All piping shall be installed parallel or perpendicular to the building construction.
4. All piping shall be installed to allow for expansion.
5. Perform all work in accordance with State of Iowa Plumbing Code.

B. Joints
1. All pipe shall be reamed to full pipe diameter before joining.
2. Joints may be sweat or screwed.
3. Screwed joints shall be made with standard pipe thread and approved compound applied to male thread only.
4. Use only shaped nipples, welding laterals, or saddle fittings for intersection welding of branches to mains.
5. Valves and specialties shall have screwed or flanged joints.

C. Testing
1. Entire system shall be tested per international plumbing code.
2. Owner or Owner's representative to be present for all testing and provide final signature of acceptance.
3. See system startup.

D. Sectionalized
1. Pipe may be tested a section at a time in order to facilitate construction. Contractor will provide necessary fittings to accomplish testing.

E. Protection
1. Piping shall be protected at all times from dirt and moisture.
2. During storage on job site or construction, keep pipe ends plugged or capped to prevent dirt or moisture from entering the pipe.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 2 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

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SECTION 22 40 00
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water Closets.

B. Floor Drains.

C. Lavatories.

D. Lavatory Faucets.

E. Bath Tubs.

F. Combination Bath/Shower Valves.

G. Prefabricated Fiberglass Shower Inserts

H. Shower Valves.

I. Water Hammer Arrestors.

1.02 REFERENCE STANDARDS

A. ASME A112.18.1 - Plumbing Supply Fittings; American Society of Mechanical Engineers; 2005.

1.03 SUBMITTALS

A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in the University of Iowa's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.01 WATER CLOSET, ADA (WC-1)

A. Accessible, floor mounted, tank type, white vitreous china, siphon jet, elongated bowl, 12" rough-in, float valve with vacuum breaker, chrome-plated trip lever, insulated tank liner, 1.6 gallons per flush (maximum) in compliance with Energy Policy Act of 1992.

White, open front, injection molded, solid anti-microbial plastic, self-sustaining hinge with stainless steel mounting bolts and nuts.

Provide quarter-turn 3/8" chrome-plated heavy brass angle supply with loose-key stop and chrome-plated soft copper supply line.

B. Mount top of seat at 17"-19" above finished floor. Field verify equipment requirements and rough-in locations.

C. Acceptable water closet manufacturers:
   1. Zurn Model Z5550
   2. Kohler Model K-3979
   3. Crane Model 3814,
   4. Eljer Model 091-2175
   5. Gerber Model 21-718
   6. Toto Model CST744SL
   7. Approved equivalent.

D. Acceptable water closet seats:
   1. Bemis 3155C
   2. Church 3155C,
   3. Beneke 533PC,
   4. Olsonite 95
   5. Approved equivalent.

2.02 FLOOR DRAIN (FD-1)

A. Cast iron body, nickel bronze adjustable top, 6" Square, 2" bottom outlet, flashing collar, surface membrane clamp.

B. Acceptable manufacturers:
   1. Zurn Z-415
   2. Smith 2005
   3. Wade 1100
   4. Josam 30000
   5. Watts FD-100
   6. Mifab F1100
   7. Approved equivalent.

2.03 LAVATORY, WALL-MOUNT, ADA (L-1)

A. Accessible, wall mounted, white vitreous china, 20"x18", 4" high contoured backsplash, single faucet hole, drilled for concealed arm carrier.

B. Provide open grid strainer with tailpiece, 17 gauge chrome plated brass offset trap assembly (ADA compliant), P-trap and supplies with loose key stops. Provide closed cell insulation with vinyl cover on trap and stop valves and supply piping. Cover must be antimicrobial.

C. Provide white pipe wrap on all exposed piping under lavatories.
   1. Acceptable manufacturer:
      a. TrueBro Lav-Gard
      b. Approved equivalent.

D. Acceptable P-Traps:
   1. Eljer.
   2. American Standard
   3. Kohler: Model #K-8998, basis of design.
   4. Approved equivalent.

2.04 LAVATORY FAUCET (F-1)

A. Single handle mixing faucet, brass construction, chrome-plated finish, conventional spout with aerator, washerless push-pull lever handle with supplies for single hole, ceramic disc cartridge, perforated grid strainer with 1-1/4" 17 gauge tailpiece. Maximum flow to be 0.5 gpm in compliance with Energy Policy Act of 2005 and ASME/ANSI Standard A112.18.1.

B. Acceptable Manufacturers:

1. Delta 22C631
2. American Standard 6114.116.002
3. Chicago Faucet 2200-E2805ABCP
4. Moen 8417
5. Zurn Z822200-XL
6. Approved equivalent

C. Single master thermostatic mixing valve arrangement for tempered water control, all bronze/brass construction, rough brass finish, union inlets with strainers and check stops. Unit to mix 120 degree F hot water supply and 55 degree F cold water supply for 110 degree F outlet.

D. Recessed 18 gauge stainless steel cabinet with 16 gauge locking door to enclose valve, inlet stops, and outlet valves.

E. Provide field adjustment by factory authorized representative. Unit shall be ASSE 1017 listed and approved. Valve shall comply with Federal Act S.3874.

F. Acceptable mixing valve manufacturers:

1. Leonard XL-LF Series
2. Bradley TMV Series
3. Lawler 800 Series
4. Powers LFMM430 Series
5. Symmons Tempcontrol Series 7
6. Acceptable equivalent.

2.05 BATH TUB (T-1)

A. Acceptable Manufacturers:

1. AMERICAN STANDARD 2696
2. KOHLER K-505
3. Approved equal.

B. Bathtub - Cast iron construction, white enamel finish, 60"x32"x16" (nominal), slip-resistant bottom, left or right hand as shown on drawings.

C. Bath drain - Pop-up type, brass construction, polished chrome finish, integral overflow and operating lever, all operating parts removable for cleaning, 1-1/2" 17 gauge brass tailpiece and "P" trap.

2.06 COMBINATION TUB/SHOWER VALVE (TV-1)

A. Acceptable Manufacturers:
1. Moen Commercial 8343
2. Symmons 1-217-FS
3. American Standard 1662.223

4. Delta R10700-UNWS/T13H903/52667-15-BG
5. Leonard PAM-II
6. Powers PB417
7. Approved equal.

B. Accessible, single handle pressure balanced mixing faucet, brass or bronze construction, washerless design, off-cold-hot temperature range indicator dial, polished chrome cast metal lever handle, integral check stops, adjustable temperature limit stop, ASSE 1016 listed.

C. Accessories: Chrome-plated brass showerhead with swivel ball joint, chrome-plated brass arm and flange, hand held shower with 69" chrome-plated metal hose and quick disconnect, chrome-plated brass swivel connector, 36" chrome-plated mounting rail, chrome-plated brass supply elbow flange, chrome-plated vacuum breaker with chrome-plated piping and flanges.

D. Install D. Install controls between 26 inches and 29 inches above finish floor. Install bottom of shower head at 78 inches above finish floor. Maximum flow to be 2.5 GPM in compliance with Energy Policy Act of 2005. Set safety limits stop to 110°F discharge.

2.07 PREFABRICATED FIBERGLASS SHOWER INSERT (SH-1)

A. Manufacturers:

1. 1. Best Bath 3CS3838B17T
2. 2. Clarion MP3837LBF34 or MP3837RBF34
3. 3. Aquatic 1363BFS

B. One piece, reinforced fiberglass construction, white gelcoated finish, 36"x36" (nominal), right or left hand as shown on drawings, slip-resistant floor with 2" integral floor drain, 4" nickel bronze strainer, ASTM F-446, in compliance with latest ANSI A117.1 and ADA standards.

C. Fold down phenolic simulated teakwood seat, 1 1/2" 18 gauge type 304 stainless steel horizontal grab bar on back wall and valve wall, 1" diameter stainless steel curtain rod, commercial grade vinyl shower curtain.

D. Grab bar to be mounted with stainless steel nuts and bolts and fastened from the backside of the unit with minimum 3"x3" metal plates. Unit is to be recessed in sub-floor to allow for a maximum curb height of 1/2" or less above finished floor.

2.08 SHOWER VALVE (SV-1)

A. Acceptable manufacturers:

1. Moen Commercial 8342
2. Symmons 1-117-FS
3. American Standard 1662.223
4. Delta R10700-UNWS/T13H323-20
5. Leonard PAM-II
6. Powers PB413-9

B. Shower valve - accessible, single handle pressure balanced mixing faucet, brass or bronze construction, washerless design, off-cold-hot temperature range indicator dial, polished chrome cast metal lever handle, integral check stops, adjustable temperature limit stop. ASSE 1016 listed.

C. Chrome-plated brass showerhead with swivel ball joint, chrome-plated brass arm and flange, hand held shower with 69" chrome-plated metal hose and quick disconnec], chrome-plated brass swivel connector, 36" chrome-plated mounting rail, chrome-plated brass supply elbow flange, chrome-plated in-line vacuum breaker with chrome-plated piping and flanges.

D. Install all controls between 38" and 48" above finished floor in compliance with latest ada standards. Install bottom of showerhead at 72" above finished floor. Maximum flow to be 2.5 gpm in compliance with Energy Policy Act of 2005 and ASME/ANSI standard A112.18.1. Set safety limit stop to 110 degree F discharge.

2.09 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Watts Regulator Company; Model SG: www.wattsregulator.com.
   2. Zurn Industries, Inc: www.zurn.com.

B. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300°F and maximum 250 psi working pressure.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install components level and plumb.

B. Install and secure fixtures in place with wall supports and bolts.

3.02 CLEANING AND ADJUSTING

A. After plumbing fixtures have been installed, 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 premises. All valves and faucets shall be adjusted to suit operating water pressure and all work maintained in clean and proper operating condition until accepted by Architect/Engineer.

B. All fixtures will be caulked at floor and walls using white flexible silicone caulk.

C. Following completion of installation, clean all construction dirt dust, and debris from all plumbing fixtures. Verify that all flow or temperature settings have been made where required and that all necessary electrical connections are powered up.

D. Protect installed products from damage due to subsequent construction operations.

END OF SECTION

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SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers.

1.02 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2007.

B. ASHRAE Std 70 - Method of Testing for Rating Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006.

C. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.03 SUBMITTALS

A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission.

1.04 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Manufacturer Qualifications: Company specializing in manufacturing type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Diffusers, Registers, and Grilles:
1. Titus, basis of design: www.titus-hvac.com.
2. Carnes Company HVAC: www.carnes.com.
3. Krueger: www.krueger-hvac.com.
4. Price Industries: www.price-hvac.com.
5. Metal*aire www.metalaire.com
6. Nailor
7. Tuttle and Bailey.
8. Raymon-Donco.

2.02 RECTANGULAR CEILING DIFFUSERS

A. Basis of design, Titus OMNI.

B. Fabrication: Aluminum with factory off-white enamel finish.

C. Type: Square, panel ceiling diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated.

D. Frame: Hard ceiling type. In plaster ceilings, provide plaster frame and ceiling frame.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.

E. All screws and fastening hardware to be concealed where available. Fasteners exposed to chlorine environment, provide 316L stainless steel hardware.

3.02 SCHEDULES

A. See plan drawings for schedule.

B. Verify plan drawings for all duct connection sizes and ceiling types prior to final selection.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 WORK INCLUDES

A. All labor, materials, equipment, tools and services required to perform all work and services for execution, installation and completion of all electrical work including all parts lists, operating instructions, wiring and control diagrams as shown on the drawings and as specified and completely coordinated with work of all other trades.

B. All supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete electrical installation, although such work is not specifically indicated.

C. Complete, in operative condition and to approval of Architect/Engineer, materials contemplated herein and shown on drawings.

D. Equipment, materials and accessories for electrical systems as shown and noted on the drawings including but not limited to the following:
   1. A complete rough-in system including conduit, outlet boxes, pull boxes, junction boxes, sleeves and hangers.
   2. Complete wiring system.
   3. All cutting and patching.
   4. Wiring devices and coverplates.
      a. Interconnecting power raceway and wiring for specified heating and refrigeration equipment, unless otherwise shown.
      b. Interconnecting power raceway and wiring for specified ventilating equipment, unless otherwise shown.
      c. Starters, controllers and interconnecting power and control raceway and wiring for specified pumps unless otherwise shown.
      d. Flashing and sealing of all raceway roof penetration.

1.02 DELIVERY, STORAGE AND HANDLING

A. Manufacturer to prevent damage during shipment shall suitably package materials. Damaged materials will not be acceptable for use.

B. Store materials on site in clean, dry storage area; when outside, elevated above grade and enclosed with durable watertight wrapping.

C. Handle all materials carefully to prevent damage. Minor scratches, marks or blemishes to finish shall be repaired to satisfaction of Architect/Engineer.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Permits: Arrange and pay for all permits, inspections and utility connections required.
   2. Comply with ANSI C1, National Electrical Code, 2011.
   3. Reference Publications:
      a. American National Standards Institute, ANSI
         1) C80.1 - Specification for Rigid Steel Conduit, zinc coated.
         2) C80.3 - Specification for Electrical Metallic Tubing, zinc coated.
         3) C80.4 - Specification for fittings for Rigid Metal Conduit and EMT.

b. National Electrical Manufacturers Association, NEMA.
   1) OS-1 - Sheet steel outlet boxes, device boxes, covers and box supports.
   2) 250 Enclosures for electrical equipment.
   3) WC-5 - Thermoplastic insulated wire and cable.
   4) WD-1, WD-5 - General Purpose Wiring Devices.
   5) FB-1 - Conduit and cable assemblies.
   6) KS-1 - Switches.
c. Manufacturer's Catalog.
   1) Catalogs of specified manufactures current at date of contract documents are incorporated by reference to same force and effect as if repeated herein. In conflicts between catalogs and project manual. Project Manual governs.

4. Provide all new materials, without blemish or defect, in accord with standards specified and NRTL (Nationally Recognized Testing Laboratory) listed or labeled.

1.04 STANDARDS

A. Provide materials, perform work and install materials in strict accordance with the latest requirements of the following:
   1. National Electrical Code (NEC) of National Fire Protection Association (NFPA).
   2. Other applicable codes and standards of NFPA.
   3. Factory Mutual System (FM).
   4. American National Standards Institute (ANSI).
   5. Occupational Safety and Health Act (OSHA).
   6. Federal, state and local codes, laws, ordinances; and rules and regulations of authorities having jurisdiction.
   7. In case of conflict or disagreement between codes, laws, ordinances, rules and regulations or within either document itself, the more stringent condition shall govern.
   8. Use electrical materials tested, listed and labeled by NRTL and bearing the NRTL label.
      a. All fabricated assemblies, manufactured items or electrically operated equipment shall have NRTL approval or NRTL re-examination listing in every case where such approval has been established for the particular type of materials or devices in question.

1.05 COORDINATION & SUBMITTALS

A. The contractor shall provide 1/4" = 1'-0" coordination drawings showing locations, dimensions and height of installation of all major pieces of equipment, electrical conduits >1-1/2", ductwork, and piping provided under their respective contracts. The contractor shall overlay their respective drawings and resolve all conflicts before actual installation begins.

B. Submit copies of drawings and information for review in accordance with project specifications.

C. Submit for review and before installation, shop drawings and/or descriptive literature on all electrical products, materials and specialties proposed to be furnished including the following:
   1. Wiring devices and coverplates.
   2. All cuts for the above shall have rough-in dimensions, connection sizes and any special installation requirements.

D. Operation & Maintenance Manual:
   1. Upon completion of the work, provide the Owner with three (3) copies of a hard bound-operating manual for all equipment furnished and installed under this work. The manual shall, however, first be approved by the Architect/Engineer.

1.06 DEFINITIONS

A. Wherever the words “the Contractor”, “this Contractor” or “Electrical Contractor”, appear in this section, they refer to the Contractor for Electrical Work.

B. The term “provide” includes such labor, methods, materials, equipment and transportation or other facilities required to complete the Contract, and the performance of all duties thereby upon the Contractor.

1.07 GUARANTEE

A. In entering into a contract covering this work, the contractor accepts the specifications and guarantees that the work will be carried out in accordance with the requirements of this specification or such modifications as may be made under the contract documents.

B. Contractor further guarantees that the workmanship and material will be of the best procurable and that none but experienced workmen familiar with each particular class of work will be employed.

C. Contractor further guarantees to replace and make good at his own expense all defects, which may develop within 1 year after final payment and acceptance by the Architect/Engineer, due to faulty workmanship or material, upon, receipt of written notification from the Owner.

1.08 JOB CONDITIONS

A. Existing conditions:
   1. In order to become familiar with the scope of the work involved, visit the existing site, before submitting bid, and carefully examine the existing condition in order to have full knowledge and understanding of the conditions and restrictions affecting the performance of the work required. Include in bid all work which is reasonably inferred by the contract drawings and specifications, whether specifically shown or not, as a result of existing conditions, construction, irregularities and interferences which may affect work. No additional compensation will be considered for misunderstanding the conditions to be met.
   2. The layout shown on the drawings is necessarily diagrammatic but shall be followed as closely as other work will permit. Changes from these drawings required to make this work conform to the building construction shall be made only with prior written approval of the Architect/Engineer. All proposed changes shall be shown on shop drawings. All measurements shall be verified by actual observation and all work shall fit in place meeting the approval of the Architect/Engineer.
   3. The contractor shall provide openings required in new and existing construction that may be necessary for the installation of electrical work and all patching and workmen competent in the trade required, at the expense of the contractor shall do repairing. The contractor shall be responsible for arranging the work so that minimum cutting will be required. All rubbish and excess materials involved in such cutting shall be promptly removed from the site and disposed of by the contractor. Cutting through the floor or roof systems or load bearing walls shall be done only with the prior written approval of the Architect/Engineer so as to avoid damaging the structural system.
   4. Sequencing, scheduling:
      a. Confer with the contractor regarding the location and size of conduits, equipment, rough-in openings and special architectural treatments in order that there may be no interferences between the installation or the progress of the work of the contractor on the project. The order of space preference shall be as listed above.
      b. In the case of interconnection of the work of two or more contractors, verify at the site or on shop drawings all dimensions relating to such work. All errors due to the failure to so verify any such dimensions shall be promptly rectified.

c. All line voltage wiring and final connections to complete mechanical systems shall be provided by the Electrical Contractor. All electrical conduit, wire, and connections relating to mechanical equipment controls and all wiring associated with starter holding coils, shall be the responsibility of the contractor installing the mechanical equipment unless otherwise indicated on the drawings. The contractor installing the mechanical equipment shall be responsible for magnetic motor starters where such starters are part of the control package of the equipment supplied. All other starters shall be furnished and installed by the Electrical Contractor.
d. Access panels, in walls or ceilings, required for access and maintenance shall be provided by the respective contractor. Access panels are not required in areas where the ceiling system is lay-in tile; however, sufficient space must be available in and through the ceiling system to allow maintenance and adjustment of equipment. Access panels shall be approximately 15 inches by 18 inches wherever possible and shall be provided with flush trim and an allen key operated cam lock fastener. Karp, Milcor, or Bilco shall manufacture panels.
e. Items of equipment may be specified in the singular however, provide and install the number of items of equipment as indicated on the drawings and as required for a complete system.
f. Each contractor shall provide excavating, pumping, backfilling, and compacting required for the installation of their respective work as shown on the drawings.
g. Equipment and devices furnished and installed by electrical contractors, which have factory prime coat, or final surface finish shall be replaced, repaired or refinished if defective or damaged during installation.
h. Arrange all work so a minimum period of interruption or outages will occur in the temporary or permanent transfer of services as required for all electrical revisions. Not less than 48 hours notification to the Owner shall be required before approval will be granted for any disruption of gas, electric, or telephone services. The outage request shall include the extent of the work to be done, length of outage time required, and the time at which the outage is to begin. No allowance will be made for extra payment as a result of scheduling "overtime" work necessary to perform before or after normal or regular working hours to accomplish the work intended.
i. Submit a "Sequence of Work Schedule" in respect to all temporary and permanent utility and service cutovers after final determination. This schedule shall be submitted for approval to the Architect/Engineer. The submittal shall designate priority order, service or utility affected, date of cutover, and time of day to start and finish.

PART 2 PRODUCTS

2.01 RACEWAYS AND CONDUIT

A. Electrical Metallic Tubing (thin wall conduit, EMT)
1. All electrical metallic tubing shall be hot dipped galvanized coated, bear a NRTL label and shall conform to Federal Specifications WW-C-563, ANSI C80-3, and UL 797.
2. Allied Tube and Conduit Corp., Republic Steel Corp., Wheatland Tube Co., Southwire Co. shall manufacture all electrical metallic tubing, or Architect/Engineer approved equal.

B. Rigid Steel Conduit
1. All rigid steel conduits shall be hot dipped galvanized coated plus a secondary coat with galvanized threads bears a NRTL label and shall conform to Federal Specifications WW-C-581d, ANSI C80-1.
2. Allied Tube and Conduit Corp., Republic Steel Corp, Wheatland Tube Co., Southwire Co. shall manufacture all rigid steel conduits, or Architect/Engineer approved equal.

C. Intermediate Metal Conduit (IMC)
1. Intermediate metal conduit shall be hot dipped galvanized coated; galvanized coated threads bear a NRTL label and shall conform to a NRTL standard for IMC.

2. Allied Tube and Conduit Corp., Republic Steel Corp., Wheatland Tube Co., Southwire Co. shall manufacture intermediate metal conduit or Architect/Engineer approved equal.

D. Flexible Steel Conduit
   1. All flexible steel conduits shall be hot dipped galvanized coated bears a NRTL label and shall conform to Federal Specifications WW-C-566C.
   2. Triangle PWC, American Flexible Conduit Co., Inc., Anaconda Metal Hose, shall manufacture all flexible steel conduits or Architect/Engineer approved equal.

E. Liquid-tight Flexible Steel Conduit
   1. All liquid-tight flexible steel conduit shall be interlocking flexible galvanized steel conduit with a special polyvinyl chloride covering extruded over the flexible conduit to make the conduit liquid-tight resistant to moisture, oil, chemicals and corrosive fumes.
   2. Anaconda Metal Hose, O-Z/Gedney, Triangle PWC shall manufacture all liquid-tight flexible steel conduits, or Architect/Engineer approved equal.

F. PVC Plastic Conduit
   1. All PVC conduits shall be schedule 40 heavy wall duct. Conduit shall be composed of high impact PVC (Polyvinyl Chloride-C-200 compound) and shall conform to industry NEMA Standards and be NRTL listed for underground and exposed use. Material shall have tensile strength of 7,000 psi at 73.4°F, flexural strength of 11,000 psi, compression strength of 8,600 psi, and minimum wall thickness in various sizes.
   2. All conduit fittings, couplings, terminal adapters, junction boxes and necessary fittings shall be of the solvent welding material.
   3. Carlon, Can-Tex, Triangle PWC Inc., shall manufacture all PVC conduits or Architect/Engineer approved equal.

2.02 CONDUIT HANGERS AND SUPPORTS

A. Surface Mounted Conduits
   1. Rigid steel, IMC and EMT conduits 1 inch and smaller shall be supported with hot dipped galvanized one hole steel pipe straps.
   2. Rigid steel, IMC and EMT conduits 1 1/4 inches and larger shall be supported with hot dipped galvanized one hole malleable iron pipe straps with pipe spacers.
   3. Raco, Efcor, T & B, Appleton shall manufacture all pipe straps, or Architect/Engineer approved equal.

B. Suspended Conduits
   1. Individual rigid steel, IMC and EMT conduit 1 inch and smaller shall be supported with conduit clips of high carbon spring steel or zinc plated steel and support 100 pounds static load. Conduit clip shall be provided with 1/4” 20 threaded impression for attachment to 1/4 inch 20 threaded rod.
   2. Individual rigid steel, IMC and EMT conduit 1 1/4 inches and larger shall be supported with stamped steel conduit clamps with 1/4 inch 20 bolt and nut and support 150 pounds static load. Provide conduit clamps with 3/8 inch 16 threaded boss for attachment to 3/8 inch 16 threaded rod.
   3. Support two or more rigid steel, IMC or EMT conduits adjacent to each other by 1 5/8 inches by 1 5/8 inches metal framing channel with minimum of two 1/2 inch 13 threaded rod at each end. Attach conduits to metal framing channel with electro-galvanized split pipe clamps with screw and nut.
   4. Raco, Efcor, T & B, Appleton shall manufacture conduit clips and clamps, or Architect/Engineer approved equal.
   5. Unistrut, Super Strut, Kindorf shall manufacture metal framing channel and split pipe clamps, or Architect/Engineer approved equal.
   6. Conduit shall not be supported from plumbing lines or ductwork.

C. Anchors
   1. Toggle bolts or spider type expansion anchors shall be used for hollow masonry.
   2. Lead expansion anchors or preset anchors shall be used for solid masonry.
   3. Self-drilling anchors or preset anchors shall be used for concrete.
   4. Machine screws, bolts, self-tapping screws or welded studs shall be used for metal.
   5. Wood screws shall be used for wood.

2.03 CONDUIT FITTINGS

A. All conduit fittings and box connectors shall be strong in construction and shall be of such material and finish as not to cause any chemical reaction between itself and the conduit or outlet box which it is fastened or supported.

B. All conduit fittings and box connectors shall be listed by a NRTL.

C. Insulated throat fittings are only required on conduits 2” and larger.

D. All conduit fittings, box connectors and lock nuts shall be of steel or malleable iron materials.

E. Fittings for EMT shall be set compression type, rain-tight and concrete-tight. Connectors, couplings, locknuts and other fittings for rigid steel heavy wall and IMC conduit shall be threaded type.

F. Connectors specified in this paragraph can be zinc plated steel in lieu of malleable iron.

G. Liquid-tight flexible conduit connectors shall be steel or malleable iron compression type with insulated throat and “O” ring assembly.

H. Fittings for flexible conduit or liquid-tight flexible conduit shall be of the straight 45 degree or 90 degree connectors and approved for grounding purposes.

I. Provide expansion joint fittings where expansion joints are shown on architectural drawings.

2.04 BOXES AND COVERS

A. All junction boxes pull boxes, fixture outlet boxes and switch boxes shall be listed by a NRTL.

B. All boxes and covers shall meet all requirements of the National Electrical Code.

C. All boxes and covers shall be made of code gauge steel.

D. All boxes shall be of proper size and shape for all conduits and conductors entering them.

E. Install device boxes with bracket attached to box and wall stud to eliminate movement of box in wall.

F. All boxes installed in poured concrete, block, brick or tile shall be masonry type.

G. All multiple gang switch boxes of more than three-gang shall be solid gang box.

H. Surface mount boxes on the ceiling are note required to be FS or FD type boxes. Stamped steel boxes are acceptable for boxes on the ceiling.

I. Where two or more conduits enter a box, the minimum size of boxes shall be 4 inches by 4 inches by 1 1/2 inches minimum depth. For single device installation, install square cut single device cover.

J. Install all device boxes with square cut device covers for number of devices required.

K. All boxes shall have tapped hole for 10-32 ground screw.

L. Raco, Steel City, Appleton shall manufacture boxes and covers, or Architect/Engineer approved equal.

2.05 CABLE AND WIRE

A. All wire shall have copper conductors and be listed by a NRTL.

B. Service entrance conductors shall be 600 volts insulation type XHHW-2 90°C. All other wire shall be 600 volts insulation type THWN 90°C insulation for sizes No. 6 to 500 MCM and type THHN 90°C insulation for sizes No. 12 to No. 8.

C. Under ground wire to pole mounted light fixtures shall be type USE in conduit.

D. Provide long barrel, NEMA 2 hole copper compression connectors for all cables connected to the padmounted transformer. Make all connections with stainless steel hardware.

E. All pulling lubricants shall be water based, no exceptions.

F. Minimum wire size shall be No. 12 except for internal fixture wire that shall be minimum size of No. 14 type AF, CF or TFN, 300 volt.

G. All wire (excluding fire alarm and low voltage wiring) shall be stranded, including #12 AWG and #10 AWG branch circuit wiring.

H. All branch circuit wiring and feeder cables for circuits over 20 amperes shall be sized as noted on the drawings. If size is not specifically noted, size all branch circuit wiring and feeder cables in accordance with the National Electrical Code.

I. Cable and wire not installed in conduit shall be #12 AWG SO or SJO type grounded cord. Cord shall terminate at junction boxes and devices with strain relief cord grids.

J. Triangle, Crescent, Colleyer, and General Cable shall manufacture all wire, or Architect/Engineer approved equal.

2.06 METAL CLAD CABLE

A. MC cable is not allowed.

2.07 ELECTRICAL WIRING DEVICES

A. All devices are specified as having black finish in wood, white finish if in drywall. The Architect/Engineer reserves the right to change the color.

B. Furnish all special outlets with mating caps with cord grips.

C. Schedule of all electrical devices:
   1. Single Pole Switch - 20 amperes at 120 volts
      a. Hubbell DS120
   2. Three Way Switch - 20 amperes at 120 volts
      a. Hubbell DS320
   3. Four Way Switch - 20 amperes at 120 volts
      a. Hubbell DS420
   4. Duplex Convenience Outlet - 20 amperes at 120 volts
      a. Hubbell DR20

5. Duplex Convenience Tamper Resistant Outlet - 20 amperes at 120 volts
   a. Hubbell D20TR
6. Duplex Convenience Outlet - GFI - 20 amperes at 120 volts
   a. Hubbell GF20

D. Forward submittals to Architect/Engineer for review.

2.08 WIRING DEVICE PLATES

A. All device plates shall be furnished with proper openings for the device with which it is being used. Where required, multiple gang plates for correct combination shall be used.

B. Device plates shall fit tight against the finished walls and shall completely cover the openings in the walls for the boxes.

C. Device plates shall be attached and adjusted so they finish straight and level.

D. Where more than one light switch is gained or a light switch and outlet are installed in a two gang box, install multiple gang device plates with proper openings.

E. Provide 1/2 inch raised galvanized device covers where used for exposed conduit work.

F. All device plates shall be black if located on wood and white if located on drywall, with the proper openings for the device with which they are being used.

G. All device plates for exterior weatherproof outlets and switches shall be lockable. Cover shall meet NRTL WDL “in use” listing requirement. Cover shall be suitable for standard boxes or FS type boxes.

H. Mounting screws for all plates shall have the same finish as the plate.

I. The same manufacturer shall furnish all device plates as devices for proper color match except stainless steel covers.

J. Forward submittals to Architect/Engineer for review.

2.09 SEALS

A. Fire Seal:
   1. Seal penetrations of fire-rated walls, floors or ceilings by raceways for compliance with NEC 300-21. Fill void around raceway. Sleeves shall be heavy wall steel pipe, anchored to building construction and finished plug with wall or ceiling. Fire stop material shall be Dow Corning #-6548 Silicone RTV Foam, Chase Technology Corp, CTC PR-855 fire resistant foam sealant, 3M 303 Fire Barrier, T & B S-101 Fire Barrier or Nelson Flameseal.
   2. Must be listed as part of a NRTL approved assembly.

B. Water Seal:
   1. Seal penetrations of perimeter walls or floors below grade to prevent entry of water. Use materials compatible with wall or floor construction and approved by Architect/Engineer.
   2. Seal all conduit penetrating air handling units air tight including conduit installed by the air handling unit manufacturer.

PART 3 EXECUTION

3.01 SPACE PREFERENCE

A. Carefully verify and coordinate the location and level of all lines. Run preliminary levels and check with all other contractors so that conflict in location may be avoided.

B. If conflicts occur, the following preference schedule shall be followed:
   1. Recessed electric fixtures
   2. High-pressure duct work
   3. Soil and waste piping
   4. Domestic water piping
   5. Low-pressure ductwork
   6. Domestic water storm and vent lines.
   7. Electric conduits

C. No other work shall have preference over plumbing lines below fixtures.

D. No other work shall have preference over conduit above or below electric switchgear and above or below panels.

E. No piping conveying fluids shall be provided directly over electrical, communications or elevator equipment.

3.02 FIELD CORRECTIONS AND CHANGES

A. Carefully and accurately record on field set of drawings, any deviations or changes in location of conduit, wiring and/or equipment made in the field and shall keep the Architect/Engineer informed on all deviations and changes.

B. At the completion of the job, furnish the Architect/Engineer three complete sets (not the field set) of drawings indicating these deviations or changes. Extra sets of drawings will be provided to the contractor for this purpose. Any changes in the exterior work shall be recorded by dimension.

3.03 LOCATION OF EQUIPMENT

A. The approximate location of all equipment is shown on the drawings.

B. The Architect/Engineer reserves the right to change the location of all equipment 5 feet in any direction without these changes being made the subject of an extra charge provided such changes are made before final installation.

3.04 LINES AND LEVELS

A. Determine all grades, maintain necessary lines and levels throughout the progress of the work, and assume full responsibility for their correctness. Where levels are indicated on the drawings, work shall be installed at those levels unless prior written approval to change is obtained from the Architect/Engineer.

3.05 CLEANING

A. Upon completion of the contract all remaining materials and rubbish shall be removed from the building and premises and the work areas shall be left clean and free from stains, mortar, paint spots, etc.

B. All switches, 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 their function and purpose is understood.

C. Upon completion of the work, put systems into service maintaining responsibility for the equipment during all testing operations including turning on and off of such apparatus.

3.06 OPENINGS IN NEW CONSTRUCTION

A. Openings required in new construction for Division 26 Work will be provided by the General Contractor at the request of and in accordance with information furnished by the Electrical Contractor. The General Contractor will advise the Electrical Contractor in advance so that he may lay out the required openings. If said Electrical Contractor fails to lay out required openings, he shall be financially responsible for the necessary cutting, patching and repairing. The General Contractor will do the patching and repairing.

3.07 WALL AND FLOOR SLEEVE INSTALLATION

A. Set all wall and floor sleeves during the construction of the portion of the new construction through which the piping is to pass.

B. Provide sleeves of black iron pipe and of proper size to accommodate raceway. Install sleeves flush with walls and ceilings. Coordinate locations of sleeves with other trades to avoid interferences with their work.

C. Anchor all sleeves properly to the building construction.

D. Set floor sleeves plumb, wall sleeves level and center all piping in sleeves.

E. Care shall be taken to set sleeves in formwork and check all dimensions before concrete is poured.

F. Extend floor sleeves in finished areas 1/2 inch above finished floor and neatly level top of sleeve.

G. Finish all wall sleeves flush with wall lines unless otherwise specified.

H. Where sleeves occur in exterior walls above grade, caulk sleeves with sealant.

I. Where sleeves occur in exterior walls below grade, caulk sleeves with oakum and lead wool.

J. Openings between sleeves and conduit through fire or smoke barriers shall be closed with fire stop material to maintain fire or smoke barrier rating.

K. All occupied and unoccupied conduit sleeves in closet shall be fire stop after cable or conduit is in place. Occupied conduit sleeves shall be fire stopped with fire stop material and unoccupied conduit sleeves shall be fire stopped with metal caps on both ends.

3.08 PROTECTION OF WORK

A. Protect work from damage 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.

3.09 INSTALLATION

A. Coordinate with other contractors engaged in project. Execute work in a manner not to interfere with other contractors or Owner's operation.

B. Coordinate work with other contractors regarding location and size of pipes, raceways, ducts, openings, switches, outlets, so there is no interference between installations or of progress of any contractor.

C. Install all equipment with ample space allowed for removal, repair, or changes to equipment. Provide ready accessibility to removable parts of equipment and to all wiring without moving equipment installed or already in place. Provide access panels for all devices installed above non-accessible ceilings or within walls or partitions.

D. At project completion, clean all equipment to the original finish. Remove all shipping labels.

E. Provide touch-up painting of all equipment marred in any way during shipment or installation.

3.10 INSTALLATION OF RACEWAYS AND CONDUITS

A. All raceways shall be concealed in wall construction and/or above ceiling construction except in mechanical equipment rooms, where it may be exposed at the ceiling or on walls.

B. There shall not be any branch circuit conduits installed horizontally in the concrete floor slabs throughout the building, except where specifically shown on the drawings.

C. In mechanical and electrical equipment spaces, expose ceiling outlets and conduit with due consideration to ventilating ducts and mechanical piping. Where numerous ducts occur, install conduits and outlets after ventilating ducts. Puncturing of ductwork or hanging equipment such as light fixtures, ceiling hangers, conduit, from ductwork, is prohibited, unless specifically noted otherwise.

D. Lay out all partitions on the project, for proper rough-in locations of all boxes and conduits. Verify all partition locations, door swings, cabinet locations before roughing in, and make any/all changes necessary to ensure that all switches, outlets, systems equipment, rough-ins are located properly. Any changes necessary in locations and rough-ins, due to a partition change and this contractor's failure to coordinate and verify same, shall be made.

E. The routing of conduit shown on the drawings is diagrammatic only, and this contractor shall install conduit as required to complete the systems so as not to interfere with other trades in both elevation and location.

F. The location of all conduit, boxes, fixtures, etc., in all areas finished and unfinished shall be coordinated.

G. Route conduit through roof openings for piping and ductwork where possible. Provide flashing making waterproof joints where conduits pass through roof or roofing membrane.

H. Provide conduit expansion joints at building expansion joints for conduit runs 1 1/2 inches and larger. Provide conduit expansion joints or flexible conduit connection at building expansion joints for conduits less than 1 1/2 inches.

I. Conduit shall be a minimum of 3/4 inch unless otherwise noted on the drawings.

J. All conduit bends shall be long radius with not more than the equivalent of three 90-degree bends between pull points.

K. Provide all open ends of conduit with bush caps to exclude any foreign material during construction.

L. All conduits installed in or under concrete or underground shall have joints sealed to exclude all water or other foreign material.

M. Coordinate the installation of all conduits in mechanical equipment spaces or where large amounts of ductwork and piping are present, with the other contractors so as to avoid interferences.

N. Unless otherwise noted on the drawings, size all conduits according to the National Electrical Code.

O. Install all exposed conduits parallel or perpendicular to adjacent walls, ceilings or floors.

P. All conduit couplings and fittings shall be made up wrench tight.

Q. Make all conduit systems mechanically and electrically continuous from source of current to all outlets, and ground in accordance with the National Electrical Code.

R. Where building construction or other conditions make it impossible to use standard threaded couplings, install watertight threaded unions.

S. Install rigid steel conduit for the following:
   1. All conduit in poured concrete construction (unless noted as PVC).
   2. All conduit underground (unless noted as PVC).
   3. All conduit exposed in exterior areas.
   4. All conduit installed through foundation or basement wall, below grade, to a minimum of 10'0" beyond wall.
   5. All service entrance conduit and all exterior conduit larger than 2" trade size.

T. Install electrical metallic tubing (thin wall) conduit for the following:
   1. All conduits in block, brick, tile or stud walls.
   2. All feeders for panelboards and distribution equipment.
   3. All conduit exposed in interior areas.

U. Install flexible steel conduit for the following:
   1. Final connections for all recessed lighting fixtures (fluorescent and incandescent).
   2. All vibration generating equipment except where flexible liquid-tight is specifically called for.
   3. A maximum length of flexible steel conduit shall be limited to 6'0".

V. Install liquid-tight flexible steel conduit for the following:
   1. Final connections to all motors, except exhaust fans in ceiling space and wall 1/8 horsepower and less.
   2. All vibration generating equipment exposed to exterior conditions.
   3. Maximum length of liquid-tight flexible conduit shall be limited to 6'0".

W. Install PVC conduit for the following:
   1. All conduit for underground exterior circuits 2" and smaller. PVC conduit shall be complete with all accessories, such as, couplings, male and female adapters, expansion couplings, elbows and support straps. Install one expansion coupling for every 100 feet of run, or in any run solidly connected at both ends. Use solvent welding cement recommended by the duct manufacturer, for all conduit terminations at fittings of all types to seal and secure the connections. Support the plastic conduit horizontal conduit runs 4 feet on center and vertical runs every 8 feet.

X. Communications
   1. Minimum communications raceway size to be 1" conduit, unless otherwise noted on drawings.
   2. Provide one conduit from each communications box. Horizontal conduit runs between wall boxes are not allowed.
   3. Provide insulated grounding bushings on end of conduit.
   4. Provide flush two-gang box with single gang plaster ring for each communications outlet or as noted on drawings.
   5. Conduit bends to be no less than 10 times outside diameter of conduit.
   6. Conduits shall have no more that (2) 90 degree bends or total of 180 degree bends or offsets without a pull box. Pull boxes shall be installed in accessible locations.
   7. No underslab installations allowed.

3.11 RACEWAY SUPPORTS AND HANGERS

A. Securely fasten raceways in place and support from ceiling or walls.

1. Maximum Spacing of Supports	Material
a. 1/2" through 1” trade size	6 feet
b. 1 1/4" through 1 1/2" trade size	8 feet
c. 2” through 4” trade size	10 feet
d. Flexible metal conduit	4 1/2 feet

B. Support IMC or EMT conduit within three feet of every outlet box, junction box, pull box, cabinet or termination. Support flexible conduit within 12 inches of every outlet box or fitting.

C. Support vertical runs or conduits at each floor level and at interval not to exceed ten feet.

D. Support conduits by pipe straps, wall brackets, hangers, or ceiling trapeze. The use of perforated iron on wire for supporting conduits is prohibited. Fasten with wood screws or screw nails to wood; by toggle bolts on hollow masonry units, by concrete inserts, or expansion steel conduits on steel. Do not weld conduits or pipe straps to steel structures unless specifically indicated.

E. The load applied to fasteners shall not exceed one-third the proof test load of the fasteners.

F. For fasteners attached to concrete, use vibration and shock resistant.

G. In partitions of light steel construction, use sheet metal screws.

H. Conduit shall not be supported from suspended ceiling hangers, ductwork or plumbing lines.

I. Where two or more conduits one inch trade size or larger run parallel, trapeze hangers may be used consisting of threaded solid rods, washers, nuts and galvanized “L” angle or channel iron. Individually fasten conduits to the cross member of every other trapeze hanger with one hole straps or clamp backs with proper size bolts, washers and nuts. When adjustable trapeze hangers are used, use U-bolt type clamps at end of conduit runs, at each elbow and at each third intermediate hanger to fasten each conduit.

J. Make hangers of durable materials suitable for the application involved. Applied loads shall not exceed one-third of their loading capacity.

K. Fabricate all screws, bolts, washers and miscellaneous hardware used for conduit supports from rust-resisting metal. Trapeze hangers shall have hanger assemblies' protected galvanized finish.

3.12 INSTALLATION OF BOXES

A. Provide pull boxes, junction boxes or outlet boxes as shown on the drawings and/or in all runs of conduit having the equivalent of three 90 degree bends or more than 100 feet in length.
   1. Communications conduit runs shall have no more than 100 linear feet and/or no more than two (2) 90-degree bends without a pull box.
   2. Do not provide pull box in lieu of 90-degree bend for communications cable.
   3. LB type fittings are not to be used for communications cable.

B. Location of outlets shown on the drawings is diagrammatic only. Coordinate exact location of outlets with architectural details, equipment connection requirements and all ceiling outlets with due consideration to clearance from ventilating ducts and piping.

C. Locations of all junction boxes shall be verified on the job.

D. All junction boxes shall be installed so that they are accessible by removing an access door, recessed fixture, coverplate, etc.

E. Where flush coverplates are required in finished areas, they shall be painted to match adjacent wall or ceiling finishes.

F. All junction boxes, other than for power or lighting, shall be identified as to their usage; such as, television, telephone, door security, fire alarm, etc., by permanently attached labels on the inside or outside of the coverplate.

G. Power and communication outlets shall not be installed in the same junction box.

3.13 METHOD OF WIRING

A. Install all the conductors in conduits.

B. Equipment and devices installed and not constructed with cases especially suited for mounting and enclosing all live parts shall be installed in metal cabinets.

C. A complete metal raceway or enclosure shall be provided for all circuiting throughout the extent of the systems specified.

D. Make conductors continuous from outlet to outlet. Do not make splices except in outlet or junction boxes. Make all feeder cables continuous from origin to panel or equipment terminations without running splices in intermediate pull or boxes, unless specifically indicated on the drawings or approved in writing by Architect/Engineer.

E. Blow out and swab all conduit until all moisture and grit is removed before any wires are pulled or installed. Use water-based pulling lubricant, compatible with insulation and covering, that will not cause deterioration of insulation or jacket covers of cables on conductors. Use pulling lubricant recommended by wire manufacturer.

F. Provide each cable or conductor in panels, pullboxes or troughs with a permanent pressure-sensitive label with suitable numbers or letter for easy identification. Identify control wires at each end and in junction boxes with designated wire numbers corresponding to control schematic drawings.

G. Provide wires and cables entering equipment or panels with enough slack to eliminate stretched, angular connection. Neatly arrange wiring, bundle and fan out to termination panels. Make minimum bending radius for conductors in accord with National Electrical Code.

H. Support all conductors in vertical raceways in accord with National Electrical Code.

I. Leave at least six-inch loops or ends at each outlet for installation of devices or fixtures. Roll up all wires in outlet boxes not for connection to fixture or device at that outlet, connect together and tape.

J. Size all branch circuit wiring for circuits over 20 amperes as shown on the drawings and/or as required by the National Electrical Code. All home run branch circuit wiring from the first outlet, fixture or device on 120 volt, 1 phase, or 277 volt, 1 phase circuit to the panelboard shall conform to the following wire sizes for amp circuits unless otherwise noted on the drawings:
   1. 120-VOLT CIRCUITS
      a. 0 to 50 feet #12 wire
      b. 51 to 100 feet #10 wire
      c. 101 to 150 feet # 8 wire
      d. 151 to 200 feet #6 wire

K. Clarification to the color-coding of conductors is as follows: For all voltages and systems equipment grounds shall be green, isolated grounds shall be green with yellow stripe or with yellow tape bands and travelers for 3-way switches shall be violet.

L. At the Electrical Contractor's option, the three phase power circuits and feeder cables can be installed with color-coded conductors or with three conductors of the same color. If they are installed with the same color of insulation, mark with colored tape in the panelboard and starter.

M. Phase all distribution equipment left-to-right, A, B, and C for continuity of phasing throughout the installation.

N. All stranded cables shall terminate into mechanical type or compression type lugs at termination points.

O. Neatly group all circuits in all distribution equipment and tie with Seine Twine, Ty-Rap or Wrap Tabs.

P. Special care shall be taken to balance connections of circuit wires on different phases at the lighting panelboards using distinguishing colors for identifying the particular phase on which the circuit belongs.

Q. In general, lighting and outlet circuits shall distribute from single pole 20-ampere breakers, 2 wire with solid neutral. Where noted on drawings, run single phase or 3 phase power circuits from two or three pole breakers.

R. A separate neutral conductor shall be pulled for each phase conductor for all 120 volt and 277 volt branch circuits. Common neutrals are not allowed.

3.14 WIRING JOINTS

A. Joints in conductors shall be as few in number as practicable and where they are necessary they shall be mechanically strong, well made and shall provide complete electrical contact.

B. Joints shall be so made that they have an electrical resistance not in excess of that of two feet of the conductor.

C. Make all branch circuit joints for wire up to and including No. 10 AWG with expandable steel spring and polypropylene body type connectors and wire nuts manufactured by Ideal, Scotch, Buchanan or Architect/Engineer approved equal.

D. Make all wire splices in wire No. 6 and larger with mechanical compression crimp type connectors of proper size and wire configuration. Cover all connectors with a minimum of three layers of 600 volts tape or heat shrinkable insulation equivalent to 150 percent conductor insulation.

E. Neutral conductors in outlet boxes at receptacles shall be jointed and pigtailed to the outlet. The removal of a receptacle from the circuit shall not affect the continuity of the neutral conductor.

3.15 HEIGHTS OF WALL SWITCHES AND RECEPTACLES

A. Determine the exact height of each light, receptacle outlets, and outlet boxes on the premises and examine the general drawings and details to see that outlets are properly spaced and located with relation to the interior finish and treatment.

B. In order that all outlets may be located in proper relation to paneling and decorated areas, become familiar with the details of these areas. Consult with the other contractors on the project and procure all details of the various areas so as to make the outlet boxes and panelboards come in proper relation to the work of all other contractors. Be responsible for the exact and proper location of the various portions of work. Such work must be entirely satisfactory to the Architect/Engineer.

C. Mounting heights of devices shall comply with ADA. The following is a list of mounting heights for equipment:
   1. Locate wall switches 3'6" above the floor, except where special treatment requires a higher or lower setting.
   2. Locate receptacles as follows:
      a. In general, locate 18 inches above finished floor except as hereinafter specified or as indicated on the architectural drawings.
      b. In block walls, locate either in the bottom or top of the nearest block course.
      c. In brick walls, mount in the horizontal position, in the fourth brick course.
      d. In spaces where noted to be above counters, mount in the horizontal position, 4 inches from backsplash to bottom of box.
      e. In rooms that house mechanical and electrical equipment, locate 40 inches above finished floor.
      f. Locate weatherproof receptacles 24 inches above finished grade.
   3. F.A. Speakers and Visual Indicators: 84" above finished floor to bottom of device.
   4. F.A. Pull Stations: 3'6" above finished floor to center of device.
   5. Disconnect Switches: 5'0" above finished floor.
   6. Manual and Magnetic Starters or Pushbutton Controls: 5'0" above finished floor
   7. Telephone/Data Outlets: Same as receptacles above.

D. All of the above mounting heights shall be held as near as possible to the center line of the equipment.

E. The above list is general in nature. Examine all Architectural Drawings and consult with the Architect/Engineer and vary mounting heights as directed.

3.16 TESTING 600 VOLT

A. After wires and cables are in place and before connection to the devices and equipment is made, test the system for shorts and grounds by means of an approved type of constant potential "Megger", which is to be furnished by the Electrical Contractor.

B. Remove and replace all hot wires if shorted or grounded.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDES

A. Completely grounded system. Electrical equipment, conduits, supports, cabinets and panels shall be grounded in accord with NEC and as shown on Drawings.

1.02 QUALITY ASSURANCE

A. Codes & Standards:
   1. UL listed.
   2. NFPA 70 (NEC), 2011
   3. NEMA
   4. NEC Article 250

PART 2 PRODUCTS

2.01 MATERIALS

A. Equipment:
   1. All grounding clamps and devices shall be of type approved by UL.
   2. Approved Manufacturers:
   3. Thomas & Betts Co.
      a. O.Z.
      b. Burndy

PART 3 EXECUTION

3.01 INSTALLATION

A. Electrical System shall be grounded. Grounding shall be in accord with NEC 250 and NEC 680. By reference herein, NEC Sections 250 and 680 shall become a part of this specification and shall be adhered to strictly.

B. All conduit, raceways, equipment, enclosures, panel housings, fixture housings, bus ducts, shall be grounded back to the service equipment location utilizing the continuous metallic conduit system as the grounding means. Discontinuity of the metallic conduit grounding system will not be acceptable.

C. All connections to motors, receptacles and equipment shall contain a separate grounding conductor bonded to the panelboard grounding bus at one end and the motor frame, receptacles, or equipment at the other end.

D. Provide a ground wire in all lighting circuits. Ground all lighting equipment.

E. Provide a ground wire for all 120V receptacle outlet circuits.

F. See Sections 26 05 00 for fittings for continuous conduit grounding system.

G. All ground wires shall be run in conduit except where otherwise indicated on the drawings.

H. Color code of ground wire shall be green.

END OF SECTION

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SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDES

A. Provide identification as listed below.

1.02 QUALITY ASSURANCE

A. Provide proper identification in accordance with NFPA 70- (NEC), 2011.

1.03 GENERAL

A. Provide identification of electrical system components in accordance with University of Iowa standards.
   1. Standard codes for junction boxes and covers:
      a. Fire Alarm - Red with “FA” stenciled on cover
      b. Emergency Power - Yellow
      c. Telecommunications - Brown
      d. Building Automation System - Blue
      e. Sound Systems - Gold
      f. Primary Distribution System - Gray
      g. 208/120 Volt System - White

B. Provide the following items with nameplates:
   1. All motor starters, motor controls, push-button stations, control panels and time switches.
   2. Switchboards, disconnect switches, circuit breakers, contactors or relays in separate enclosures. Power receptacles where the nominal voltage between any contact is greater than 150V to ground. Use at least 1-1/8” x 2-1/4” signs
   3. Special electrical systems shall be properly identified at junction and pull boxes, terminal cabinets and equipment racks.
   4. Nameplate inscription: Nameplate shall adequately describe the function or use of the particular equipment involved. Nameplate for panelboards and switchboards shall include the panel designation, voltage and phase of the supply, and where the circuit-feeding panel originates, i.e.:
      a. aPanel A
      b. 208/120 V.
      c. 3 Phase - 4 W.
      d. FED from “MDS”
   5. When equipment has more than one source of power, i.e.: separate control power source. The location of all power sources shall be CLEARLY identified at the equipment location. I.e.: Nameplate on door, etc.
   6. Mark all wires in panelboards with the circuit number they serve.
   7. Legibly mark feeder conduits entering and leaving a panelboard or switchboard with their destination.

1.04 PANELBOARDS

A. Provide a typed card directory for each panel. Directory shall designate breaker number and load served. Panel shall have all breakers individually numbered and panel shall have an interior nameplate provided by manufacturer with voltage, amperage, phase and hertz listed. Provide an exterior engraved plastic signage with the panel name or number or letter designation., and where the panel is served from.

PART 2 PRODUCTS

2.01 MATERIALS

A. Nameplate construction shall be laminated phenolic plastic, black front and back with white core, with lettering engraved through the outer covering. Lettering shall be 3/16 inches high at push-button station starter, receptacles and similar devices where the nameplate is attached to the device plate. At all other locations, lettering shall be 1/4 inch high unless otherwise detailed on the drawings.

B. Other types and sized of signage may be used where appropriate.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install labels on motor starters, TT switches, relays, disconnect switches, main distribution switchboard, power distribution panels, branch power panels, branch lighting panels and cable trays.

B. Special outlets and receptacles shall be clearly labeled to identify the utilization equipment.

C. Overcurrent devices in panels clearly identify what they feed. This may be accomplished by means of the typewritten panel schedules mounted inside of the front cover doors under glass or plastic.

END OF SECTION

SECTION 26 51 00
LIGHTING

PART 1 GENERAL

1.01 WORK INCLUDES

A. Light fixtures.

B. Lamps.

C. Ballast.

D. Fixture bases.

E. Fixture lens.

F. Accessories.

1.02 QUALITY ASSURANCE

A. All fixtures shall have UL label.

B. Ballasts shall be in accord with ANSI Standards.

C. Comply with:
1. NFPA - 70
2. I.E.S.

D. Verify the ceiling trim requirements for fixtures to assure proper installation for the type of ceiling construction.

1.03 SUBMITTALS

A. Submit in accord with Division 01.

B. Submit manufacturer's data demonstrating compliance with this specification and the schedule on the drawings.

C. Shop Drawings:

1. Include data specified herein including fixture “mark” corresponding to the Drawings.

2. Clearly indicate type and color of each lamp(s) to be used for each fixture type.

3. Submit shop drawings for each type of lamp.

D. Submittals will be reviewed a maximum of three revisions. If after the third submission submittal package does not conform to Specifications herein, CONTRACTOR will be billed at Electrical Engineer's standard hourly rate.

E. Maintenance data for fixtures to include in the operation and maintenance manual specified in Division 1.

PART 2 PRODUCTS

2.01 FIXTURE SCHEDULE

A. Light fixtures shall be as listed on the drawing Fixture Schedule.

B. The various types of fixtures to be provided are indicated on the drawings. A fixture shall be provided for each ceiling outlet, bracket outlet and other lighting fixture outlets. Where a fixture type is not indicated, provide a fixture of the same type used in similar areas.

2.02 FIXTURES

A. Where installed on combustible surfaces, fixtures shall be specifically UL listed for this condition or be spaced not less than 1-1/2-inch from the combustible surface.

B. All glassware shall be high quality, homogeneous in texture and free from streaks, cords, stones, or blisters and of uniform thickness and properly annealed.

C. Enamel finish shall be baked. The finish of each fixture shall be uniform in quality, durable and free from defects.

D. All plastic molded lenses shall be acrylic prismatic K19, 0.156” type.

E. Disconnecting Means:
1. All applicable luminaires must be provided with means to comply with luminaire disconnect requirements specified in NEC 410.130(G), 2011 Edition.

PART 3 EXECUTION

3.01 FIXTURE INSTALLATION

A. Light fixtures for all outlets shown on the drawings shall be furnished and installed complete including the assembly, wiring, support materials, and installation of each unit in place. All lenses, glassware and metal parts shall be thoroughly cleaned just prior to final acceptance.

B. Lighting fixtures shall be mounted as specified, and shall include all necessary fittings for a complete installation. Provide all materials to adequately and safely support all fixture installations.

C. Verify ceiling suspension material and systems in the various areas and provide plaster frames and proper fixture trims.

3.02 FIXTURE LOCATION

A. Space fixtures as indicated on the drawings and in keeping with ceiling patterns, air inlets and outlets.

B. Light fixtures recessed in ceiling shall be coordinated with ceiling construction. Recessed fixtures as scheduled serve only as a guide as to the type of fixture, lamp, and lens. Supply fixture that shall integrate with the type of ceiling as scheduled on architectural drawings approved for construction. Recessed light fixtures installed in grid ceiling shall have tee grid clamps.

C. Exit lights shall be coordinated with adjacent architectural work and shall be located and modified as to type of mounting, as directed by Architect/Engineer.

3.03 FIXTURE SUPPORT

A. Conduits run to recessed fixtures shall terminate in a suitable box adjacent to fixture opening with final connections to fixture made with flexible conduit and Type AF wire. Airtight fiberglass gaskets shall be provided around recessed fixtures to eliminate light leakage or hot air dirt streaks between fixture trim and finished ceiling. Fixtures shall be designed, insulated and ventilated to prevent scorching of adjacent construction. Plaster or other special frames, including extension pan for exposed conduit installation, shall be provided.

B. Light fixtures shall have proper supports, flanges, and plaster frames to integrate with the type of ceiling construction. All fixtures shall be constructed so that they may be securely supported. All fixtures shall be supported from 3/8-inch stud in outlet box. Outlet boxes shall have fixture studs and shall be securely hung independently of conduits.

C. Provide auxiliary supports for mounting fixtures in areas without ceilings (i.e., exposed beams and slabs), for proper installation of fixtures. Such supports shall span a minimum of 2 beams for each individual fixture and shall be securely and suitably anchored.

D. Fixtures shall be supported with a stem and “L” hanger on one end and pipe stem on the other end. When conduit is used to support fixtures, 1-inch rigid heavy wall shall be the minimum size. When conduits are used as stems, locknuts and washers shall be employed. Conduit may not be reduced in size between fixtures.

E. Fixtures installed adjacent to unit heaters or mechanical equipment, which may cause fixtures to vibrate, shall be installed so not to sway.

F. Fixtures shall not be supported from underside of metal roof decks, except where specifically noted otherwise on the drawings.

G. Compression or indenter type couplings will not be acceptable for fixtures supports.

H. Recessed grid fixtures shall be provided with T-bar clips. Install 4 per fixture.

I. Fixtures installed in continuous rows shall be supported a minimum of 8'-0” on center. Where fixtures are mounted in continuous rows over 16 feet long, support from Kindorf, Unistrut, or Storack which will limit deflection to acceptable values. When channels are used for a wireway, thus eliminating conduit shown on the drawings as running parallel to the channels. Channels shall have closure plates if used as wireways. Continuous wireways may be used in place of conduit when approved in writing by Architect/Engineer for the installation.

J. In general, support all fluorescent fixtures from the building structure and not from the ceiling suspension system (such as tee bar system for a suspended acoustical tile ceiling.)

K. At the Electrical Contractor's option recessed fluorescent fixtures can be supported from the ceiling suspension system if the Electrical Contractor makes arrangements and pays for additional ceiling hanger wires of adequate strength and quantity to support the fixtures. Where recessed fixtures occur in grid system, install tie wires on all four corners of the grid system about the fixture. Fixtures so supported shall be securely fastened to the grid system members with safety tee bar clips.

3.04 MISCELLANEOUS REQUIREMENTS

A. Color of exit light lettering shall be green LED. All letters shall be 6 inches high by 3/4-inch stroke. Exit signs at an egress shall read “EXIT”.

B. Fixtures marked “WP” shall be waterproof with special waterproof boxes and gaskets as required to keep rain or hose spray from coming into contact with wiring.

C. Letters “a”, “b”, “c”, etc., indicate associated switch or switches. Figures “1”, “2”, “3', etc., indicate associated branch circuit. “F1”, “F2”, “F3”, etc. indicate fixture type.

3.05 LAMP INSTALLATION

A. Provide all lamps for all outlets and fixtures. All fixtures shall be complete with lamps and in operating condition when the building is turned over to the Using Agency. All “burnt out” or broken lamps that occur during the construction period shall be replaced.

B. All fixtures, reflectors, lenses, and lamps shall be cleaned.

END OF SECTION