VOLUME 2 – TECHNICAL SPECIFICATIONS

And

DRAWINGS

BID NO. 2019-104

PROJECT MANUAL

FOR

NORTH PATROL STATION

EMERGENCY POWER SYSTEM

BIDS DUE MARCH 18, 2019

2:00 P.M.

Technical Specifications Prepared by

Bennett Benner Partners

500 West Seventh Street

Suite 1400

Fort Worth, TX 76102

RFB NO. 2019-104
Installation of an Owner furnished, Contractor installed emergency generator and automatic transfer switch. The Contractor shall also provide a masonry screen wall and generator equipment pad.

1. Perform all work in accordance with all applicable national and local codes and code authorities.

2. Submit electronic copy of shop drawings for all material furnished under this division of work.

3. Secure and pay for all necessary permits, licenses and inspections required by law for the completion of the work. Secure and pay for all certificates of approval that are required and deliver them to the engineer before final acceptance of the work.

4. Make excavations to the proper depth, with allowances made for floor slabs, forms, beams, etc. Compact the ground under conduits before conduits are installed.

5. Identify electrical equipment using laminated three-ply, engraved, plastic nameplates as required with black surface and white interior core, at least 1/16 inch thick. Attach nameplates using chromium plated screws as required. Provide nameplates for new disconnect switches.

6. Examine the project site and make allowances in the bid to accommodate existing conditions.

7. All material shall be new, UL listed, and free from defects, unless existing material is specifically shown to be reused. Install all material in accordance with good workmanship standards.

8. Substitutions of specified material shall be approved in writing by the engineer prior to bidding.

9. Provide all cutting and patching necessary for the work. Patching shall be done to the satisfaction of the engineer.

10. Provide factory finish on all material furnished to the jobsite and touch up finishes which have been damaged.
11. Provide new typewritten directories for existing panelboards in which the loads served have been changed by the scope of this project.

12. Provide a copy of as-built plans to the Owner upon completion of project.

13. Maintain operations of all building systems during construction. Coordinate all shutdowns or system disruptions with owner seven days in advance.

14. Use EMT conduit with compression type fittings and insulated bushings, 3/4 inch minimum, for interior, concealed work and exposed work above switch height.

15. Use rigid galvanized steel conduit for exposed work below switch height.

16. Use schedule 40 PVC conduit, 3/4 inch minimum, for all underground work. Provide PVC coated, rigid galvanized steel bends.

17. Use 4" square (minimum) galvanized steel outlet boxes.

18. Use copper conductors, type THHN/THWN insulation, or approved equal. Use solid conductors for #10 AWG and smaller and stranded conductors for #8 AWG and larger. Aluminum conductors are not acceptable.

19. Make splices and provide work as required to maintain circuit continuity to existing devices and equipment to remain in service.

20. Remove all existing conductors, cables and exposed conduit rendered unused by the scope of this project back to the source of supply.

21. Circuit breakers shall be number of poles and ampere rating as shown on plans. Circuit breakers shall be capable of interrupting the fault current available to them without the use of series connected ratings with upstream circuit breakers.

22. Provide a ground system that includes all connections and testing of: ground rods, ground cables, ground buses, conduits, fittings, anchors, supports, and other materials as required for a complete installation.

23. Owner-furnished generator will be Kohler model 100REOZJF.

Submitted By: Ken Randall, Electrical Engineer

BAIRD, HAMPTON & BROWN
Scope Summary

To: Bidders

From: Ken Randall, PE

Date: December 3, 2018

Subject: Tarrant County North Patrol Station – Emergency Power System

Installation of an Owner furnished, Contractor installed emergency generator and automatic transfer switch. The Contractor shall also provide a masonry screen wall and generator equipment pad.

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10. Provide factory finish on all material furnished to the jobsite and touch up finishes which have been damaged.
11. Provide new typewritten directories for existing panelboards in which the loads served have been changed by the scope of this project.

12. Provide a copy of as-built plans to the Owner upon completion of project.

13. Maintain operations of all building systems during construction. Coordinate all shutdowns or system disruptions with owner seven days in advance.

14. Use EMT conduit with compression type fittings and insulated bushings, 3/4 inch minimum, for interior, concealed work and exposed work above switch height.

15. Use rigid galvanized steel conduit for exposed work below switch height.

16. Use schedule 40 PVC conduit, 3/4 inch minimum, for all underground work. Provide PVC coated, rigid galvanized steel bends.

17. Use 4" square (minimum) galvanized steel outlet boxes.

18. Use copper conductors, type THHN/THWN insulation, or approved equal. Use solid conductors for #10 AWG and smaller and stranded conductors for #8 AWG and larger. Aluminum conductors are not acceptable.

19. Make splices and provide work as required to maintain circuit continuity to existing devices and equipment to remain in service.

20. Remove all existing conductors, cables and exposed conduit rendered unused by the scope of this project back to the source of supply.

21. Circuit breakers shall be number of poles and ampere rating as shown on plans. Circuit breakers shall be capable of interrupting the fault current available to them without the use of series connected ratings with upstream circuit breakers.

22. Provide a ground system that includes all connections and testing of: ground rods, ground cables, ground buses, conduits, fittings, anchors, supports, and other materials as required for a complete installation.

23. Owner-furnished generator will be Kohler model 100REOZJF.

Submitted By: Ken Randall, Electrical Engineer
BAIRD, HAMPTON & BROWN
PROJECT MANUAL
FOR
THE CONSTRUCTION OF
TARRANT COUNTY NORTH PATROL STATION
EMERGENCY POWER SYSTEM

6651 Lake Worth Boulevard
Lake Worth, Texas 76135

November 29, 2018

CONSTRUCTION SET

PREPARED BY
BAIRD, HAMPTON & BROWN, INC.
6300 RIDGLEA PLACE, SUITE 700
FORT WORTH, TX 76116
817-338-1277
TBPE FIRM F-44
BHB Project No. 2018.177.000
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Frank W. Neal & Assoc., Inc.  
Texas Firm Registration No.: F-296
SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Form-facing material for cast-in-place concrete.

B. Related Requirements:
   1. Section 32 13 13 "Concrete Paving" for formwork related to concrete pavement and walks.
   2. Section 32 13 16 "Decorative Concrete Paving" for formwork related to decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:
   1. Exposed surface form-facing material.
   2. Form ties.
   3. Form-release agent.
PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:
   1. Provide continuous, true, and smooth concrete surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints.
   3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
      a. Plywood, metal, or other approved panel materials.
      b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
         1) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

2.2 RELATED MATERIALS


B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   2. Form release agent for form liners shall be acceptable to form liner manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes

C. Limit concrete surface irregularities as follows:

D. Construct forms tight enough to prevent loss of concrete mortar.
   1. Minimize joints.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
   1. Provide and secure units to support screed strips
   2. Use strike-off templates or compacting-type screeds.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

I. Construction and Movement Joints:
   1. Construct joints true to line with faces perpendicular to surface plane of concrete.
   2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
   3. Clean embedded items immediate prior to concrete placement.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
   1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
SECTION 03 20 00
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Steel reinforcement bars.
   2. Welded-wire reinforcement.

B. Related Requirements:
   1. Section 32 13 13 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Each type of steel reinforcement.
   2. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:
   1. Include placing drawings that detail fabrication, bending, and placement.
   2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:
   1. Steel Reinforcement:
a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

   a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

  1. Finish: Plain.
2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.
   1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.
   1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
   2. Stagger splices in accordance with ACI 318.

G. Install welded-wire reinforcement in longest practicable lengths.
      a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
   2. Lap edges and ends of adjoining sheets at least one mesh spacing plus 2 inches for plain wire and 8 inches for deformed wire.
   3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
   4. Lace overlaps with wire.
3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement.
   2. Continue reinforcement across construction joints unless otherwise indicated.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
   1. Steel-reinforcement placement.

END OF SECTION 03 20 00
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
B. Related Requirements:
   1. Section 03 10 00 "Concrete Forming and Accessories" for form-facing materials.
   2. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
   3. Section 03 33 00 "Architectural Concrete" for general building applications of specially finished formed concrete.
   4. Section 32 13 13 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS
A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS
A. Product Data: For each of the following.
   1. Portland cement.
   2. Fly ash.
   3. Aggregates.
   4. Admixtures:
      a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at
time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

5. Curing materials.
7. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Semirigid joint filler.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures:

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
   1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL
   A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
      1. ACI 301.

2.2 CONCRETE MATERIALS
   A. Source Limitations:
      1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
      2. Obtain aggregate from single source.
      3. Obtain each type of admixture from single source from single manufacturer.

   B. Cementitious Materials:
      2. Fly Ash: ASTM C618, Class C or F.

   C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
      2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

   D. Air-Entraining Admixture: ASTM C260/C260M.

   E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
      1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
      2. Retarding Admixture: ASTM C494/C494M, Type B.
      3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
      4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
      5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
      6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
         a.

2.3 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Corporation.
b. ChemMasters, Inc.
c. Dayton Superior.
d. Euclid Chemical Company (The); an RPM company.
e. Laticrete International, Inc.
f. Sika Corporation.
g. SpecChem, LLC.
h. W.R. Meadows, Inc.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Water: Potable or complying with ASTM C1602/C1602M.

D. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ChemMasters, Inc.
b. Dayton Superior.
c. Euclid Chemical Company (The); an RPM company.
d. Laticrete International, Inc.
e. SpecChem, LLC.
f. W.R. Meadows, Inc.

2.4 RELATED MATERIALS


B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
2.5    CONCRETE MIXTURES, GENERAL

A.    Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1.    Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B.    Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1.    Fly Ash: 20 percent by mass.

C.    Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1.    Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2.    Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3.    Use water-reducing admixture in pumped concrete.

2.6    CONCRETE MIXTURES

A.    Class A: Normal-weight concrete used for footings and grade beams and exterior grade supported slabs.

2.    Minimum Compressive Strength: 4500 psi at 28 days.
3.    Maximum w/cm: 0.45.
4.    Slump Limit: 5 inches, plus or minus 1 inch or 8 inches, plus or minus 1 inch for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5.    Air Content:
   a.    Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
6.    Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.7    CONCRETE MIXING

A.    Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure facilities for storage, initial curing, and field curing of test samples, including continuous electrical power.
4. Security and protection for samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.
   a. Continue reinforcement across construction joints unless otherwise indicated.
3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items are complete and that required inspections are completed.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
   a. Do not use vibrators to transport concrete inside forms.
   b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
   c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
   d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Do not place concrete slabs in a checkerboard sequence.
   2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   4. Screed slab surfaces with a straightedge and strike off to correct elevations.
   5. Level concrete, cut high areas, and fill low areas.
   6. Slope surfaces uniformly to drains where required.
   7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
   8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:
   1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
      a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
      b. Remove projections larger than 1 inch.
      c. Tie holes do not require patching.
      d. Surface Tolerance: ACI 117 Class D.
      e. Apply to concrete surfaces not exposed to public view.
   2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
      a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
      b. Remove projections larger than 1/4 inch.
      c. Patch tie holes.
      d. Surface Tolerance: ACI 117 Class B.
3.7 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restaightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:
   1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
   2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:
   1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
   2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
   3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations: (Coordinate with Mechanical Drawings)
   1. Coordinate sizes and locations of concrete bases with actual equipment provided.
   2. Construct concrete bases 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings.
   3. Minimum Compressive Strength: 4500 psi at 28 days.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   5. For supported equipment, install anchor rods that extend through concrete base and anchor into structural concrete substrate.
   6. Prior to pouring concrete, place and secure anchorage devices.
      a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
      b. Cast anchor-rod insert into bases.
      c. Install anchor rods to elevations required for proper attachment to supported equipment.

3.9 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
   1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
   2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply in accordance with manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
   1. If forms remain during curing period, moist cure after loosening forms.
   2. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
      a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
      b. Continuous Sprinkling: Maintain concrete surface continuously wet.
      c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
      d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
      e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
         1) Recoil areas subject to heavy rainfall within three hours after initial application.
         2) Maintain continuity of coating and repair damage during curing period.

D. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
   1. Begin curing immediately after finishing concrete.
      a. Floors to Receive Curing Compound:
         1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
         2) Recoil areas subjected to heavy rainfall within three hours after initial application.
         3) Maintain continuity of coating, and repair damage during curing period.

3.10 TOLERANCES

A. Conform to ACI 117.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete:
   1. Repair and patch defective areas when approved by Architect.
   2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
   a. Limit cut depth to 3/4 inch.
   b. Make edges of cuts perpendicular to concrete surface.
   c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
   d. Fill and compact with patching mortar before bonding agent has dried.
   e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
   a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
   b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

3. After concrete has cured at least 14 days, correct high areas by grinding.

4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
   a. Finish repaired areas to blend into adjacent concrete.

5. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
c. Place patching mortar before bonding agent has dried.
d. Compact patching mortar and finish to match adjacent concrete.
e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
2. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.
2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:
   a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
   a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:
   a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M:
   a. Cast and laboratory cure two sets of three 6-inch by 12-inch cylinder specimens for each composite sample.

   a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

9. Additional Tests:
   a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000
SECTION 04 22 00

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Concrete masonry units.
   2. Mortar and grout.
   3. Steel reinforcing bars.
   5. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

C. Samples for Initial Selection:
   1. Weep holes/vents.
1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

1. Masonry units.
   a. Include data on material properties material test reports substantiating compliance with requirements.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups, if required by Architect.

1. Build sample panels for exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockups for exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
      a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
   2. Protect accepted mockups from the elements with weather-resistant membrane.
   3. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
      a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 CONCRETE MASONRY UNITS

A. CMUs: ASTM C90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
   2. Density Classification: Medium weight.
   4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Cemex S.A.B. de C.V.
      b. Essroc.
      c. Holcim (US) Inc.
      d. Lafarge North America Inc.
      e. Lehigh Hanson; HeidelbergCement Group.

E. Mortar Cement: ASTM C1329/C1329M.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Lafarge North America Inc.

F. Aggregate for Mortar: ASTM C144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.


H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.
2. Wire Size for Side Rods: 0.148-inch diameter.
4. Spacing of Cross Rods: Not more than 16 inches o.c.
5. Provide in lengths of not less than 10 feet, with prefabricated corner units.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type S.
   2. For reinforced masonry, use Type N.
   3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Grout for Unit Masonry: Comply with ASTM C476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 3000 psi.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as top of walls, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.
C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

3.4 LAYING MASONRY WALLS
A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING
A. Lay hollow CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in grouted masonry, including starting course on footings.
   3. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

D. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT
A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.

   B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

   C. Provide continuity at corners by using prefabricated L-shaped units.

3.7 CONTROL AND EXPANSION JOINTS

   A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

3.8 FLASHING

   A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

3.9 REINFORCED UNIT MASONRY

   A. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

   B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

      1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

      2. Limit height of vertical grout pours to not more than 60 inches.

3.10 FIELD QUALITY CONTROL

   A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

   B. Inspections: Special inspections according to Level C in TMS 402/ACI 530/ASCE 5.

      1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

      2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

      3. Place grout only after inspectors have verified proportions of site-prepared grout.

   C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

   D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 042200
PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, supervision, tools, services, equipment and incidentals necessary for complete and operational systems as specified under this division and as shown on the Contract Drawings.

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

1.2 DRAWINGS AND SPECIFICATIONS

A. Prior to submitting a bid:

1. Examine the Drawings.

2. Read the Specifications and other Contract Documents, including Addenda and referenced material.

3. Visit the site of the work.

4. Become informed prior to bidding as to existing conditions and limitations of the project.

B. Bring exceptions and inconsistencies in Drawings, specifications, addenda, referenced material, other Contract Documents and site conditions to the attention of the Engineer in writing seven days before the bid opening; otherwise be responsible for changes and additions that become necessary during construction.

C. Interpretation or correction of the Contract Documents will be made by Addendum and will be mailed or delivered to each Contract Bidder of Record.

D. Location of material, equipment, devices and appliances shown in the Contract Drawings are approximate and are subject to such revisions as may be necessary or desirable at the time the work is installed. Install the work in relation to existing conditions and be responsible for the correctness of the work with reference to finish elevations and surrounding conditions.

E. The Contract Documents show the general arrangements of the work. Should project conditions require any rearrangement, or if equipment or accessories can be installed to better advantage in a different manner, the Contractor may, before proceeding with the work, prepare and submit five copies of shop drawings of the proposed rearrangement for the Engineer's review.

F. If the Contractor proposes to install equipment requiring space conditions other than those shown, he shall assume responsibility for the rearrangement of the space and shall have the Engineer's review the change before proceeding with the work. The request for such changes shall be accompanied by shop drawings of the space affected.
G. The accompanying Drawings do not indicate the existing electrical installations other than to identify modifications and extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installations and/or installing any new or temporary work under this Division.

1.3 CODES AND STANDARDS

A. Execute the work in accordance with local, state and national codes, ordinances and regulations having jurisdiction or authority over the work. Make any and all adjustments required by these agencies without further cost to the Owner. In addition, conform to the applicable provisions and recommendations of the following standards:

1. National Electrical Manufacturer Association (NEMA)
3. National Fire Protection Association (NFPA)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Electrical Code (NEC)
7. Underwriters’ Laboratories (UL)
8. American National Standards Institute (ANSI)
10. Occupational Safety and Health Administration (OSHA)
11. Americans with Disabilities Act (ADA)
12. Applicable utility companies
13. Texas Accessibility Standards (TAS)

B. Execute the work in accordance with the most current codes and standards in effect at the time of bidding.

C. In the event standards and codes conflict with each other, the most stringent shall apply.

D. Conform to National Electrical Code rules. Provide material and equipment, which is approved by Underwriter’s Laboratories, bears UL label and is acceptable to Factory Mutual.

E. It is specifically understood, however, that in those instances where capacities, sizes, etc., of electrical equipment, devices or material as designated in these Specifications or on the Drawings are in excess of the minimum requirements of the National Electrical Code, such designated capacities shall prevail.
PART 2 - PRODUCTS

2.1 SHOP DRAWINGS AND SUBMITTALS

A. Submit Shop Drawings for all material furnished under this division of the work. Refer to the General Requirements for additional requirements. In addition to the quantity of Shop Drawing copies required by the General Requirements, furnish one additional copy for the Electrical Engineer's file. No material shall be fabricated, delivered to the jobsite, or installed which the Engineer through Shop Drawing submittals has not approved.

B. The submittals shall include sufficient descriptive material, such as catalog cuts, diagrams, and other data published by the manufacturer, as well as evidence of compliance with safety and performance standards, to demonstrate conformance to the specification requirements; catalog numbers alone will not be acceptable. The data shall include the name and address of the nearest service and maintenance organization that regularly stocks repair parts.

C. Deliver Shop Drawings to the Engineer in sufficient time to avoid delay of the project. Group Division 26 submittals as identified below, submit sections not included in these groupings separately. The Electrical Contractor shall acknowledge receipt of all Division 23 mechanical equipment submittals and confirm the overcurrent protection requirements of the project specific HVAC equipment has been coordinated with the distribution equipment prior to submitting for approval. All proposed changes to the overcurrent protection devices shall be clearly identified in the distribution equipment submittal.

1. Distribution Equipment – Low Voltage
   a. Section 26 28 16 - OVERCURRENT PROTECTIVE DEVICES

2. Lighting
   a. Section 26 51 13 - LIGHTING

D. Before submitting Shop Drawings for review, examine them and verify that they correctly represent the material or equipment intended for this project. The Contractor's review of Shop Drawings is not intended to take the place of the review of the Engineer, and Shop Drawings which have not been reviewed by the Engineer shall not be used in fabricating or installing any work.

E. List deviations and exceptions from the specified equipment in writing. Failure to do so will be cause for rejection of submittals. Contractor agrees that if deviations, discrepancies, or conflicts between Shop Drawing submittals and the Contract Documents are discovered either prior to or after Shop Drawing submittals are reviewed by the Engineer, the Contract Documents shall control and shall be followed, unless deviations have been specifically approved by the Engineer.

F. The review of Shop Drawings or catalog data by the Engineer shall not relieve the Contractor from responsibility for deviations from plans and specifications unless he has, in writing, specifically called attention to such deviations at the time of submission and has obtained the permission of the Engineer thereon; nor shall it relieve him from responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Engineer, he shall state in his letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra cost is involved for making the change.
G. Contractor agrees that Shop Drawing submittals reviewed by the Engineer are not change orders; that the purpose of Shop Drawing submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

2.2 STANDARDS FOR MATERIALS

A. It is the intention of these specifications to indicate a standard of quality for all materials incorporated in this work. Manufacturer's names and catalog numbers are used to designate the item of equipment or material as a means of establishing grade and quality. Where several manufacturers are named, only the named manufacturer's products will be considered and the Contractor's bid shall be based on their product.

B. Where the phrase 'or approved equivalent' or 'or equivalent' or 'equivalent to' or 'accepted substitute' is used in these specifications, the names or name mentioned are to be used as a basis of quality. Other manufacturers will be considered if the quality of the proposed material is equivalent to that of materials named, in the opinion of the Engineer. Such unnamed manufacturers' products will, however, be considered as substitutions and shall not be used as a basis for bidding.

C. Basis of quality shall include material, workmanship, weight, finishes, and gauges of material, appearances, capacity and performance. Manufacturer's representation as to availability of equipment, replacement parts and service personnel in the area will be a factor in consideration of submittals.

D. All materials shall be fully warranted.

E. Furnish standard products and manufacturers regularly engaged in production of such equipment.

F. Furnish manufacturer's latest standard design.

G. All equipment shall conform with applicable IEEE, UL, ANSI and/or NEMA Standards.

H. Obtain manufacturer's recommendations and instructions for all installed equipment including installation instructions, preparation cleaning, tests and preservice checks, and then ensure all have been performed prior to completion of work.

2.3 SUBSTITUTIONS

A. The Engineer prior to installation shall approve substitutions of equipment. Substitution of equipment shall be in accordance with Division 01 of the specifications.

B. When alternate or substitute materials and equipment are used, the Contractor shall be responsible for space requirements, configurations, performance, changes in bases, supports, structural members and openings in structure, and other apparatus and trades that may be affected by their use.

C. Contractor shall bear all additional costs resulting from the use of substituted materials. Such changes shall be at no additional cost to the Owner.
PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate and direct the work under this division of the specifications with the work under other divisions of the specifications. Examine the Contract Documents and report any discrepancies between divisions of the work to the Engineer and obtain written instructions for changes necessary in the work.

B. Before installation, make proper provisions to avoid interferences with the work under other divisions of the specifications. Changes required in the work of the Contractor caused by his neglect to do so shall be made by him at his own expense.

C. Harmonize the work under this division with the work under other divisions of the specifications such that it may be installed in the most direct and workmanlike manner without hindering, handicapping, or conflicting with the work under other divisions of the specifications. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation.

3.2 PERMITS AND FEES

A. Secure and pay for all necessary permits, licenses and inspections required by law for the completion of the Work. Secure and pay for all certificates of approval that are required and deliver them to the Engineer before final acceptance of the Work.

B. If a utility company in connection with the work under this division makes any charges, the Contractor shall advise the Owner, so that the Owner can pay these charges. Advise the Owner of these charges in a timely manner, so as not to delay construction of the project.

3.3 QUALITY ASSURANCE

A. Use adequate quantities of skilled workmen who are trained and experienced in their crafts and who are familiar with the specified requirements and methods needed to perform the work in this division.

B. Install materials and equipment based upon actual dimensions and conditions at the project site. Field measure for materials or equipment requiring exact fit.

C. Be responsible for the proper location and sizes of all slots, holes or openings in the building structure pertaining to the work in this division, and for the correct location of pipe sleeves.

D. Perform work in accordance with good commercial practice. The good appearance of the finished work shall be of equivalent importance with its operation.

E. Isolate all conduit, transformers and motors to insure an acceptable noise level free from objectionable vibration for all systems.
3.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Follow the manufacturer's directions in the delivery, storage and handling of equipment and materials.

B. Equipment and materials shall be tightly covered and protected against dirt, water, chemical or mechanical injury and theft. Damaged equipment will not be accepted.

C. After materials are installed, protect the installation until the work is completed and accepted by the Owner.

3.5 CLEANING UP

A. Remove all shipping labels, dirt, paint, grease and stains from all equipment under this division of the Work. Remove debris as it accumulates. Upon completion of the Work, clean all electrical equipment and the entire electrical installation in order to present a first class electrical installation suitable for occupancy. No loose parts, scraps, tools nor debris shall be left on the premises.

3.6 CUTTING AND PATCHING

A. Be responsible for the cost of cutting and patching required in connection with the work under this division of the specifications.

B. Coordinate the work to eliminate unnecessary cutting of construction. Where it becomes necessary to cut through walls, floors, ceilings and other construction to permit installation of the work, or to repair defective work under this division, the costs for such cutting and patching shall be included in this division of the work. Comply with other applicable divisions of the specifications concerning the quality of cutting and patching.

C. Where openings are cut through masonry walls, provide lintels or structural supports to protect the remaining masonry. Provide adequate support during the cutting operation to prevent any damage to the affected masonry.

D. Cutting of structural members is not permitted unless the Engineer grants specific written permission.

3.7 FLASHINGS, SLEEVES, INSERTS

A. Be responsible for maintaining the integrity of the waterproofing of conduit penetrations through exterior walls.

B. Install galvanized wrought iron pipe sleeves around conduits and raceways that pass through walls and masonry exterior walls. The inside diameter of these sleeves shall be at least 1/2 in. greater than the outside diameters of the service pipes. After the pipes are installed in these sleeves, fill the annular space between pipes and sleeves with mastic. The completed installation shall be watertight.

C. Be responsible for maintaining the fire rating of penetrations through walls, floors and ceilings.
D. Waterproofing and fireproofing work shall conform to the requirements of other applicable sections of the specifications.

3.8 FOUNDATIONS

A. Be responsible for the installation of steel reinforced concrete foundations below all floor-mounted switchboards, panelboards, motor control centers, transformers and other floor mounted electrical equipment.

B. Concrete foundations shall not be less than 4 in. high. All top edges shall be neatly chamfered.

C. Concrete foundations shall be 3 in. wider and 3 in. longer than the base of the equipment being installed.

D. All concrete work shall be steel reinforced with a minimum of 6 in. by 6 in., No. 6 mesh and shall conform entirely to the requirements of the other sections of the specifications describing this class of work.

E. Be responsible for the installation of steel reinforced concrete piers for pole-mounted lighting fixtures. Neatly chamfer top edges and conform to the requirements of the other sections of the specifications describing this class of work. Remove all form marks, burrs and imperfections from all exposed surfaces for a neat and appealing appearance.

3.9 PAINTING

A. Maintain original factory finish on all material and equipment installed under this division of the work unless specifically noted otherwise within the Contract Documents. Should the finish be marred in transit or during installation, it shall be re-finished to present a neat, workmanlike appearance. Leave equipment clean and free from any grease, dirt and rust and in a suitable condition for painting.

3.10 EXCAVATION AND BACKFILLING

A. Be responsible for all excavating and backfilling necessary for the installation of the work under this division. Include shoring and pumping in ditches to keep them in dry conditions until the work has been installed. Perform all shoring required to protect the excavation and safeguard employees.

B. Make excavations to the proper depth, with allowances made for floor slabs, forms, beams, etc. Compact the ground under conduits before conduits are installed. Obtain approval of excavation routing from the Engineer prior to executing the work.

C. Install exterior conduits with a minimum of 24 in. of cover below the finished grade, unless otherwise indicated.

D. Use selected soil for backfilling, free from rocks and debris, pneumatically tamped with 6 in. layers to secure a field density ratio of 90 percent as defined by ASTM Designation D698-57T (Proctor Soil Compaction Test).
E. Remove from the site excavated materials not suitable for backfill and not used in the backfill.

F. Field check and verify the locations of all underground utilities. Avoid disturbing these as far as possible. In the event existing utilities are damaged, they shall be repaired to make their operation equivalent to the existing condition before any trenching was started.

G. Replace concrete, curbs, paving and other surface improvements cut during excavation to their original condition. In a lime-stabilized area, the lime stabilization shall be fully restored after the excavation is complete.

H. Refer to Section 26 05 33 for marking underground electrical work.

3.11 IDENTIFICATION OF ELECTRICAL EQUIPMENT

A. Identify electrical equipment in accordance with the NEC, local authorities and in accordance with the requirements of the Contract Documents.

B. Use laminated three-ply, engraved plastic nameplates with black surface and white interior core, at least 1/16 in. thick. Engraved lettering shall be condensed gothic at least 1/4 in. high and properly spaced for legible and easy reading. Attach plates to equipment with chromium-plated screws. Adhesive attachment is not acceptable. Identify the following items with engraved nameplates, located as follows:

1. Each switch/fuse unit or circuit breaker in each main panel and each distribution panel - adjacent to switch/fuse unit or circuit breaker.
2. Spares shall be labeled ‘Spare’.
3. Outside light switches - custom engraved on outside of switch coverplate.

C. Refer to other sections of the specifications for conductor color-coding requirements.

D. Refer to Section 26 05 33 for identifying of underground electrical work.

3.12 BALANCING OF PANELS

A. At the completion of the installation of the electrical system, check each phase of all panels under full load and arrange loads such that all phases carry the proper proportion of load. Submit load readings to Engineer for review as part of project close out documentation.

3.13 LOCKING OF ELECTRICAL FACILITIES

A. Provide padlocks for exterior electrical facilities subject to unauthorized entry.

B. Furnish locks to match Owner’s locking system. Key all locks alike.

C. Furnish Owner with two keys per lock up to a quantity of ten keys.

D. Install locks immediately upon installation of electrical facility.
3.14 RECORD DOCUMENTS

A. Job set: Promptly following receipt of the Owner's Notice to Proceed, secure from the Engineer at no charge to the Contractor, one complete set of all Documents comprising the Contract.

B. Final Record Documents: At a time nearing the completion of the work, secure from the Architect at no charge to the Contractor one complete set of sepia transparencies of all Drawings in the Contract.

C. Maintenance of Job Set: Immediately upon receipt of the job set described in paragraph above, identify each of the Documents with the title, "RECORD DOCUMENTS - JOB SET".

D. Preservation:
   1. Considering the Contract completion time, the probable number of occasions upon which the job set must be taken out for the new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set to the approval of the Engineer.
   2. Do not use the job set for any purpose except entry of new data and for review by the Architect, from start of transfer of data to final Project Record Documents.
   3. Maintain the job set at the site of Work where the Engineer designates that site.

E. Making Entries on Drawings:
   1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.
   2. Date all entries.
   3. Call attention to the entry by a 'cloud' drawn around the area or areas affected.
   4. In the event of overlapping changes, use different colors for the overlapping changes.
   5. All equipment shall be clearly indicated in its installed location. Exposed items or those easily accessible, as above lay-in ceilings, may be located to scale. Concealed items not readily accessible, such as underground piping, shall be located by dimension.

F. Transfer of Data to Final Project Documents:
   1. Approval of recorded data prior to transfer:
      a. Following receipt of the transparencies described above, and prior to beginning transfer of recorded data thereto, secure the Engineer's approval of all recorded data.
      b. Make required revisions.
   2. Transfer of Data to Drawings:
      a. Carefully transfer change data shown on the job set of Record Drawings to the corresponding transparencies, coordinating the changes as required.
      b. Clearly indicate at each affected detail and other drawing a full description of changes made during construction, and the actual location of items described above.
      c. Call attention to each entry by drawing a 'cloud' around the area or areas affected.
d. Make changes neatly, consistently, and with the proper media to assure longevity and clear reproduction.

G. Review and Submittal:
   1. Submit the completed set of Project Record Documents to the Engineer as described above.
   2. Participate in review meetings as required.
   3. Make required changes and promptly deliver the final Project Record Documents to the Engineer.

3.15 OPERATIONS AND MAINTENANCE DATA

A. Accumulate, as the job progresses, the following data, in duplicate, prepared in a neat brochure or packet folder, and deliver to the Engineer for checking and subsequent delivery to the Owner.
   1. Manufacturers' warranties, guarantees, service manuals, and operating instructions for equipment and materials covered by this division of the specifications.
   2. Copies of approved Shop Drawings.
   3. Any and all other data and/or Drawings required during construction.
   4. Repair parts list of all major items and equipment including name, address, and telephone number of local supplier and agent.

3.16 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide the services of competent engineers or technicians acceptable to the Engineer to instruct representatives of the Owner in the complete and detailed operation of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a Letter of Release, acknowledged by the Owner or his Authorized Representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.

B. Be responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.

C. In providing the instructions to the Owner's personnel, follow the written operating and maintenance manuals in all instances, and familiarize the Owner's personnel with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturers' operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.

3.17 LOCAL PARTS AND SERVICE

A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 150 miles of the project site".
3.18  INSTALLATION INSPECTIONS AND CERTIFICATIONS

A. Obtaining timely inspections of the installation by the constituted authorities. Remedy any deficiencies to the satisfaction of the inspection authority.

B. Upon final completion of the Work, obtain certificates of acceptance from the constituted authorities. Deliver the certificates to the Engineer for transmission to the Owner.

3.19  ACCEPTANCE OF THE WORK

A. The Work, when completed, will be accepted in a finished, perfect and undamaged state only. Provide for protection of the Work during its progress, and if damaged, do all patching or replacing necessary to its full and satisfactory completion.

3.20  WARRANTY

A. Furnish a written certificate, guaranteeing all materials, equipment and labor to be free of all defects for a period of one year from the date of final acceptance by the Owner of the Work, and guarantee that if any defects appear within the stipulated guarantee period, such work shall be replaced without charge.

B. This guarantee shall be extended to include the capacity and integrated performance of all component parts of the various systems.

3.21  FINALLY

A. It is the intention that this Specification provide a complete installation. Include all accessory construction and apparatus necessary to the operation and testing of the work under this division. The omission of specific reference to any part of the work necessary for such complete installation shall not relieve this Contractor from furnishing and installing such parts.

END OF SECTION 26 05 10
SECTION 26 05 11

WORK IN EXISTING BUILDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Furnish all labor, materials, services, equipment, and appliances required in conjunction with the work in existing buildings as indicated in the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials to match existing construction unless specified elsewhere in these Contract Documents. Materials shall comply with local codes, be UL listed, and be properly applied for their intended function.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Inspect the jobsite prior to bidding and be familiar with all existing conditions. Include the cost of the work required to accommodate the existing conditions in the bid proposal.

B. Obtain data related to existing facilities from existing documents, measurements, notations, photographs, surveys and other observations at the site.

C. Relocate existing items as required to accommodate the new construction. Remove, relocate and reconnect equipment and accessories that are to be reused.

D. Coordinate the Work with other divisions of the specifications. Determine which items and equipment are to remain, to be relocated or be removed, and perform all work consistent with the Scope of Work.

E. Loads that exist and are to remain shall be connected to the new distribution system as shown on the Drawings or as required to maintain their proper operation.

F. Refer to other divisions of the specifications and determine equipment that requires power to be disconnected, or power to be relocated and disconnect power and relocate power to this equipment.

G. Remove all conductors and exposed conduit rendered unused back to the source of supply.

H. Perform splices as required to maintain circuit continuity to existing devices or equipment to remain in service.
3.2 DISRUPTION OF EXISTING FUNCTIONS

A. Access: Access to and use of the existing facilities and site will be restricted, and shall be under the direction and control of the Owner.

B. Disruptions: Maintain existing electrical, communications, alarm, and other existing systems, and maintain existing functions in service except for scheduled disruptions. Where existing functions to remain in use are disrupted, they shall be fully restored after disruption, in full compliance with this division of the specifications for new work.

C. Scheduling of Disruptions: Seek and obtain approval two weeks in advance of the event date. Indicate date of event, starting time, and duration of each required disruption.

D. Notice of Disruption: Date, time and duration of each disruption shall be subject to the Owner's prior approval, and shall include the following information in the form of a memorandum submitted by the Contractor to the Architect for approval by the Owner:

<table>
<thead>
<tr>
<th>STARTING FACILITY/SYSTEM</th>
<th>DATE</th>
<th>TIME</th>
<th>DURATION</th>
</tr>
</thead>
</table>

E. Emergency Disruptions: When circumstances preclude obtaining advance approval as specified above, make request immediately upon knowledge of the requirement, and perform work so as to cause the minimum amount of disruption, for the minimum duration.

F. Notification: Notify the Engineer and the Owner immediately by telephone and then in writing, as changes and additions to the scheduled disruption requirements become known.

G. Duration: Complete as large a portion of the work as possible before initiating disruption and perform only that work necessary so as to minimize duration of disruption. Maintain adequate personnel, supplies, materials, equipment, tools, and other resources at job site to avoid unnecessary delay in resumption of normal service.

3.3 SALVAGE, DEMOLITION AND RELOCATION

A. General

1. Modify, remove, or relocate materials and items indicated in the Contract Documents and required by the installation of new facilities.

2. Owner shall have first right of refusal for all material and equipment. Deliver salvaged material accepted by the Owner to destinations on the premises as directed and remove material rejected by the Owner from the site.

B. Relocations

1. Make minor relocations necessitated by the conditions at the site or as directed by the Engineer, without additional cost to the Owner.

2. Repair and restore to good functional condition equipment, materials and items scheduled for relocation, which are damaged during dismantling or reassembly operations.
3. New materials and items of similar design and quality may be substituted for materials and items indicated to be relocated upon approval of shop drawings, product data, and samples.

4. Remove carefully, in reverse order to original assembly or placement, items that are to be relocated.

5. Protect items until relocation is complete.

6. Clean and repair items to be relocated, and provide new materials, fittings, and appurtenances required to complete the relocations and to restore items to good operating order.

7. Perform the relocation work in accordance with applicable sections of these specifications, utilizing skilled workers.

3.4 EXISTING CEILINGS

A. Provide a typewritten list of existing damaged ceilings and ceiling tiles. Disregard rooms in which ceilings are to be repaired and replaced. Correlate list to room numbers indicated on drawings.

B. Mark damaged ceilings and ceiling tiles with easily removable red "stick-on" labels, minimum size two square in.

C. Submit list prior to commencing work. Do not start work until Engineer and Owner review list; otherwise repair and replace damaged ceilings and ceiling tiles.

3.5 EXISTING PANELBOARDS

A. Service existing panelboards to be reused as follows:

1. Clean interiors and exteriors.

2. Touch-up damaged finishes with manufacturer's matching touch-up paint.

3. Inspect for component damage and repair or replace as necessary.

4. Tighten conduit and wire terminations.

5. Verify panelboards and panelboard feeders are of adequate capacity for loads to be served as follows:
   a. Activate loads connected to panelboards to simulate 100 percent demand.
   b. Measure and record amperage readings of phase and neutral conductors of panelboards feeders.
   c. Provide typewritten record of recorded measurements to the Engineer for review.

6. Rebalance loads as specified in other sections of the specifications to provide for evenly balanced phases.

7. Provide new typewritten circuit directories.

END OF SECTION 26 05 11
SECTION 26 05 19
WIRES AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of wire and cable systems as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide conductors made of soft-drawn-annealed copper with conductivity not less than that of 98 percent pure copper. Conductors #12 gauge and smaller shall be solid. Conductors No. 10 gauge and larger shall be stranded.

B. Utilize conductors with insulation rated at 600 volts and insulated with type "THHN" insulation in dry locations and type "THWN" in wet locations. Wire in fixture channels and other special locations shall be as specifically rated for temperature in Article 300 in the NEC.

C. Minimum wire sizes shall be in accordance with other requirements of the specifications and as follows: For 20 ampere branch circuits #12 gauge, except that home runs greater than 50 ft. from the panel to the first outlet box on 120/208 volt shall be #10 gauge.

D. All wire shall be color-coded. Mark conductors on each end with a 1 in. band of colored pressure-sensitive plastic tape or by the use of brilliant waterproof lacquer, applied according to manufacturers instructions. Colors for each phase and the neutral shall be consistent throughout the system in accordance with the requirements of this section.

E. Conductor sizes shown on the Contract Documents are selected based upon use with 75 degrees C terminations. Furnish terminations, which are UL listed for 75°C, or derate conductors for use at 60°C. Use of 90°C terminations is acceptable, but conductor must be sized at the 75°C rating. Do not use 90°C rating for conductors.

F. Armored cable types MC, AC, and BX are specifically not allowed.
PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

A. Place an equivalent number of conductors for each phase, neutral and ground of a circuit in same raceway or cable.

B. Do not share neutral conductors between branch circuits connected to single pole circuit breakers unless shown otherwise on drawings.

C. Splice only in junction or outlet boxes.

D. Neatly train and lace wiring inside boxes, equipment, and panelboards.

E. Make conductor lengths equal for parallel circuits.

F. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling #4 gauge and larger wires.

G. When inserting conductors in raceways, comply with the following:
   1. Raceways shall first be installed as a complete raceway system without conductors.
   2. Do not install pull wires and conductors until the raceway system is in place.
   3. Do not use cleaning agents and lubricants that have a deleterious effect on the conductors.
   4. Completely and thoroughly swab raceway system before installing conductors.

3.2 PHASING

A. Identify wire and cable for feeders and branch circuits for general power and lighting with a visible color code in accordance with the requirements of this section as follows:

   120/208 Volt
   Phase A - Black
   Phase B - Red
   Phase C - Blue
   Neutral - White
   Ground - Green

B. Provide green or bare grounding conductor identification for grounding conductors. Identification of all ungrounded conductors at junction boxes, wireways, and/or terminations may be by means of colored tape or painting when color-coded conductors as specified above are not available.

C. Phasing of the complete electrical installation shall be connected and maintained the same throughout the power distribution system. Where the project is an addition or modification to an existing facility, the electrical distribution system phasing shall be made the same as the existing.
D. Switchgear, lighting and power panels and power receptacles shall have all the same phase arrangements throughout the facility.

3.3 INSTALLATION

A. Install conductors in a neat and workmanlike manner to meet code requirements and make runs continuous without weld, splice, or joint between boxes. Do not install wires in conduit unless the entire system of conduit and outlet boxes is permanently in place. Pull conductors using a UL approved wire lubricant.

B. Provide conductors continuous from outlet to outlet with no splices except at outlets. Leave sufficient wire at all outlets to make connections without straining.

C. Deliver cable and wire to the project in original packages. Conductors with insulation showing deterioration within one year after final completion and acceptance of the Work shall be removed and replaced at no cost to Owner.

D. Thoroughly clean wires before installing lugs and connectors.

E. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

F. Terminate spare conductors with electrical tape.

G. Torque test conductor connections and terminations to manufacturer's recommended values.

H. Where more than three current-carrying conductors are installed in a raceway, use larger size conductor and appropriate larger size raceway to comply with Article 310 of the National Electrical Code.

I. Where conductor is installed in an environment where the ambient temperature will exceed 86°F, use larger size conductor and appropriate larger size raceway to comply with Article 310 of the National Electrical Code.

J. Test all circuits for grounds. Light and test each lamp. Prove and test energy available at the load side of disconnect switches and at the final point of connection to driven equipment. Make all necessary and reasonable tests as required by the Engineer to prove the integrity of work and leave the complete electrical installation ready for operation.

END OF SECTION 26 05 19
SECTION 26 05 20

WIRE CONNECTION AND DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of wire connections and devices systems as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Make cable and wire connections for splicing or terminating with compression deforming type connectors as manufactured by Burndy Corp., Thomas & Betts Co., Inc., Dossert Manufacturing Corp., Ilsco Corp., or accepted substitute. Connectors for cable sizes 250 Kcmil and larger shall be the long barrel type for double indentation. Soldered connections will not be permitted. Twist-on insulated connectors, of proper size, and resistant to vibration, may be used. Use twist-on connectors as manufactured by Minnesota Mining and Manufacturing Co., Thomas & Betts Co., Inc., Ideal Industries, Inc., or approved equivalent.

B. Provide terminal connectors with the hole sizes and spacing in accordance with NEMA standards. Provide terminal connectors with two holes in tongue for use on conductor sizes 250 Kcmil and larger. Terminal connectors are not required for connections to the circuit breakers in the lighting and/or receptacle panels.

C. Insulate connections made with non-insulated connectors with three layers of plastic tape, each layer being half-lapped. Use No. 35+ plastic tape as manufactured by Minnesota Mining and Manufacturing Co., or similar and equivalent plastic tape as manufactured by Plymouth Rubber Co.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Make all electrical power and control connections to equipment furnished under other divisions of the specifications and furnish wiring, conduit, outlet boxes, disconnect switches, etc., as required for same. Check General Construction, Controls, Plumbing, Heating, and Air Conditioning, etc. plans and specifications to determine the amount of such wiring required and include cost of same in bid. Verify locations, horsepower, voltages, etc., of all
equipment as the job progresses. If a conflict arises in wiring, ask the Engineer immediately for clarification.

B. Branch circuits and connections to all electrically operated equipment are included in this contract, whether or not specifically mentioned. Check, on the job, for further details on Plumbing, Heating, and Air Conditioning equipment as project progresses. Ground equipment in an approved manner.

C. Before connecting equipment, check the nameplate data against the information shown on the Drawings. Call any discrepancies to the attention of the Engineer.

END OF SECTION 26 05 20
SECTION 26 05 26
GROUNDING

PART 1 - GENERAL

1.1 SUMMARY
A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.
B. Furnish all labor, materials, services, equipment and appliances required in conjunction with the installation of a grounding system as indicated in the Contract Documents.

1.2 SUBMITTALS
A. Manufacturer's Data: Submit copies of manufacturer's specifications for products used.

1.3 TESTS
A. Measure ground grid resistance with earth test megger and install additional ground rods and conductors as required until resistance to ground complies with Code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Provide a grounding system that includes all connections and testing of ground rods, ground cables, ground buses, conduits, fittings, anchors, supports, thermite process materials and equipment, and other materials as required for a complete installation.
B. Provide ground cables composed of stranded bare copper of 98 percent conductivity encased in conduits above grade, or buried to a depth not less than 12 in. below grade. Install as required to provide sufficient mechanical protection.
C. Provide Thomas & Betts Co., Inc., Catalog No. 3951, or approved equivalent, ground fittings for bonding ground cable to its encasing conduit.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Ground electrical work in accordance with NEC Article 250, local codes as specified herein, and as shown on the Drawings.
B. Install ground cables continuous between connections. Splices will not be allowed except where indicated on the Drawings. Where ground cables pass through floor slabs, building walls, etc., and are not in metallic enclosures, provide with sleeves of approved nonmetallic material.
C. Install equipment-grounding conductors in all raceways.
D. At each convenience outlet, install a grounding clip attached to the outlet box and leave a sufficient length of No. 12 wire with green colored insulation to connect to the grounding terminal of the receptacle. Grounding clip shall be equivalent to Steel City Type G. This requirement may be deleted if automatic grounding clip receptacle meeting NEC Article 250.

3.2 COORDINATION

A. Coordinate the work under this section with the work under other divisions of the specifications.

END OF SECTION 26 05 26
SECTION 26 05 27
SEALING OF PENETRATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Provide labor, materials, services, equipment and appliances required in conjunction with sealing of penetrations as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Samples: Provide samples upon written request.

B. Product Data: Manufacturer’s specifications and installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acceptable Manufacturers:


3. Composite Sheet: 3M's No. CS-195 organic/inorganic fire resistive elastomeric sheet, bonded on one side with 28-gauge galvanized steel and the other side with reinforced hexagonal shaped steel wire mesh and covered with aluminum foil.

4. Thunderline Model "LS/Link-Seal" seals, of the required size and number of links, shall be used on all conduit penetrations of exterior walls. Similar fittings by O.Z./Gedney shall be considered approved equivalents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Review the detailed requirements of the UL through penetration fire stop assembly to be used and verify dimensional requirements such as maximum conduit size, conduit spacing, maximum opening size, minimum length of sleeve, etc.

B. For sealing of sleeves on or below grade and in wet locations, install link seals around all conduit penetrations properly sealing the annular space between the sleeve and the conduit to provide a waterproof seal.

C. For sealing of sleeves above grade and in dry/damp locations, use specified fire stop material and install per manufacturer's instructions and in conformance with UL requirements.
D. Attach an adhesive warning label identifying the fire stop assembly and warning against removal without proper resealing.

E. Seal floor, wall and ceiling penetrations or fire rated assemblies in above grade and in dry/damp locations, both horizontal and vertical, utilizing intumescent (expand when heated) materials designed to be applied as a fire, cold smoke, noxious gas, and water sealant. Penetrations shall meet the requirements of ANSI/UL 1479 "Fire Tests of Through-Penetration Firestops".

END OF SECTION 26 05 27
SECTION 26 05 29
SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Furnish all labor, materials, services, equipment and appliances required in conjunction with installation of supporting devices as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Product Data:
   1. Manufacturer's engineering brochures.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kindorf
B. Unistrut
C. Superstrut
D. Powerstrut

2.2 MATERIALS

A. Continuous slotted channel: 12 gauge steel with electro-galvanizing and gold zinc dichromate barrier bases and dimensions as required for application.

B. Hanger rods: Continuous thread, electro-galvanized, steel, with gold zinc dichromate barrier, sizes as required for loads imposed.

C. Hex head cap screws and nuts: No. H-113 and No. 114, respectively.

D. One-hole pipe straps: Series HS-100, galvanized steel.

E. Single bolt channel pipe straps: Steel, with machine screw and nut, Series C-105 and Series C-106.

F. Lay-in pipe hanger: Series C-149.

G. Conduit and pipe hanger: Series 6H.

H. Beam clamps: Series 500, RC, EC and PC as applicable.
I. Concrete inserts, spot: Series D-256 or D-255.

J. Concrete inserts, channel: Series D-980 or Series D-986.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Carefully lay out supporting devices to coordinate with the work under other divisions of the specifications.

B. Securely fasten and support conduits and raceways to the building structure.

C. Suspend horizontal runs of conduits and raceways from the floor and roof construction by rod hangers spaced 10 ft. or less on centers for sizes 2-1/2 in. and greater, and 9 ft. or less on centers for 2 in. and smaller.

D. Fasten single runs of conduit to the structure with one-hole pipe straps and beam clamps or hang on rod hangers.

E. Fasten single conduits to rod hangers with adjustable lay-in pipe hangers or for conduits of sizes 2 in. and smaller with Series 6H pipe hangers.

F. Fasten conduits to channels with pipe channel straps.

G. Support conduits and raceways within 3 ft. of each bend, of each termination, and at other intervals to maintain horizontal and vertical alignment without sag and deformation.

H. Do not use cable, strap, or wire hangers and fasteners.

I. Install supports to permit equivalently distributed expansion and contraction of conduits and raceways with expansion joints. Use guides consisting of saddles, U-bolts and anchors designed for equivalent effectiveness for both longitudinal and transverse thrusts. Submit complete details for review.

J. Do not support conduits and raceways from equipment connections.

K. Provide steel angle and channel supports to the floor and structure for panelboards, cabinets, pull and junction boxes. Provide independent support from entering conduits and raceways.

L. Provide supports as specified for conduits and raceways for outlet boxes and pull boxes 100 cubic in. and smaller.

M. Paint all cuts, breaks, welds and other points where the rust inhibiting coating of supports is damaged.

N. Provide supports sized for the ultimate loads to be imposed.

O. Anchor supporting devices with:
1. Wood screws on wood.
2. Toggle bolts on hollow masonry.
3. Bolts and expansion anchors in concrete or brick.

P. Provide supports with hot-dipped galvanized finish in outdoor and wet locations.

Q. Pipe and conduit supports:
   1. Single run pipe and conduits, 2-1/2 in. O.D. and less, shall have Type SS-8R/SS-8C as manufactured by Portable Pipe Hangers, Inc., or approved equivalent, spaced at maximum eight ft. on center and installed on roof pads if required by the roofing manufacturer.
   2. Multiple run pipe and conduits larger than 2-1/2 in. O.D. shall have Type PS, PSE, PP-10 with Roller, or PP-10 with Bar, as manufactured by Portable Pipe Hangers, Inc., or approved equivalent, spaced at maximum eight ft. on center and installed on roof pads if required by the roofing manufacturer. All conduits shall be held in place with clips on bars.

END OF SECTION 26 05 29
SECTION 26 05 33

CONDUITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Provide labor, materials, services, equipment, and appliances required in conjunction with the installation of conduit systems as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Manufacturer's Data: Submit copies of manufacturer's specifications and product data for products to be used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rigid Metal Conduit: Heavy-wall, mild steel tube with metallic corrosion-resistant coating on interior and exterior, hot-dipped galvanized, free from defects and manufactured in accordance with ANSI standards, and UL listed.

B. PVC Coated Rigid Metal Conduit:
   1. Hot dip galvanized inside and out. Factory-cut threads shall be protected with hot galvanized threads and a clear urethane coating. Thread protectors shall be used on the exposed threads. The PVC coating must have been investigated by UL as providing the primary corrosion protection for the rigid galvanized steel conduit. The PVC coating shall be gray, 40 mils in thickness, continuous over the entire length of the conduit except at the threads, and be free of blisters, bubbles, or pinholes and manufactured in accordance with UL 6 Standard for Safety, Rigid Metal Conduit.
   2. The PVC coated rigid galvanized steel conduit must be certified and authorized to apply the ETL Verification Mark “ETL Verified to PVC-001”. ETL Verified to: Intertek ETL SEMKO High Temperature H20 PVC Coating Adhesion Test Procedure.

C. Electric Metallic Tubing (EMT): Welded steel tubing formed of low carbon steel, electro-galvanized exterior, inside coated with a thick, baked, tough elastic low-friction coating of enamel, and UL approved.

D. Intermediate Metal Conduit (IMC): Manufactured in accordance with UL 1242 with interior coating of silicone epoxy ester lubricant.

E. Flexible Metal Conduit: Single strip helically wound interlocking galvanized steel, UL listed; provide liquid tight with extruded polyvinyl jacket in damp and wet locations and in kitchens.

F. Rigid Nonmetallic Conduit:
   1. Direct buried - Schedule 40, UL listed.
2. Concrete encased - Schedule 20, UL listed.

G. Elbows and Bends:
   1. Rigid nonmetallic conduit systems - PVC coated rigid metal conduit.
   2. Other conduit systems - same material as the conduit with which they are installed.

H. Bushings:
   1. 1-1/4 in. and smaller - high-impact thermosetting phenolic insulation, 150°C, O-Z/Gedney Type A.
   2. 1-1/2 in. and larger - hot-dipped galvanized with thermosetting phenolic insulation, 150°C, O-Z/Gedney Type B.

I. Locknuts:
   1. 1-1/4 in. and smaller - zinc-plated heavy stock steel, O-Z/Gedney.
   2. 1-1/2 in. and larger - cadmium-plated malleable iron, O-Z/Gedney.

J. Hubs: Cadmium-plated malleable iron, tapered threads, neoprene 'O' ring, insulated throat, O-Z/Gedney.

K. EMT Connectors: Compression type, zinc-plated steel body, cadmium-plated malleable iron nut, insulated throat, O-Z/Gedney.

L. EMT Couplings: Compression type, zinc-plated steel body, O-Z/Gedney.

M. Liquid tight Conduit Connectors: Cadmium-plated malleable iron body and nut, cadmium plated steel ferrule, insulated throat, integrally-cast external ground lug, O-Z/Gedney Type 4QL.

N. Through-Wall Seals: Malleable iron body, oversize sleeves, sealing rings, pressure clamps and hex-head cap screws, O-Z/Gedney Type FSK.

O. End Bells: Hot-dipped galvanized, threaded, malleable iron, O-Z/Gedney Type TNS.

P. Expansion Fittings: Hot-dipped galvanized, malleable iron with bonding jumpers.
   1. Linear - O-Z/Gedney Type AX or TX.
   2. Linear with deflection - O-Z/Gedney Type AXDX.

Q. Escutcheons: Chrome-plated sectional floor and ceiling plates, Crane No. 10.

R. Accessories: Reducers, bushings, washers, etc., shall be cadmium-plated, malleable iron of the forms and dimensions best suited for the application.

S. Identifying Tape for Buried Conduits: 6 in. wide, polyethylene, with printing continuous along length of tape, Brady Identoline.
   1. For buried electric power conduits- red with black letters.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Size conduits as indicated on the Contract Drawings and as required by the National Electrical Code for the quantity and sizes of wires to be installed in the conduit. Do not use conduit sized less than 3/4 in. unless specified otherwise.

B. No more than one, three-phase circuit or three, single phase circuits may be placed in a single conduit, unless specifically noted on the drawings as such.

C. Conceal conduits from view in all areas except mechanical and electrical rooms and crawl spaces. Should it appear necessary to expose any conduit:
   1. Bring it to the attention of the Engineer immediately and obtain Engineer’s approval for location of exposed conduit.
   2. Rearrange the work to facilitate an approved installation.

D. Install conduits at elevations to maintain headroom and at locations to avoid interference with other work requiring grading of piping, the structure, finished ceiling, walls, access panels, etc. Avoid crossing other work.

E. Ream, remove burrs, and swab inside conduits before pulling in conductors.

F. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.

G. Make bends and offsets in 1 in. and smaller conduits with approved bending devices. Do not install conduits, which have had their walls crushed, deformed or their surface finish damaged due to bending.

H. Where space conditions prohibit the use of standard ells, elbows, and conduits, use cast ferrous alloy fittings of such forms and dimensions as best suited for the application.

I. Make conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in areas where moisture may subsequently be present in a manner to avoid creating moisture traps; where unavoidable, provide junction box with drain fitting at conduit low point.

J. Install insulated throat threaded hubs on conduits entering enclosures without threaded hubs in wet and damp locations.

K. Install and neatly rack exposed conduits parallel with and perpendicular to building walls. Provide space for 25% additional conduit. Do not install exposed diagonal conduit runs.

L. Do not place conduits in close proximity to equipment, systems and service lines, such as hot water supply and return lines, steam pipes, which could be detrimental to the conduit and its contents. Maintain a minimum of 3 in. separation, except in crossing, which shall be a minimum 1 in.
M. Connect motors, equipment containing motors, equipment mounted on isolated foundations, transformers and other equipment and devices which are subject to vibration and which require adjustment, with flexible metallic conduit from the device to the conduit serving it. Restrict length of flexible conduit to 6 ft. maximum unless specifically instructed in writing otherwise by the Engineer. Provide secure supports at the points of attachment on each side of the connection. Use bonding jumpers as directed by the National Electrical Code and other sections of these specifications.

N. Install fire seals on conduits passing through fire-rated partitions, floors and ceiling.

O. Install through-wall seals on conduits passing through exterior walls or use standard galvanized steel pipe sleeves, diameters 1/2 in. greater than the outside diameter of the sleeved conduit and fill the annular space with mastic.

P. Install insulated throat grounding bushings on conduits stubbed through slabs and foundations into electrical enclosures.

Q. Provide grounding of conduits, fittings and accessories. Refer to grounding section of specifications.

R. Feeder Circuits:
   1. Install rigid metal conduit in damp and wet locations, and where exposed in mechanical and electrical equipment rooms.
   2. Install flexible metal conduit where specified above and where permitted by the authorities having jurisdiction. Use liquid tight flexible metal conduit in damp and wet locations.
   3. Exterior to the building and below grade, bury Schedule 40 nonmetallic conduit, where permitted by the authorities having jurisdiction. If not permitted, use rigid steel conduit in accordance with installation requirements stated below. Exterior to the building and above grade, use rigid steel conduit and for elbows and bends greater than 30 degrees regardless of whether conduit is above or below grade. Wrap buried metal conduit portions with .020 in. thick self-sticking, anti-corrosive PVC pipe wrapping tape. Wrap tape half-lapped continuously around metal portions.

S. Branch Circuits:
   1. Install rigid metal conduit in damp and wet locations.
   2. Install electrical metallic tubing where concealed by building structure and where exposed in mechanical and electrical equipment rooms.
   3. Exterior to the building and below grade, bury Schedule 40 nonmetallic conduit, where permitted by the authorities having jurisdiction. If not permitted, use rigid steel conduit in accordance with installation requirements stated below. Exterior to the building and above grade, use rigid steel conduit and for elbows and bends greater than 30 degrees regardless of whether conduit is above or below grade. Wrap buried metal conduit portions with .020-inch thick self-sticking, anti-corrosive PVC pipe wrapping tape. Wrap tape half-lapped continuously around metal portions.
4. Install flexible metal conduit where specified above and where permitted by the authorities having jurisdiction. Use liquid tight flexible metal conduit in damp and wet locations, where exposed in mechanical and electrical equipment rooms, and in kitchen and shop areas. Limit flexible conduit to a length of 6 ft. maximum unless specifically instructed otherwise, in writing, by the Engineer.

END OF SECTION 26 05 33
SECTION 26 05 34
OUTLET BOXES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of outlet boxes as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, with 1/2 in. male fixture studs where required.

B. Cast Boxes: Cast metal, deep type, gasketed cover, threaded hubs. Use cast boxes for damp and outdoor installation.

C. Furnish boxes with proper covers and device plates.

D. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain tight. Cast metal box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on the Drawings, and as required for splices, taps, wire pulling, equipment connections and code compliance.

B. Determine from dimensions shown on the Contract Documents and by actual measurements on the site, the exact location of each outlet. Outlet locations shall be modified from those shown on the plans to accommodate changes in door swings, space changes or to clear other interferences that arise or from job modifications. Make such modifications at no cost to the Owner as a matter of job coordination. Coordinate job conditions and notify the Engineer of discrepancies before proceeding with the installation of the work. Set wall boxes in advance of wall construction blocked in place, and secure. Set wall boxes flush with the finish. Install extension sleeves as required to extend boxes to finished surfaces.
C. The locations of equipment and outlets shown on the Contract Documents are approximate. Check and verify exact locations in the field. Coordinate installation with the Engineer and with the work under other divisions of the specifications.

D. Unless otherwise noted, location of outlet boxes, measured to centerline of box, shall be as follows:

<table>
<thead>
<tr>
<th>EQUIPMENT OR OUTLETS</th>
<th>ELEVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toggle Switches</td>
<td>3 feet - 10 inches</td>
</tr>
<tr>
<td>Fire Alarm Pull Stations</td>
<td>3 feet - 10 inches</td>
</tr>
<tr>
<td>Receptacles</td>
<td>1 foot - 6 inches</td>
</tr>
<tr>
<td>Clock and Clock Outlets</td>
<td>7 feet - 6 inches</td>
</tr>
<tr>
<td>Fire Alarm Audible or Audible/Visual</td>
<td>6 feet - 8 inches to bottom of device</td>
</tr>
<tr>
<td>Devices</td>
<td></td>
</tr>
<tr>
<td>Combination motor starters</td>
<td>5 feet - 0 inches</td>
</tr>
<tr>
<td>Control stations</td>
<td>3 feet - 10 inches</td>
</tr>
<tr>
<td>Manual starters</td>
<td>5 feet - 0 inches</td>
</tr>
<tr>
<td>Thermostats in office</td>
<td>3 feet - 10 inches</td>
</tr>
<tr>
<td>Telephone/data outlets</td>
<td>1 foot - 6 inches</td>
</tr>
<tr>
<td>Circuit protective devices</td>
<td>6 feet - 6 inches to top of enclosure</td>
</tr>
</tbody>
</table>

E. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of required access doors in accordance with other sections of the specifications.

F. Locate and install to maintain headroom and to present a neat appearance.

3.2 OUTLET BOX INSTALLATION

A. Provide knockout closures for unused openings.

END OF SECTION 26 05 34
SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Provide labor, materials, services, equipment and appliances required in conjunction with the installation of wiring devices as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Manufacturer’s Data: Submit copies of manufacturer’s specifications for products to be used. Manufacturer’s catalog numbers listed are used to set the standard.

B. Acceptable Manufacturers: Hubbell, Leviton and Pass & Seymour. All wiring devices for the project shall be of one manufacturer.

PART 2 - PRODUCTS

2.1 SWITCHES

A. Three way, 20 amp
   1. Hubbell HBL1223; Leviton 1223-2; Pass & Seymour PS20AC3

2.2 RECEPTACLES

A. Ground fault circuit interrupting (GFCI), tamper resistant, type receptacle, equivalent to Hubbell GFR5262SG. Provide weather resistant GFCI receptacle for exterior locations. Do not use feed-through feature. Install GFCI device at each location.

B. Use 20-amp receptacle when only one receptacle is on a circuit by itself, or as otherwise noted.

2.3 WIRING DEVICES

A. All wiring devices shall be white unless otherwise noted.

2.4 COVERPLATES

A. Exterior - extra heavy duty, die cast aluminum, weatherproof while-in-use cover equivalent to Hubbell WP26E series.
PART 3 - EXECUTION

3.1 COORDINATION

A. Determine from dimensions shown in the Contract Documents and by actual measurements on the site the exact location of each wiring device. The wiring device locations shall be modified from those shown on the plans to accommodate changes in door swings, space changes or to clear other interferences that arise, or from other job modifications. Make such modifications at no cost to the Owner as a matter of job coordination. Notify the Engineer of discrepancies before proceeding with the installation of the work.

3.2 INSTALLATION OF WIRING DEVICES

A. Install receptacles and switches only in electrical boxes that are clean, free from excess building materials, debris, etc.

3.3 TESTING

A. Test wiring devices to insure electrical continuity of grounding then energize circuit to demonstrate compliance with requirements.

END OF SECTION 26 27 26
PART 1 - GENERAL

1.1 SUMMARY

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Furnish all labor, materials, services, equipment appliances required in conjunction with installation of overcurrent protective devices as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Manufacturer's Data: Submit copies of manufacturer's specifications for products to be used.

PART 2 - PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKERS

A. Molded Case Circuit Breaker Characteristics – General

1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.

3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing International I/O markings.

4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.

5. Circuit breakers shall be equipped with UL Listed electrical accessories as noted in these specifications. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.

6. All circuit breakers shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.

7. Circuit breakers shall be equipped with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs (except Square D type Q2, Q2H and Q2-H or equivalent). Lug body shall be bolted in place; snap in design not acceptable. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the National Electrical Code. Provide lugs as required to accept feeder conductor sizes and quantities as shown on drawings.

8. All circuit breakers shall be capable of accepting bus connections.
9. Circuit breakers shall be fully rated and capable of interrupting the fault current available to them. Series connected ratings with upstream devices is not acceptable to meet this requirement.

B. Thermal-Magnetic Circuit Breakers

1. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.

2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40°C ambient temperature.

3. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker except type Square D, Q2, Q2H and Q2-H or equivalent.

4. Standard two- and three-pole circuit breakers up to 250 amperes at 600 VAC shall be UL Listed as HACR type.

C. Electronic Trip Circuit Breakers With Standard Function Trip System

1. Circuit breaker trip system shall be a microprocessor-based true rms sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the drawings.

2. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.

3. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and adjustment positions shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 80% of their ampere rating continuously.

4. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.

   - Long Time Pickup
   - Long Time Delay
   - Short Time Pickup
   - Short Time Delay (I²t IN only)
   - Instantaneous Pickup
   - Ground Fault Pickup
   - Ground Fault Delay (I²t OUT only)

5. A means to seal the trip unit adjustments in accordance with NEC Section 240-6(b) shall be provided.

6. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.

7. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in true RMS with 2% accuracy.

8. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.

9. The trip system shall include a Long Time memory circuit to sum the time increments of intermittent overcurrent conditions above the pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
10. Circuit breaker trip system shall be equipped with an externally accessible test port for use with a Universal Test Set. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.

D. Equipment Ground Fault Protection (Electronic Trip Circuit Breakers)

1. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.

2. A separate neutral current transformer shall be provided for three-phase four-wire systems.

3. Ground fault sensing system shall be residual sensing type.

4. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.

5. A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95(c) shall be provided.

6. Local visual trip indication for a ground fault trip occurrence shall be provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overcurrent devices in accordance with the National Electrical Code. Coordinate the work under this section with the work under other divisions of the specifications.

B. Unless otherwise indicated, protective devices shall be mounted with top of cabinet or enclosure 6 ft. 6 in. above finished floor, properly aligned, and adequately supported independently of the connecting raceways. All steel shapes, etc., necessary for the support of the equipment shall be furnished and installed where the building structure is not suitable for mounting the equipment directly thereon.

C. Circuit breaker pick-up level and time delay settings shall be adjusted to values indicated on the arc flash study.

END OF SECTION 26 28 16
SECTION 26 32 13

DIESEL GENERATOR SYSTEM

GENERAL

1.1 RELATED DOCUMENTS

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

B. SUMMARY

1. This Section includes installation of an Owner furnished packaged engine-generator set suitable for use in mission critical applications. Engine generators will be used as the Standby power source for the system but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.

C. DEFINITIONS

1. Emergency Standby Power (ESP): Per ISO 8528: The maximum power available during a variable electrical power sequence, under the stated operating conditions, for which a generating set is capable of delivering in the event of a utility power outage or under test conditions for up to 200 hours of operation per year with the maintenance intervals and procedures being carried out as prescribed by the manufacturers. The permissible average power output (Ppp) over 24 hours of operation shall not exceed 70 percent of the ESP unless otherwise agreed by the RIC engine manufacturer.

2. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

D. QUALITY ASSURANCE

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

2. Comply with NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).

3. Comply with NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).

4. Comply with NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.

5. Comply with UL 2200.

E. PROJECT CONDITIONS

1. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   a. Ambient Temperature: 0.0 deg C (32.0 deg F) to 40.0 deg C (104.0 deg F).
   b. Relative Humidity: 0 to 95 percent.
   c. Altitude: Sea level
1.2 PRODUCTS (INFORMATION ONLY)

A. MANUFACTURER
   1. Kohler

B. ENGINE-GENERATOR SET
   1. Capacities and Characteristics:
      a. Power Output Ratings: Electrical output power rating for Standby operation at 100.0 kW, at 80 percent lagging power factor, 120/208, Series Wye, Three phase, 4 -wire, 60 hertz.

C. ENGINE
   1. Fuel: ASTM D975 #2 Diesel Fuel
   2. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
      a. Designed for operation on a single 120 VAC, Single phase, 60Hz power connection.

D. OUTPUT CIRCUIT BREAKER
   1. Provide one 400 amp, 3 pole, 80% rated output circuit breaker with LSI (long-time, short-time and instantaneous) functions.

E. FUEL OIL STORAGE
   1. Comply with NFPA 30 and NFPA 110.
   2. UL 142 listed, sub-base fuel tank with the following features:
      a. Minimum 125% secondary containment capacity.
      b. Emergency pressure relief vent terminated a minimum of 12 feet above the bottom of the tank.
      c. Normal atmospheric vent terminated a minimum of 12 feet above the bottom of the tank.
      d. Raised fuel fill with lockable sealed cap.
      e. Lifting eyes to allow lifting of fuel tank with generator set installed.
      f. Secondary containment basin switch to activate a warning in the event of a primary tank leak.
      g. Low fuel level switch to activate a warning when 40% of the fuel is left in the tank.
      h. Electric fuel level sender with gauge to allow remote electrical monitoring of the fuel tank level.
      i. Spill containment box for fuel fill, five gallon capacity with integral drain to tank and lockable cap.
      j. Overfill prevention valve to shut off fuel flow during filling at approximately 95% full including fill down tube terminating within 6 inches of the fuel tank bottom.
      k. High fuel switch to activate at 90% of full fuel level.
      l. High fuel alarm panel to provide audible and visual alarm when fuel level reaches 90% of full fuel level.

F. CONTROL AND MONITORING
1. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.

2. Remote Alarm Annunciator: Comply with NFPA 110. A LED annunciator labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.

3. Remote Emergency-Stop Switch: Surface; wall mounted NEMA 3R enclosure, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

G. OUTDOOR GENERATOR-SET ENCLOSURE

1. Description: Weatherproof, sound attenuated, steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.

2. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
   a. Louvers: Fixed-engine, cooling-air inlet and vertical discharge.

3. Site Provisions:
   a. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank shall be designed to be lifted into place as a single unit, using spreader bars.

1.3 EXECUTION

A. INSTALLATION

1. Depending upon the generator's delivery date to the site the Contractor shall either:
   a. Provide equipment to off load the generator from the manufacturer's delivery truck and place the generator on its equipment pad or...
   b. Provide equipment to relocate the generator from the temporary location in the parking lot south of the project site and place the generator on its equipment pad.

2. Comply with packaged engine-generator manufacturers’ written installation, application, and alignment instructions and with NFPA 110.

3. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

4. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

5. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer’s instructions.

6. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

7. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be
thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

8. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer’s recommended practice.

B. ON-SITE ACCEPTANCE TEST

1. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer and Owner shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:
   a. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
   b. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
   c. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

2. Fuel tank shall be filled at the end of all testing.

C. TRAINING

1. The Owner’s purchase of this equipment included supplier training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be arranged by the Contractor and coordinated with the the Owner's representatives.

D. FIELD QUALITY CONTROL

1. Manufacturer's Field Service: The Owner's purchase of this equipment included a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing after equipment has been installed.

END OF SECTION 26 32 13
SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes installation of an Owner furnished automatic transfer switch rated 600 amps, 208 V.

1.3 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify (Engineer/Construction Manager/Owner) no fewer than (insert appropriate number) days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without (Engineer/Construction Manager/Owner’s) written permission.

3. Do not energize any new service or distribution equipment without notification and permission of the (Engineer/Construction Manager/Owner).

PART 2 - PRODUCTS (INFORMATION ONLY)

2.1 MANUFACTURERS

A. Kohler

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. 600 amp, 3 pole, open transition, automatic transfer switch.

B. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.

C. Enclosures: Weatherproof, NEMA 3R, enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Depending upon the transfer switch's delivery date to the site the Contractor shall either:
1. Provide equipment to off load the switch from the manufacturer’s delivery truck and then install it or...

2. Provide equipment to relocate the switch from the temporary location in the parking lot south of the project site and then install it.

B. Wall Mounted Switch: Anchor to wall/ground by bolting.

C. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. The Owner’s purchase of this equipment included the following services for the Owner Furnished, Contractor installed equipment and shall be arranged with the manufacturer by the Contractor:

1. Manufacturer’s Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.

2. Manufacturer’s representative shall perform tests and inspections and prepare test reports.

3. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
   a. Perform recommended installation tests as recommended in manufacturer’s installation and service manuals.
   b. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
      1) Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      2) Verify time-delay settings.
      3) Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
B. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of the switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. The Owner's purchase of this equipment included the following services for this Owner Furnished, Contractor installed equipment and shall be arranged with the manufacturer by the Contractor:

1. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
   a. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, and emergency operation procedures.
   b. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

END OF SECTION 26 36 23
SECTION 26 51 13

LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Furnish all labor, materials, services, equipment and appliances required in conjunction with the installation of a lighting system as indicated in the Contract Documents.

1.2 SUBMITTALS

A. Manufacturer’s Data: Submit copies of fixture, ballast and lamp manufacturer’s specifications for products used. Identify the total input watts including ballast losses for each fixture type.

B. Submit lighting facts documentation for all LED fixtures.

PART 2 - PRODUCTS

2.1 MATERIALS


B. Where fixtures are subject to moisture, provide damp location (DL) or wet location (WL) label on fixtures as required for the location.

2.2 LED FIXTURES

A. Shall be tested for adherence to IESNA LM79 standards for lumen output and depreciation.

B. Shall be tested to IESNA LM80 standards and shall be rated to deliver LM80 performance for 50,000 hours.

C. Shall be DLC (DesignLight Consortium) certified.

D. Shall carry a 5 year all inclusive component warranty for defects.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide lighting fixtures as specified and scheduled in the Contract Documents. Provide in accordance with the type designation shown in the Contract Documents. If a type designation is omitted, verify fixture selection with Engineer prior to installation.
B. Immediately before final inspection, clean all fixtures, inside and out, including plastics and glassware, adjust all trim to properly fit adjacent surface, replace broken or damaged parts. Lamp and test all fixtures for electrical as well as mechanical operation.

END OF SECTION 26 51 13
EXTERIOR MATERIAL SCHEDULE

1.1 MATERIALS

a. BRICK: ASTM C 652, TYPE HBS, GRADE SW
b. MATCH EXISTING MASONRY COURSING, BONDING, COLOR, AND TEXTURE

c. STEEL TUBE RAILS: 3 BY 3 INCHES (76 BY 76 mm)
d. INFILL: CUSTOM DESIGN AS INDICATED ON DRAWINGS

e. WEEP HOLES: CELLULAR PLASTIC
f. REINFORCING BAR POSITIONERS

g. REINFORCING BAR POSITIONERS

1.2 INSTALLATION

a. COPINGS: FORMED ALUMINUM, 0.040 INCH THICKNESS
b. MASTER PAINTERS INSTITUTE (MPI)-LISTED PRODUCTS

c. STEEL TUBE RAILS: 3 BY 3 INCHES (76 BY 76 mm)
d. INFILL: CUSTOM DESIGN AS INDICATED ON DRAWINGS

e. BAND SAW COMPARE MATERIALS - MATCH EXISTING ADJACENT BLDG.
f. BAND SAW COMPARE MATERIALS - MATCH EXISTING ADJACENT BLDG.

g. COPINGS: FORMED ALUMINUM, 0.040 INCH THICKNESS
h. COPINGS: SPRI ES-1 TESTED

1.3 INSTALLATION

a. COPINGS: FORMED ALUMINUM, 0.040 INCH THICKNESS
b. MATCH EXISTING ADJACENT BLDG.

c. MATCH EXISTING ADJACENT BLDG.
d. MATCH EXISTING ADJACENT BLDG.

1.4 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.

1.5 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.

1.6 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.

1.7 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.

1.8 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.

1.9 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.

1.10 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.

1.11 WEATHER RESISTANCE

a. MATCH EXISTING ADJACENT BLDG.
600A SERVICE METER
600A SERVICE DISCONNECT
AUTOMATIC TRANSFER SWITCH "ATS"
EXISTING CONDENSING UNITS
EXISTING 208/120V PANEL "AC2"
MOTORIZED GATE TRACK
SCREEN WALL
EXISTING PANEL "DP"
ELECTRICAL ROOM
GENERATOR WORKING CLEARANCE
EXISTING UNDERGROUND TELEPHONE UTILITY LINE
EXISTING UNDERGROUND ELECTRIC UTILITY LINE
GATE
EMERGENCY GENERATOR "EG"
CONNECT TO JACKET WATER HEATER & BATTERY CHARGER
4#12 IN 3/4"C. (ATS CONTROL WIRING)
WP1
WP1
1
2
3
5
WP
5
2
WP
2
WP
3P
REMOVE BONDING JUMPER BETWEEN NEUTRAL AND GROUND BUSES
E-101

cardigan 10mm 2 mm paper line.jpg 2018.03.11 10:32 AM E:\2018.000.000\2018.177.000 - N Patrol Station Generator\01 CAD\06 Elec\E1 - Generator Yard.dwg 24x36
NO. DESCRIPTION
DATE
DATE:
PROJECT NUMBER:
DRAWN BY:
CHECKED BY:
DESIGN BY:
SHEET:
TARRANT COUNTY NORTH PATROL STATION
EMERGENCY POWER SYSTEM
6651 LAKE WORTH BLVD. LAKE WORTH, TX 76135
2018.177.000
6300 Ridglea Place, Suite 700 Fort Worth, TX  76116
mail@bhbinc.com  • 817.338.1277  • bhbinc.com
TBPE Firm #44  •  TBPLS Firm #10011300
SCALE: 1/4" = 1'-0"
ENLARGED SITE PLAN - GENERATOR YARD
SCALE: 1/2" = 1'-0"
ELEVATION
NO SCALE
SINGLE LINE DIAGRAM
SERVICE GROUND DETAIL
GENERAL NOTES:
1. PROVIDE A PERMANENT NAMEPLATE ON THE FACE OF THE SERVICE ENTRANCE EQUIPMENT INDICATING THE MAXIMUM AVAILABLE FAULT CURRENT AND THE DATE THE FAULT CURRENT CALCULATION WAS PERFORMED.
2. PREPARE AN ARC FLASH CALCULATION BASED UPON ACTUAL CONDUCTOR LENGTHS AND DISTRIBUTION EQUIPMENT COMPONENTS INSTALLED FOR ALL NEW DISTRIBUTION EQUIPMENT, AIR CONDITIONING AND REFRIGERATION EQUIPMENT, ELEVATOR CONTROL PANELS, ADJUSTABLE SPEED DRIVES, MOTOR CONTROL CENTERS, INDUSTRIAL CONTROL PANELS, AUTOMATIC TRANSFER SWITCHES, AND OTHER EMERGENCY, LEGALLY REQUIRED STANDBY, OPTIONAL STANDBY AND CRITICAL OPERATIONS POWER SYSTEMS PRESENT AND INSTALLED AS A PART OF THIS PROJECT. APPLY WARNING LABELS TO THE FACE OF THE EQUIPMENT CABINET(S) INDICATING THE AVAILABLE FAULT CURRENT, DATE CALCULATED, AND HAZARD LEVEL POTENTIAL PRESENT AS REQUIRED BY NFPA 70E.

NOTES BY SYMBOL:
"G"  
1. CONNECT BATTERY CHARGER AND JACKET WATER HEATER TO SPACE AVAILABLE IN PANEL AC2.
2. CONNECT LIGHTING AND RECEPTACLE TO SPACE AVAILABLE IN PANEL AC2.
3. PROVIDE THREE 1P/20A CIRCUIT BREAKERS FOR NEW CIRCUITS.
4. INSTALL FIXTURE AT 8'-0" TO TOP OF HOUSING
5. INSTALL CONDUIT INSIDE BUILDING.
6. PROVIDE ELECTRONIC TRIP CIRCUIT BREAKER.

LIGHTING FIXTURE SCHEDULE

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>LUMENS</th>
<th>WATTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP1</td>
<td>LED PAR 64, ALUMINUM HOUSING WITH BLACK FINISH, EXTERIOR USE</td>
<td>75W</td>
<td>75W</td>
</tr>
</tbody>
</table>

NOTES:
1. FORWARD PHASE, REAR CHORD IDENTIFIED AS PHASE AVAILABLE IN PANEL AL2
2. CONNECT FIXTURES AND RECEPTACLES TO SPACE AVAILABLE IN PANELS.
3. PROVIDE THREE 20A CIRCUIT BREAKERS FOR EACH UNIT
4. INSTALL CONDUIT INSIDE BUILDING
5. INSTALL CONCRETE-ENCASED ELECTRODE
EXISTING UNDERGROUND ELECTRIC UTILITY LINE
EXISTING Pad Mounted Utility Transformer
EXISTING TREE TO BE REMOVED. REFER TO CIVIL DRAWINGS
REMOTE GENERATOR ANNUNCIATOR.
VERIFY LOCATION WITH OWNER

ELECTRICAL SITE PLAN

TARRANT COUNTY NORTH PATROL STATION
EMERGENCY POWER SYSTEM
6651 LAKE WORTH BLVD. LAKE WORTH, TX 76135

SCALE: 1" = 20'-0"

ELECTRICAL SYMBOL LIST

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Electrical Site Plan</td>
</tr>
<tr>
<td>ER</td>
<td>Indicates existing device or equipment to be removed</td>
</tr>
<tr>
<td>NF</td>
<td>Non-fuse</td>
</tr>
<tr>
<td>MC</td>
<td>Mechanical contractor</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical contractor</td>
</tr>
<tr>
<td>GFI</td>
<td>Ground fault circuit interrupting</td>
</tr>
<tr>
<td>WP</td>
<td>Weatherproof</td>
</tr>
</tbody>
</table>

NOTES:
1. WHEN NO HASH MARKS ARE SHOWN, PROVIDE ONE PHASE & ONE NEUTRAL CONDUCTOR.
2. SOME OF THESE SYMBOLS AND ABBREVIATIONS MAY NOT APPEAR ON THE DRAWINGS.