

ELECTRICAL SPECIFICATIONS

A. DESCRIPTION OF WORK

1. The electrical contractor shall provide all labor, material, equipment, and tools necessary for demolition and removal of existing and the complete installation of the new electrical work, ready to use, as shown on the drawings or specified herein. Work shall include, but not be limited to the following:
 - i. Furnish and install new conduit and wire.
 - ii. Furnish and install new fuses, circuit breakers, panelboards etc.
 - iii. Install new lighting fixtures as indicated.
 - iv. Furnish & install new light fixtures as indicated.
 - v. Furnish & install new communications devices.
2. The exact location of all items shown on the electrical drawings is dependent upon field conditions. Review the plans and specifications for all parts and details with other trades of this project for pertinent data on sizes, locations, wiring, etc., as required for a complete electrical installation.
3. The electrical contractor shall not attach to, cover up, or finish against any defective work, or install in a manner which will prevent proper installation of the work of other trades.
4. The electrical contractor shall warrant all work & material indicated on these electrical drawings for a period of 1 year from the date of final acceptance. Warranty shall include any additional labor or material required to repair or replace defective item.

B. CODES, PERMITS AND FEES

1. All work included by the drawings and specifications, together with all material (or equipment) furnished, shall comply with the latest published codes and standards listed insofar as such shall apply. All electrical items shall be new and UL labeled & listed.
2. The contractor shall secure all permits and pay all fees that are required by the applicable local and state codes.
3. Perform all work in accordance with the latest edition of applicable codes including, but not necessarily limited to those listed below:
 - i. The National Electrical Code - sometimes referred to herein as the "NEC" - (NFPA-70)
 - ii. National Electrical Safety Code (ANSI-C2)
 - iii. All applicable state and local codes.
 - iv. Applicable provisions of the Occupational Safety and Health Act.

C. GENERAL REQUIREMENTS FOR SUBMITTING & BID

1. The drawings represent the design for the listed manufacturers' requirements. If any substitutions are accepted by the engineer, this contractor shall be responsible for all necessary modifications, including cost, to the electrical system required because of the substituted equipment or material.
2. The electrical, mechanical, architectural, structural, and all other drawings as well as the specifications and addendums are part of the contract documents. Any electrical requirements called for on other trades contract documents shall be included in the electrical bid.
3. Co-ordination & knowledge of local standards of utility companies is required to submit a bid. Any required deviation from the design by local utility shall be brought to the attention of the Architect or Engineer prior to submitting bid. No extra compensation will be awarded for adjustments to the design that are required by the local utility company.
4. The contractor shall visit the job site and become familiar with all existing conditions. Submission of a bid assumes the contractor has reviewed or accepts all field Conditions and existing conditions. No additional compensations shall be allowed for labor or material because of ignorance of these conditions before or after bid submission.
5. Discrepancies between the drawings or between the drawings and actual field conditions shall be brought to the attention of the architect and the engineer prior to submitting the bid. The more comprehensive and most expensive scope of work shall be considered for the electrical bid unless written clarification is provided by the architect and the engineer prior to submitting the bid.

D. RACEWAYS

1. EMT conduit shall be used in all interior locations which call for conduit unless noted otherwise. Conduits routed thru areas of significant temperature differences shall be provided with seal-off fittings to minimize condensation. Conduits penetrating fire walls shall be firestopped per NEC & Underwriters Laboratories.
2. Rigid PVC Schedule 40 shall be used for all exterior or below slab conduit runs.
3. Heavy wall rigid steel conduit shall be used in underground applications. Provide 2 coats of rust inhibiting paint for exterior runs. Paint shall match surface conduit is attached to.
4. MC cable may be used for all branch circuits located above ceilings or in wall cavities or exposed & attached to supports of suspended light fixtures as allowed by the National Electrical Code & the authority having jurisdiction. Cable shall be installed in a neat professional manner adhering to industry standards.
5. When power or control conductors are installed in a raceway, a green equipment grounding conductor shall be included in each raceway system and shall be sized as shown on the drawings or if not noted on the drawings, then in accordance with Table 250-95 of the NEC, or as indicated on the drawings if green insulation is not available, the grounding conductor shall be bare and clearly and permanently marked at all tap and terminating points by green "scootch" marking tape, code markers, or other approved means.
6. All conduit shall be securely fastened in full accordance and as directed by the latest edition of the National Electrical Code. In addition to the NEC requirements, conduit hangers, supports, or fastenings shall be provided at each elbow and at the end (within 6") of each straight run terminating at a box or cabinet.
7. Conduits or boxes may not be supported by ceiling suspension wires or other ceiling supporting hardware.
8. Horizontal and vertical conduit runs may be supported by one-hole malleable straps, clamp bolts, or other approved devices with suitable bolts, expansion shields (where needed) or beam type clamps for mounting to building structure or special brackets.
9. The use of perforated iron for supporting conduits will not be permitted.
10. Conduit runs between outlets shall contain not more than the equivalent of three (3) quarter bends. Provide junction and/or pull boxes where shown on the drawings or as required, whether shown on the drawings or not. Pull boxes shall be approved for use in the area where they are to be installed. Pull boxes or junction boxes shall be provided in accordance with the following schedule:
 - i. Straight runs - not over one hundred (100) feet apart.
 - ii. One (1) 90 degree bend - not over seventy five (75) feet apart.
 - iii. Two (2) or more 90 degree bends - not over fifty (50) feet apart.
11. In Class I and Class II hazard areas, as designated on the drawings, explosion-proof flexible metal conduit shall be used for all final conduit terminations at motors and at all other devices subject to vibration or movement. This shall include all pendant mounted lighting fixtures and conduit runs at building expansion joints in Class I and Class II hazard areas. Electrical ground continuity shall be provided as noted above.
12. Telephone and data (including other special communication systems such as cable TV) shall be installed in a minimum of 3/4" in size unless noted otherwise, and shall run continuously from outlet to outlet. Conduits shall be terminated in a terminal board, or shall be stubbed into the ceiling space (6" above the ceiling) and terminated in a plastic bushing. Bond conduit stub with a #10 bare copper conductor to the nearest electrical ground or to a continuous metal conduit body. Refer to plans for specific details about the routing of the conduit in empty riser shafts and rooms with a #10 gaw pull wire.
13. Cables installed in plenums without conduit shall be UL classified for low smoke and low toxicity properties with "FEP" Teflon or Halar insulation suitable for plenum application.
14. Conduits below grade shall be installed in conformance with:
 - i. Provide all necessary trenching, backfill & repair of trench material to match.
 - ii. The bottom of the trench shall be trenched, compacted, or thoroughly compacted fill. The contractor shall be responsible for the completion of the trench, free of projecting rocks or other foreign matter. Where muck or unstable soil is encountered, the bottom of the trench it shall be excavated to a depth of at least 12in below the bottom of the trench and filled with pea gravel in the proper grade. Duct shall not be installed over loose, sandy, or silty soil. Sand sheets or bedding shall be provided where necessary to protect the work or adjacent property. Where trenching and pea gravel shall be installed by the electrical contractor at no additional expense to the owner. The trench shall be a minimum of 3 inches of compacted sand below conduits and 12" depth of pea gravel. Clear trench shall be installed and compacted to 6" below final grade or as shown on the architectural specifications. Final grade patch shall be by E.C.
 - iii. Joints shall be sealed with waterproof joint compound. Ducts shall be supported at least 3in above the trench bottom on level supports with spacing not exceed 5'. Before duct is placed, supports shall be aligned to grade, and placed in concrete to prevent movement when encasement is placed. Ducts shall be supported on level supports and spaced placed for nested ducts.
 - iv. All secondary power service underground ducts shall be encased with 3000 psi concrete. All underground ducts shall be 4" in diameter schedule 40 rigid non-metallic (P.V.C.) ducts with ground wires, unless specifically indicated otherwise on the drawings. concrete encasement shall be in accordance with the applicable provisions of the general trades portion of the specifications.
 - v. Encasement shall be continuous monolithic pour providing a minimum of 3" completely around the ducts. Concrete shall not be poured directly on top of the ducts, but shall be poured from the sides and allowed to flow over the ducts.
 - vi. Bell ends shall be installed at all duct terminations or as required by the power company. Fittings, couplings and other accessories, as recommended by the manufacturer, shall be provided and installed.
 - vii. Ducts shall be cleaned by rodding and flushing. It shall be the contractor's responsibility to assure a full bore opening throughout the duct system.

E. FITTINGS FOR CONDUIT

1. Couplings and connectors for EMT: Die cast zinc, steel, or aluminum compression type. Set screw type will also be permitted. Approved manufacturers: Thomas & Betts, Steel City, O-Z Gedney.
2. Fittings for rigid plastic conduit: Polyvinyl chloride, joints solvent welded in field, providing continuity of mechanical strength and water tightness. Fittings and cement shall be produced by the same manufacturer as the conduit.
3. Fittings for rigid conduit: Cast or malleable iron boxes, zinc or cadmium plated, with full threaded hubs, screw covers and gaskets when located in areas requiring gaskets. Approved manufacturers: Crouse-Hinds, Pyle-National, Appleton.

4. Couplings and connectors for flexible steel conduit: Malleable iron or steel, zinc or cadmium plated and shall fasten to the conduit by a clamping action around the periphery. Connectors for "fluid-tight" flexible conduit shall be approved for the purpose and maintain the liquid-tight of the installation. Approved manufacturers: Thomas & Betts, Steel City, O-Z Gedney.
5. Bushings: Grounding type, with insulating plastic insert, malleable iron, zinc or cadmium plated, for steel conduit and aluminum alloy for aluminum conduit. Install grounding type bushings as required in the grounding section of this specification.
6. Fittings for conduits: All conduit runs at building expansion joints shall be provided with O-Z type expansion fittings. Sizes shall be as dictated by the conduit size. A bonding jumper shall be securely connected to each conduit. Exterior exposed runs of PVC conduit shall be provided with expansion fittings at intervals not exceeding manufacturers recommendations.
7. Outlet, Pull, Terminal and Junction Boxes in Classified (Hazardous) Areas: Cast boxes shall be copper-free aluminum with integral hubs or box wall thickness sufficient for a minimum of five full tapered threads. Covers shall be screw-on bolt on through 12" x 12" boxes and hinged removable bolt-on covers for larger boxes. Boxes other than outlet boxes shall be equipped with a breather drain and equipment grounding lug and specifications, as applicable, for installation in the certified hazardous areas which are designated on the drawings. Approved Manufacturers: Crouse-Hinds, Pyle-National, Appleton, Adlert, O-Z Gedney, or Killark.
8. Conduit Fittings in Classified (Hazardous) Areas: Conduit seals and/or drain seals shall be installed in strict accordance with the NEC in classified (Hazardous) areas designated on the drawings, with special attention to the following:
 - i. Entering or cross-connecting enclosures containing arcing or high temperature devices.
 - ii. Two-inch conduit and larger entering any enclosure.
 - iii. Passing from Division 1 to Division 2, from Division 2 to non-classified areas, with or without a barrier.
 - iv. Multi-conductor and shielded cables.

F. ELECTRICAL SUPPORTING DEVICES

1. Supports shall be suitable for the device or equipment to be mounted. All supports shall present a neat appearance, and shall be installed in such a way that they do not detract from the appearance of the space. Supports shall have adequate strength and shall be installed so as to properly support the device or equipment mounted on them.
2. Electrical supports shall be attached to the structure by one of the following methods:
 - i. Wood - wood screws.
 - ii. Concrete - expansion bolts or cast in place anchors.
 - iii. Structural steel - approved brackets or machine bolts.

G. CONDUCTORS

1. Conductors shall be new, 800 volt, 90c, type XHHW, THHN or THWN insulation, stranded copper for feeders rated above 60 amps. Compact aluminum may be used for feeders of 150amps or higher. Minimum size shall be #12 AWG for runs of less than 100 feet total circuit length (out and back for single phase circuits and out only for three phase circuits with no neutral). Use #10 AWG for circuits longer than 100 feet. Other sizes shall be as noted. Control wiring may be #14 AWG. All 120 volt and 277 volt circuits shall have a dedicated neutral conductor. The neutral conductor shall be the same size as the phase conductor. All conductors shall be copper. The conductor sizes for feeders and branch circuits are designed to maintain a voltage drop of less than 5 percent. (2 percent for feeders and 3 percent for branch circuits)
2. Compression type lugs and connectors shall be used for all terminations and splices. All terminations shall be permanently identified and numbered, using "sturdy" labels or other approved equal. Wire numbering shall be panelboard and circuit numbers. Also, all wiring which passes through junction or pull boxes shall be identified with appropriate numbers. When panelboard/circuit numbers are not appropriate for identification, the contractor shall assign a unique number and record this number on the construction set.

H. WIRING DEVICES

1. Provide wiring devices which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Device Color shall be white unless otherwise noted. Coverplate color shall match device color. Confirm color selection with architect before purchasing and installing.
2. Receptacles: Devices shall be specification grade, NEMA 5-20R configuration, Duplex type, Hubbell Cat No. CR362, single outlet type; Hubbell Cat No. CR361, GFCI duplex; Hubbell Cat No. CR GF362, Catalog numbers for Hubbell are shown for reference purposes and equivalent receptacles by other manufacturers as noted above are also approved. Receptacles shall comply with UL 498 and NEMA WD 1. Special receptacles not shown below shall be specification grade with Nema configuration as noted on the drawings.
3. Ground-fault interrupter (GFI or GFCI) receptacles as indicated above shall be designed for and installed in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 94.3.
4. Snap switches: Devices shall be specification grade, quiet type, 20 A 120/277V, single pole Hubbell Cat No. CS1221, two pole Hubbell Cat No. CS1222, three pole, Hubbell Cat No. CS1223, and four pole, Hubbell Cat No. CS1224. Catalog numbers for Hubbell are shown for reference purposes and equivalent receptacles by other manufacturers as noted above are also approved. Devices shall be specification grade, quiet type ac switches, and shall comply with UL 20 and NEMA WD1.
5. Approved manufacturers for wiring devices: Hubbell P & S.
6. Dimmer switches: solid state dimmer switches conforming to NEMA WD 1, mounted in outlet boxes or incandescent fixtures; switch poles and wattage as indicated, 120 V, 60-Hz, continuously adjustable, single-pole, with on-off switch. Equip with electromagnetic filter to eliminate noise, RF and interference. Dimmers to be Lutron "Nova T-Star" series for dimmers rated up to 1500 watts and "Nova" series for 2000 watt dimmers. Lighting switches shown adjacent to dimmers shall be Lutron "Nova T-Star" or standard "Nova" style to match dimmers and shall be provided with a single piece coverplate. Color shall be specified by architect.

I. WIRING DEVICES ACCESSORIES

- i. Wall plates: Single and combination, of types, sizes, and with on-off switches as indicated. Provide plates and attachment screws which mate and match with wiring devices as specified. Provide wall plates with engraved legends where indicated. Provide smooth finish, non-splintering, finished areas, and galvanized steel plates for unfinished areas.
- ii. Floor service outlets: Modular, above-floor service outlets and fittings of types and ratings indicated. Construct of die cast aluminum with floor color finish, after floor color finish writing methods indicated. Provide 20 Amp, 125 Volt, 1-pole duplex receptacles, NEMA configuration 5-20R where indicated. Provide 3/4 inch or 1 inch NPT, 1/2 inch long, locking nipple for installation where compatible with wiring method.

J. LIGHTING

1. Lighting Fixtures: see drawings for manufacturers catalog numbers.
2. Indoor installation
 - i. The Contractor shall refer to the Architectural drawings for ceiling type, construction and details of mounting. Adjust fixture trim ring as required for correct mounting in ceiling fixture is to be installed. All fixtures shall be supported per NEC Article 410.
 - ii. Suspended ceiling systems shall be supported for fixture installation as noted above, and as a minimum condition, as noted in ANSI/ASTM C826-76, par. 2.7, CEILING FIXTURES.
 - iii. Install fixtures in accordance with the Architectural Reflected Ceiling Plans. Where substantial differences may occur between the Reflected Ceiling Plans and the Electrical Plans, inform the Architect/Engineer for resolution of the discrepancy.
 - iv. The Contractor shall coordinate fixture construction details with ceiling system in which they are installed, i.e.: support system dimensions, flanges where required, acoustical tile or pan pattern, etc. v. Boxes of ceiling fixtures shall be installed accurately as to line and level. Fixtures shall be securely mounted so that they will not be distorted by handling incidental to normal maintenance.
 - vi. Surface type fluorescent lighting fixtures mounted on acoustical ceiling must be coordinated with the Architectural drawings in order that a main "T" runner shall be placed in the center of each fixture and/or each row of fixtures. Main "T" runner shall be of at least the same length as the lighting fixture and shall be supported to carry at least twice the weight of the lighting fixture.
 - vii. All fixtures shall be securely supported with approved hangers. Where fixtures will be installed in suspended ceilings, any Code-required additional ceiling supports as approved by the Architect, shall be provided by this Contractor.
 - viii. Provide supports for all lighting fixtures as detailed on the Drawings, as specified, or as required by the fixture specified. Fixtures installed in unfinished areas (areas including but not necessarily limited to warehouses, factory areas, manufacturing areas, office spaces without lay-in ceilings, and spaces above lay-in ceilings) shall not be fastened directly to the structure. In these cases, unused type channel along with the appropriate fasteners and clips shall be used to support the fixtures.
3. Fixtures shall not hang directly from conduit boxes unless the boxes have been specifically designed for such purposes. These boxes shall be supported independent of the conduit system and shall not rely upon the conduit for support.

- x. Lay-in troffers in suspended ceilings and surface type fixtures mounted to suspended ceilings shall be secured mechanically by screws, rivets, clips, etc., as per Article 410, NEC. Additionally, lay-in fixtures shall also be supported by two independent support devices diagonally opposite corners of the fixture to the overhead structure. Surface mount fixtures shall be additionally supported by means of at least two clips for each fixture which surround the T-bar and are tied to the overhead structure with a separate wire. The surface fixtures shall be secured to these clips.
- xi. Plaster frames shall be furnished for each recessed fixture installed in plaster ceilings and walls.
- xii. Pendant mounted fixtures shall utilize pipe stems to mount fixtures at elevations as noted on the drawings. Chains or cords will not be accepted. Wherever the mounting surface slopes, fixtures shall be provided with universal-type fixture hangers to allow the fixture to hang plumb.
- xiii. Fixtures shall be installed with due regard for beams, piping, ductwork, and other mechanical or plumbing equipment.
- xiv. Branch circuit conductors shall be run in fluorescent fixture wiring channels only as permitted by the N.E.C. The Contractor shall be responsible for providing all necessary boxes and conduit for an approved installation.
- xv. Where a modular wiring system is installed, all ceiling mounted recessed fluorescent lighting fixtures shall be furnished with suitable receptacles to match the modular wiring system furnished and installed by this Contractor. Each fixture shall be equipped to permit either single or multiple fixture circuit wiring as is appropriate for the fixture type.
- xvi. When fixtures are installed in a fire proof ceiling, the fixture shall be UL listed to maintain the fire proof rating or the fixture shall be fire proofed by the electrical contractor using a U. L. accepted standard, see architectural drawings for ceiling ratings.
- xvii. At the time of final inspection all fixtures and equipment shall be complete with all required glassware and/or reflectors, clean and free of defects. Any glass-ware, or reflectors, etc., which have defects shall be replaced at the Contractor's expense before final acceptance.
- xviii. All lamps shall be in working order at the time of final acceptance of the work by the Owner and Architect/Engineer. This Contractor shall replace all defective lamps with new lamps until the work is finally accepted.
- xix. Low voltage lighting transformers should be protected by fuses. Fuse sizes shall be as recommended by the transformer manufacturer. Busman type HRB or Life/Life 155020, fuse holders are recommended.
- xx. Solid state transformers for low voltage lighting shall not be used for dimming applications unless the transformer and dimmer are a U. L. listed assembly specifically intended for the application.

3. Outdoor and Site Lighting Installation:

- i. Site lighting luminaires shall be as called for on the drawings.
- ii. Bases for site and roadway luminaires where required, shall be augered into the earth and concrete shall be poured into the augered hole without a sona tube below grade to allow the concrete to fill the natural crevices in the earth. Portion of base above grade shall be formed using a sonotube. Exposed portion of finished base shall be smoothed and voids filled with grout.
- iii. Bases shall have reinforcing steel as indicated on the contract drawings and shall be Class "A" or better.
- iv. Anchor bolts for poles shall be performed for the pole bolt circle at the factory.

J. Panelboards

1. Panelboards for 480/277, 208/120, or 240/120 panels shall be dead front type, conforming to NFPA standard PB-1-71 and UL 67, and consisting of three phase, three or four wire solid dielectric main lugs and overcurrent device as indicated, branch overcurrent devices as noted and approved by the Architect. Surface or flush mounted code group galvanized steel cabinet indicated. Enclosures to be Class "1" unless noted otherwise with primer and finish paint of the manufacturer's standard. All bus work shall be as specified.
- i. Standard enclosure shall be NEMA 1, unless noted otherwise, with primer and finish paint of the manufacturer's standard. Cabinets shall be oversized where necessary to accommodate the entrance of several large conduit and/or when necessary to avoid overcrowding of main cabinets. Panels mounted flush shall be not more than 22 inches deep and 5-3/4 inches deep at maximum. All cabinets shall be installed by the architect/engineer. All panels (branch and distribution type) within HAZARDOUS areas shall have time that contain hinged doors and shall be equipped with flush chrome plated information key locks and catches. Locks shall be keyed alike and shall be furnished to the owner.
- ii. Column-type enclosures shall be similar to the standard enclosure except panel shall be approximately 8-1/2 inches wide for mounting between building columns as indicated, and provided with external main and pullout with neutral bar when indicated.
- iii. Where space is indicated on the drawing, the panelboard with bus and all necessary hardware for the circuit shall be installed.
- iv. Where the air panelboard is indicated, the typewritten card shall be mounted inside each panel door. Information on the panelboards shall correspond to the circuit numbers as installed in the field.

Overcurrent Protective Devices

- i. General use circuit breakers for panelboards shall be bolt-on molded plastic case type, 1, 2, or 3 pole, quick-make, quick-break, with trip-free operating handle, position indicating and thermal-magnetic trip device. Function 2 and 3 pole breakers with common operating handle and common trip mechanism. All circuit breakers used for switching applications shall be UL listed type "SVC" for that application. All circuit breakers used for protection of motors, refrigeration equipment, or HVAC equipment shall be UL listed type "HACR" for that application.
- ii. Circuit breakers furnished with panelboards shall conform to the following interrupting ratings (symmetrical) in amperes unless otherwise noted:

| Voltage Rating | Trip Rating | No. of Poles | I.c. Amperes (Symmetrical) | Frame Size |
|----------------|----------------|--------------|----------------------------|------------|
| 120 | 15-100 ampere | 1 | 22,000 | 100 amp |
| 240 | 15-100 ampere | 2&3 | 22,000 | 100 amp |
| 240 | 125-225 ampere | 2&3 | 22,000 | 225 amp |
| 240 | 250-400 ampere | 2&3 | 42,000 | 400 amp |
| 277 | 15-100 ampere | 1 | 25,000 | 100 amp |
| 480 | 15-100 ampere | 2&3 | 25,000 | 100 amp |
| 480 | 125-225 ampere | 2&3 | 30,000 | 225 amp |
| 480 | 250-400 ampere | 2&3 | 42,000 | 400 amp |
| 480 | 400-800 ampere | 2&3 | 42,000 | 800 amp |

Ground fault circuit interrupters shall be similar to general use circuit breakers specified, 15-20 ampere, 1 or 2 pole with 5ma sensitivity. Furnish when indicated on drawing.

- i. Fuses over 600 ampere shall be Busman Hi-cap time delay type KRP-C, or Gould Swammitt A4BQ (600-2000 ampere) or Gould Swammitt A4BY (200-4000 ampere) 600-volt, UL Class I with minimum interrupting rating of 200,000 ampere rms symmetrical.
- ii. Fuses 600 ampere or below shall be Busman low-peak dual element LPN-RK (250 volt) or LPS-RK (600 volt) or Gould Swammitt Amp-trap type AX2 (250 volt) or ASK (600 volt) UL Class RK1 with minimum interrupting rating of 200,000 ampere rms symmetrical.
- iii. Provide spare circuit breakers installed in panelboards as indicated on the panel schedule as shown on the drawings. Provide 10% spare (minimum of 3) of each type and rating of fuses installed.

3. Safety Switches

- i. Provide fusible or non-fusible safety switches as indicated on the drawings. Switches shall be quick-make, quick-break, heavy duty visible blade type, horsepower and I squared rated. Use NEMA 12 enclosures in factory areas, NEMA 1 enclosures in other interior areas and NEMA 4X stainless steel type enclosures outside unless otherwise indicated on the drawings. Furnish three pole, single-throw switches unless otherwise specified, with current and voltage ratings as indicated.
- ii. Provide safety switches with an external operating handle interlocked with the cover door to prevent the door from being opened while the switch is in the "on" position except by operating an inconspicuous interlock releasing mechanism. Provide means for padlocking the operating handle in the "off" position. Equip switches with auxiliary contacts when indicated.
- iii. Fuse clips shall be reaction type for fuses specified (up to 600 ampere). Fuses clips for 601 ampere to 6000 ampere shall be suitable for UL Class I fuses.

4. Transformers

- i. Transformers shall be indoor dry, two winding, quiet type, well ventilated enclosure, conforming to NEMA standards, 220 degrees Celsius insulation for continuous operation in a 40 degree Celsius ambient temperature with a temperature rise not to exceed 80 degrees Celsius. Provide a minimum of two 2-1/2% FCAN and four 2-1/2% FCBN taps in the primary winding for transformers over 25 KVA and a minimum of two 2-1/2% FCBN taps for transformers 25 KVA and below. Transformers 25 KVA through 75 KVA shall be designed for floor or wall mounting.
- ii. Sound levels shall not exceed those established in ANSI standard C59 shown in the following table:

| KVA | dB level |
|-------|----------|
| 0-150 | 42 |
- iii. Furnish transformers having voltage, KVA ratings and connections as indicated on the drawings, and shall be supported to carry at least twice the weight of the lighting fixture.

- vi. Mount panelboard, safety switches, and similar equipment securely to walls or steel supports. Equipment mounted on the building perimeter foundation walls shall be shimmed at least 1/4 inch from the wall to permit back ventilation.
- vii. Provide supports for those mounted and wall mounted transformers. All transformers which are mounted above panelboards shall be mounted away from the wall by an amount equal to the depth of the panelboard. The width of the panelboard shall also be maintained clear behind the transformer.
- viii. Approved Manufacturers for Power Distribution Equipment:

| | |
|----------------------------|--------------------------|
| General Electric Company | Siemens |
| Culler Hammer/Westinghouse | Cleveland Switchboard Co |

K. RACEWAY AND GENERAL GROUNDING

1. The entire power, lighting system as well as building structure, mechanical & plumbing systems, fences & similar metal objects shall be permanently and effectively grounded in accordance with the minimum requirements of the National Electrical Code, or as specified herein, whichever is the more stringent.
2. Ground conductors shall be stranded, annealed copper with green insulation (insulation material as specified for general building use).
3. The entire power and lighting system shall be permanently and effectively grounded including panels, starter enclosures, motor frames, and other exposed, non-current carrying parts of the electrical equipment. The equipment ground conductor shall be separate from the neutral conductor and shall not be used to load current carrying conductor.
4. Any item covered by the preceding paragraph which is within six feet of grounded metal shall be directly interconnected with the grounded metal shall have a flexible bare copper cable connection no smaller than #6 AWG to the grounding system.
5. Where building type conductors are installed in a raceway, a green equipment ground conductor shall be included in each raceway system.
6. Lighting fixtures permanently connected to the conduit system shall be grounded in accordance with the minimum requirements of the National Electrical Code, or as specified herein, whichever is the more stringent.
7. Convenience outlets shall be self-grounding type and shall have a green equipment conductor installed from the ground lug on the outlet to the outlet box.
8. Motors shall be connected to the equipment ground bus with a conduit grounding bushing and with a bolted solderless lug connection to the metal frame.
9. The armor of interlocked armor cable, wiring channels, cable trays, and all metallic conduit including rigid, EMT, and flexible conduit, shall be connected at one end to the equipment ground conductor utilizing a conduit grounding bushing and nut and other enclosures (sizes above 5" x 5") shall utilize an equipment ground bushing and nut to connect to the equipment ground conductor to the enclosure.
10. Where an bonding conductor requires physical protection to maintain grounding integrity, it shall be run through a narrow slot or bonded to a continuous steel conduit at both ends.
11. The grounding electrode system shall consist of 2" diameter x 10' copper clad ground rods. Exterior ground rods shall be provided to 12" above finished grade & be provided with a 1/2" diameter x 30" long rigid PVC pipe with cap for inspection purposes; center ground rod in pipe & install pipe flush with grade. PVC pipe and cap shall be traffic rated. Interior ground rods shall be driven to 6" above grade & installed as close to wall as possible, all connections to ground rods shall be cadweld type.

EXECUTION

1. The contractor shall exercise due caution when working so as not to damage that portion of the electrical system that is to remain.
2. Positively no conduit or wire removed shall be reused in the new installation.
3. All circuits shall be identified on the panel directories by this contractor. At the completion of the job, the contractor shall provide each panelboard with a new typed directory with the existing loads as noted from the old directory and the new loads as installed. The directory shall be installed in a conspicuous place that contain hinged doors and shall be equipped with flush chrome plated information key locks and catches. Locks shall be keyed alike and shall be furnished to the owner.
4. The contractor shall keep on the job, one complete set of working drawings on which he shall record any deviations or changes from such contract drawings made during construction. Record drawings shall show changes in the following:
 - i. Size, type, capacity, etc. of any material, device or piece of equipment.
 - ii. Location of any device or piece of equipment.
 - iii. Location of any outlet or source in the building service system.
 - iv. Routing of any conduit, or other building electrical service.
 These drawings shall be kept clean and undamaged, and shall not be used for any other purpose than recording deviations from working drawings and exact locations of concealed work. After the job is completed, this set of drawings shall be delivered to the owner in good condition, as a permanent record of the installation as actually constructed.

M. CUTTING AND REPAIRING

1. All necessary cutting in walls, floors and other such work shall be neatly and carefully done and the work shall be repaired in an approved and workmanlike manner. No cutting into the structural parts of the building, which may impair its strength, shall be permitted without the prior written approval of the owner. If such cutting is permitted, the area shall be suitably reinforced to restore the structural integrity of the work to its designed value.
2. The electrical contractor shall be responsible for all damage to work of his or other trades, caused by his work or through the neglect of his workmen. All patching and repairing of damaged work shall be done by the trade which originally installed it, at the direction of the owner's representative, and the cost of such repair shall be paid by the electrical contractor.
3. Absolutely no cutting of wall, floor or other finished material or fastening of electrical components to the exposed surfaces of finished areas will be permitted.

N. TESTING

1. The testing work shall include all labor, materials, tools, and equipment to perform and record all necessary tests and adjustments of equipment, including Load Center Unit Substations, Motor Control Centers, High Voltage Cable, 900 Volt Wire and Cable, and Grounding, as indicated on the drawings, specified herein, or where necessary to verify performance requirements.
2. Inspection tests shall provide a visual inspection of electrical equipment for manufacturing, shipping or installation defects.
3. Acceptance tests shall show that the methods and materials used in the installation of equipment conform to applicable codes and standards, and the manufacturers installation instructions, and to determine that the equipment involved may be energized for operational tests.
4. Operational tests shall show the electrical equipment will perform the functions for which it was designed.
5. The services of a recognized independent testing laboratory shall be engaged to conduct all tests described herein with the exception of routine insulation resistance, continuity and rotation tests.
6. Perform all acceptance and operational tests in the presence of the Architect/Engineer. Notify the Architect/Engineer of time of test at least two (2) days prior to testing. Notify manufacturers of electrical equipment to permit their representatives to witness the test should they so request.
7. Submit test reports, including complete data and actual readings taken, for all equipment tested to the Architect/Engineer for approval after each test period. Do not energize any equipment for operating tests until data has been approved. Include copies of the final approved test reports upon completion of the work as part of the required operating and maintenance data to be furnished as specified in Division 1.
8. Give each power feeder and subfeeder cable (600 Volt Wire and Cable) a continuity and megger test. Insulate power cables to be megger tested by opening switches at each end of cable prior to testing. Apply megger tests, using a 1000 volt megger, between each conductor and ground with the other two conductors in the conduit grounded to the same ground. Minimum acceptable readings for disconnected cables shall be 1 (one) megohm. Cable must pass megger test to be reported as acceptable.
9. The following test and inspections shall be made on the grounding system:
 - i. Inspect ground conductors and connections for compliance with plans and specifications and for satisfactory workmanship. After installation of the grounding electrodes, provide ground resistance testing verify the interconnection of other grounding systems. Do not perform tests under unusually wet weather; tests should be performed during normal weather conditions.
 - ii. Reports shall include all resistance readings obtained, temperature, humidity and condition of the soil at the time of the tests.
10. Operational tests shall be performed on all electrical systems, and shall include, but not be limited to, building lighting system, panelboards, motor starters and control devices, alarm circuits and site lighting equipment.

O. GUARANTEE

1. Material, equipment and installation shall be guaranteed for a period of one year from the date of acceptance. Defects which appear during that time period shall be corrected by this contractor at his expense.



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REVISIONS

| NO. | DATE | TYPE |
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