



February 29, 2024

**CITY OF PADUCAH
PADUCAH, TEXAS
PUBLIC WATER WELL SYSTEM REHABILITATION**

Addendum No. 3

Attention is called to the following modifications to the referenced Plans, Specification and Contract Documents for the above referenced project. The City of Paducah (City) will receive sealed Bids for 2022 TWDB DWSRF #62867 Water Supply Improvements – Public Water Well System Rehabilitation (CID-02) at Paducah City Hall, located at 804 10th Street, Paducah, Texas 79248, until **2:00 p.m.**, local time on **Thursday, March 7, 2024**, at which time the sealed Bids received will be publicly opened and read. We hereby modify the documents as follows:

SPECIFICATIONS:

1. **DELETE AND REPLACE** Specification 08111 “Hollow Metal Doors and Frames”: Updates have been made to remove fire rating door requirements.
2. **DELETE AND REPLACE** Specification 13122 “PEMB”: Updates have been made for the building materials and requirements.
3. **DELETE AND REPLACE** Specification 16000 “Electrical”:
 - a. Specification 16000 has been changed.
4. **ADD** Specifications Division 16 Electrical:
 - a. Specification 16100 – Raceways and Boxes
 - b. Specification 16115 – Underground Electrical Duct and Conduit
 - c. Specification 16120 – Conductors
 - d. Specification 16131 – Device, Pull & Junction Boxes
 - e. Specification 16140 -Wiring Devices
 - f. Specification 16165 – Disconnect Switches
 - g. Specification 16190 – Supporting Devices
 - h. Specification 16195 – Electrical Identification
 - i. Specification 16450 – Grounding
 - j. Specification 16675 – TVSS

DRAWINGS:

1. Sheet No. 3 “Well No. 1 and Well No. 2”:
 - a. **DELETE** Sheet 3 and **REPLACE** with attached sheet. This Sheet has been updated to reflect the dimensioning of the fences.

2. Sheet No. 9 "Typical Well Details":
 - a. **DELETE** Sheet 9 and **REPLACE** with attached sheet. This sheet has been updated to distinguish scope of work to be performed by the Contractor and items that are the Owner's responsibility. Clarified Electrical, Refer to New Sheet 12 and Sheet 13.
3. Sheet No. 11 "Water Well Building Plan and Section":
 - a. **DELETE** Sheet 11 and **REPLACE** with attached sheet. This sheet has been updated to show correct slab depth.
4. Sheet No. 12 "Electrical Details":
 - a. **ADD** Sheet 12 with attached sheet. This sheet has been added to address the electrical details.
5. Sheet No. 13 "Electrical One Line Diagram and Details":
 - a. **ADD** Sheet 13 with attached sheet. This sheet has been added to address the electrical details.
6. Sheet No. 14 "Typical Well Skirt Detail":
 - a. **ADD** Sheet 14 with attached sheet. This sheet has been added to detail the connection between the well seal pad and the concrete skirt.

CLARIFICATIONS:

1. Per the last addendum, the well housing may either be FRP buildings per Specification 02671 or a pre-engineered metal building per Specification 13122. Shop fabrication of pre-engineered metal buildings will be acceptable. Shop fabricated pre-engineered metal buildings shall be properly anchored and sealed to well pump skirt for longevity.
2. Well No. 11 casing will not need to be replaced.
3. Well Horse Powers – Well Horse Powers can be found in Specification 02671 Section 1.3.
4. Starters – the starters will be across the line starters.
5. SCADA – There is no SCADA system to tie-into for the well field. The well pumps are currently operated manually by the Owner.
6. Disconnects – Refer to the electrical drawings for disconnects.
7. Meters on poles – Refer to the electrical drawings for meters.
8. Transformers – Refer to the electrical drawings for transformers.

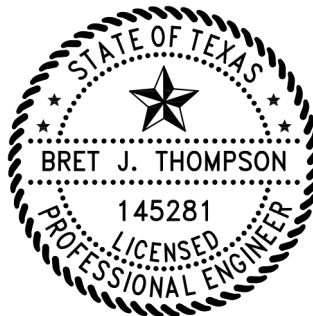
9. Current surface water levels, total depths, casing diameter, casing materials and saturated volumes of the wells.

Well No.	SWL (ft)	TD (ft)	Casing Dia. (inch)	Casing Material	Saturated Volume (gal)
1	83	167	12	Steel	487
2	106	208	12	Steel	622
3	123	231	12	Steel	722
5	144	238	12	Steel	846
6	131	238	12	Steel	769
7	139	246	12	Steel	816
8	N/A	N/A	N/A	N/A	
9	134	212	12	Steel	787
10	137	234	10	PVC	559
11	144	251	12	Steel	845
12	126	243	12	Steel	740
13	159	265	10	N/A	648

10. Any acid water removed from the well rehabilitation will need to be neutralized before properly disposed of.
11. Refer to Plan Sheet 09 for the updated flowmeter manufacturer. The Azbil MagneW PLUS+ Magnetic Flowmeter or Engineer-approved equivalent will be acceptable for this project.

This addendum consists of **one hundred two (102)** pages and becomes a part of the referenced plans, specifications and contract documents and shall be acknowledged by the proposer and attached to the sealed proposal submitted.

Bret Thompson
 By Bret J. Thompson, P.E. #145281
 Project Manager



2/29/2024

Donald S. Mattern
 By Donald S. Mattern, P.E. #106161
 Electrical Engineer



2/29/2024

SECTION 08111

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Fabricated rated and non-rated steel doors.
- B. Hinges and lock sets.

1.2 REFERENCES:

- A. ASTM A569--Steel, Carbon, Hot-Rolled Sheet and Strip, Commercial Quality.
- B. ASTM A591--Steel Sheet, Cold-Rolled, Electrolytic Zinc Coated.
- C. NFPA 80--Fire Doors and Windows.
- D. NFPA 252--Fire Tests for Door Assemblies.
- E. ANSI/SDI A250.8-2003 (R2008)--Standard Steel Doors and Frames.

1.3 QUALITY ASSURANCE:

- A. Conform to requirements of ANSI/SDI A250.8-2003 (R2008).
- B. Fire rated frame construction to conform to NFPA 252.
- C. Install frame and door assembly to conform to NFPA 80 for fire rated class indicated on drawings.

1.4 SHOP DRAWINGS AND PRODUCT DATA:

- A. Submit shop drawings and product data under provisions of Section 01300.
- B. Indicate frame configuration, anchor spacings, anchor types, and location of cutouts for hardware, reinforcement, and finish.

1.5 DELIVERY, STORAGE, AND PROTECTION:

- A. Protect products under provisions of Section 01600.
- B. Protect doors with resilient packaging.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Republic Builders Products Corp./Sub Republic Steel.
- B. Ceco Corporation.

- C. Tex-Steel Corporation.
- D. Steelcraft.
- E. Or Engineer-approved equivalent

2.2 DOORS:

- A. Materials and Fabrication: ANSI/SDI A250.8-2003 (R2008) except as amended in this Section, 18 gauge.
- B. Types: Type II--Heavy duty 1-3/4-inch, Style 2.
- C. Thermal Insulated Door: Total insulation R value of 4.34, measured in accordance with ASTM C236. Locate thermal insulated door at all exterior door locations.
- D. Material: 18-gauge steel.

2.3 PROTECTIVE COATINGS:

- A. Bituminous Coating: Fibered asphalt emulsion.

2.4 FABRICATION:

- A. Fabricate frames and assemble as a complete welded unit.
- B. Fabricate frames with hardware reinforcement plates welded in place. Provide 26 Ga mortar guard boxes.
- C. Prepare frames for silencers. Provide three single silencers for single door on strike side.
- D. Fabricate jamb anchors to be set in masonry from minimum 16 gage electrolytic coated zinc steel complying with ASTM A591.
- E. Mechanically interlock longitudinal seams of honeycomb core-type doors. Leave seams invisible, or weld-fill and grind smooth.
- F. Reinforce and prepare doors to receive hardware. Refer to Section 08712 for hardware requirements.
- G. Fill surface depressions with metallic paste filler and grind to smooth uniform finish.

2.5 FINISH:

- A. Primer: Baked on.
- B. Finish: As specified in Section 09800.
- C. Coat inside of frame profile for those frames set with bituminous coating to a thickness of 1/16 inch in masonry or concrete.

2.6 HINGES:

- A. Manufacturer: Stanley or approved equivalent.
- B. Description: Full mortise standard plain bearing template-type meeting ANSI Standards, security type for outside doors with outside pin.
- C. Size: 4" x 4".
- D. Finish: Prime coat.

2.7 LOCKSETS:

- A. Manufacturer as shown in the table below or approved equivalent.

Function	Yale	Arrow	Best	Corbin	Sargent
Passage Set	5301	M01	52K-ON	6610	6U15
Privacy Lock	5302	M02	52K-OL	6620Y	6G65(S2)
Storeroom Lock	5305	M12	52K-D	6657	6G04
Entrance Lock	5307	M11	52K-AB	6651	6G05(S3)

- B. Description: Locksets shall be standard-duty cylindrical type, ANSI Series 4000, Grade 2.
- C. Finish: Bright brass
- D. Nomenclature: Passage lock--for doors that do not require locking; privacy lock--outside knob can be locked by pushbutton on inside, releases when turning inner knob; storeroom lock--key in outside knob and always locked; entrance lock--key in outside knob, pushing or turning button on inside locks outside, lock released when inner or outer knob is turned.
- E. Application: Provide entrance locks on all outside doors unless noted otherwise. Provide 6 (six) keys for each lockset furnished.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Install frames in accordance with SDI- ANSI/SDI A250.8-2003 (R2008).
- B. Install minimum of 3 anchors per jamb for frames set in masonry.
- C. Install minimum of 4 anchors per jamb for frames set in metal stud framing.
- D. Install hollow metal doors plumb and square, and with maximum diagonal distortion of 1/8 inch. Install hardware in accordance with manufacturer's requirements.

3.2 TOLERANCES:

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.3 ADJUSTING AND CLEANING:

- A. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up paint of compatible air-drying primer.

END OF SECTION

SECTION 13122

PRE-ENGINEERED METAL BUILDING

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Pre-Engineered, Shop-Fabricated Structural Steel Building Frame.
- B. Metal Wall and sloped Roof System.
- C. Exterior Doors, Windows, and Overhead Doors.

1.2 REFERENCES:

- A. AISC--Specification for Structural Steel for Buildings--Allowable Stress Design and Plastic Design.
- B. ANSI--Quality Certification Program, Category MB.
- C. ASTM A36/A36M--Structural Steel.
- D. ASTM A123--Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.
- E. ASTM 153--Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A307--Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- G. ASTM A325/A325M--High Strength Bolts for Structural Steel Joints.
- H. ASTM A490/A490M--Heat Treated Steel Structural Bolts, Classes 150 ksi Tensile Strength.
- I. ASM A500--Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- J. ASTM A501--Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- K. ASTM A653/A653M--Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- L. ASTM A529/A529M--Structural Steel with 42 kips Minimum Yield Point (1/2 in Maximum Thickness).
- M. ASTM A572/A572M--High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
- N. ASTM A792/A792M--Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot-Dip Process.

- O. ASTM C665–Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- P. ASTM C991– Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings.
- Q. ASTM C1107–Packaged, Dry, Hydraulic-Cement Grout (Non-shrink).
- R. AWA A2.0–Standard Weld Symbols.
- S. AWS D1.1–Structural Welding Code–Steel.
- T. MBMA (Metal Building Manufacturers Association)–Metal Building Systems Manual.
- U. SSPC (Steel Structures Painting Council)–Steel Structures Painting Manual.
- V. SSPC–Paint 20 Zinc Rich Coating.
- W. UL–Building Materials Director–Roof Deck Construction.

1.3 DESIGN REQUIREMENTS:

- A. Design members to withstand dead load, and design loads due to pressure and suction of wind calculated in accordance with the International Building Code.
- B. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effectors, when subject to temperature range of 100 degrees F.
- C. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.
- D. The building structure frame types shall be clear span rigid frame (solid web) type with straight or tapered sections designed in accordance with AISC Type 1 construction. Roof slope shall be as indicated on drawings. Column bases shall be designed as pin connected.
- E. Design of structural steel sections and welded plate members shall be based upon the applicable specifications of AISC Specifications for Structural Steel Buildings.
- F. Light-gage, cold-formed structural members and exterior coverings shall be designed based upon the applicable sections of AISI Specifications for the Design of Cold-Formed Steel Structural Members.
- G. The design of primary and secondary structural framing as well as roof and wall covering shall be the responsibility of the Pre-engineered Building manufacturer and shall be based upon the provisions of the specified code.

H. Loads:

1. Live Load 10 PSF
2. Wind Load 75 mph
3. Snow Load 5 PSF;

I. Deflections:

1. Live Load:
 - a. Rigid Frames and columns – Drift Height / 100 Lateral
 - b. Rigid frames and Roof Purlins Span / 180 Vertical
 - c. Door heads L / 120 Horizontal
 - d. Wall girts: Span / 120 Lateral

J. Connections:

1. Bolted moment connections shall be designed in accordance with accepted industry standards utilizing flush plate design methods or extended plant design methods as determined by the manufacturer.
2. Field connections, made with high strength bolts, shall be made in accordance with the AISC Specification for Structural Joints Using ASTM A325 bolts. Recommended method of installation, "Turn-of-Nut" method.

K. Foundations - Foundation loads, anchor bolt diameters, and anchor bolt patterns shall be determined by the building manufacturer.

L. Metal building shall be designed and detailed as required to support roof supported mechanical and electrical piping, conduits and equipment. Provide extra roof purlins and/or structural steel members as required to support roof supported items.

1.4 SUBMITTALS FOR REVIEW:

A. Section 01300–Submittals: Procedures for Submittals.

B. Product Data: Provide data on profiles, component dimensions, and fasteners.

C. Calculations: Submit detailed calculations signed and sealed by a registered professional engineer licensed in the State of Texas. Calculations shall include column base reactions as service load reactions broken down as follows:

1. Dead load
2. Live load
3. Wind load
4. Seismic load
5. Snow load

- D. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections, attachments, and openings; wall and roof system dimensions, panel layout, general construction details, anchorage and method of anchorage, method of installation; framing anchor bolt settings, sizes, and locations from datum, and foundation loads; indicate welded connections with AWS A2.0 welding symbols; indicate net weld lengths; signed and sealed by a registered professional engineer licensed in the State of Texas.
- E. Samples: Submit two samples of precoated metal panels for each color selected, 12 x 12 inch in size illustrating color and texture of finish.
- F. Provide manufacturer's warranty on all products and accessories.

PART 2 PRODUCTS

2.1 MANUFACTURERS-BUILDING SYSTEM:

- A. Manufacturers:
 - 1. Metallic Steel Buildings
 - 2. Butler Building Systems
 - 3. Midwest Steel Building
 - 4. Mueller Metal Buildings, Inc.
 - 5. Red Dot Corporation
 - 6. Tyler Building Systems
 - 7. Or approved equivalent.

2.2 MATERIALS-FRAMING:

- A. Structural Steel Members: W Shapes – ASTM A992/A992M; other Shapes - ASTM A36/A36M;
- B. Structural Tubing: ASTM A500, Grade B;
- C. Plate or Bar Stock: ASTM A36/A36M; or ASTM A529/A529M;
- D. Anchor Bolts: ASTM F1554, Grade 36;
- E. Bolts, Nuts, and Washers: ASTM A325;
- F. Welding Materials: AWS D1.1; type required for materials being welded;
- G. Primer: SSPC 15, Red Oxide, or as required for specified finish;
- H. Grout: ASTM C1107, Non-shrink type, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2400 psi in two days and 7000 psi in 28 days.

2.3 MATERIALS–WALL AND ROOF SYSTEM:

- A. Sheet Steel Stock: ASTM A653/A653M galvanized to G90 coating designation.
- B. Panel Configuration and Construction: Wall and roof panels shall be Panel Rib configuration with not less than 1 1/4 in. deep ribs spaced not more than 12 inches on center. Panels shall be furnished up to 40 feet in length to minimize endlaps. Material shall be 50 KSI minimum yield steel. Panels shall have a smooth finish. Panels shall be 26-gauge Galvalume® sheet steel, ASTM A653/A653M, Class G90, approximately 50% aluminum and 50% zinc by weight.
- C. Flashing and Trim: Exposed flashings and trim shall be minimum 26 ga. and shall be of the same finish as the walls. Trim color shall be white.
- D. Fasteners: Fasteners shall be self-drilling or self-tapping, zinc-plated carbon steel structural fasteners for panel to secondary connections. Panel to panel connections shall be self-tapping screws. Panel fasteners shall have colored heads to match the colors of the material fastened.
- E. Sealant: Manufacturer's standard non-staining, elastomeric, skinning.
- F. Trim, Closure Pieces, Flashings and Rain Water Diverter: Same material, thickness and finish as exterior sheets, brake formed to required profiles. Panel closures shall be Ethylene-Propylene-Diene-Monomer or equivalent closed cell strips formed to match panel configuration.

2.4 METAL DOOR AND FRAME:

- A. Doors and Frames: Specified in Section 08111.

2.5 OVERHEAD COILING DOOR:

- A. Not applicable

2.6 MONORAIL (or BRIDGE CRANE) SYSTEM AND HOIST:

- A. Not Applicable.

2.7 FABRICATION–FRAMING:

- A. Fabricate members in accordance with AISC Specification for flat, bar, tube, or rolled structural shapes.
 - 1. Wall framing to be flush-mounted system.
- B. Anchor Bolts to be formed with bent shank, assembled with template for casting into concrete.

2.8 FABRICATION–WALL AND ROOF SYSTEMS:

- A. Siding: Minimum 26 gauge metal thickness R-Panel, profile lapped edges.

- B. Roofing: Minimum 26 gauge metal thickness, male/female edges.
- C. Soffit Panels: Minimum 26 gauge metal thickness, flat profile unperforated.
- D. Girt/Purlins: Rolled formed structural shape to receive siding, roofing sheet. Siding to be flush-mounted purlin system.
- E. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners with 26 gauge sheet.
- F. Expansion Joints: Same material and finish as adjacent material where exposed, 26 gauge, manufacturer's standard brake formed type, of profile to suit system.
- G. Flashings: Closure Pieces, Fascia, Infills, and Caps: Same material and finish as adjacent material profile to suit system.
- H. Fasteners: To maintain load requirements and weather-tight installation, same finish as cladding, non-corrosive finish.
- I. Ventilator: As shown on Drawings.

2.9 FINISHES:

- A. Framing Members: Hot-dip galvanized.
- B. Wall and Roof Panels: color shall be selected from manufacturer's standard colors and finish shall meet the following minimum standards:
 - 1. Panels shall have a high-performance oven baked epoxy primer on both surfaces.
 - 2. Exposed panel surface shall have a silicone polyester coating oven baked over the primer for a total dry film thickness of not less than 1 mil.
 - 3. Panels shall also have an oven baked silicone polyester back coating for a total dry film thickness of not less than 0.5 mil. Color shall be Off White.
 - 4. Finish shall be warranted for 10 years against chalking, fading, blistering, peeling, or cracking, when exposed to normal atmospheric conditions.

PART 3 EXECUTION

3.1 EXAMINATION:

- A. Verify existing conditions before starting work.
- B. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position.

3.2 ERECTION–FRAMING:

- A. Erect framing in accordance with AISC Specification.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as required.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.
- D. Do not field-cut or alter structural members without approval.
- E. After erection, prime welds, abrasions, and surfaces not shop-primed.

3.3 ERECTION–WALL AND ROOFING SYSTEMS:

- A. Install in accordance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.
- E. Provide expansion joints where required.
- F. Use exposed fasteners.
- G. Install sealant and gaskets to prevent weather penetration.

3.4 INSTALLATION–ACCESSORIES:

- A. Install door frame, door, window and glass, in accordance with manufacturer's instructions.
- B. Seal wall and roof accessories watertight and weather-tight with sealant.

3.5 TOLERANCES:

- A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
- B. Siding and Roofing: 1/8 inch from true position.

END OF SECTION

SECTION 16000

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 GENERAL

1.1 SECTION INCLUDES:

General requirements for electrical work. This includes quality standards and system testing.

1.2 REFERENCES:

- A. The 2023 National Electrical Code (NFPA 70).
- B. The National Electrical Safety Code (ANSI C-2).
- C. The Life Safety Code (NFPA 101).
- D. Americans With Disabilities Act (Public Law 101-336).
- E. The International Building Code.

1.3 SUBMITTALS:

- A. Where specified, submittals shall be provided in accordance with Section 01300. The submittals shall be identified by the specified equipment number and specification section.
- B. Submit results of the testing services as specified herein.

1.4 QUALITY ASSURANCE:

- A. All work shall meet the requirements of the NEC and be performed by a Licensed Electrical Contractor with the State of Texas and employees of said contractor.
- B. Installation shall be supervised by an electrician licensed as a "Master Electrician" to whom the State Electrical Contractor license is issued to.
- C. Field work shall be under the onsite supervision of a licensed "Journeyman or Master Electrician."
- D. Licensing as a "Master" or "Journeyman" electrician shall mean to hold a current certification or license to that effect issued by the State of Texas. Additionally, if the local authority having jurisdiction requires a local license, the Contractor shall maintain licensed electricians that meet the requirements of the local authority. Submit copies of current licenses or certificates for persons employed on the work. Notify Engineer and remove from the work (within 10 days) any persons for whom a license or certificate is suspended, revoked, or is otherwise rendered void by the issuing agency.

- E. Contractor is required to have one "Licensed Journeyman" per seven "Licensed Apprentices" on the site.
- F. All electrical contractor personnel to have a State issued license on hand at anytime while working on site and shall make it available for viewing anytime if asked to provide by Engineering or Inspection personnel.

1.5 EQUIPMENT ACCESSIBILITY:

- A. All equipment requiring access for monitoring, controlling other equipment, or servicing shall be accessible. Motor starters and other control equipment shall be installed at a height that will allow an operator to view or control the equipment without stooping or without requiring a platform, stool, or raised floor to view or control the equipment. Generally, motor starters, panels, and similar equipment shall be installed with the top of the enclosure at approximately 5'-6" above floor level. Control stations, and other small enclosures that require normal access, shall be installed with the top of the enclosure at approximately 48-inches above floor level.
- B. Equipment that is not considered accessible by the Engineer or Owner shall be relocated by the Contractor, at the request of the Engineer or Owner, at no additional cost to the Owner.

1.6 STORAGE OF MATERIALS AND EQUIPMENT:

- A. Materials and equipment shall be stored so as to protect the materials and equipment during storage. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Equipment and materials to be located indoors shall be stored indoors. Instrumentation shall be stored indoors.

PART 2 PRODUCTS

2.1 COATING SYSTEM:

A. GENERAL:

Where specified, electrical equipment in Division 16 shall be painted by the manufacturer as specified below.

B. COLOR:

Exterior color shall be ANSI 61, gray. Interior shall be painted white. Nonmetallic electrical enclosures and equipment shall be the manufacturer's standard gray or beige color.

2.2 TERMINAL BLOCKS:

Unless otherwise specified, terminal blocks shall be screw terminal, heavy duty, rated at 600V AC. Minimum capacity for control service is 5 amps. Terminals shall be provided with integral marking strips which shall be permanently identified as shown on the shop drawings or required for installation.

2.3 MISCELLANEOUS METAL:

Miscellaneous metal installed in conjunction with electrical or instrumentation work shall be stainless steel. Painted or galvanized steel is not acceptable. Materials included in this specification group includes, but is not limited to bars, rods, sheet, plate, channel, or other metal shapes used to, or incorporated in support frames, brackets, mounting plates, etc. Bolts, nuts, screws, washers, or similar ancillary materials used shall be 316 or 304 stainless steel.

2.4 QUALITY CONTROL:

All work shall be furnished, installed, and connected in accordance with the National Electrical Code, these specifications, and the drawings. All materials used in this work shall be new and shall bear the inspection label of Underwriter's Laboratories, Inc.

PART 3 EXECUTION

3.1 GENERAL:

- A. Drawings are generally diagrammatic and show the arrangement and location of fixtures, equipment, and conduit. Not all conduit, wire, and cable are shown on the Engineers drawings. The Electrical contractor shall provide all that is necessary for a complete and functional system. The Electrical Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly.
- B. Any discrepancy between the Contract Documents and the existing conditions or any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, the Electrical Contractor shall report to the Engineer in accordance with the Standard Conditions of the Contract.
- C. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Electrical contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured. Additional penetrations/openings not shown on the drawings shall not be made without preapproval by the Engineer.
- D. Materials, equipment, or labor not indicated, but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- E. The right by the Owner and Engineer is reserved to make reasonable changes in locations of equipment indicated on drawings prior to rough-in without increase in contract cost.
- F. The Contractor shall not reduce the size or number of conduit runs indicated on the drawings without the written approval of the Engineer.

- G. Locate pull boxes, panelboards, control pushbuttons, terminal cabinets, safety switches, and such other apparatus that may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations which are found to be inaccessible, the Engineer shall be advised of the situation before work is advanced to the point where extra costs will be involved.
- H. All additional circuit connections to panelboards shall be preapproved by the Engineer.
- I. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.
- J. The location of equipment fixture outlets, and similar devices shown on the Drawings are approximate only. Do not scale drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on electrical plans.
- K. Review all drawings for door swings, cabinets, counters, and built-in equipment.

3.2 RACEWAY INSTALLATION:

Use the following raceway materials for raceways in the identified applications.(or where specified on plans)

- A. Rigid PVC: Buried Raceways.
- B. RGS or Rigid Aluminum: Above grade.

3.3 PHASE CONNECTIONS:

Phase connections for equipment shall be A, B, C, counting from front to back, top to bottom, and left to right as viewed from the operating mechanism side. Conductors shall be color coded as specified.

3.4 TESTING:

A. GENERAL:

Prior to energizing the electrical circuits, the following tests shall be performed. Unless otherwise specified, a 1000 volt megohmmeter shall be used for resistance measurements. Record and submit test results using form at the back of this Section.

B. INSULATION RESISTANCE MEASUREMENTS:

Test all energized electrical components including conductors for circuits 120V volts and higher. Conductors and devices with less than 50 megohms resistance to ground or between conductors or phases shall be removed and replaced. All conductors in a raceway shall be removed if a conductor in that raceway fails the insulation resistance test. The conductors shall not be reused.

C. MOTOR TESTS:

All motors shall have their insulation resistance measured before they are connected. Insulation resistance values less than 10 megohms are not acceptable. Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation. Measure the full load current on each phase with the motor running at maximum operating load.

D. FUNCTIONAL CHECKOUT:

Protective devices shall be adjusted and operative during the testing period. Prior to start-up of each piece of equipment or system, perform a functional checkout on control circuits. The checkout shall consist of energizing each control circuit and operating each control, alarm, or malfunction device, and each interlock in turn to verify that the specified action occurs. This may be performed with the motor connected or disconnected. Providing that no harm will be done to the equipment.

3.5 AS-BUILT DRAWINGS:

At the end of the project, provide one set of "red-lined" as-built drawings to the Engineer. As-built drawings shall show all addenda, change orders, or other modifications made by the contractor or directed by the Engineer/Owner. Drawings shall be complete and shall be accurate. Manholes and other in-ground structures shall be dimensioned from a known structure. Modifications to control schematics shall be marked on the drawings. Final payment will not be made until as-built drawings are accepted by the Engineer.

END OF SECTION

MOTOR, CIRCUIT, AND DEVICE
ELECTRICAL TEST RESULTS

PROJECT _____

OWNER _____

DATE _____

CIRCUIT OR
EQUIPMENT ID _____

1 PHASE 3 PHASE 120 VOLT 208 VOLT 480 VOLT _____ VOLT

MEASURED VOLTAGES: MEASURED CURRENT:

PH. A--GND _____ A-B _____ PH. A _____ AMPS

PH. B--GND _____ B-C _____ PH. B _____ AMPS

PH. C--GND _____ A-B _____ PH. C _____ AMPS

MEASURED INSULATION RESISTANCE, MEG OHMS, PHASE TO GROUND @ 1,000 VOLTS:

PH. A _____ PH.B _____ PH.C _____

MOTOR NAMEPLATE DATA:

VOLTS _____ pH _____ SF _____ FLA _____

THERMAL OVERLOAD DEVICE:

MFG: _____ CAT/PART NO. _____ AMPS _____ SETTING _____

OPERATING CONDITIONS:

COMMENTS:

CONTRACTOR'S SIGNATURE_____
INSPECTOR'S SIGNATURE

SECTION 16110

RACEWAYS AND BOXES

PART 1 GENERAL

1.1 SUMMARY:

A. Section includes:

1. Material and installation requirements for:

- a. Conduits.
- b. Conduit fittings.
- c. Conduit supports.
- d. Wireways.
- e. Outlet boxes.
- f. Pull and junction boxes.

B. Related Specification Sections include but are not necessarily limited to:

- 1. Division 1 – General Requirements
- 2. Section 16115 – Underground Ducts and Conduit
- 3. Section 16140 – Wiring Devices

1.2 DEFINITIONS:

A. Underfloor Conduits.

- 1. Conduits which run underground within perimeter of building walls under building floor. This may consist of one conduit, or several conduits grouped together.

B. Duct Bank Conduits

- 1. Conduits which run underground outside perimeter of building walls. This may consist of one conduit, or several conduits grouped together.

C. Underground Conduits

- 1. Underground conduits are both under floor conduits and duct bank conduits.

1.3 SUBMITTALS:

A. Shop Drawings:

- 1. See Division 1 – General Requirements for requirements for mechanics and administration of the submittal process.
- 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.

3. Fabrication and/or layout drawings:
 - a. Identify dimensional size of pull and junction boxes to be used.

1.4 QUALITY ASSURANCE:

- A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

- B. Referenced Standards:

1. Aluminum Association (AA).
2. American Iron and Steel Institute (AISI).
3. ASTM International (ASTM):
 - a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. D2105, Standard Test Method for Longitudinal Tensile Properties of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube.
 - d. D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.
 - e. F512, Standard Specification for Smooth-Wall Polyvinyl Chloride (PVC) Conduit and Fittings for Underground Installation.
4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit (IMC).
 - c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
5. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):

- a. C80.1, Electric Rigid Steel Conduit (ERSC).
 - b. C80.3, Steel Electrical Metallic Tubing (EMT).
 - c. C80.5, Electrical Aluminum Rigid Conduit.
 - d. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
6. National Fire Protection Association (NFPA):
- a. 70, National Electrical Code (NEC)
7. Underwriters Laboratories, Inc. (UL):
- a. 1, Standard for Flexible Metal Conduit.
 - b. 6, Standard for Electrical Rigid Metal Conduit – Steel.
 - c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
 - d. 360, Standard for Liquid-Tight Flexible Steel Conduit.
 - e. 467, Grounding and Bonding Equipment.
 - f. 514A, Metallic Outlet Boxes.
 - g. 514B, Conduit, Tubing, and Cable Fittings.
 - h. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
 - i. 797 Electrical Metallic Tubing – Steel.
 - j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
 - k. 886, Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
 - l. 1660, Liquid-Tight Flexible Nonmetallic Conduit.
8. ANSI B1.20.2 – NPT – American National Standard Taper Pipe Threads.

C. Comply with NECA "Standard of Installation."

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with the Contract Documents, the following manufactures are acceptable:
 - 1. Rigid metallic conduits:

- a. Allied Tube and Conduit Corporation.
 - b. Triangle PWC Inc.
 - c. Western Tube and Conduit Corporation.
 - d. Wheatland Tube Company.
 - e. LTV Steel Company.
 - f. EASCO Aluminum.
 - g. Indalex.
 - h. VAW of American, Inc.
2. PVC coated rigid metallic conduit and repair kits:
 - a. Perma-Cote
 - b. Rob-Roy Ind.
 - c. Raychem "GelTek" tape.
 - d. Thomas & Betts O-Cal
 - e. Calbond
3. Rigid non-metallic conduit:
 - a. Carlon.
 - b. Cantex.
 - c. Osburn Associates.
 - d. Allied Tube and Conduit Corporation
 - e. Prime Conduit
4. Flexible metallic conduit:
 - a. AFC Cable Systems.
 - b. Anamet, Inc.
 - c. Carlon.
 - d. Electri-Flex.
 - e. Flexible Metal Hose Company.
 - f. International Metal Hose Company.
 - g. Triangle PWC Inc.
 - h. LTV Steel Company.
5. Flexible non-metallic conduit.
 - a. Carlon
 - b. Carflex.
6. Wireway:
 - a. Hoffman Engineering Company.
 - b. Weigmann.
 - c. Square D.
7. Conduit fittings and accessories:
 - a. Appleton.
 - b. Carlon.
 - c. Cantex.
 - d. Crouse-Hinds.

- e. Killark.
- f. Osburn Associates.
- g. OZ Gedney Company.
- h. RACO.
- i. Steel City.
- j. Thomas and Betts.
- k. Atkore Calbond

8. Support systems:

- a. Unistrut Building Systems.
- b. B-Line Systems Inc.
- c. Kindorf.
- d. Minerallac Fastening Systems.
- e. Caddy.
- f. Atkore Power-Strut

9. Outlet, pull, and junction boxes:

- a. Appleton.
- b. Crouse-Hinds.
- c. Killark.
- d. OZ Gedney Company.
- e. Steel City.
- f. RACO.
- g. Bell.
- h. Hoffman Engineering Company.
- i. Wiegmann.
- j. B-Line Circle AW.
- k. Adalet.
- l. Rittal.

10. Anti-seize compound:

- a. Crouse-Hinds

2.2 RIGID METALLIC CONDUITS (Refer to Section 3.3 for acceptable application locations):

A. PVC-Coated Rigid Steel Conduit (PVC-RGS):

- 1. Nominal 40 mil Polyvinyl Chloride (PVC) exterior coating:
 - a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
 - b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
- 2. Nominal 2 mil, minimum, urethane interior coating.
- 3. Urethane coating on threads.

4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
 5. Female Ends:
 - a. Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 in, whichever is less beyond the opening.
 - b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
 6. Standards: NEMA/ANSI C80.1, UL 6, NEMA RN
 7. Standards: ANSI B1.20.2 – NPT – American National Standard Taper Pipe Threads.
- B. PVC-Coated Rigid Aluminum Conduit (PVC-RAC):
1. Nominal 40 mil Polyvinyl Chloride (PVC) exterior coating:
 - a. Coating: Bonded to hot-dipped galvanized rigid Aluminumconduit conforming to NEMA/ANSI C80.1.
 - b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
 2. Nominal 2 mil, minimum, urethane interior coating.
 3. Urethane coating on threads.
 4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
 5. Female Ends:
 - a. Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 in, whichever is less beyond the opening.
 - b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
 6. Standards: NEMA/ANSI C80.1, UL 6, NEMA RN 1.
 7. Standards: ANSI B1.20.2 – NPT – American National Standard Taper Pipe Threads.
- C. Rigid Galvanized Steel Conduit (RGS):
1. Mild steel with continuous welded seam.
 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
 3. Threads galvanized after cutting.

4. Internal coating: Backed lacquer, varnish, or enamel for smooth surface.
5. Standards: NEMA/ANSI C80.1, UL 6.
6. Standards: ANSI B1.20.2 – NPT – American National Standard Taper Pipe Threads.

D. Electrical Metallic Tubing (EMT):

1. Mild steel with continuous welded seam.
2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
3. Internal coating: Baked lacquer, varnish, or enamel for a smooth surface.
4. Standards: NEMA/ANSI C80.3, UL 797.

E. Rigid Aluminum Conduit (RAC):

1. AA Type 6063 aluminum alloy, T-1 temper.
2. Maximum copper content of 0.10 percent.
3. Extruded, seamless.
4. Standards: NEMA/ANSI C80.5, UL 6.
5. Standards: ANSI B1.20.2 – NPT – American National Standard Taper Pipe Threads.

2.3 RIGID NON-METALLIC CONDUIT:

A. Schedules 40 (PVC-40) and 80 (PVC-80)

1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
2. Rated for direct sunlight exposure.
3. Fire retardant and low smoke emission.
4. Shall be suitable for use with 90 DegC wire and shall be marked "maximum 90 DegC".
5. Standards: NEMA TC 2, UL 651.

2.4 FLEXIBLE CONDUIT:

A. Flexible Galvanized Steel Conduit (FLEX):

1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
2. Standard: UL 360.

- B. PVC-Coated Flexible Aluminum core (liquid-tight) Conduit (LFMC): (allowed for sizes 2-1/2" to 4" only).
 - 1. Core formed of continuous, spiral wound, aluminum strip with successive convolutions securely interlocked.
 - 2. Extruded PVC outer jacket positively locked to the steel core.
 - 3. Liquid and vaportight.
 - 4. Standard: UL 360.
- C. Flexible non-metallic (liquid-tight) conduit (LFNC) (allowed for sizes ½" to 2" only)
 - 1. Formed of a helically wound spiral of rigid PVC reinforcement embedded within a flexible PVC wall.
 - 2. Layered construction with a smooth seamless inner core of flexible PVC that is bonded to a covering of flexible PVC.
 - 3. Between the layers is a woven nylon mesh for reinforcement.
 - 4. Standard: UL1660

2.5 WIREWAY:

- A. General:
 - 1. Suitable for lay-in conductors.
 - 2. Designed for continuous grounding.
 - 3. Covers:
 - a. Hinged or removable in accessible areas.
 - b. Non-removable when passing through partitions.
 - c. Finish: Rust inhibiting primer and manufacturer's standard paint inside and out except for stainless steel type.
 - d. Standards: UL 870, NEMA 250.
- B. General Purpose (NEMA 1 rated) Wireway:
 - 1. 14 or 16 gage steel without knockouts.
 - 2. Cover: Non-gasketed and held in place by captive screws.
- C. Raintight (NEMA 3R rated) Wiring Trough:
 - 1. 14 or 16 gage galvanized steel without knockouts.
 - 2. Cover: Non-gasketed and held in place by captive screws.

D. Watertight (NEMA 4X rated) Wireway:

1. 14 gage type 304 or 316 stainless steel bodies and covers without knockouts and 10 gage stainless steel flanges.
2. Cover: Fully gasketed and held in place with continuous piano hinge with three-point latch.
3. Flanges: Fully Gasketed and bolted.

E. Dusttight (NEMA 12 rated) Wireway:

1. 14 gage steel bodies and covers without knockouts and 10 gage steel flanges.
2. Cover: Fully gasketed and held in place with continuous piano hinge with three-point latch.
3. Flanges: Fully gasketed and bolted.

2.6 CONDUIT FITTINGS AND ACCESSORIES:

A. Fittings for use with RGS:

1. General:
 - a. In hazardous locations, provide fittings listed for use in Class I, Groups C and D locations.
2. Locknuts:
 - a. Threaded steel or malleable iron.
 - b. Gasketed or non-gasketed.
 - c. Grounding or non-grounding type.
3. Bushings:
 - a. Threaded, insulated metallic.
 - b. Grounding or non-grounding type.
4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
5. Couplings:
 - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
 - b. Threadless type (Only allowed with written approval from engineer): Gland compression or self-threading type, concrete tight.
6. Unions: Threaded galvanized steel or zinc plated malleable iron.

7. Conduit bodies (ells and tees):
 - a. Body: Zinc plated cast iron with threaded hubs.
 - b. Standard and mogul size.
 - c. Cover:
 - i. Clip-on type with stainless steel screws.
 - ii. Gasketed or non-gasketed galvanized steel, zinc plated cast iron.
 8. Conduit bodies (round):
 - a. Body: Zinc plated cast iron.
 - b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron.
 9. Sealing fittings:
 - a. Body: Zinc plated cast iron with threaded hubs.
 - b. Standard and mogul size.
 - c. With or without drain and breather.
 - d. Fiber and sealing compound: UL listed for use with the sealing fitting.
- B. Fittings for use with RAC:
1. General:
 - a. In hazardous locations, provide fittings listed for use in Class I, Groups C and D locations.
 2. Locknuts:
 - a. Threaded stainless steel.
 - b. Gasketed or non-gasketed.
 - c. Grounding or non-grounding type.
 3. Bushings:
 - a. Threaded, insulated metallic.
 - b. Grounding or non-grounding type.
 4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
 5. Couplings:
 - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
 6. Unions: Threaded copper free cast aluminum.
 7. Conduit bodies (ells and tees):

- a. Body: Copper free cast aluminum with threaded hubs.
 - b. Standard and mogul size.
 - c. Cover:
 - i. Clip-on type with stainless steel screws.
 - ii. Gasketed or non-gasketed copper free cast aluminum.
- 8. Conduit bodies (round):
 - a. Body: Copper free cast aluminum.
 - b. Cover: Threaded screw on type, gasketed, copper free cast aluminum.
- 9. Sealing fittings:
 - a. Body: Copper free cast aluminum with threaded hubs.
 - b. Standard and mogul size.
 - c. With or without drain and breather.
 - d. Fiber and sealing compound: UL listed for use with the sealing fitting.
- C. Fittings for use with PVC-RGS:
 - 1. The same material, construction, and color as those fittings listed under paragraph "Fittings for use with RGS" and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS).
- D. Fittings for use with PVC-RAC:
 - 1. The same material, construction, and color as those fittings listed under paragraph "Fittings for use with RAC" and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RAC).
- E. Fittings for use with EMT:
 - 1. Connectors:
 - a. Straight, angle and offset types furnished with locknuts.
 - b. Zinc plated steel.
 - c. Insulated gland compression type.
 - d. Concrete and raintight.
 - 2. Couplings:
 - a. Zinc plated steel.
 - b. Gland compression type.
 - c. Concrete and raintight.
 - 3. Conduit bodies (ells and tees):
 - a. Body: Copper free aluminum with threaded hubs.
 - b. Standard and mogul size.
 - c. Cover:

- i. Screw down type with steel screws.
 - ii. Gasketed or non-gasketed galvanized steel or copper free aluminum.
 - 4. Standard: UL 514B
- F. Fittings for use with FLEX:
 - 1. Connector:
 - a. Zinc plated malleable iron.
 - b. Squeeze or clamp type.
 - 2. Standard: UL 514B.
- G. Fittings for use with LFMC:
 - 1. Connector:
 - a. Straight or angle type. (angle type not allowed to be used for transition from conduit to flex)
 - b. Aluminum construction, insulated and gasketed.
 - c. Composed of locknut, grounding ferrule and gland compression nut.
 - d. Liquid tight.
 - 2. Standards: UL 467, UL 514B.
- H. Fittings for use with LFNC:
 - 1. Connector:
 - a. Straight or angle type. (angle type not allowed to be used for transition from conduit to flex)
 - b. Non-metal construction, insulated and gasketed.
 - c. Composed of locknut, grounding ferrule and gland compression nut.
 - d. Liquid tight.
 - 2. Standards: UL 467, UL 514B.
- I. Fittings for use with Rigid Non-Metallic PVC Conduit:
 - 1. Coupling, adapters, and conduit bodies:
 - a. Same material, thickness, and construction as the conduits with which they are used.

- b. Homogeneous plastic free from visible cracks, holes, or foreign inclusions.
 - c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
 - 2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
 - 3. Standards: ASTM D2564, NEMA TC3, UL 651, UL 541B.
 - J. Weather and Corrosion Protection Tape (Allowed only with Engineer Approval).
 - 1. PVC based tape, 10 mils thick.
 - 2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
 - 3. Used with appropriate pipe primer.
- 2.7 ALL RACEWAY AND FITTINGS:
- A. Mark Products:
 - 1. Identify the nominal trade size on the product.
 - 2. Stamp with the name or trademark of the manufacturer.
- 2.8 OUTLET BOXES:
- A. Metallic Outlet Boxes (allowed only in areas where Nema 1 equipment is installed or with written engineer approval):
 - 1. Hot-dip galvanized steel.
 - 2. Conduit knockouts and grounding pigtail.
 - 3. Styles:
 - a. 2 IN x 3 IN rectangle, 3-1/2 IN deep, gangable or non gangable (In CMU Walls only)
 - b. 4 IN square x 2-1/8 IN deep
 - c. 4 IN octagon.
 - d. Masonry/tile.
 - 4. Accessories:
 - a. Flat blank cover plates.
 - b. Barriers.
 - c. Extension, plaster or tile rings.
 - d. Box supporting brackets in stud walls. (all boxes must be supported by 2 studs)
 - e. Adjustable bar hangers.
 - 5. Standards: NEMA/ANSI OS 1, UL 514A.

B. Cast Outlet Boxes:

1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.
2. Threaded hubs and grounding screw.
3. Styles:
 - a. "FD"
 - b. Single or multiple gang and tandem.
 - c. "EDS" or "EFS" for hazardous locations.
4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
5. Standards: UL 514A, UL 886.
6. Bell Boxes not allowed without written engineer approval.

C. Non-metallic Outlet Boxes (only in chemical areas)(where specified on the plans):

1. Polyvinyl-chloride (PVC) plastic compound.
2. Rated for direct sunlight exposure.
3. Fire retardant and low smoke emission.
4. Suitable for use with 90 DegC wire.
5. Styles:
 - a. "FD"
 - b. Single or multiple gang.
6. Standard: UL 514A, NEMA TC 3.

D. See Specification 16140 for wiring devices, wallplates, and cover plates.

2.9 PULL AND JUNCTION BOXES (Must be sized per NEC):

A. NEMA 1 Rated:

1. Body and cover: 14 gage minimum, galvanized steel or steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
2. With or without concentric knockouts on four (4) sides.
3. Flat cover fastened with screws.

B. NEMA 3R Rated:

1. Body and cover: 14 gage minimum steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
2. No knockouts.

3. Seams continuously welded and ground smooth.
4. Door with hinge and latch
5. All connections to box shall be with Myers Hubs

C. NEMA 4X Rated (metallic):

1. Body and cover: 14 gage type 304 or 316 stainless steel.
2. Seams continuously welded and ground smooth.
3. No knockouts.
4. External mounting flanges.
5. Door with oil-resistant gasket.
6. All connections to box shall be with Myers Hubs.

D. NEMA 4X Rated (non-metallic):

1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
2. No knockouts.
3. External mounting flanges.
4. Hinged door with quick release latches and padlocking hasp.
5. Door with oil resistant gasket.
6. All connections to box shall be with Myers Hubs.

E. NEMA 7 and NEMA 9 Rated:

1. Cast gray iron allow or copper-free aluminum with manufacturer's standard finish.
2. Drilled and tapped openings or tapered threaded hub.
3. Cover bolted down with stainless steel bolts or threaded cover with neoprene gasket.
4. External mounting flanges.
5. Grounding lug.
6. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.

F. NEMA 12 Rated:

1. Body and cover:
 - a. 14 gage steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
 - b. Type 5052 H-32 aluminum, unpainted.
2. Seams continuously welded and ground smooth.
3. No knockouts.
4. External mounting flanges.

5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
6. Flat door with oil resistant gasket.

G. Miscellaneous Accessories:

1. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
2. Split covers when heavier than 25 LBS.
3. Weldnuts for mounting optional panels and terminal kits.
4. Tamper proof screws.
5. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

H. Standards: NEMA 250, UL 50

I. All pull/junction boxes must be sized per NEC

2.10 SPECIAL PURPOSE BOXES:

A. Pedestal-Type Floor-Mounted or Counter-Mounted Duplex Receptacles:

1. Horizontal design housing with threaded conduit fittings in base with satin chromium finish.

B. Flush in Floor Duplex Receptacles:

1. Dual level, full adjustable box with power fittings and brass carpet flange.

2.11 SUPPORT SYSTEMS:

A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:

1. Material Requirements.
 - a. Galvanized steel: ASTM A123 or ASTM A153.
 - b. Stainless steel: AISI Type 304 or 316.
 - c. PVC coated galvanized steel: ASTM A123 or ASTM A153 and 20 mil PVC coating.
 - d. Aluminum: AA Type 6063-T6.

B. Single Conduit and Outlet Box Support Fasteners:

1. Material Requirements:
 - a. Zinc plated steel.
 - b. Stainless steel, Type 304 or 316.

- c. Malleable iron.
- d. PVC coated malleable iron or steel: 20 mil PVC coating.
- e. Steel protected with zinc phosphate and oil finish.

2.12 RACEWAY/DUCT SEALING COMPOUND:

- A. Use with explosion-proof fittings to separate hazardous areas from non-hazardous areas:
 - 1. UL Listed compound
 - 2. Crouse-Hinds Chico or approved equal.
 - 3. Use fiber dam for vertical installation.
- B. All other areas:
 - 1. Non-hardening, putty-like consistency workable at temperatures as low as 35 F.
 - 2. Compound shall not slump at temperature of 300 F and shall readily adhere to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

PART 3 EXECUTION

3.1 RACEWAY INSTALLATION – GENERAL:

- A. Shall be in accordance with requirements of:
 - 1. NFPA 70- NEC.
 - 2. Manufacturer's instructions.
 - 3. ANSI B1.20.2 – NPT – American National Standard Taper Pipe Threads.
- B. Size of Raceways:
 - 1. Raceway sizes are shown on Drawings. If not shown on the Drawings, then size in accordance with NFPA 70.
 - 2. Unless specifically indicated otherwise, the minimum raceway size shall be:
 - a. Conduit: 1 IN.
 - b. Wireway: 2-1/2 IN x 2-1/2 IN.
 - c. ½" Flex can be utilized for connection to instruments and lighting.
- C. Field Bending and Cutting of Conduits:
 - 1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.

2. Do not reduce the internal diameter of the conduit when making conduit bends.
 3. Prepare tools and equipment to prevent damage to the PVC coating. Use strap wrenches only to tighten joints in PVC-RGS. Replace all conduit and fittings with damage to the PVC coating, such as cuts, nicks, and threader chuck jaw marks.
 4. Degrease threads after threading and apply a zinc rich paint.
 5. Field cut threads shall be same length and amount as factory cut threads.
 6. Make-up of threads inside fittings, boxes, & condulets shall be minimum half the amount of factory threads with no more than minimum amount of factory threads showing after make-up.
 7. Running threads are NOT allowed.
 8. Deburr interior and exterior after cutting.
- D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
1. Repair galvanized components utilizing a zinc rich paint.
 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicon composition strip, followed by a protective coating of vinyl tape.
 - a. Total nominal thickness: 40 mil.
 4. Repair surface which will be inaccessible after installation prior to installation.
- F. Remove moisture and debris from conduit before wire is pulled into place.
1. Pull mandrel with diameter nominally $\frac{1}{4}$ IN smaller than the interior of the conduit, to remove obstructions.
 2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
 3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

- G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.
- H. Install pull wires in empty raceways. Leave not less than 12 IN of slack at each end of the pull wire.
- I. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.
- J. Damp or Wet Locations: In damp or wet locations make every effort to avoid installing raceways in a manner which will create moisture traps. Where they must be so installed, seal both ends of raceways with an approved sealing compound to prevent "breathing" and moisture condensation within the raceways.
- K. Fill openings in walls, floor, and ceilings and finish flush with surface.
 - 1. Where penetrating CMU block walls, repair with cementitious grout and paint to match.
 - 2. Where conduit terminates at a cable tray system, fit conduit with an insulated bushing.
 - 3. When conduits are passing through a firewall or fire-rated floor into different rooms, cabinets, or enclosures, use a fire-rated seal.
- L. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area. Install CSBE removable sealing fittings to seal submersible pump cables in the wet well and at the first junction box outside the well.
- M. Conduit Stub-ups (from top of 90 Deg Transition to min 6" AFG)
 - 1. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above finished slab.
 - 2. Transition underground conduit to aboveground conduit at 90 DEG elbow where conduit transitions from horizontal to vertical conduit.
 - 3. Provide "PVC-RGS" or "PVC-RAC" to a minimum of 6" above grade.
 - 4. Stub-up connections: Extend conduits for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with finished floor.
 - 5. Provide corrosion tape over any exposed threads connected at PVC to rigid adapters.

N. Installation of Condulets

1. Install Condulets with minimum of 24" of clearance in front of covers for access.

3.2 RACEWAY ROUTING:

A. Raceways shall be routed in the field unless otherwise indicated.

1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
2. Run in straight lines parallel to or at right angles to building lines.
3. Install raceways level and square and at proper elevations. Provide adequate headroom.
4. Do not route conduits:
 - a. Through areas of high ambient temperature or radiant heat.
 - b. In suspended concrete slabs.
5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
6. Provide pull boxes or conduit bodies as needed so that there is a maximum of 270 degrees of bends or 3-90 degree bends in the conduit run or in long straight runs to limit pulling tensions.
7. Make changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.
8. Minimum 1" spacing required between all exposed conduits.

B. All rigid conduits within a structure shall be installed exposed except as follows:

1. As indicated on the Drawings.
2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
3. Concealed within stud frame, poured concrete, concrete block and brick walls of an architecturally finished area.
4. Embedded in floor slabs or buried under floor serving equipment in non-architecturally finished areas that are not locate on or near a wall or column and the ceiling height is greater than 12 FT.
5. Embedded in floor slabs or buried under floor slabs where shown on the Drawings or with the Engineer's permission.

- C. Maintain 1 IN minimum spacing between all parallel conduit and piping runs.
- D. Conduits shall be installed to eliminate moisture pockets.
 - 1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
- E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.
- F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.
- G. Provide all required openings in walls, floors, and ceilings for conduit penetration.
 - 1. Repair penetrations to existing condition or better.
- H. Conduit embedded in columns and floor slabs or buried under slab-on-grade:
 - 1. Run in the most direct, practical route.
 - 2. Not to be installed under equipment pads unless approved by Engineer.
 - 3. No crossovers unless approved by Engineer.
 - 4. To be backfilled with concrete during the installation of the slab-on-grade or to be placed, backfilled, and compacted in the slab subgrade, as indicated on drawings.
 - 5. Secured in place to prevent movement during the backfill and pour.
- I. Conduits and accessories embedded in concrete where shown on the Drawings:
 - 1. Shall not be considered to replace structurally the displaced concrete except as indicated in the following:
 - a. Conduit and fittings shall not displace more than 4 percent of the area of the cross-section of a column on which stress is calculated or which is required for fire protection.
 - b. Size and locate sleeves or conduits passing through floors, walls, or beams so as not to significantly impair the strength of the construction.
 - c. Sleeves or conduits passing through floors, walls or beams may be considered as replacing the displaced concrete structurally in compression.
 - i. Shall not be exposed to rusting or other deterioration.
 - ii. Nominal inside diameter shall not exceed 2 IN.
 - iii. Minimum spacing: 3 DIA OC.

2. Shall not be larger in outside diameter than one-third the thickness of the slab, column, or beam.
3. Shall have a minimum spacing of 3 DIA OC.
4. In reinforced concrete construction:
 - a. Conduit shall not be run in beams.
 - b. Place conduit after reinforcing steel has been laid.
 - c. The reinforcement steel shall not be displaced by the conduit.
 - d. Provide a minimum of 1-1/2 IN of cover over conduit, excluding surface finish.
 - e. Conduits parallel to main reinforcement shall be run near the center of the wall.
 - f. Conduits perpendicular to main reinforcement shall be run midway between wall or slab supports.

3.3 RACEWAY APPLICATIONS:

A. Permitted Raceway Types Per Area Designations (unless specifically indicated on Drawings):

1. Dry areas:
 - a. RGS.
 - b. RAC.
2. Wet areas:
 - a. RGS.
 - b. RAC.
3. Exterior & Corrosive areas (includes, but not limited to wastewater project sites): (unless specifically indicated on Drawings):
 - a. PVC-RGS.
 - b. PVC-RAC.
 - c. As Indicated on Drawings
4. Interior & Corrosive areas (includes, but not limited to chemical rooms): (unless specifically indicated on Drawings):
 - a. PVC-40.
 - b. PVC-80.
 - c. As indicated on drawings.

B. Permitted Raceway types per Routing Locations:

1. In stud framed walls:
 - a. EMT.
2. In concrete block or brick walls:
 - a. PVC-40.
 - b. EMT
3. Above acoustical tile ceilings:
 - a. EMT.
 - b. NEMA 1 rated Wireway.
4. Embedded in poured concrete walls and floors:
 - a. PVC-40
 - b. PVC-80
 - c. PVC-RGS or PVC-RAC when emerging from concrete into areas designated as exterior and corrosive.
5. Beneath floor slab-on grade:
 - a. PVC-40
 - b. PVC-80
6. Direct buried conduits and ductbanks:
 - a. PVC-40.
 - b. PVC-80.
 - c. 90 degree elbows for transition to above grade:
 - i. PVC-RGS.
 - ii. PVC-RAC
 - d. Long sweeping bends greater than 15 degrees.
 - i. PVC-RGS.
 - ii. PVC-RAC
7. Concrete encased ductbanks:
 - a. PVC-40.
 - b. PVC-80.
 - c. 90 degree elbows for transition to above grade:
 - i. PVC-RGS.
 - ii. PVC-RAC
 - d. Long sweeping bends greater than 15 degrees.
 - i. PVC-RGS.
 - ii. PVC-RAC

- C. FLEX conduits shall be installed for connections to light fixtures, HVAC equipment and other similar devices above the ceilings.
 - 1. The maximum length shall not exceed:
 - a. 6 FT
 - 2. The minimum length shall be as follows:
 - a. 2ft for ½" thru 1"
 - b. 2ft 6" for 1-1/4" & 1-1/2"
 - c. 3ft for 2" & 2-1/2"
 - d. 4ft for 3" thru 4"
- D. LFMC and LFNC conduits shall be installed as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
 - 1. The maximum length shall not exceed:
 - a. 6 FT
 - 2. The minimum length shall be as follows:
 - a. 2ft for ½" thru 1"
 - b. 2ft 6" for 1-1/4" & 1-1/2"
 - c. 3ft for 2" & 2-1/2"
 - d. 4ft for 3" thru 4"
- E. NEMA 1 Rated Wireway:
 - 1. Surface mounted in electrical rooms.
 - 2. Surface mounted above removable ceilings tiles of an architecturally finished area.
- F. NEMA 3R Wiring Trough:
 - 1. Surface mounted in exterior, non-corrosive locations.
- G. NEMA 4X Rated Wireway:
 - 1. Surface mounted in areas designated as corrosive.
- H. NEMA 12 Rated Wireway:
 - 1. Surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.

3.4 CONDUIT FITTINGS AND ACCESSORIES:

- A. Conduit Seals:

1. Install in conduit systems located in hazardous areas as required by the NEC or as shown on Drawings.
- B. Rigid non-metallic conduit and fittings shall be joined utilizing solvent cement.
 1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated $\frac{1}{4}$ turn to provide uniform contact.
- C. Install Expansion Fittings:
 1. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
 2. Elsewhere as identified on the Drawings.
- D. Install Expansion/Deflection Fittings:
 1. Where conduits enter a structure.
 - a. Except electrical manholes and handholes.
 - b. Except where the duct bank is tied to the structure with rebar.
 2. Where conduits span structural expansion joints.
 3. Elsewhere as identified on the Drawings.
- E. Threaded connections shall be made wrench-tight.
 1. Field cut threads shall be same length and amount as factory cut threads.
 2. Make-up of threads inside fittings, boxes, & condulets shall be minimum half the amount of factory threads with no more than minimum amount of factory threads showing after make-up.
 3. Running threads are NOT allowed.
- F. Conduit joints shall be watertight:
 1. Where subjected to possible submersion.
 2. In areas classified as wet.
 3. Underground.
- G. Terminate Conduits:
 1. In metallic outlet boxes:
 - a. RGS and RAC:
 - i. Conduit hub and locknut.
 - ii. Insulated bushing and two (2) locknuts.
 - iii. Use grounding type locknut or bushing when required by NEC.

- b. EMT: Compression type connector and locknut.
- 2. In NEMA 1 rated enclosures:
 - a. RGS and RAC:
 - i. Conduit hub and locknut.
 - ii. Insulated bushing and two (2) locknuts.
 - iii. Use grounding type locknut or bushing when required by NEC.
 - b. EMT: Compression type connector and locknut Indoors
 - i. Raintight Compression type and locknut outdoors
- 3. In NEMA 12 rated enclosures:
 - a. Watertight, insulated and gasketed hub and locknut.
 - b. Use grounding type locknut or bushing when required by NEC.
- 4. In NEMA 3R, 4 and NEMA 4X rated enclosures:
 - a. Watertight, insulated and gasketed hub and locknut.
- 5. In NEMA 7 and NEMA 9 rated enclosures:
 - a. Into an integral threaded hub.
- 6. When stubbed up through the floor into floor mounted equipment:
 - a. With an insulated grounding bushing on metallic conduits.
 - b. With end bells on non-metallic conduits.
- H. Threadless couplings shall only be used (with written engineer approval) to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

3.5 CONDUIT SUPPORT:

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
 - 1. Dry or wet and/ or hazardous areas:
 - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit straps.
 - b. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
 - c. Stainless steel system consisting of: Type 304 or 316 stainless steel channels and fittings, nuts and hardware and conduit

straps.

2. Corrosive areas:

- a. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
- b. Stainless steel systems consisting of Type 304 or 316 stainless steel channels and fittings, nuts and hardware and conduit straps.

3. Conduit type shall be compatible with the support system material.

- a. Galvanized steel system may be used with RGS and EMT.
- b. Stainless steel system may be used with RGS, PVC-RGS and RAC.
- c. PVC coated galvanized steel system may be used with PVC-RGS, RAC, PVC-40, and PVC-80.
- d. Aluminum system may be used with RAC and PVC-RGS.

B. Permitted single conduit support fasteners per area designations and conduit types:

1. Architecturally finished areas:

- a. Material: Zinc plated steel, or steel protected with zinc phosphate and oil finish.
- b. Types of fasteners: Spring type hangers and clips, straps, hangers with bolts, clamps with bolts, and bolt on beam clamps.
- c. Provide anti-rattle conduit supports when conduits are routed through metal studs.

2. Dry or wet and/or hazardous areas:

- a. Material: Zinc plated steel, stainless steel and malleable iron.
- b. Types of fasteners: Straps, hangers with bolts, clamps with bolts, and bolt on beam clamps.

3. Corrosive areas:

- a. Material: Type 304 or 316 stainless steel or PVC coated malleable iron or steel. For indoor corrosive areas, non-metallic PVC straps may be used.
- b. Types of fasteners: Straps, hangers with bolts, clamps with bolts, and bolt on beam clamps.

4. Conduit type shall be compatible with the support fastener material.
 - a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS and EMT.
 - b. Stainless steel system may be used with RGS, PVC-RGS, and RAC.
 - c. PVC coated fasteners may be used with PVC-RGS, RAC, PVC 40, and PVC-80.
 - d. Non-metallic fasteners may be used with PVC-40, and PVC-80.

C. Conduit Support General Requirements:

1. Maximum spacing between conduit supports per NEC and below.
 - a. Maximum 3 feet from each box or conduit connection and every 3 feet for PVC.
 - b. Maximum 3 feet from each box or conduit connection and every 10 feet for all rigid metal conduit.
 - c. Provide support within 2 feet of any direction change not utilizing a box or conduit.
2. Support conduit from the building structure.
3. Do not support conduit from process, gas, air, water piping or other conduits.
4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load. Recommended by the manufacturer if the support is rated less than 25 LBS.
 - a. Do not exceed the maximum concentrated load recommended by the manufacturer on any support.
 - b. Conduit hangers:
 - i. Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire. (Threaded rod cannot be bent. Provide proper attachment to purlins, beams, or structure so that threaded rods hang vertical.)
 - c. Do not use suspended ceiling support systems to support raceways.
 - d. Hangers in metal roof decks:

- i. Utilize fender washers.
- ii. Not extend above top of ribs.
- iii. Not interfere with vapor barrier, insulation, or roofing.

5. Conduit support system fasteners:

- a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
- b. Do not use concrete nails and powder-driven fasteners.

3.6 OUTLET, PULL, AND JUNCTION BOX INSTALLATION:

A. General:

- 1. Install products in accordance with manufacturer's instructions.
- 2. Install approved thread grease on all plugs prior to installation.
- 3. Fill unused punched-out tapped, or threaded hub openings with insert plugs. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.
 - a. All 4 square boxes must be at least 2-1/8" deep
 - b. All other boxes sized per NEC.
- 4. Install all boxes with a minimum of 24" clearance from cover for access of boxes.

B. Outlet Boxes:

- 1. Permitted uses of metallic outlet boxes:
 - a. Housing of wiring devices:
 - i. Recessed in all stud framed walls and ceilings.
 - Boxes must be supported by 2 studs
 - All boxes must be at least 2-1/8 IN deep
 - ii. Recessed in poured concrete, concrete block, and brick walls of architecturally finished areas and exterior building walls.
 - b. Pull or junction box:
 - i. Above gypsum wall board or acoustical tile ceilings.
 - Boxes located above acoustical tile ceilings must be accessible without removing ceiling grid.
 - All boxes must be at least 2-1/8" deep

- ii. Above 10 FT in an architecturally finished area where there is no ceiling.
- 2. Permitted uses of cast outlet boxes:
 - a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, corrosive, and hazardous areas.
 - b. Pull and junction box surface mounted in non-architecturally finished dry, wet, and corrosive areas.
- 3. Permitted uses of non-metallic outlet boxes:
 - a. Housing of wiring devices surface mounted in non-architecturally finished corrosive areas.
 - b. Pull and junction boxes mounted in non-architecturally finished corrosive areas.
- 4. Mount devices outlet boxes where indicated on the Drawings and at the following heights: unless noted otherwise on the plans.
 - a. Light switch (to center): 48 IN.
 - b. Receptacle in architecturally finished areas (to center): 18 IN.
 - c. Receptacle on exterior wall of building (to center): 18 IN.
 - d. Receptacle in non-architecturally finished areas (to center): 24 IN.
 - e. Telephone outlet in architecturally finished areas (to center): 18 IN.
 - f. Telephone outlet for wall-mounted phone (to center): 54 IN.
 - g. Pushbutton or selector switch control station (to center): 48 IN.
 - h. Receptacles & switches installed over countertops to be 10 IN. above countertop.
- 5. Set device outlet boxes plumb and vertical to the floor.
- 6. Outlet boxes recessed in walls:
 - a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
 - i. Boxes must be supported by 2 studs where possible.

- b. Locate in cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.
- 7. Place barriers between switches in boxes with 277 V switches on opposite phases.
- 8. Back-to-back installations are not permitted.
- 9. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.
- C. Pull and Junction Boxes:
 - 1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
 - a. Make covers of boxes accessible. (2 feet clearance must be provided in front of all boxes)
 - 2. Permitted uses of NEMA 1 enclosure:
 - a. Pull or junction box surface mounted above removable ceiling tiles of an architecturally finished area.
 - i. Boxes installed above removable ceiling tiles must be accessible without removing ceiling grid.
 - b. Pull or junction box surface in a non-architecturally finished area.
 - 3. Permitted uses of NEMA 3R enclosure:
 - a. Pull or junction box surface mounted in dry and wet areas, unless stated otherwise in Drawings.
 - 4. Permitted uses of NEMA 4X metallic enclosure:
 - a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
 - 5. Permitted uses of NEMA 4X non-metallic enclosure:
 - a. Pull or junction box surface mounted in indoor areas designated as wet and/or corrosive where used with PVC-40 or PVC-80 conduit.
 - 6. Permitted uses of NEMA 7 enclosure:
 - a. Pull or junction box surface mounted in Class I hazardous areas.
 - i. Provide PVC coating in corrosive areas when PVC-RGS or PVC-RAC conduit is used.

7. Permitted uses of NEMA 9 enclosure:
 - a. Pull or junction box surface mounted in Class II hazardous areas.
 - i. Provide PVC coating in corrosive areas when PVC-RGS or PVC-RAC conduit is used.
8. Permitted uses of NEMA 12 enclosure:
 - a. Pull or junction box surface mounted in areas designated as dry.

END OF SECTION

SECTION 16115

UNDERGROUND ELECTRICAL DUCT AND CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Underground electrical duct and direct burial conduit, together with all other accessories required.

1.2 SUBMITTALS:

- A. Submit manufacturer's data on all materials, under provisions of Section 01300.

PART 2 PRODUCTS

2.1 UNDERGROUND DUCTS:

- A. Schedule 40, heavy wall, high impact rigid virgin polyvinyl chloride (PVC) conduit and fittings, conforming to NEMA Publications TC2 and TC3 and UL listed; Carlon or equivalent.

2.2 CONDUITS:

- A. Underground PVC Conduit: Schedule 40, heavy wall, high impact rigid virgin polyvinyl chloride (PVC) conduit and fittings, conforming to NEMA Publications TC2 and TC3 and UL listed for direct burial use; Carlon or equivalent.
- B. "PVC-RGS" & "PVC-RAC": As specified under Raceways and Fittings, Section 16110.

PART 3 EXECUTION

3.1 GENERAL:

- A. After the affected electrical work has been installed, tested, and approved, backfill all excavations with suitable material. Include the cutting of all sidewalks, streets, and other pavement and repairing the openings in them to return the surface to approximately its original condition.
- B. All conduits to be swabbed clean after installation before wire installation.

3.2 EXCAVATIONS:

- A. Perform all excavations of every description of whatever substances encountered and to the depths required for installation of the work under this Division.
- B. During excavation, stockpile material suitable for backfilling in an orderly manner a sufficient distance from the banks of the trenches to prevent slides or cave-ins. Remove all excavated material not required or suitable for backfill, or waste as directed. Control grading to prevent surface water from flowing into

excavations and remove any accumulated water by pumping.

- C. Use open cut grading and make trenches of the necessary width for proper installation of the lines with banks as nearly vertical as possible.
- D. Grade the bottom of trenches accurately to provide uniform bearing and support for conduit or duct on undisturbed soil at every point along its entire length (bottom of trench must be flat to allow conduit to lay flat before backfilling).
- E. Except at locations where excavation of rock from the bottoms of trenches is required, take care not to excavate below the depths required. Where rock excavation is required, remove the rock to a minimum overdepth of 4 inches below the trench depths specified. Backfill the overdepth rock excavation and excess trench excavation to the proper level with sand prior to the installation of conduit or ducts. Whenever wet or otherwise unstable soil that is incapable of properly supporting conduits or ducts is encountered in the trench bottom, remove such soil to a depth required and backfill the trench to trench bottom grade with sand or other suitable material.

3.3 BACKFILLING:

- A. Carefully backfill trenches with earth, sandy clay, sand and gravel, or other approved material free from large clods of earth or stone, deposited in thoroughly and carefully compacted 6-inch layers. Do not use blasted rock, broken concrete or pavement, or large boulders as backfill material. Settling the backfill with water will be permissible and will be required when so directed. Re-open any trenches improperly filled or where settlement occurs to the depth required for proper compaction the refill, mound over and smooth off.
- B. Backfill open trenches across roadways or other areas to be paved as specified above except that the entire depth of trench shall be backfilled in 6-inch layers, each layer moistened and compacted to a density of not less than 95 percent Standard Proctor in such manner as to permit the rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing value and permit paving of the area immediately after backfilling is completed. Along all other portions of the trenches, grade the ground to a reasonable uniformity and leave the mounding over the trenches in a uniform and neat condition.

3.4 UNDERGROUND DUCT INSTALLATION:

- A. Use PVC electrical ducts, installed with concrete encasement, with a minimum of 3" of concrete between ducts and earth, and with 2 inches of concrete between adjacent ducts. Provide minimum 30 inches of cover from the top of concrete to finished grade, or as indicated on the drawings. Install with uniform slope for drainage, with no low pockets to collect water.
- B. Where ducts cross beneath roadways, or other locations as indicated on the drawings, reinforce the duct with rebar as indicated on the drawings.
- C. After the concrete is poured, cover the entire surface of the concrete with a red dye. The red dye shall be provided with a uniform cover and shall be worked into the concrete a minimum of 2-3 inches.

- D. Build up duct banks completely in the trench before placing concrete, using factory-fabricated plastic conduit spacers. Use solvent cement as directed by the duct manufacturer in making up all joints.
- E. Fabricate duct runs with standard factory-made fittings, elbows and accessories. Make all changes of direction, horizontal or vertical with long sweep bends having a minimum radius of 25 feet, except that manufactured bends at or near the ends of the runs may be used on short runs of 100 feet or less. Make long sweep bends with one or more curved or straight sections of duct. Manufactured bends, where permitted, shall have a minimum radius of 10 times the nominal duct diameter. Where manufactured ducts of greater than a 15 degree angle are required, use "PVC-RGS" or "PVC-RAC" conduit bends. During construction, protect partially completed duct lines from entrance of dirt and debris by means of suitable factory-made duct plugs. After completion of installation, seal all ends of spare ducts with factory-made duct plugs (any exposed threads at transition from rigid conduit to PVC adapter must be wrapped with corrosion tape).
- F. Where ducts enter in or under buildings, or turn up through equipment pads, change from PVC duct to "PVC-RGS" or "PVC-RAC".
- G. Install the concrete envelope for a given duct run in one pour where possible. Use concrete of 3000 psi compressive strength. In pouring concrete, do not allow heavy masses of concrete to fall on ducts. Direct flow of concrete down sides of assembly to bottom, forcing it to flow to center of bank and then to rise up in middle, filling all spaces uniformly. Spade concrete liberally and carefully with a long, flat slicing bar between vertical rows to eliminate voids. Weight or brace the duct bank assembly if necessary, to prevent the assembly from floating. Because of the fact that PVC conduits may expand considerably during construction, each run and its concrete envelope shall be installed starting at one end and progressing toward the other with any necessary adjustments to length being made at the end toward which the work is progressing.
- H. After ducts are installed, complete with envelope, and before pulling any cable, pull a mandrel through every duct to check for alignment and clear passage. Use an iron-shod mandrel with a diameter of 1/4 inch less than the nominal size of the duct and a length equal to the duct diameter. Mandrel shall have a leather or rubber gasket slightly larger than the duct hole. After testing the ducts with the mandrel, pull a stiff-bristled brush through each duct until it is clear of all particles of earth, sand or gravel; then install duct plugs immediately.

3.5 UNDERGROUND PVC CONDUIT INSTALLATION:

- A. Install at least 18 inches below finished grade unless indicated otherwise. Assemble and install raceways in accordance with manufacturer's instructions. Make joints with couplings and solvent cement. Fabricate bends of 15 degrees or more with factory-made elbows, or make field bends with proper heating equipment(with engineer approval). Bends showing signs of overheating or flattening are unacceptable. Ream ends of all conduits before joining.

- B. "Snake" plastic conduit in trench, from side to side, with a complete cycle every 40 feet to allow for expansion and contraction. Maintain this configuration during backfilling.
- C. Where conduit turns up out of earth, or floor slabs, change from plastic to "PVC-RGS" or "PVC-RAC" (any exposed threads at transition from rigid conduit to PVC adapter must be wrapped with corrosion tape).
- D. Do not extend any plastic conduit above grade unless approved by the engineer.
- E. Install 6 inch wide detectable electrical warning tape above conduits. Minimum 6" to maximum 1 foot from finished grade.

3.6 UNDERGROUND RIGID STEEL CONDUIT INSTALLATION:

- A. All rigid underground conduits shall be "PVC-RGS" or "PVC-RAC"

END OF SECTION

SECTION 16120

CONDUCTORS

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Conductors, together with all splices, connections, and identification, including pulling devices.

1.2 SUBMITTALS:

- A. Submit manufacturer's data on all materials, under provisions of Section 01300 - *Submittals*.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 1. Building wire, power and control cable:

- a. Alphawire.
 - b. General Cable.
 - c. Okonite Company.
 - d. Southwire Company.

- 2. Instrumentation and Ethernet cable:

- a. Alphawire.
 - b. Belden Inc.
 - c. General Cable.

- 3. Shielded 600 Volt VFD cable:

- a. Belden Inc.
 - b. General Cable.
 - c. Okonite Company.
 - d. Priority Wire and Cable (Prysmian).
 - e. Southwire Company.

2.2 CONDUCTORS (600 VOLTS AND UNDER):

- A. Type: Soft drawn, annealed copper, UL listed, rated at 600 volts, continuous without weld, splice or joint, uniform cross-section, free from flaws, scale and other imperfections; Okonite, Triangle, or Simplex. All Cables shall be stranded unless approved by Engineer.

- B. Insulation: Branch circuits shall have type THHN/THWN or XHHW insulation unless the type is specifically designated or specified. Service feeders shall be type THHN/THWN or XHHW. Feeder circuits shall be Type THHN/THWN or XHHW.
- C. All conductors installed underground or in areas where exposed to damp or wet locations shall be rated THWN or XHHW.
- D. Circuits Subjected to High Temperatures: Type XHHW 90 C conductors for wiring in proximity to boilers, and for motors and devices subject to high temperature because of high ambient temperature or convection or radiant heat.

2.3 INSTRUMENT CABLE:

- A. Reference: UL 2250, UL 1277.
- B. The assembly shall be rated 600 volts, 90° C.
- C. The assembly shall be UL listed as sunlight resistant, for cable tray use, and shall meet the requirements for types CL2 and CL3 cable.
- D. Conductor: No 16 AWG minimum, 7 strand, concentric-lay, uncoated copper.
- E. Insulation: Polyvinyl chloride. Not less than 15 mils average thickness (13 mils minimum thickness), UL 62, Type TFFN.
- F. Lay: Twisted pair or triad with 1-1/2 to 2-1/2 inch lay.
- G. Shield: Each pair or triad and cable assemble shall have combination aluminum-polyester helically applied tape and 7 strand AWG minimum size, tinned copper drain wire, shield applied to achieve 100 percent cover over insulated conductor. Shield tape on pair and/or triad assemblies shall be applied in such a way as to give total shield isolation from all other pair or triad shields.
- H. Cable assembly: Black flame retardant polyvinyl chloride, UL 1277 applied over tape wrapped cable core.
- I. Conductor Identification: Single pair: One conductor black, one conductor white. Single triad: One conductor black, one conductor white, and one conductor red.
- J. Factory Tests: Insulated conductors shall conform to the requirements of UL 62 for Type TFFN. Assembly jacket shall conform to the requirements of UL 1277. Cable shall meet the vertical-tray flame test requirements of UL 1277.

2.4 Ethernet Copper Cable and Connectors:

- A. Data cable consisting of four twisted pairs of insulated copper conductors, Category 6 (TIA/EIA 568-C2-1) for high performance with 300 MHz channel bandwidth and a maximum data rate of 4.8 Gb/s. Temperature Rating: 60 deg C.

1. Cable shall be waterproof.

B. Wire Size:

1. 23 AWG copper, insulated, designed for low Insertion Loss (flow signal Attenuation) and meeting performance standards of TIA/EIA-568-C2-1.
2. Provide Bonded–Pair design.

C. Cable Insulation Material:

1. Plenum: 100% FEP for Bonded Pair.
2. Riser and LSZH: Polyolefin.

D. Jacket Material:

1. Industrial Ethernet Cable
 - a. Sunlight and Oil Resistant PVC Jacket
2. Plenum: LSPVC
3. Riser: PVC
4. Lszh: Low smoke, zero halogen polymer alloy.
5. Jacket printed at intervals indicating cable code, AWG, listings (NEC Code), verification, date, manufacturing traceability code.

- E. Connectors:** Provide RJ-45 modular connectors, unshielded metal housing, field installable, compatible for Category 6 cables.

- F. Manufacturer:** Belden (or approved equal)

2.5 JOINTS AND SPLICES:

- A. Make splices in accessible junction boxes.**

1. Splices in junction boxes, wireways, panels or in ground pull boxes on wire #2AWG or larger will not be acceptable without prior approval from engineer.

- B. Stranded Copper Conductors:** UL approved tin-plated, copper compression connectors, Thomas & Betts, Panduit, or Burndy. All connectors shall be of proper sizes to match conductor sizes. All compression connectors shall be applied with properly sized dies and tools. Split-bolt connectors are not acceptable.

- C. Do not splice instrument cables.** Instrument cables shall only be terminated at devices or on terminal blocks. Conductors may be terminated without compression connector on terminal blocks with appropriate mechanical type

terminals. Conductors terminated at terminal blocks with screw terminals shall be terminated with insulated, tin-plated copper locking fork terminals.

- D. Solid Copper Conductors: UL approved electrical spring connectors of "Scotchlock", Ideal, T&B, or approved equivalent. All connectors shall be of proper sizes to match conductor sizes. Split bolt connectors are not acceptable.

2.6 COLOR CODING:

- A. Use standardized color-coding of conductors throughout. All color coding shall be continuous for the entire length of the conductors, and shall be permanent and readily distinguished after installation. In cases where they specified colors of insulated wire and cable are unavailable, such conductors shall be color-coded, as specified above, by means of Brady, or plastic tape at all pull boxes, support boxes, outlet boxes, panelboards, and other terminal and splicing points. Heat shrink sleeves for tight fit.
- B. For No. 6 AWG and smaller conductors, color coding shall be provided by using conductors with continuous color imbedded in the insulation.
- C. Neutral conductors shall be white (120V) or natural gray (277V). Grounding conductors shall be green or green with one or more yellow stripes.
- D. Conductors shall be black, red, and white for phases 1, 2 and neutral respectively in the 240/120 volt system.
- E. Phase conductors shall be brown, purple, yellow and gray for phases A, B, C, and neutral respectively in the 277/480 volt system.
- F. Phase conductors shall be black, red, blue, and white for phases A, B, C, and neutral respectively in the 208 volt system.
- G. Phase conductors shall be black, orange, and blue for phases A, B, and C respectively in the 120/240 volt, 3-phase, 4-wire system. Identify the "high leg" with orange.

PART 3 EXECUTION

3.1 CONTINUITY:

- A. All conductors shall be continuous between points of termination.
- B. Splices between points of termination are not acceptable unless specifically approved.
- C. Splices in boxes permissible in 120-volt lighting and receptacle circuits only.

3.2 WIRE PULLING:

- A. Provide suitable installation equipment for pulling conductors into raceways or conduits. Use ropes of polyethylene, nylon or other suitable material to pull in conductors. Attach pulling lines to conductors by means of woven basket

grips or by pulling eyes attached directly to conductors. Grips and pulling eyes shall be Kellems or equivalent. All conductors to be installed in a single conduit shall be pulled in together. Pull no conductors into conduits until all work of a nature which may cause injury to conductors is completed. Use cable pulling compound where necessary.

1. Any wire pulled with equipment not designed for wire pulling will not be accepted.

B. Cable Lubricants: All cable lubricants shall be UL listed, and shall be certified by their manufacturer to be non-injurious to the insulation on which they are used.

3.3 WIRE INSTALLATION (600 VOLTS AND UNDER):

A. Feeders: Run all feeders their entire length in continuous pieces without joints or splices, insofar as practicable. Make joints in branch circuits only where circuits divide as shown on drawings. Such joints shall consist of one through circuit to which shall be spliced the tap circuit.

B. Sizes: No wire shall be smaller than No. 12 except for control circuits.

C. Joints and Splices: Only receptacle and lighting circuits will be allowed to be spliced. Make joints and splices in conductors only where necessary and only at outlet boxes and pull boxes. All joints shall be mechanically and electrically secure.

D. Wire and cable shall not be pulled tight against bushings nor pressed heavily against enclosures.

E. After wire and cable have been installed and connected, conduit ends shall be sealed with a non-hardening sealing compound (Duxseal or equal), forced into conduits to a minimum depth equal to the conduit diameter. This shall apply for all conduits, including spares, entering any structures or electrical enclosures from underground, or from wet/corrosive areas. Seal conduit at both ends of the conduit.

F. Ground the drain wire of shielded instrumentation cables at one (1) end only. Grounding location shall be at the load (e.g., control panel), not at the source (e.g., field mounted instrument).

G. No more than 4 (120v) branch circuits (4 hots & 4 neutrals) allowed in one conduit unless specifically indicated on plans or with engineer approval)

H. Equipment grounding conductor min. #12 shall be installed in every raceway.

I. Provide separate neutral for each 120v branch circuit.

1. All neutrals must be identified for each branch circuit in panels and boxes.

3.4 CABLE IDENTIFICATION:

- A. Identity Tags: Non-ferrous; stamped to clearly identify each circuit. Securely fasten tags to all cables, feeders and power circuits in pull boxes, lighting, power and distribution panelboards, motor control centers, control panels, etc.
 - 1. Slip-on, PVC wire sleeves with legible, machine-printed markings.
 - 2. Adhesive, snap-on, or adhesive type labels are not acceptable.
 - 3. All Cable Terminations to identify To/From termination identification.

3.5 CONNECTIONS AND TERMINATIONS:

- A. Cut conductor off square, trim insulation back the correct distance and prepare the conductor strands for termination as specified. Apply the proper lug or splice connector, making certain that the conductor strands are inserted full length of the barrel.

END OF SECTION

SECTION 16131

DEVICE, PULL AND JUNCTION BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Specifications for device, pull, and junction boxes.

1.2 REFERENCES:

- A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).
 - 1. FB1 - Fittings and Support for Conduits and Cable Assemblies
 - 2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)
- B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 370 - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.
- C. Underwriters Laboratories (UL):
 - 1. 50 - Safety Cabinets and Boxes
 - 2. 508 - Safety Industrial Control Equipment
 - 3. 514B - Safety Fittings for Conduit and Outlet Boxes
 - 4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas

1.3 SUBMITTALS:

- A. Submit all products covered under this specification for Engineer's approval.
- B. Manufacturer's cut sheets, catalog data
- C. Instruction for handling and storage
 - 1. Installation instructions
 - 2. Dimensions and weights
- D. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Cast Device Boxes
 - 1. Appleton Electric Company
 - 2. Crouse-Hinds, Division of Cooper Industries
 - 3. Killark Electric Manufacturing Company

2.2 MATERIALS AND EQUIPMENT:

A. Device Boxes

1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 370.
2. Supply boxes that are hot-dip galvanized on cast iron suitable for corrosive and 0 wet atmosphere.

B. Hardware

1. Mounting Hardware: Stainless steel
2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 EXECUTION

3.1 PREPARATION:

- A. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.2 INSTALLATION:

- A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.
- B. Install boxes in accordance with NEC Article 370 in locations indicated on the Drawings.
- C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair.
- D. Plug unused conduit openings.
- E. Make conduit connections to sheet metal boxes with watertight conduit connectors.
- F. All boxes shall have a minimum of 24" clearance for access.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Suitable outlet boxes, with the wiring devices indicated, coverplates, etc. All shall be properly connected to conductors so as to be operable.

1.2 SUBMITTALS:

- A. Submit manufacturer's data on all materials, under provisions of Section 01300.

PART 2 PRODUCTS

2.1 MATERIALS:

- A. Acceptable Manufacturers: The catalog numbers listed herein are generally of Hubbell manufacture. Equivalent devices of Arrow-Hart, Pass and Seymour, or Leviton are acceptable.
- B. Classification: All wiring devices shall be "Specification Grade", and shall be UL listed.
- C. Colors: All devices shall have an ivory finish.

2.2 WALL SWITCHES:

- A. Provide the following 120/277 volt switches or approved equal:

<u>Device</u>	<u>Hubbell Catalog No.</u>
Single pole wall switch	1221
Three-way wall switch	1223
Four-way wall switch	1224

2.3 RECEPTACLES:

- A. Receptacle, 20-ampere, 125-volt, 2-pole, 3-wire grounding duplex: Hubbell No. 5362 or approved equal.
- B. Receptacle, 20-ampere, 125-volt, 2-pole, 3-wire Grounding Duplex with Self-contained Ground Fault Circuit Interrupter: Hubbell No. GF 5362 (NEMA 5-20R) or approved equal.
- C. Other receptacles as indicated on the drawings.

2.4 OTHER DEVICES:

- A. Weatherproof Devices: Provide the specified device in FD box with a weatherproof cover that meets the requirements of NEC Article 406.8(B). Cover shall be cast metal equal to Intermatic, Incorporated. Simplex or duplex, vertical or horizontal as indicated.

- B. Provide stainless steel cover for surface mounted boxes unless specified on plans.

PART 3 EXECUTION

3.1 CIRCUIT IDENTIFICATION:

- A. At each wiring device, install a label on the inside of the coverplate which shall identify the panel and circuit number to which the device is finally connected. The labels shall be made on the job with indentation-type Dynamo adhesive tape. Attach the label to the plate with contact cement or other suitable adhesive material. In lieu of a label, the panel and circuit number may be neatly marked on the inside of the coverplate with an indelible pencil.

3.2 MOUNTING HEIGHTS:

- A. Where mounting heights are indicated on the drawings, the device shall be installed with the centerline of the device at the indicated height.
- B. Unless otherwise noted on the drawings, or directed, install device at the following heights:

<u>Device</u>	<u>Mounting Height</u>
Light Switch	48"
Exposed receptacles	18"

- C. All Devices Above Counter top shall be 10" to Center above Conter top.

END OF SECTION

SECTION 16165

DISCONNECT SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Specifications for disconnect switches including:

1. Fusible disconnect switches
2. Non-fusible disconnect switches
3. Circuit breaker type disconnect switches
4. Fuses
5. Circuit breakers

1.2 REFERENCES:

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA AB1: Molded Case Circuit Breakers
2. NEMA KS1: Enclosed Switches

B. Underwriters Laboratories (UL)

1. UL 98: Standard for safety enclosed switches and Dead Front Switches
2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type
3. UL 198E: Class R Fuses

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 380 - Switches.

1.3 SUBMITTALS:

A. Submit all products covered under this specification for Engineer's approval:

1. Manufacturer's cut sheets and catalog data
2. Switch internal arrangement
3. Breaker or fuse characteristic curves
4. Instructions for handling and storage
5. Installation instructions
6. Dimensions and weights

1.4 QUALITY ASSURANCE:

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be defined in OSHA Regulation 1910.7.
 2. Terms "listed" and "labeled" shall be defined in National Electrical Code, Article 100.
- B. Single-Source Responsibility: Enclosed switches and circuit breakers shall be product of single manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Have disconnect switches packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Disconnect Switches and Circuit Breakers:

1. Eaton/Cutler-Hammer
2. General Electric
3. Siemens
4. Square D Company

B. Fuses:

1. Bussman Division, Cooper Industries
2. Mersen
3. Littelfuse Incorporated

2.2 MATERIALS AND EQUIPMENT:

A. Disconnect Switches:

1. Characteristics: Horsepower rated, 300-volt, heavy-duty type with an interlocked door, positive quick-make, quick-break mechanism and visible blades.
2. Use switches and components designed, manufactured and tested in accordance with NEMA AB1, NEMA KS1, UL 98, and NEC Article 380.
3. Enclose switch in the enclosure type as stated on the drawings. If not stated on drawings, provide NEMA 12 type enclosure for indoor application and NEMA 3R type enclosure for outdoor applications except in corrosive areas. In corrosive areas, provide NEMA 4X (type 304 or 316 stainless steel).
4. Provide switches with provisions for padlocking the operating lever in OFF position and door in closed position.
5. Select switches having the number of poles and general size conforming to the Drawings.

6. Conform to fusible, non-fusible or circuit breaker type switch requirements as shown on Drawings or one-line diagrams.
 7. Provide an auxiliary contact, shown on the Drawings.
 8. Select fuses or circuit breakers with current interrupting duty as calculated for the points of switch application or as indicated on the Drawings or one-line diagrams.
- B. Fuses: Unless otherwise noted on Drawings, for fuses used in disconnect switches, provide the dual-element, time-delay type with the maximum interrupting rating of 200,000 amperes, conforming to the current NEC.
- C. Circuit Breakers: When circuit breakers are used in disconnect switches, provide the thermal-magnetic type with current interruption ratings as required at the point of application.
- D. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 EXECUTION

3.1 PREPARATION:

- A. Review the Drawings and verify the disconnect switches are correct for the applications.
- B. Make sure that the correct fuses or breakers are being used regarding size and short circuit interrupting capability.
- C. Prepare adhesive labels on the inside door of each switch indicating UL fuse class and size or breaker type and size for replacement.

3.2 INSTALLATION:

- A. Install disconnect switches in accordance with manufacturer's written instructions and NEC Article 380.
- B. Mount switches a maximum of 6'-6" (to top of cabinet) above finished floor or grade.
- C. Install switches level and plumb.
- D. In wet and corrosive areas, including outdoor locations, install switches on spacers to provide a space of approximate 1/4-inch between the back of cabinet and the mounting surface.
- E. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.
- F. Provide minimum of 30"W x 36"D clearance for access.
- G. Refer to section 16195 for labeling requirements.

3.3 ADJUSTING:

- A. Set field-adjustable enclosed switches and circuit breaker trip ranges as indicated.

3.4 CLEANING:

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

- A. Requirements of Division 16 "Basic Electrical Requirements" apply to this Section.

1.2 SECTION INCLUDES:

- A. Conduit and equipment supports.
- B. Anchors and fasteners.
- C. Strut.
- D. Fittings.
- E. Hangers.
- F. Hanger rod.
- G. Brackets.
- H. Cable ties.
- I. Spring vibration isolators.
- J. Concrete Equipment Pads.

1.3 SUBMITTALS:

- A. Submit the following in accordance with Section 16000:
 - 1. Provide strut by no more than two (2) manufacturers.
 - 2. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.
 - 3. Shop drawings indicating details of fabricated products and materials.
 - 4. Submittals in this section shall also be signed by the Structural Engineer and/or System Building Manufacturers where applicable.

1.4 QUALITY ASSURANCE:

- A. Comply with the following:

1. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.
2. Comply with Federal Specification W-C-582A, FF-B-575C and FS-S-760A(2).

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

1. Slotted Metal Angle and U-Channel Systems:

- a. Allied Tube & Conduit
- b. American Electric
- c. B-Line Systems, Inc.
- d. GS Metals Corp.
- e. Unistrut Corporation
- f. Atkor Power-Strut

2. Hangers:

- a. Erico/Caddy
- b. Allied
- c. American Electric
- d. B-Line
- e. GS Metals
- f. Unistrut
- g. Atkor Power-Strut

3. Brackets:

- a. Erico
- b. Bowers
- c. Raco
- d. Steel City

4. Vibration Isolators:

- a. Amber/Booth
- b. Dynasonic
- c. Grinnell
- d. Mason Industries

2.2 COATINGS:

- A. Coating: Strut, fittings, hangers and hanger rod shall be ASTM A123 hot dip galvanized after fabrication. Hardware fasteners and clamps shall have ASTM B633 Type III SCI electroplated zinc coatings.

2.3 MANUFACTURED SUPPORTING DEVICES:

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps. Purlin hangers shall mount to the vertical member of the purlin or as otherwise required by building manufacturer and/or structural engineer.
- B. Fasteners: Types, materials, and construction features as follows:
 - 1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using beam clamps.
 - 2. Use steel springhead type toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
 - 3. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.
 - 4. Do not use powder-actuated anchors.
 - 5. Do not drill structural steel members.
- C. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.
 - 1. Tie wraps installed outdoors on elevated storage tank or outdoor antenna installations shall be stainless steel.
- D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
- E. U-Channel Systems (Strut): 12-gauge steel 1-5/8" x 1-5/8" minimum channels, with 9/16" x 1-1/8" maximum short slots at 2" on center maximum. Strut shall be cold formed per ASTM A570 GR33. Joints in strut system shall be made with 4 bolt accessories as a minimum. Conduit clamps to strut shall be bolt unistrut 1100, 1200, 1400 Series or equal.
- F. Recessed Box Supports Brackets: Mount boxes with Erico/Caddy SGB Series, FBS Series or equal.

2.4 FIELD FABRICATED SUPPORTING DEVICES:

- A. General: Shop or field-fabricated supports or manufactured supports assembled from U-channel components.

- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
 - a. 3-inch and smaller: 20-gauge.
 - b. 4-inch to 6-inch: 16-gauge.
 - c. over 6-inch: 14-gauge.
 - 2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
- D. All Thread Rod: Hot dip galvanized, 1/4" minimum.

2.5 VIBRATION ISOLATORS:

- A. Hangers: Spring steel hangers shall be amber/booth BS Series or equal.
- B. Pads: Provide ribbed neoprene pads amber/booth Type NR or equal.

PART 3 EXECUTION

3.1 GENERAL:

- A. Install supporting devices to fasten electric components securely and permanently in accordance with NEC, NECA and manufacturers requirements.
- B. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
 - 1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
 - 2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 - 3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration and shock resistant fasteners for attachments to concrete slabs.

C. Exclusions:

1. Do not fasten supports to ceiling system, pipes, ducts, mechanical equipment and conduit.
2. Tie wires and perforated pipe straps shall not be used for securing conduits.
3. Do not support loads from the bottom chord member of trusses or open web steel joists.
4. Do not attach conduit to ceiling support wires or ceiling tees.
5. Do not use powder-actuated anchors unless indicated by Architect or Structural Engineer.
6. Do not drill or cut structural members unless directed by Architect or Structural Engineer.

- D. Touch up all scratches or cuts on steel components with an approval zinc chromate or a 90 percent zinc paint. Use PVC compound on PVC coated components.

3.2 CONDUIT, RACEWAYS AND SLEEVES:

- A. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nut unless otherwise noted.
- B. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four.
- C. Install individual and multiple raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
- D. Support parallel runs of horizontal raceways together on trapeze-type hangers. Where conduit is of different sizes, use the same trapeze hanger space supports for the smallest size conduit on the rack.
- E. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼-inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
- F. Branch circuit raceways which are 1-inch or smaller may be attached to wall studs by use manufactured clips.
- G. Space supports for raceways in accordance with NEC.

- H. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
- I. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. For sleeves through fire-rated wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

3.3 BOXES AND WIRING DEVICES:

- A. Structural Mounting: They shall be rigidly supported from a structural member of the building either directly or by using a metal or wood brace. Support wires that do not provide rigid support shall not be permitted as the sole support.
- B. Outlet or junction boxes in exposed or concealed ceilings, all thread rod, manufactured brackets shall be mounted to building structure, strut suspended from building structure.
- C. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- D. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- E. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- F. Metal braces shall be protected against corrosion and formed from metal not less than .020 inch (508 micrometers) thick uncoated.
- G. Use adjustable steel channel fasteners for hung ceiling outlet box.
- H. Do not fasten boxes to ceiling support wires or tees.

3.4 CABLE TRAYS:

- A. Cable tray shall be supported with strut, all thread rod and beam clamps.

3.5 WIRES AND CABLES:

- A. Vertical Conductor Supports: Install simultaneously with installation of conductors.

3.6 BUSWAY:

- A. Provide hangers and supports as require at intervals required by busway manufacturer.

3.7 LIGHTING FIXTURES:

- A. Provide supports as required by specified Light Fixture manufacture requirements.

3.8 INDOOR AND OUTDOOR WALL MOUNTED EQUIPMENT:

- A. This shall include but not be limited to cabinets, enclosures, disconnect switches, panelboards, motor controllers, VFD's, small transfer switches and wireways.
- B. All cabinets and panelboards shall be wall mounted unless otherwise indicated.
- C. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- D. In wet and damp locations use steel channel supports to stand cabinets and panelboard one inch off wall.
- E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

3.9 INDOOR FLOOR MOUNTED EQUIPMENT:

- A. This shall include but not be limited to switchboards, dry type transformers and large transfer switches.
- B. Free standing equipment shall be installed on concrete pads unless noted otherwise.
- C. Concrete pads shall be 3" tall and be 2" wider than equipment on all 4 sides.
- D. Concrete shall be 3500 PSI, 28 day compressive strength.
- E. Concrete, forms and reinforcing shall be in accordance with Division 3.
- F. Floor mounted transformers shall also be provided with neoprene vibration isolation pads.

3.10 INDOOR SUSPENDED EQUIPMENT:

- A. Equipment to be suspended shall be supported with strut, with all thread rod and beam clamps.
- B. Transformers shall also have spring steel hanger vibration isolators.

3.11 INDOOR AND OUTDOOR RACK OR PEDESTAL MOUNTED EQUIPMENT:

- A. Equipment shall be rack or pedestal mounted only where indicated or required by installation.

- B. Mount on strut bolted to concrete or anchored with concrete base when located outside.

3.12 OUTDOOR PAD MOUNTED EQUIPMENT:

- A. This shall include but not be limited to distribution transformers, switchgear, switchboards, dry type transformers, motor control centers and other electrical equipment.
- B. Concrete pads shall have a footprint 12" larger than equipment on all sides minimum or per plans.
- C. Concrete pads shall be 6" thick with 24" deep by 12" wide grade beams on all sides or per plans.
- D. Concrete shall be 3500 PSI, 28 day compressive strength.
- E. Concrete, forms and reinforcing shall be in accordance with Division 3

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Identification of electrical materials, equipment, and installations.

1.2 SUBMITTALS:

A. Submit all products covered under this specification for Engineer's approval.

B. Product Data:

1. Submit for each type of product specified.

C. Samples:

1. Submit for each color, lettering style, and or graphic representation required for identification materials, samples of labels and signs.

D. Miscellaneous:

1. Schedule of identification nomenclature to be used for identification signs and labels.

1.3 QUALITY ASSURANCE:

A. Regulatory Requirements:

1. National Electrical Code: Components and installation shall comply with NFPA 70.

B. Comply with ANSI C2.

PART 2 PRODUCTS

2.1 RACEWAY AND CABLE LABELS:

A. Manufacturer's Standard Products:

1. Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.
 2. Legend: Indicates voltage.
- C. Adhesive Labels:
1. Preprinted, flexible, self-adhesive vinyl. Legend is over-laminated with clear, wear and chemical resistant coating.
- D. Pre-tensioned, Wraparound Plastic Sleeves:
1. Flexible, preprinted, color-coded, acrylic bands sized to suit diameter of line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.
- E. Colored Adhesive Tape:
1. Self-adhesive vinyl tape not less than 3-mils thick by 1 to 2-in. wide (0.08-mm thick by 25 to 51-mm wide).
- F. Underground Line Warning Tape:
1. Permanent, bright-colored, continuous printed, vinyl tape with following features:
 - a. Size: Not less than 6-in. wide by 4-mils thick (152-mm wide by 0.102-mm thick).
 - b. Compounded for permanent direct burial service.
 - c. Embedded continuous metallic strip or core.
 - d. Printed Legend: Indicates type of underground line.
- G. Tape Markers:
1. Vinyl or vinyl cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- H. Aluminum, Wraparound Marker Bands:
1. Bands cut from 0.014-in. (0.4-mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- I. Plasticized Card Stock Tags:
- J. Vinyl cloth with preprinted and field printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
- K. Aluminum Faced Card Stock Tags:
1. Wear resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002-in. (0.05-mm) thick, laminated with moisture resistant acrylic adhesive, and punched for fastener. Preprinted legends suit each application.

L. Brass or Aluminum Tags:

1. Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2-in. (51 by 51-mm) by 0.05-in. (1.3-mm).

2.2 ENGRAVED NAMEPLATES AND SIGNS:

A. Manufacturer's Standard Products:

1. Where more than one type is listed for specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, or as specified elsewhere.

B. Engraving stock, melamine plastic laminate, 1/16-in. (1.6-mm) minimum thick for signs up to 20-sq. in. (129-sq. cm), 1/8-in. (3.2-mm) thick for larger sizes.

1. Engraved Legend: Black letters on white face.
2. Punched for mechanical fasteners.

C. Baked Enamel Signs for Interior Use:

1. Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for application. 1/4-in. (6.4-mm) grommets in corners for mounting.

D. Exterior, Metal Backed, Butyrate Signs:

1. Wear resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-in. (1-mm), galvanized steel backing, with colors, legend, and size appropriate to application. 1/4-in. (6.4-mm) grommets in corners for mounting.

E. Fasteners for Plastic Laminated and Metal Signs:

1. Self-tapping stainless steel screws or No. 10/32 stainless steel machine screws, with nuts, flat washers and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS:

A. Cable Ties:

1. Fungus inert, self-extinguishing, 1 piece, self-locking, Type 6/6 nylon cable ties with following features:
 - a. Minimum Width: 3/16-in. (5-mm).
 - b. Tensile Strength: 50-lb (22.3 kg) minimum.
 - c. Temperature Range: Minus 40 to 185°F (Minus 4 to 85°C).
 - d. Color: As indicated where used for color-coding.

B. Paint:

1. Alkyd-urethane enamel. Primer as recommended by enamel manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION:

A. Install identification devices according to manufacturer's written instructions.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics:

1. Coordinate names, abbreviations, colors, and or designations used for electrical identification with corresponding designations used in Contract Documents or required by codes and standards. Use consistent designations throughout Project.

D. Sequence of Work:

1. Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Self Adhesive Identification Products:

1. Clean surfaces of dust, loose material, and oily films before applying.

F. Identify feeders over 600 V with "DANGER HIGH VOLTAGE" in black letters 2-in. (51-mm) high, stenciled with paint at 10-ft (3-m) intervals over continuous, painted orange background. Identify following:

1. Entire floor area directly above conduits running beneath and within 12-in. (305-mm) of basement or ground floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to conduits concealed within wall.
3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.
4. Entire surface of exposed conduits.

G. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime Surfaces:

- a. For galvanized metal, use single component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy duty, acrylic resin block filler. For concrete surfaces, use clear, alkali resistant, alkyd binder type sealer.
- 3. Apply one intermediate and one finish coat of silicone alkyd enamel.
- 4. Apply primer and finish materials according to manufacturer's instructions.
- H. Identify Raceways and Exposed Cables of Certain Systems with Color Banding:
 - 1. Band exposed and accessible raceways of systems listed below for identification.
 - a. Bands: Pre-tensioned, snap around, colored plastic sleeves; colored adhesive tape; or combination of both. Make each color band 2-in. (51-mm) wide, completely encircling conduit, and place adjacent bands of 2 color markings in contact, side by side.
 - b. Locate bands at changes in direction, at penetrations of walls and floors, at 50-ft (15 m) maximum intervals in straight runs, and at 25-ft (7.6 m) in congested areas.
 - c. Colors: As follows:
 - i. Fire Alarm System: Red.
 - ii. Fire Suppression Supervisory and Control System: Red and yellow.
 - iii. Combined Fire Alarm and Security System: Red and blue.
 - iv. Security System: Blue and yellow.
 - v. Mechanical and Electrical Supervisory System: Green and blue.
 - vi. Telecommunications System: Green and yellow.
- I. Install Caution Signs for Enclosures Over 600 V:
 - 1. Use pressure sensitive, self-adhesive label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover.
- J. Install Circuit Identification Labels on Boxes:
 - 1. Label externally as follows:

- a. Exposed Boxes: Pressure sensitive, self-adhesive plastic label on cover.
- b. Concealed Boxes: Plasticized card stock tags.
- c. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

K. Identify Paths of Underground Electrical Lines:

- 1. During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8-in. (150 to 200-mm) below finished grade. Where multiple lines installed in common trench or concrete envelope do not exceed an overall width of 16-in. (400-mm), use single line marker.

Install line marker for underground wiring, both direct buried and in raceway.

L. Color Code Conductors:

- 1. Secondary service, feeder, and branch circuit conductors throughout secondary electrical system.
 - a. Field applied, color coding methods may be used in lieu of factory coded wire for sizes larger than No. 10 AWG.
 - i. Colored, pressure sensitive plastic tape in half-lapped turns for distance of 6-in. (150-mm) from terminal points and in boxes where splices or taps are made. Apply last 2 turns of tape with no tension to prevent possible unwinding. Use 1-in. (25-mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
- 2. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3-in. (76-mm) from terminal and spaced 3-in. (76-mm) apart. Apply with special tool or pliers, tighten to snug fit, and cut off excess length.

<u>System Voltage</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Neutral</u>
120/240 Volt 1Ph/3w	Black	Red		White
120/208 Volt 3Ph/4w	Black	Red	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Gray
Ground				Green

- 3. On a 4-wire, delta-connected system where the midpoint of one phase winding is grounded, only the conductor or busbar having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color or by other effective means. Such identification shall be placed at each point on the system where a connection is made if the grounded conductor is also present.

M. Power Circuit Identification:

1. Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.
 - a. Legend: ¼-in. (6.4-mm) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 - b. Fasten tags with nylon cable ties; fasten bands using integral ears.

N. Apply identification to conductors as follows:

1. Conductors to Be Extended in Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
3. Multiple Control and Communications Circuits in Same Enclosure: Identify each conductor by its system and circuit designation. Use consistent system of tags, color-coding, or cable marking tape.
4. Branch circuit neutral conductors shall be labeled in each location (panel, j-box, condulets, control panel, ect.) to indicate which circuit it is for.

O. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. Emergency Operating Signs:
 - a. Install engraved laminate signs with white legend on red background with minimum 3/8-in. (9-mm) high lettering for emergency instructions on power transfer, load shedding, and or emergency operations.

P. Install identification as follows:

1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide single line of

text with ½-in. (13-mm) high lettering on 1-1/2-in. (38-mm) high label; where 2 lines of text are required, use lettering 2-in. (51-mm) high. Use white lettering on black field. Apply labels for each unit of following categories of equipment:

- a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Electrical substations.
 - e. Motor control centers.
 - f. Motor starters.
 - g. Push button stations.
 - h. Power transfer equipment.
 - i. Contactors.
 - j. Remote controlled switches.
 - k. Dimmers.
 - l. Control devices.
 - m. Transformers.
 - n. Inverters.
 - o. Rectifiers.
 - p. Frequency converters.
 - q. Battery racks.
 - r. Power generating units.
 - s. Telephone switching equipment.
 - t. Clock/program master equipment.
 - u. Call system master station.
 - v. TV/audio monitoring master station.
 - w. Fire alarm master station or control panel.
 - x. Security monitoring master station or control panel.
2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
 3. All switchboards and panelboards shall have engraved label with panel designation, type of system, and where it is fed from example below.

"PB-MCB"
 3 phase 4 wire
 Fed from MSB
 4. All switchboards and panelboards shall have engraved label identifying color code of each system. Examples below.

120/240V SYSTEM

PHASE A BLACK
 PHASE B RED
 PHASE C BLUE
 NEUTRAL WHITE

277/480V SYSTEM

PHASE A BROWN
 PHASE B PURPLE
 PHASE C YELLOW
 NEUTRAL GRAY

5. All disconnects and Control panels shall have engraved label with panel and circuit number of feed. example below.

LP-MCB-33,35,37

6. All transformers shall have engraved label with designation, panel and circuit number of feed. Example below.

Trans. LP-MCB
FED FROM MCC-A

7. All j-boxes over 6"x6" with multiple circuits shall have an engraved red with white lettering label with "CAUTION: MULTIPLE CIRCUITS PRESENT"

END OF SECTION

SECTION 16450

GROUNDING

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Grounding systems as specified and in accordance with the National Electrical Code.

1.2 SUBMITTALS:

- A. Submit manufacturer's data on all products, under provisions of Section 01300.

1.3 QUALITY ASSURANCE:

- A. Comply with applicable sections of Article 250 of the NEC and local amendments.
- B. Provide products specified in the Section that are listed and labeled by a nationally recognized testing laboratory.
- C. Install products that comply with UL 467, "Grounding and Bonding Equipment."

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING PRODUCTS:

- A. Install types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications shall govern.
- B. Conductor Material: Copper.

2.2 WIRE AND CABLE CONDUCTORS:

- A. Equipment Grounding Conductor: Bare or green insulated. Minimum size No. 12 AWG.
 - 1. Must be installed in every conduit
- B. Grounding Electrode Conductor: Class B, concentric stranded.
 - 1. Bare Copper conductors: Conform to the following:
 - a. Solid Conductors: ASTM B-3.
 - b. Stranded Conductors: ASTM B-8.
 - c. Tinned Conductors: ASTM B-33.

2.3 MISCELLANEOUS CONDUCTORS:

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.4 CONNECTOR PRODUCTS:

- A. Listed and labeled as grounding connectors for the materials used.
- B. Connector Material: Copper or bronze.
- C. Pressure Connectors: High conductivity plated units.
- D. Bolted Clamps: Heavy duty units listed for the application.
- E. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sized, and combinations of conductors and other items to be connected.

2.5 GROUNDING ELECTRODES:

- A. Copper clad steel $\frac{3}{4}$ " x 10' with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.

PART 3 EXECUTION

3.1 SERVICE AND EQUIPMENT GROUNDING:

- A. Provide adequate and permanent service neutral and equipment grounding in accordance with the National Electrical Code, and subject to the following additional requirements.
- B. Connect the service ground and equipment ground to a common point within the metallic enclosure containing the main service disconnecting means. From the common point of connection of the service ground and equipment ground, run in conduit a combined service and equipment grounding conductor without joints or splices to the grounding grid as shown. Grounding grid shall be constructed of 10 feet long by $\frac{3}{4}$ inch diameter copperclad steel ground rods with buried grounding conductors as indicated on the drawings.
- C. Size grounding conductors in accordance with National Electrical Code Tables 250.66 and 250.122 or as indicated.
- D. The building structural steel frame shall be grounded to the building service grounding electrode, using the conductor size specified in National Electrical Code Section 250.66.

- E. Provide additional connections as may be required by the local authority.

3.2 GROUNDING RACEWAYS:

- A. Assure the electrical continuity of all metallic raceways systems, pulling up all conduits and/or locknuts wrench tight. Where expansion joints or telescoping joints occur, provide bonding jumpers. Where flexible conduit is employed, provide a green-insulated grounding jumper installed in the flexible conduit. Install a separate green-insulated conductor in each conduit.
- B. Provide grounding bushings on all service and feeder raceways terminating within switchboards, motor control centers, panel boards, cabinets, and all other enclosures. Provide grounding conductors from such bushings to the frame of the enclosure and to the ground bus or equipment grounding strap. Size grounding conductors in accordance with NEC Table 250.122. or as indicated on plans.

3.3 EQUIPMENT GROUNDING CONDUCTORS:

- A. Provide a separate, green-insulated copper grounding conductor, with insulation of the same rating as phase conductors, for each feeder and for each branch circuit indicated. Install the grounding conductor in the same raceway with the related phase and neutral conductors. Where paralleled conductors in separate raceways occur, provide a grounding conductor in each raceway. Connect all grounding conductors to bare grounding bars in panel boards, and to ground buses in service equipment to the end that there will be an uninterrupted grounding circuit from the point of a ground fault back to the point of connection of the equipment ground and system neutral. Size all of these grounding conductors per NEC Table 250.122. or as indicated on plans.

3.4 UNDERGROUND CONNECTIONS:

- A. All underground connections shall be made using exothermic weld connections.

3.5 GROUNDING DRY-TYPE TRANSFORMERS:

- A. Ground the secondary neutral point and the housing of each dry-type transformer. Connect these items together within the transformer housing and run a common grounding conductor from their point of connection to a point of grounding. The grounding electrode shall be in order of preference:
 - 1. The nearest available effectively grounded structural metal member of the building; or
 - 2. Other electrodes as specified in National Electrical Code Section 250.30 where the above described electrodes are not available.

END OF SECTION

SECTION 16675

TRANSIENT VOLTAGE SURGE SUPPRESSION

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A Section includes field-mounted SPDs for low-voltage (<1000 V) power distribution and control equipment.

1.3 DEFINITIONS:

- A. VPR: Voltage Protection Rating.
- B. SPD: Surge Protective Device(s)
- C. I(n): Nominal Discharge Current

1.4 SUBMITTALS:

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, electrical characteristics, furnished specialties, and accessories.
- B. Qualification Data: For qualified testing agency.
- C. Product Certificates: For SPDs from manufacturer.
- D. Operation and Maintenance Data: For SPDs to include operation, and maintenance manuals.
- E. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.
- B. The unit shall be UL 1449 Listed and CUL Approved as a Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference Filter.
- C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.
- D. Comply with NFPA 70.

E. PROJECT CONDITIONS

1. Contractor to confirm Utility Service Voltages before purchasing to ensure proper SPD is installed for that particular service conditions.
2. Service Conditions: Rate SPDs for continuous operation under the following conditions unless otherwise indicated:
 - a. Maximum Continuous Operating Voltage (MCOV) of not less than 115% for 277/480V and 125% for 120/208V nominal RMS operating system voltage.
 - b. Operating Temperature: 30 to 150 deg F.
 - c. Humidity: 0 to 95 percent, non-condensing.
 - d. Altitude: Less than 12,000 feet above sea level.

1.6 COORDINATION:

Coordinate location of field-mounted SPDs to allow adequate clearances for maintenance.

1.7 WARRANTY:

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fails in materials or workmanship within specified warranty period.

Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS:

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Replaceable Protection Modules: one of each size and type installed.

PART 2 PRODUCTS

2.1 MANUFACTURER:

- A. Square D.
- B. Eaton.
- C. nVent Erico
- D. Approved Equal.

2.2 SERVICE ENTRANCE SUPPRESSORS:

A. Surge Protective Devices shall be:

1. ANSI/UL 1449 Listed.
2. Modular design (with field-replaceable modules).
3. Fuses, rated at 200-kA interrupting capacity.
4. Minimum ANSI/UL 1449-2006 withstand (In) rating to be 20kA per mode.
5. Tested with the ANSI/IEEE Category CHigh exposure waveform (20kV-1.2/50 μ s, 10kA-8/20 μ s).
6. Pulse life test: Capable of protecting against and surviving 20,000 ANSI/IEEE Category CHigh transients without failure or degradation of clamping voltage by more than 10%.
7. Bolted compression lugs for internal wiring.
8. Coordinated thermal and surge current fusing.
9. Redundant suppression circuits.
10. Replaceable modules, 1 per phase minimum.
11. LED indicator lights for power and protection status.
12. Audible alarm, with silencing switch, to indicate when protection has failed.
13. Form-C contacts rated at 2 A and 24-V ac minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
14. Six-digit transient-event counter set to totalize transient surges.

B. Peak Single-Impulse Surge Current Ratings to be selected by environment:

Category/Type	Application	Per Phase	Per Mode
C Type 2	Service Entrance	240 kA	120 kA
B Type 2	High Exposure Locations (Distribution Equipment)	160	80

C. The ANSI/UL 1449 voltage protection rating (VPR) in grounded wye circuits, the SPDs shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N,L-G, N-G	800	1200	1500
L-L	1200	2000	2500

- D. The ANSI/UL 1449 VPR for 240/120 V, 3-wire or 4-wire circuits with high leg shall not exceed the following:

Modes	240/120
L-N,L-G, N-G	1200/800

2.3 PANELBOARD SUPPRESSORS:

- A. Surge Protective Devices shall be:

1. ANSI/UL 1449 Listed.
2. Modular design (with field-replaceable modules).
3. Fuses, rated at 200-kA interrupting capacity.
4. Minimum ANSI/UL 1449-2006 withstand (In) rating to be 20kA per mode.
5. Tested with the ANSI/IEEE Category CHigh exposure waveform (20kV-1.2/50μs, 10kA-8/20μs).
6. Pulse life test: Capable of protecting against and surviving 20,000 ANSI/IEEE Category CHigh transients without failure or degradation of clamping voltage by more than 10%.
7. Bolted compression lugs for internal wiring.
8. Coordinated thermal and surge current fusing.
9. Redundant suppression circuits.
10. Replaceable modules, 1 per phase minimum.
11. LED indicator lights for power and protection status.
12. Audible alarm, with silencing switch, to indicate when protection has failed.
13. Form-C contacts rated at 2 A and 24-V ac minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

14. Six-digit transient-event counter set to totalize transient surges.

B. Peak Single-Impulse Surge Current Rating:

Category/Type	Application	Per Phase	Per Mode
B Type 2	High Exposure Locations (Distribution Equipment)	160 kA	80 kA
B Type 2	Branch Locations	120	60

C. The ASNI/UL 1449 voltage protection rating (VPR) in grounded wye circuits, the SPDs shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N,L-G, N-G	800	1200	1500
L-L	1200	2000	2500

D. The ANSI /UL 1449 VPR for 240/120 V, 3-wire or 4-wire circuits with high leg shall not exceed the following:

Modes	240/120
L-N,L-G, N-G	1200/800

2.4 ENCLOSURES:

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250 Type 4X.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Install SPDs at the service entrance on the load side, with ground lead bonded to service entrance ground.
- B. Install SPDs for panelboards and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- C. Provide a 60 Amp circuit breaker as a dedicated disconnecting means for SPD unless otherwise indicated.
- D. The SPDs ground shall be connected to the power system ground.

3.2 FIELD QUALITY CONTROL:

- A. Ensure that interiors are free of foreign materials and dirt.

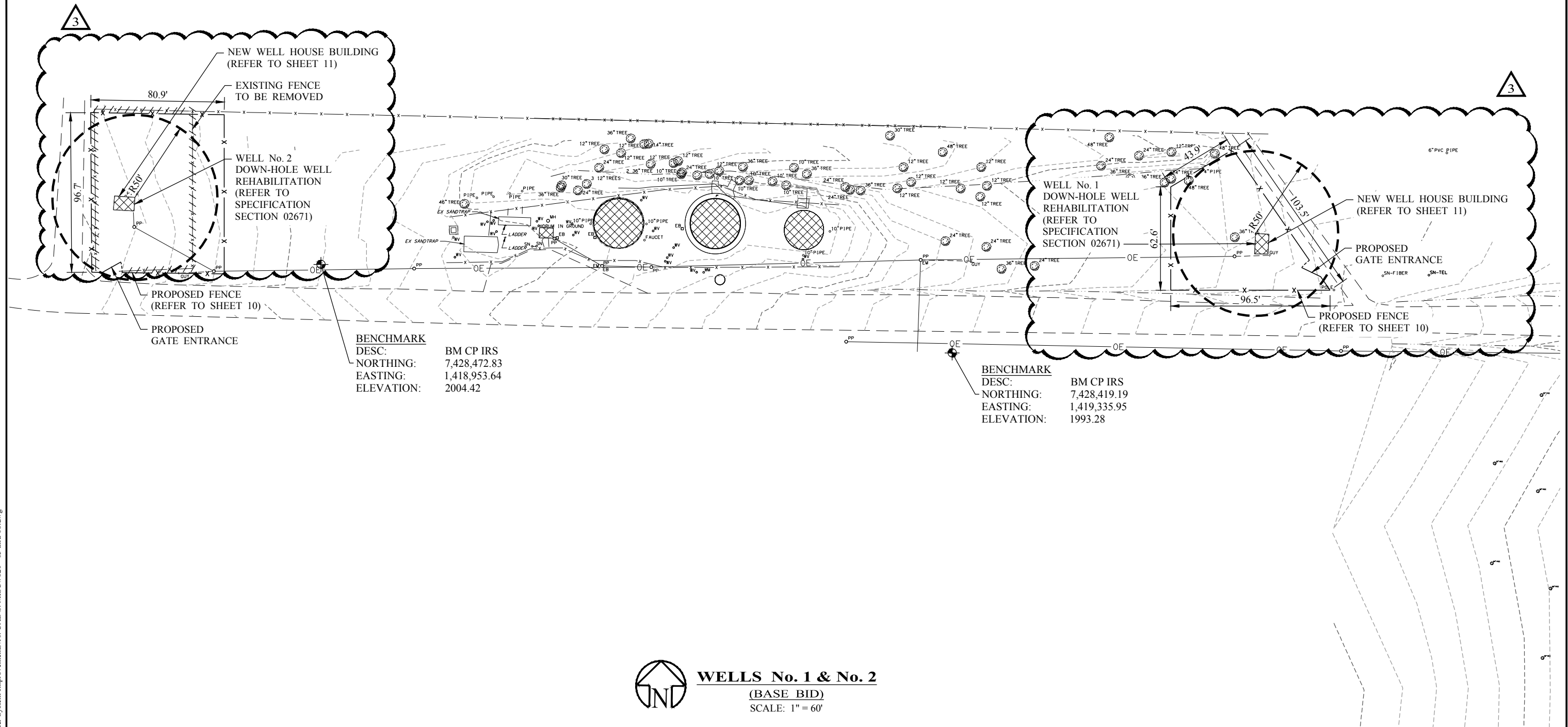
- B. Check and test switches, pushbuttons, meters for proper operation.
- C. Check and test indicating lights for proper operation and color.
- D. Perform manufacturer's on site field test procedures.

3.3 STARTUP SERVICE:

- A. Do not perform insulation resistance (MEGGER) tests of the distribution wiring equipment with the SPDs installed. Disconnect all wires, including neutral, before conducting insulation resistance tests, and reconnect immediately after the testing is over.
- B. Test the unit status by pressing the buttons below the Phase LED on the diagnostic panel. The LED will turn from Green to Red while the button is pressed. The LED will return to Green upon release of the Phase button.

END OF SECTION

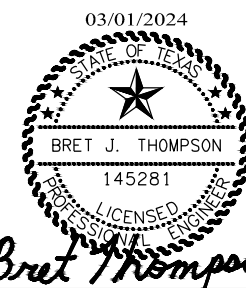
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NOTES:

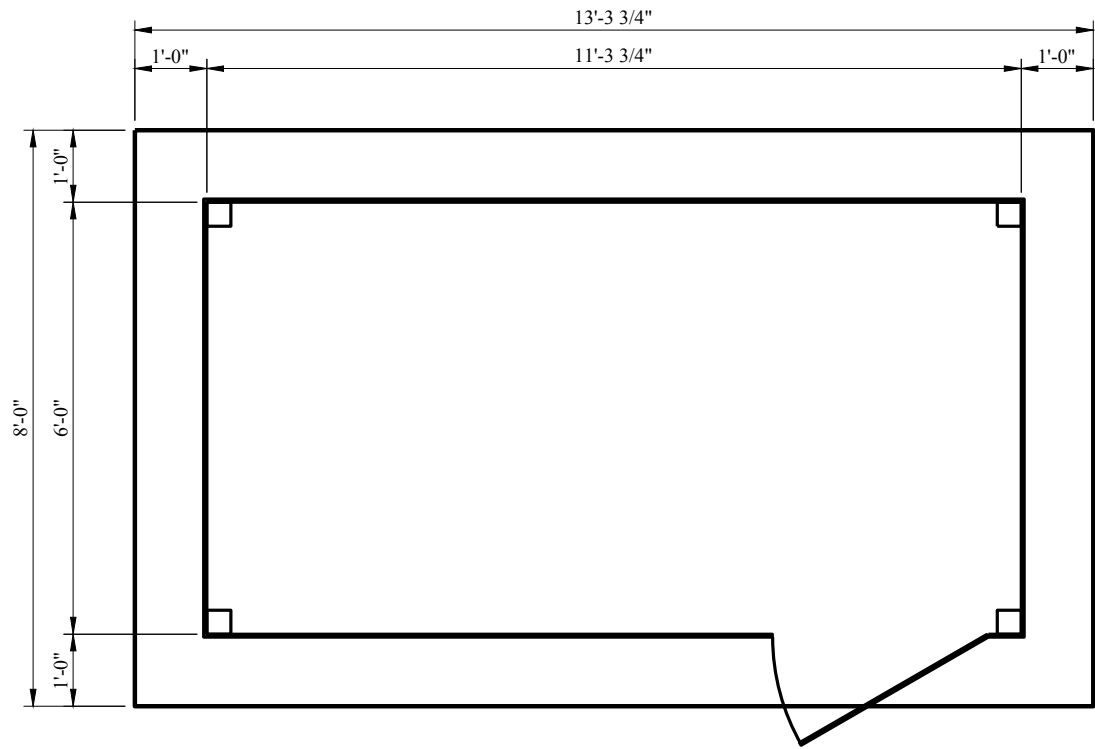
1. REFER TO SHEET 02 FOR GENERAL NOTES.
2. CONTRACTOR SHALL FIELD VERIFY ALL EQUIPMENT AND STRUCTURES.

NO.	REVISION	DATE
3	ADDENDUM No. 3	03/01/2024

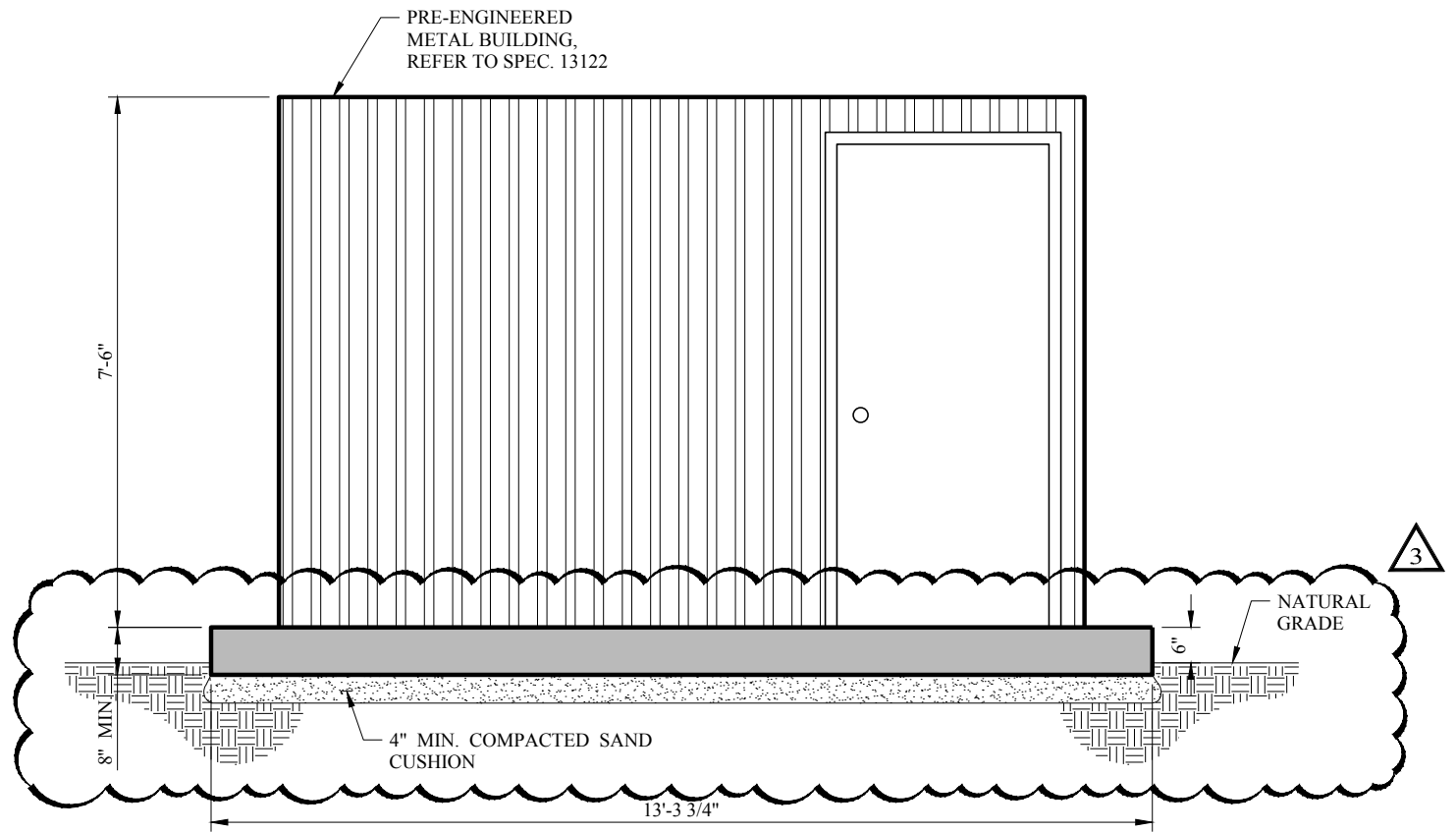


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	B.J.T. DESIGNED BY: D.B.H. DRAWN BY: B.J.T. CHECKED BY:
CITY OF PADUCAH COTTE COUNTY, TEXAS WELL FIELD IMPROVEMENTS	
WELL No. 1 (BASE BID) WELL No. 2 (BASE BID)	03 OF 14

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PLAN VIEW

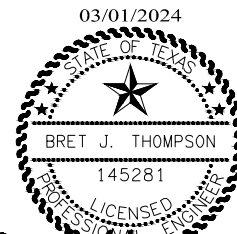


SOUTH ELEVATION VIEW


WATER WELL BUILDING

SCALE: 3/8" = 1'-0"

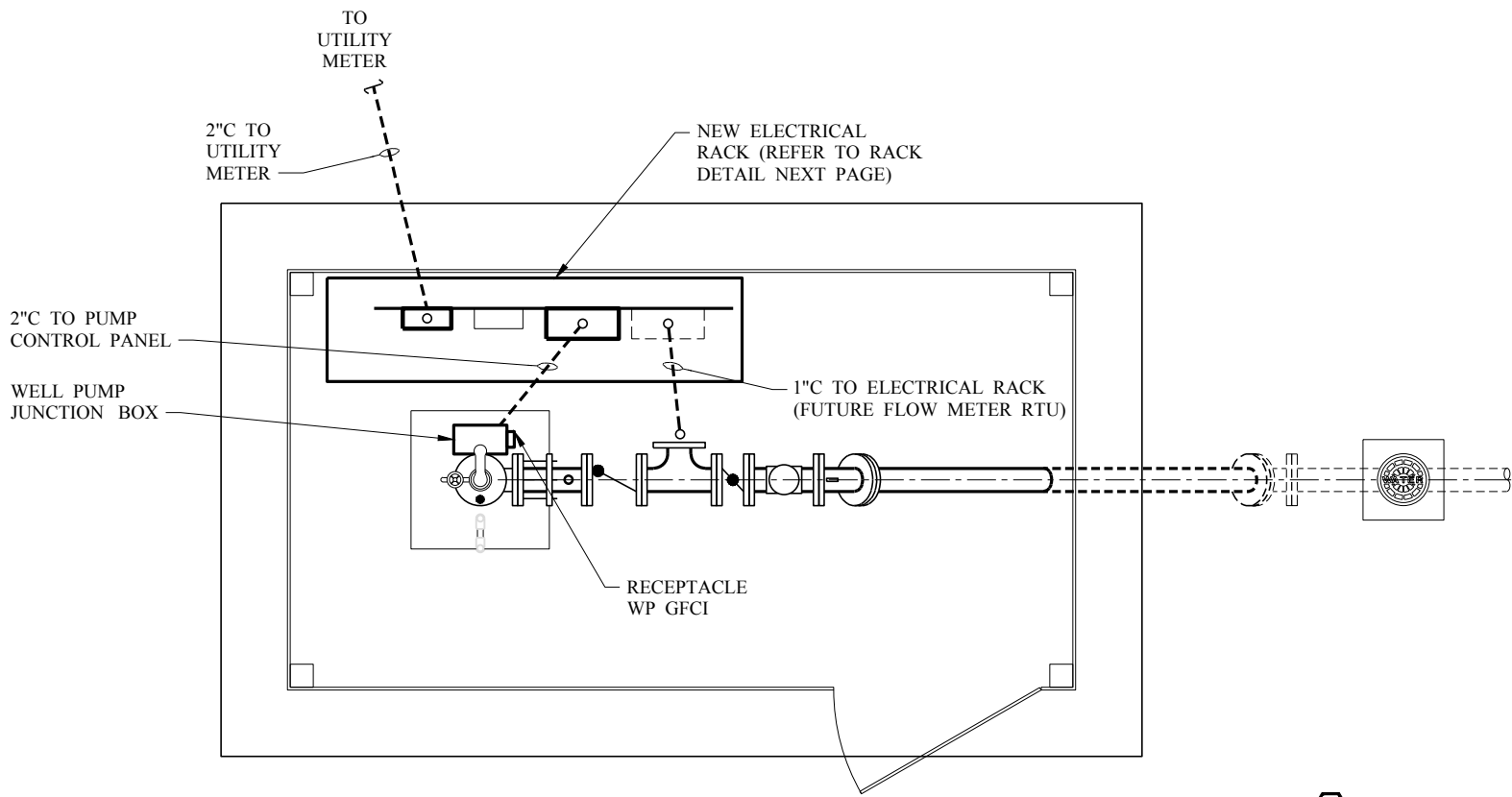
NO.	REVISION	DATE
1	ADDENDUM No. 1	02/14/2024
3	ADDENDUM No. 3	03/01/2024



Bret Thompson

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	03/01/2024 DATE
CITY OF PADUCAH COTTLE COUNTY, TEXAS WELL FIELD IMPROVEMENTS	B.J.T. DESIGNED BY: D.B.H. DRAWN BY:
	B.J.T. CHECKED BY:
WATER WELL BUILDING PLAN AND SECTION	11 OF 14

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NOTE INDICATED BY # :

1. INSTALL PLUG IN LED LIGHT (ULINE PART #H-7162 OR APPROVED EQUAL) IN PUMP HOUSE, MOUNT LIGHT TO ENCLOSURE.
2. CONTRACTOR TO RPOVIDE PLUG IN AUTOMATIC HEAT TRACE (FROST KING PART #HC30A OR APPROVED EQUAL).

TYPICAL WATER WELL BUILDING/ENCLOSURE


SCALE: 3/8" = 1'-0"

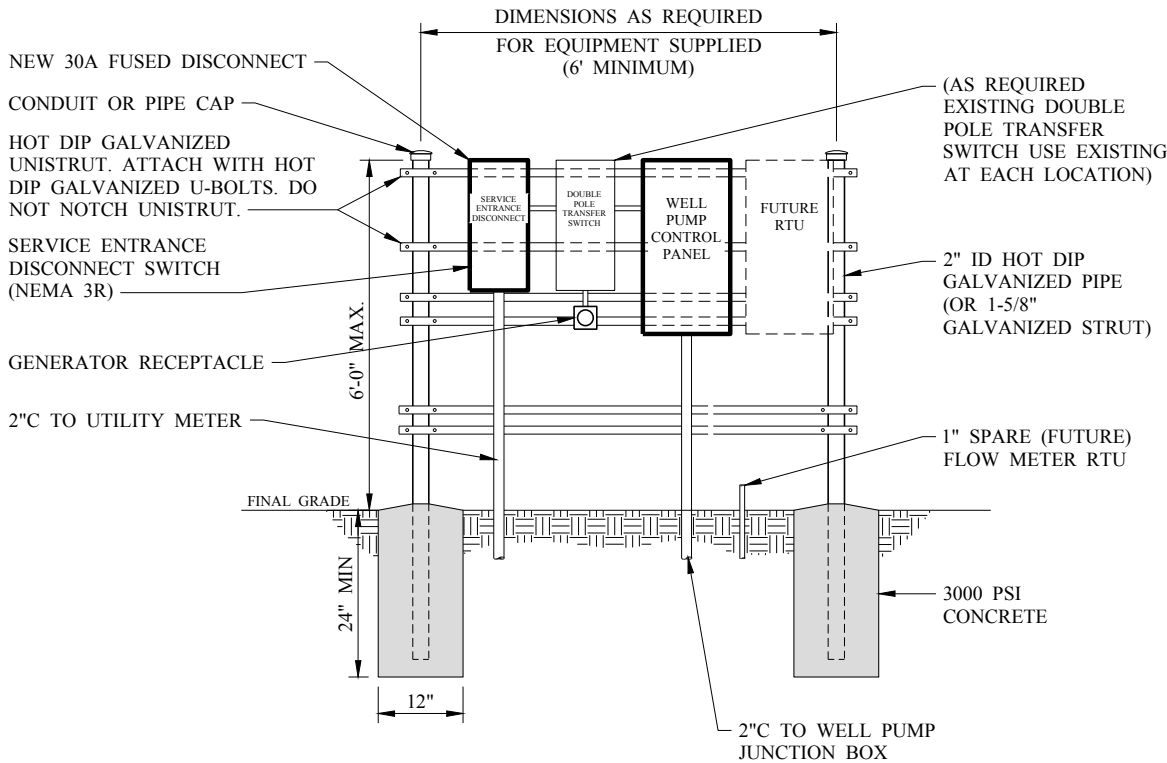
GENERAL ELECTRICAL NOTES:

1. THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA. EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.
2. FIELD VERIFY AND LOCATE ALL UNDERGROUND UTILITIES PRIOR TO ANY EXCAVATION. CALL TEXAS 811 PRIOR.
3. PROVIDE SLACK IN ALL CABLES OR CONDUCTORS ROUTED THROUGH PULL BOXES.
4. CONTRACTOR SHALL REVIEW ALL SPECIFICATIONS BEFORE SUBMITTING A BID OR STARTING CONSTRUCTION.
5. THE DRAWINGS AND SPECIFICATIONS ARE COMPLEMENTARY. WHAT IS SHOWN ON ONE IS BINDING WHETHER SHOWN OR SPECIFIED IN THE OTHER OR NOT. FAILURE TO CHECK BOTH THE DRAWINGS AND THE SPECIFICATIONS WILL NOT BE GROUNDS FOR A CHANGE ORDER IF ADDITIONAL EQUIPMENT OR MATERIAL IS REQUIRED TO BE PROVIDED BY THE CONTRACTOR AFTER THE ENGINEER REVIEWS, OR DEFICIENCIES ARE IDENTIFIED DURING TESTING, EITHER IN THE FACTORY OR THE FIELD.
6. PVC CONDUIT SHALL NOT BE INSTALLED ABOVE GRADE. MAKE TRANSITION TO RIGID CONDUIT IN ACCORDANCE WITH THE SPECIFICATIONS.
7. ALL SUPPORT MATERIAL AND ANCHOR BOLTS SHALL BE STAINLESS STEEL. SEE SPECIFICATIONS.
8. ALL EQUIPMENT OUTDOOR SHALL UTILIZE STAINLESS STEEL STRUT UNLESS OTHERWISE NOTED.
9. ALL CONSTRUCTION SHALL COMPLY WITH LOCAL AND NATIONAL CODES AND REQUIREMENTS.
10. CONDUITS SHALL NOT BE ROUTED ACROSS WALKWAYS, PATH OF ACCESS, TRAVEL, OR EGRESS, ROUTE BENEATH GRATINGS, IN CONCRETE STRUCTURES, OR AROUND EQUIPMENT. DO NOT ROUTE IN CONFLICT WITH OTHER PIPING, CONDUITS, EQUIPMENT, OR STRUCTURES.
11. CONDUITS SHOWN ARE FOR SIGNIFICANT PIECES OF ELECTRICAL EQUIPMENT AND IN A DIAGRAMMATICAL ORIENTATION FOR CLARITY. INSTALL ALL CONDUITS AND CONDUCTOR SPECIFIED IN OTHER ELECTRICAL SCHEMATICS, SCHEDULES, SPECIFICATIONS, AND AS REQUIRED FOR VENDOR SUPPLIED EQUIPMENT. ROUTE CONDUITS THE BEST WAY TO MINIMIZE BENDS.
12. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY AND ALL PERMITS ASSOCIATED WITH THE WORK. THE COSTS OR THE PERMITS, IF ANY, SHALL BE BORNE BY THE CONTRACTOR.
13. VERIFY BY FIELD INVESTIGATION THE LOCATIONS OF ALL UTILITY FACILITIES WITHIN AND ADJACENT TO THE LIMITS OF THE WORK THAT MAY BE AFFECTED BY THE WORK. CONFLICTS WHICH ARISE DUE TO THE NEGLIGENCE OF THE CONTRACTOR TO LOCATED, HORIZONTALLY AND VERTICALLY, EXISTING UTILITIES SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
14. ALL ASPECTS OF THIS INSTALLATION MUST COMPLY WITH THE LATEST UTILITY CO. STANDARDS. REVIEW THIS PROJECT'S SERVICE REQUIREMENTS OF LOCATION, RATINGS, AND METHODS WITH POWER COMPANY PRIOR TO BEGINNING CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR ALL COORDINATION WITH UTILITY COMPANY.
15. ALL POWER AND ANALOG INSTRUMENTATION CONDUCTORS SHALL BE INSTALLED IN SEPARATE CONDUITS.
16. ALL RECEPTACLES INSTALLED OUTDOORS AND INDOOR RECEPTACLES MARKED AS "WP" ON THE PLANS SHALL BE GFI TYPE WITH CAST IRON WEATHERPROOF WHILE-IN-USE COVERS.
17. THIS CONTRACT INCLUDES FIELD INSTALLATION AND COMPLETION OF VENDOR SUPPLIED COMPONENTS. CONDUIT, WIRE, MOTORS, INSTRUMENTATION, AND CONTROLS SHOWN ARE TYPICAL. ALL DRIVE MOTORS, ALARM CONTACTS, RUN LIGHTS, ETC. ARE TO BE WIRED TO THE VENDOR'S PANEL OR SITE MOTOR CONTROLS AS REQUIRED. CONTRACTOR SHALL VERIFY VENDOR SUPPLIED COMPONENTS AND PROVIDE A COMPLETE AND OPERATING SYSTEM.
18. REMOVE ALL CONDUIT AND CONDUCTORS FOR ABANDONED EQUIPMENT. FOR ALL DEMOLITION WORK, REMOVE ALL CONDUCTORS AND ALL CONDUIT TO 6" BELOW GRADE AND CAP.
19. REPAIR ALL DAMAGE TO ROADS AND SIDEWALKS NECESSARY FOR CONSTRUCTION TO PRE-EXISTING CONDITION OR BETTER.
20. PROVIDE TRADITIONAL "NEMA" DEVICES AS DEFINED IN NEMA STANDARDS PUBLICATION NO. ICS 2.4.2003. IEC COMPONENTS ARE NOT ALLOWED.



Donald S. Mattern

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	03/01/2024 DATE
	D.S.M. DESIGNED BY: J. SALINAS DRAWN BY: D.S.M.
	CHECKED BY: 12 OF 13
CITY OF PADUCAH COTTLE COUNTY, TEXAS WELL FIELD IMPROVEMENTS	
ELECTRICAL DETAILS	

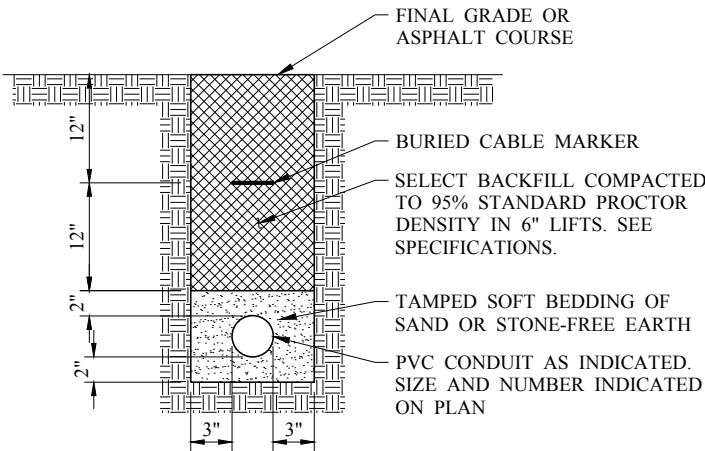


NOTES

- ALL CONDUIT ENTERING SIDE OR BOTTOM OF PUMP CONTROL PANEL, SHALL USE WEATHER-TIGHT HUBS. CONDUITS OR OTHER CABLES SHALL NOT ENTER ENCLOSURE FROM THE TOP.
- CAST FD BOX WITH 20A GFCI RECEPTACLE, NEMA 5-20R. WEATHERPROOF COVER, FOR WELL PUMP RECEPTACLE.
- MAINTAIN 3' WORKING CLEARANCE IN FRONT OF DISCONNECT.
- PROVIDE 2 - 3/4", 10' GROUND ROD TYPICAL SPACED 6' APART FOR ELECTRICAL RACK, GROUND RACK WITH BURNDY K25B1 CONNECTOR.
- CONTRACTOR TO INSTALL GENERATOR RECEPTACLE COORDINATE WITH OWNER ON STYLE/PART # TO MATCH OWNER GENERATOR).
- PROVIDE SPACE FOR FUTURE RTU ENCLOSURE.
- RACK MAY BE ANCHORED TO CONCRETE WELL ENCLOSURE PAD.

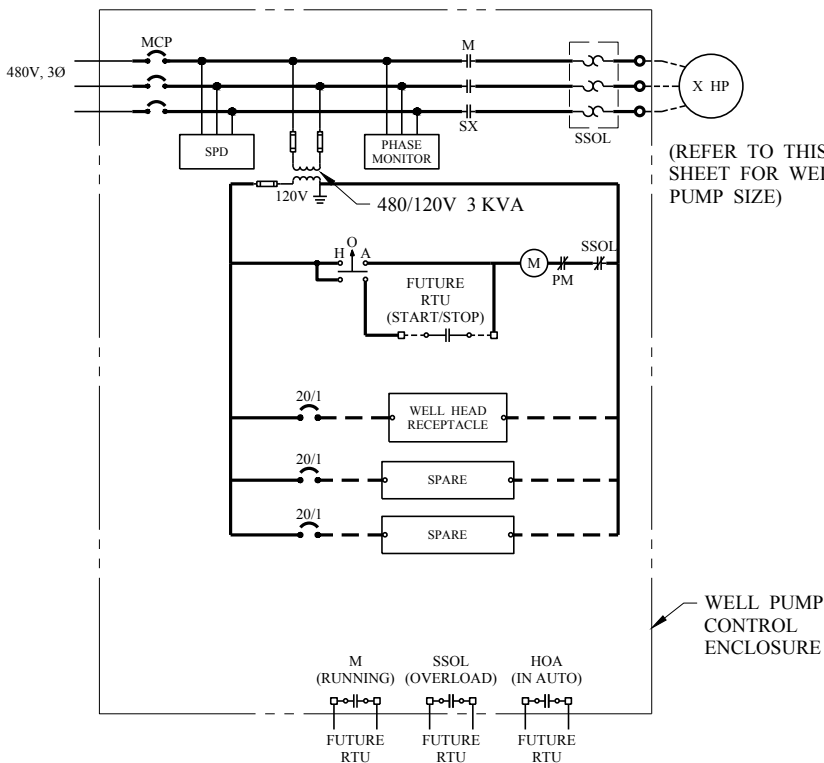
TYPICAL WELL PUMP ELECTRICAL RACK DETAIL

NO SCALE



DIRECT BURIED CONDUIT

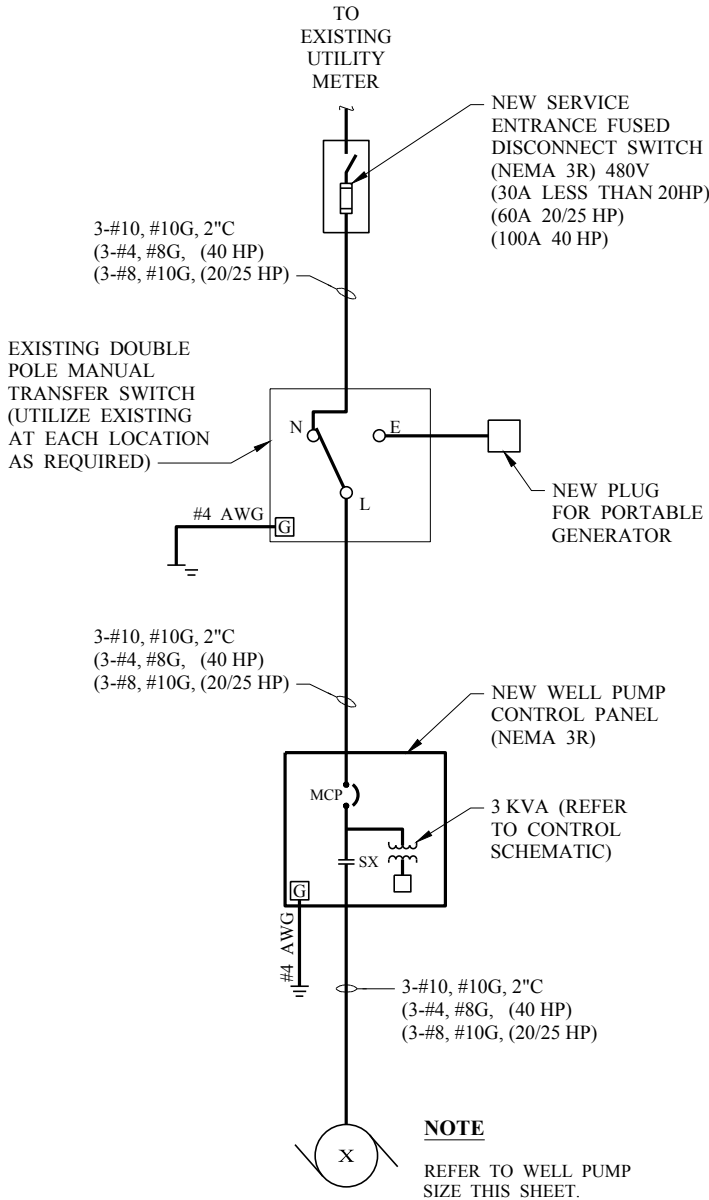
NO SCALE



WELL PUMPS		STARTERS SIZE
1	20HP	2
2	20HP	2
3	20HP	2
5	15HP	2
6	5HP	1
7	15HP	2
9	20HP	2
10	10HP	1
11	25HP	2
12	40HP	3
13	10HP	1

TYPICAL WELL PUMP CONTROL SCHEMATIC

NO SCALE



TYPICAL WELL PUMP ONE LINE DIAGRAM

NO SCALE

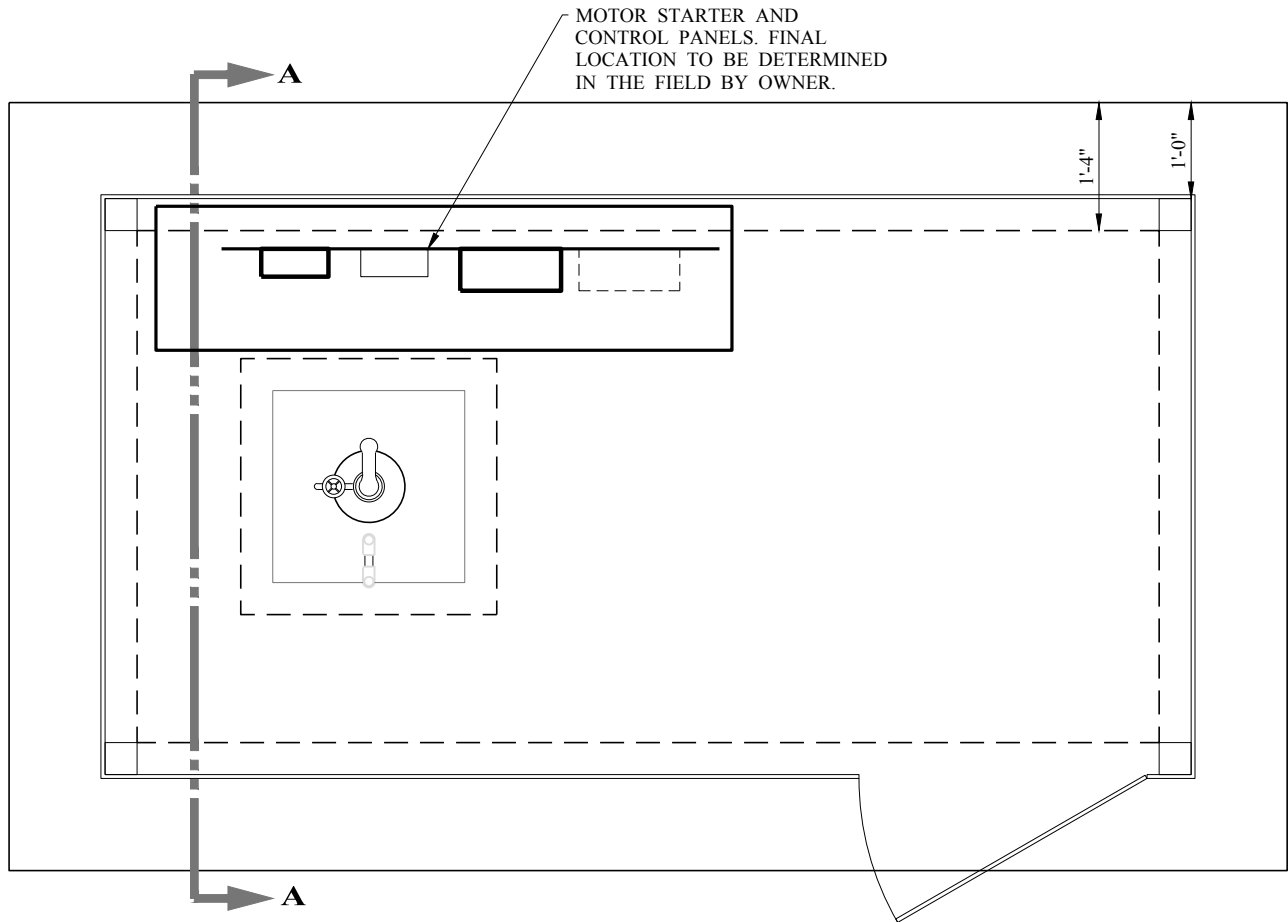


Donald S. Mattern

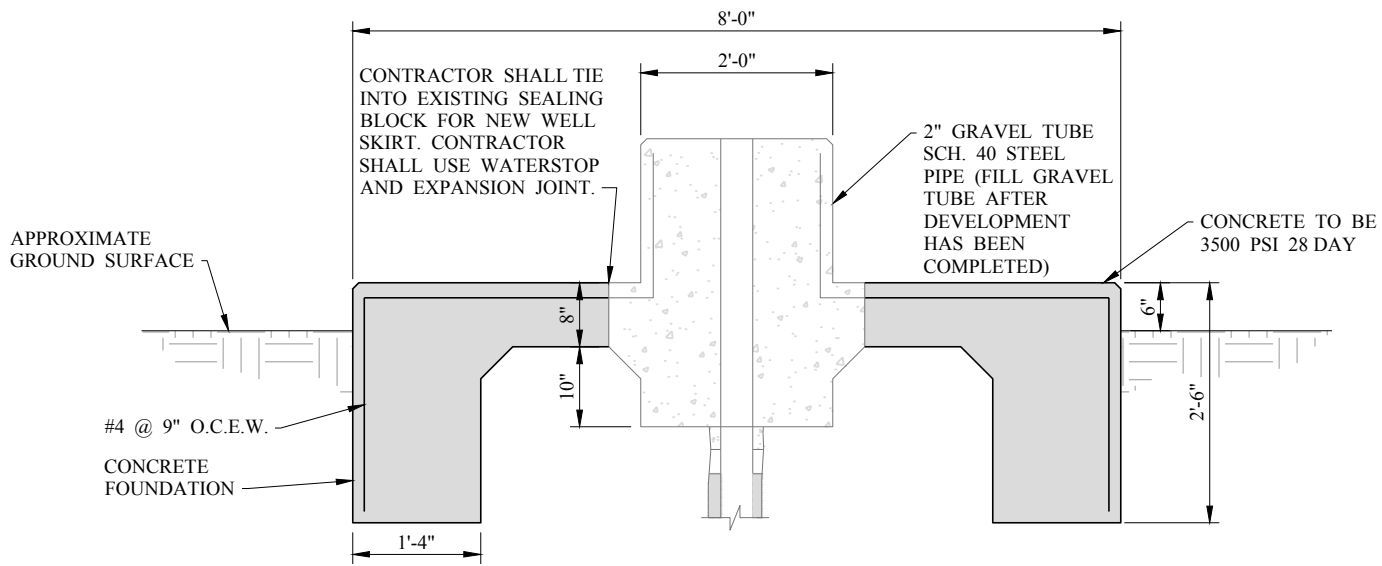
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	03/01/2024 DATE
CITY OF PADUCAH COTTLE COUNTY, TEXAS WELL FIELD IMPROVEMENTS	D.S.M. DESIGNED BY: J. SALINAS
	D.S.M. DRAWN BY:
ELECTRICAL ONE LINE DIAGRAM AND DETAILS	CHECKED BY:
	13 OF 13

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3



PLAN VIEW - WELL SKIRT
SCALE: 1/2" = 1'-0"

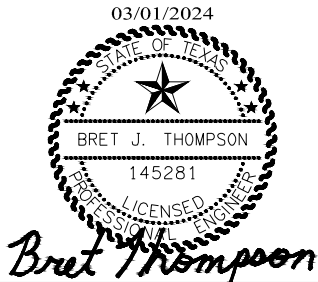



SECTION A-A
SCALE: 1/2" = 1'-0"

NOTES

1. ALL EXPOSED TO VIEW CORNERS SHALL BE CHAMFERED 3/4".
2. CONCRETE PUMP SKIRT SHALL BE CAST MONOLITHICALLY.
3. PERMANENTLY MARK THE LEVEL MONITORING TUBE AND CAP WITH AN "L".
4. PAINT ALL EXPOSED PIPING, EXCEPT SS LEVEL TUBE AS FOLLOWS:
SURFACE PREP: SSPC-SP10
PRIMER: TNE MEC SERIES 104 H.S. EPOXY 8.0-10.0 DRY MILS
FINISH: TNE MEC SERIES 290 CRV, 2.0-3.0 DRY MILS

NO.	REVISION	DATE
3	ADDENDUM No. 3	03/01/2024



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CITY OF PADUCAH COTTLE COUNTY, TEXAS WELL FIELD IMPROVEMENTS	
TYPICAL CONCRETE WELL SKIRT DETAILS	14 OF 14