SECTION 16010
GENERAL PROVISIONS - ELECTRICAL WORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope:
1. This section applies to all sections within Division 16 - Electrical.
2. Work includes completion of systems indicated on drawings and specifications. All systems shall be electrically connected into complete and fully operative systems, tested, adjusted and made ready for satisfactory use.
3. Visit the site and be familiar with existing conditions that affect the nature and scope of work, and difficulties that attend its execution.

B. Related work specified elsewhere:
1. Division Zero - Conditions of the Contract with particular emphasis on permits, fees inspections, notices, as-built drawings and other similar conditions.
2. Division One - General requirements with particular emphasis on submittals, quality control, temporary facilities, project closeout, and other similar requirements.

1.02 QUALITY ASSURANCE

A. Testing Agencies: Where testing agency standards are referenced, materials shall be certified by an independent testing laboratory as conforming. Execution or work using these materials shall conform to instruction, limitations and other conditions of these standards.

B. As a minimum, comply with local and National Electric Code.

C. Store plastic conduits to avoid warping and deterioration. Store flat surfaces, protected from rays of sun.

1.05 PAINTING

A. Comply with applicable sections of Division Nine. Equipment shall have factory standard finish.

B. Repair damaged or scratched factory finishes immediately. Lack of prompt attention to this may cause Architect to require the refinishing of the entire piece of equipment.

1.06 LABELING

A. Provide name plates on all listed equipment. Label shall be engraved black lamacoid with white letters.
   1. Switchgear, unit assembly and each device
   2. Panelboards
   3 Safety switches
   4. Control panels
   5 Control devices

B. Identify all exposed junction boxes in mechanical rooms, wire closets and janitor closets, by installing labels on their covers. Identification shall include voltage and system type.

C. Identify all exit/emergency lighting and fire alarm system junction boxes in mechanical rooms, wire closets, janitor closets and suspended ceiling spaces, by painting the covers red and attaching labels which identify the systems contained in the box and their operating voltage.

1.07 EXAMINATION OF EXISTING CONDITIONS

A. Visit and carefully examine the site and existing facilities. Become familiar with all existing conditions and difficulties that attend execution of the work.

B. The submission of a bid or offer to do specified work will be construed as evidence that the examination of existing facilities was made. Later claims for extras due to difficulties encountered will not be allowed.

C. Note the presence of any underground services. Exercise extra caution in prosecution of work to avoid disturbing these facilities. Upon discovery of an unforseen service, suspend operations that would endanger the service until an investigation is made and proper procedures are established by the Architect. Pay for all costs for repair or damages if damage could have been avoided by exercising caution.

1.08 DEMOLITION

A. During demolition and construction protect all existing equipment and services that are to remain. Drawings are diagrammatic and may not show all details involved in demolition and removal. Coordinate with all trades when removing or relocating systems and devices.

B. Where equipment or a system is to be removed, remove all accessories, conduit, wiring, hangers, etc. that are not needed by the remaining systems. Close all openings, patch finishes and leave premises in properly repaired order. Remove all unused wiring.

C. Where equipment is to be removed and reinstalled, such equipment shall be thoroughly cleaned as necessary and reinstalled in the new location.

D. Equipment control devices and appliances to be removed remain property of the Owner. Dispose of debris and scrap.

1.09 CONNECTION TO EXISTING WORK

A. Before starting work, make sure that each existing system is in working order. If a condition is discovered which prevents normal operation of specified addition, this shall be called to the attention of the Architect before additions or connections are made. If work is done without such notification, it will be assumed that connections have been made to a working system, and performance and guarantee will apply to the entire system as installed.

1.10 INTERRUPTION OF SERVICE

A. Consider all limitations in Division Zero and One. Work shall be scheduled so as not to interfere with Owner's operations that will be conducted during the construction period.

B. Submit to Architect a date and duration schedule of needed shutdowns of existing systems. Interruptions will be permitted only at such times as can be accommodated by the Owner.

C. Work in this Division includes overtime work after Owner's normal operating hours. It also includes making temporary connections, loops, by-passes, etc. to reduce or eliminate interruptions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Uniform Products: Equipment and materials of the same type of classification and used for the same purpose, shall be products of the same manufacturer.

B. Agency Approval: Equipment, assemblies and systems, whenever so available, shall be listed by Underwriters Laboratories as the assembly or system. When not available, the individual components of an assembly or system shall be listed for the application or environment.

PART 3 - EXECUTION

3.01 MATERIALS

A. Erection of all equipment and materials shall be done in a neat and workmanlike manner, aligned, leveled and adjusted for satisfactory operation. Equipment shall be installed so that all functional parts are easily accessible for inspection, operation, maintenance and repair.

B. All cutting and patching shall be coordinated with the trades whose work is affected. This work must conform in every respect to the surrounding finish and to the quality of workmanship and materials used, and upon completion, shall have a new unpatched appearance.

C. Work required to pierce any waterproofing shall be done with care and after the part piercing the waterproofing has been set in place, the opening made for this purpose shall be sealed and made absolutely watertight.

3.02 FIRE RATING

A. Installation under this Division shall be so made that the fire-protective rating of fire walls and fire-resistant or fire-stopped walls, partitions, ceilings and floors will be substantially equivalent to its original rating.

3.03 PROTECTION AND FINISH

A. All equipment, including panels, switchgear, starters, device plates, lighting fixtures and light diffusers, and other equipment installed under this Division, shall be cleaned at the completion of the installation to reflect new equipment appearance, free from splatter, rust, abrasions and dust. Where marring or disfigurement has occurred, replace or refinish the damaged surfaces as directed.

B. Equipment or components exposed to the weather shall be sealed weathertight. All equipment outlets and conduit openings shall be protected with temporary plugs or caps at all times that work is not in progress at that point.

C. Prepare all exposed raceways, fittings, wiremold, boxes, supports and panelboards for painting by removing all oil, grease and dirt. Employ the necessary precautionary methods to prevent painting over or obscuring any nameplates or designations on all electrical apparatus and devices.

D. All ferrous metal surfaces of equipment exposed to weather and all ferrous metal not otherwise specified shall be given a rust inhibitating treatment which shall consist of hot-dip galvanizing after fabrication followed by the application of rust inhibiting primer and finish paint.

Weight of the coating shall be in accordance with the ASTM A153.

3.04 CONNECTING TO & COORDINATING WITH WORK OF OTHER TRADES

A. Before starting work and from time to time as work progresses, the work and materials installed under other Divisions shall be examined insofar as they apply with this Division and the Contractor shall notify the Architect immediately in writing if any conditions exist which will prevent satisfactory results in the installation of the system. Starting the work without such notification will be construed as an acceptance of all claims or questions as the suitability of the work of other trades.

B. The exact location of the electrical outlets, piping, ducts, ceiling diffusers, lighting fixtures, etc., shall be coordinated before the material or equipment is installed so that there will be no interference. In case interference develops, the Architect will decide which equipment shall be relocated at no cost to the Owner, regardless which equipment was installed first.

3.05 TESTS AND INSPECTIONS

A. Prior to closeout inspection, clean - and where required - paint all equipment installed under this Division. Factory applied finishes that have been scratched or otherwise damaged shall be touched up with color matched paint furnished by the manufacturer. Interiors of panelboards, switchboards and cabinets shall be vacuum cleaned and shall be free of dust and debris. All unused openings in outlet boxes and cabinets shall be capped.

END OF SECTION

SECTION 16050
BASIC MATERIALS AND METHODS



PART 1 - GENERAL

1.1 SCOPE:

A. The work covered in this Section is basic methods and responsibilities for the execution of the electrical work.

1.2 FIRESTOPPING:

A. The contractor for this Division shall be responsible for firestopping all penetrations of fire resistance rated walls, floors, or floor/ceiling assemblies by his work. This includes, but is not limited to, penetrations by piping duct and sleeves for future work.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. New and of best grade of standard manufacture.

B. Approved by the UL and be so labeled.

C. For wire and cable, marked as required by Article 310-10, National Electric Code.

2.2 CODES, PERMITS AND FEES:

A. Work under this DIVISION shall comply with pertinent provisions of OSHA Building Codes.

B. All work shall comply with local and state electrical codes and 2005 National Electrical Code and current supplements thereto.

C. Obtain all required permits. Pay all legal fees for permits and inspections by authorities having jurisdiction.

2.3 MANUFACTURERS' LITERATURE:

A. Deliver all printed tags, instructions, certified drawings, parts lists, certificates, etc., supplied with equipment items, to the Architect at completion of the project.

B. Assemble all such printed materials into a stiff-back binder identified on face. Provide quadruplicate copies.

2.4 PROTECTION OF APPARATUS:

A. Take all precautions necessary for proper protection of equipment, apparatus and materials from damage. Failure to do so will be cause for rejection of any item coming under question.

2.5 SHOP DRAWINGS:

A. Contractor for this Division shall submit shop drawings as follows:

1. Consist of layouts, working drawings, cuts and operating and performance data, including 1/4" scale layout of all electrical rooms.

2. For switchboard, trnasformers, panelboards, cable, conduit, fire alarm system, lighting fixtures, and other items in which the Architect and/or Engineer may, from time to time, request.

2.6 PAINTING:

A. Switchboard and light fixtures shall be factory finished painted. Priming coat for other equipment shall be provided under this Division "PAINTING".

2.7 DRAYAGE, HOISTING AND SCAFFOLDING:

A. Contractor for this Division shall:

1. Be fully responsible for drayage, hoisting, warehousing, and demurrage, for all equipment and materials to be furnished and installed under this Division.

2. Provide all scaffolding required for erection of materials and equipment included under this Division.

3. Be fully responsible for the safety of his employees using such scaffolding.

2.8 CUTTING AND PATCHING:

A. Contractor for this Division shall provide large openings required for work under this Division.

1. Contractor for this Division shall layout, to dimension and location, all openings on surfaces to be formed, framed or cut.

2. Should Contractor for this Division fail to adhere with Paragraph 2.8.A.1., as work progresses, any openings required shall be cut and patched by General Contractor at the expense of the Contractor for this Division.

2.9 WORK NOT INCLUDED:

A. The installation and connection of the following items is not included in this Section of the Specifications:

1. Unless provided in motor control center, all motors for mechanical equipment together with the associated motor controller, starters and remote control devices, electrical heating equipment with contactors, individual element protection, etc., will be furnished under Section 15 of the Specifications.

2. Control and Interlock Wiring: Provisions for the installation of all control and interlock wiring is provided under Section 15 of Specifications.

3. Telephone Instruments: Telephone instruments and wiring for same not included in this Section of the Specification.

2.10 IDENTIFICATION:

A. Materials:

1. Provide a red finish, white core Bakelite nameplate for 277 and 480 volt feeder switches, panelboards, disconnect switches, feeder breakers, circuit breakers, contactors, etc.

2. Provide a black finish, white core Bakelite nameplate for 120 and 208 volt feeder switches, panelboards, disconnect switches, feeder breakers, circuit breakers, contactors, etc.

3. Bakelite nameplates shall have 3/8" high engraved letters.

4. Provide a white-on-red engraved laminated warning sign, having 1/2" high letters, reading for example "CAUTION - 480 VOLTS", on interior of door on each 480/277 volt distribution or lighting panel.

5. Provide a white-on-black engraved laminated job identification name plate, 3" x 6" minimum, on main switchboard.

6. Each panelboard shall be provided with a directory frame on inside of cabinet door. A neat, carefully typewritten directory card, identifying each branch circuit served by each such panel shall be placed in the frame, under clear plastic cover. Spares shall be noted in pencil.

2.11 TESTS:

A. Inspection and Tests:

1. The electrical installation shall be inspected and tested to insure safety to building occupants, operating personnel, conformity to code authorities and contract documents.

2. All tests shall be performed using all recognized safety procedures and techniques during energizing and de-energizing of all equipment to insure employee

safety and protect the work.

B. Materials:

1. Provide all instruments, labor and materials required for any essential intermediate and final tests described hereinafter or necessary to provide compliance with these specifications.

2.12 FIRESTOPPING

A. Each penetration shall be protected by a fireproofing system with an 'F' rating (fire rating) equal to or greater than the assembly in which the penetration occurs, when tested in accordance with ASTM E 814. A 'T' rating (temperature rating) equal to one-half of the required fire resistance rating of the floor is required for all floor penetrations.

B. The fireproofing system shall consist of the fire protection series of products as manufacturered by Bio Fireshield, 3M or approved equal.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. Installed by mechanics skilled in their trades, working under the direct supervision of competent experienced foremen and/or superintendents.

B. Installed in a thorough workmanlike manner, presenting a neat, clean-cut appearance when completed. Any part or parts not meeting this requirement shall be replaced or rebuilt without extra expense to the Owner.

3.2 TIMELY PLACING OF MATERIALS:

A. Switchboard, panelboard cans, transformers, raceways, conduit, pull and junction boxes, etc., shall be installed at the proper time during progress of construction. Coordinate work operations with other Crafts.

3.3 SPACE REQUIREMENTS:

A. Contractor for work under this Division shall be fully responsible for determining in advance of purchase that equipment and materials proposed for installaltion shall fit into the confines indicated and allow sufficient clearance for maintenance and service of all equipment including that of other trades.

3.4 IDENTIFICATION:

A. Nameplates for surface mounted equipment shall be installed on the exterior of equipment with sheet metal screws.

B. Nameplates for flush or recessed mounted equipment shall be installed on the inside of the panel door or cover with epoxy cement.

C. Nameplates shall be installed on every device in the main switchboard, distribution panelboard, motor control centers, etc.

3.5 TESTS:

A. Field tests shall be performed and reports submitted. Approval tests shall include but not be limited to the following:

1. All feeders rated below 600 volts shall be Megger tested between phase conductors and between phase conductors and ground. Tests shall be made upon completion of all over-current devices. Tests shall indicate freedom from short circuits and grounds.
2. All parallel circuits shall be tested for proper phasing.
3. The full load running current of all motors shall be recorded and overload heaters selected in accordance with the test results.
4. Full load currents of each feeder shall be measured and circuit rearrangement provided as necessary to achieve a balance load on each phase.
5. Operation of all control and alarm circuits.

3.6 FIRESTOPPING:

A. All firestop materials shall be installed in accordance with manufacturer's standard details and U.L. Building Materials Directory for each type of fire rated assembly penetrated.

B. Sleeves shall be firestopped using materials that will permit re-entry and use of the sleeves and firestop.

C. The firestop shop drawing submittal shall include the manufacturer's standard details and U.L. system number for each type of penetrant (pipe, duct, sleeves, etc.) and each type of fire rated assembly (gypsum wall, concrete block wall, concrete floor, etc.).

END OF SECTION

SECTION 16110
RACEWAYS

PART 1 - GENERAL

1.01 SCOPE:

A. This Section describes workmanship, conduit and raceways to be used.

PART 2 - PRODUCTS

2.01 RIGID STEEL CONDUIT:

A. Rigid steel conduit shall be used in concrete slabs, for all exposed conduit outside of the building and for all feeders.

B. Where rigid metal conduit is indicated to be installed in locations other than below or in concrete slabs of in hazardous locations, conduit may be intermediate metal conduit (I.M.C.) or rigid aluminum installed in accordance with Article 345 of the National Electrical Code.

2.02 ELECTRIC METALLIC TUBING (EMT):

A. Electric metallic tubing shall be provided for all branch wiring except in or under concrete, earth, or fill or where exposed outsides the building.

B. EMT may be utilized for feeders if the following conditions are met:

1. To feed electrical panels when panels are located inside of building not exposed to weather or to physical damage.
2. Not restricted or prohibited by local, state or national code.

2.03 PVC:

A. U.L. listed, Schedule 40 PVC conduit may be used for underground runs. All non-metallic conduit installed under driveway areas, building footings, or any locations subject to damage by heavy equipment, or when used for service entrance shall be encased in a 3 inch concrete envelope.

B. All non-metallic conduit shall be provided with code size copper bond wire inside the conduit for electrical continuity, and shall be in- stalled in strict accordance to NEC Article 250.

2.04 FLEXIBLE CONDUIT

A. Flexible metal conduit shall be constructed of galvanized steel. Where flexible conduit is exposed to the weather and where indicated on the drawings, liquid tight flexible conduit shall be used.

B. Connectors for flexible conduit shall be steel insulated throat type with nylon insulators. Connector shall be secured to flexible conduit by metal teeth biting into conduit under pressure from connector bolt. Do not use squeeze type connector.

C. Connectors for liquid tight flexible conduit shall be steel, insulated throat type with nylon insulators. Connectors shall be the screw-in ground cone type.

2.05 RACEWAYS:

A. All raceways, both rigid steel conduit and electrical metallic tubing shall be of the best quality steel of standard dimension, hot galvanized (with hot galvanized threads) and smooth both inside and outside. Unless indicated otherwise in the drawings, the raceway sizes shall be in accordance with Table No. 4 of the N.E.C. Where special type insulation on conductors is requidred, the raceway shall be of ample size to receive the conductors of larger diameter than indicated in Table No. 4.

B. Rigid conduit shall be attached to sheet metal enclosure with two lock nuts and insulated bushings. EMT connectors and couplings shall be steel, raintight, compression or set-screw type and manufactured by Thomas & Betts, Appleton or Tomic. Connectors and couplings for EMT shall be of the nylon insulated throat type. Rigid conduit stub-ups not attached to enclosure shall be terminated with insulated throat, grounding bushing.

C. Expansion fittings shall be provided in all feeder conduit where length of run exceeds 200 feet and where conduits pass through building expansion joints. Expansion couplings for metallic raceway shall have internal packings and copper bonding jumber to maintain ground continuity. Expansion fittings for non-metallic raceways shall contain internal packing and pressure rings to assure watertight joint.

D. All conduits penetrating rated fire wall or rated fire floors shall be installed to maintain the fire rating of the wall and floor penetrated.

E. Metallic conduit in contact with certain earth shall be covered with asphaltum paint.

F. Rigid aluminum conduit shall be used indoors in dry locations above grade only. Under no conditions shall it be buried in concrete slabs.

G. Conduits installed within concrete and below grade shall not be smaller than 3/4". All other conduits shall not be smaller than 1/2".

H. All raceways shall be installed with an equipment grounding conductor and sized based on the NEC Table 250-95. All computer outlets shall be furnished with an individual isolated grounding conductor per circuit.

PART 3 - EXECUTION

3.1 CONDUIT

A. Conduits shall be concealed except in unfinished spaces such as equipment rooms and penthouses without finished ceiling.

B. Concealed raceways shall be run in a direct manner with as few bends as possible, and shall be coordinated with structural, mechanical, and architectural requirements. When shown concealed where no ceiling is to be installed, raceways shall be concealed in concrete slabs.

C. Concealed branch circuit conduits shall be supported at intervals not exceeding ten feet and within three feet of each outlet, junction box, cabinet or fitting. Individual branch circuit conduits shall be attached to structural steel members with spring steel type conduit clips and to non-metallic structural members with one hold conduit straps. Conduits shall not be attached to channels of ceiling suspension system or suspension wires. Concealed feeder conduits larger than one inch trade diameter, above ceiling, shall be attached to strucdture on intervals not exceeding twelve feet with conduit beam clamps, one hold conduit straps or trapeze type support in accordance with conditions encountered.

D. Exposed conduits shall be installed parallel or at right angles to existing walls, ceilings and structural members. Support exposed conduits at no more than ten foot intervals and within three feet of outlets, junction boxes, cabinets, and fittings.

E. Where transition is made from below grade installation of PVC conduit to an installation above the slab of metallic conduit, make transition with rigid galvanized elbow.

F. All offsets, bends, fittings, pull boxes, stems, and

supports for the complete installation are not indicated on the drawings; however, it shall be the Contractor's responsibility to furnish and install all offsets, bends, raceway supports, and equipment required for the complete installaltion.

G. Where connections are made to motors not near walls, or columns, a vertical conduit attached to floor and ceiling shall be installed and the wiring carried in and out of this conduit by means of condulets. Provide wood backboards for mounting equipment shown on the drawings. Mount motor starting and control equipment, wiring, cable troughs, conduit and other apparatus on the wood backboard. Backboards shall be B-D INT-DFPA grade plywood. Backboards shall be supported by an angle iron frame. Frame and board to be painted light gray. Space shall be left on backboards for installation of equipment specified under other Sections.

H. Conduits installed in concrete slabs shall be buried in the concrete slab. Low conduits shall be wired to upper side of the bottom reinforcing steel. Parallel runs of conduits within slab shall be separated by at least one inch.

I. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until masonry is complete and wiring is to be installed.

J. All conduits entering building from below grade shall be sealed with insulating electrical putty to prevent entrance of moisture.

K. All empty conduits shall be left with pull wire or nylon jet line.

3.2 FLEXIBLE CONDUIT:

A. Flexible conduit shall be used for connection to vibrating equipment, dry type transformers, electric duct heaters, unit heaters and rotating machinery and for connection from junction box to corresponding flush mounted lighting fixtures.

B. Flexible conduit connecting motors, duct heaters, unit heaters and electrical equipment subject to vibration shall not exceed twenty-four inches in length.

C. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed six feet in length. Longer taps may be used provided conductors are fully rated and conduit is supported at lengths not exceeding 4-1/2 feet.

D. Flexible conduit used for other than connection to

lighting fixtures shall not be less than one half inch trade size and in no case shall flexible conduit size be less than permitted by the National Electri- cal Code for the number and size of conductors to be installed therein. Three eighths inch flexible conduit may be used for connection to lighting fixtures providing conduit fill requirements of National Electrical Code are not exceeded.

E. Ground continuity thru flexible conduit shall be maintained with green equipment grounding conductor; do not use flexible conduit for ground continuity.

3.3 EXCAVATION:

A. The Contractor shall do all excavating and backfilling necessary for the installation of his work. All excavation shall be made in depth to assure a firm foundation for the work.

B. The top of all duct lines should be a minimum of 24" below grade with the bottom below the frost line. Under no condition should the concrete duct bank be in direct contact with any other slab or foun- dation except for vertical risers.

C. All excavated material not used for backfill shall be removed from the site.

END OF SECTION

SECTION 16120
WIRE AND CABLES



PART 1 - GENERAL

1.1 SCOPE:

A. The work included under this Section consists of providing all feeders and branch circuits as shown on the drawings. The wiring system shall be complete from the service entrance to each and every outlet and apparatus shown on the drawings which requires electrical connections.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. Conductors shall be copper of the size indicated on the drawings, required by the National Electrical Code, or specified herein. All conductors shall have size, grade or insulation, voltage and manufacturer's name permanently marked on the outer cover.

B. In no case shall a conductor of size less than No. 12 AWG be used, unless specifically noted on the drawings.

C. Branch circuit conductors shal be color-coded as follows:

| 120/208 Volts | Phase | 277/480 Volts |
|---|---|---|
| Black | A | Yellow |
| Red | B | Brown |
| Blue | C | Orange |
| White | Neutral | White |
| Green | Ground | Green |

D. Conductors for branch circuits shall be 600 volt type THW or THHN/THWN.

E. Conductors for feeders and mechanical equipment, No. 4 and larger, shall be 600 volt type XHHW or RHH/RHW.

F. All branch circuit wiring installed thorugh continuous rows of fluorescent fixture bodies shall be type THHN, 90 degrees C.

G. Joints in No. 8 wire and smaller shall be made up with solderless connectors of the proper size: Minnesota Mining "Scotchlok" or T & B "Sta-Kon". Joints in No. 6 wire and larger shall be made up with solderless connectors: Burndy,

O.Z. or Penn-Union. All uninsulated joints shall be taped over with plastic tape, Bishop "Bi-Seal", Minnesota Mining "Scotch Brand" No. 33, Permacel 29 or slipknot gray.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Wire shall not be drawn into a conduit until all work of a nature which may cause injury is complete. Ideal, Wire-Ease, or approved equal may be used as lubricant. Where two or more circuits run to a single outlet Box Tag each circuit with linen tags as a guide to the fixture hanger in making fixture connections.

B. Feeders shall be run their entire length in continuous pieces without joints or splices.

C. Wire and cable shall have joints in branch circuits only where such circuits divide as shown on the plans, and then consist of one through circuit to which shall be spliced the branch from this circuit. In no case shall joints in branch circuits be left for the fixture hanger to make.

D. All conductors employed for flexible connections to fluorescent fixtures shall consist of two conductors, one hot leg and one neutral, enclosed in flexible metal conduit. The grounding connector shall be securely attached to both the outlet box and to the fixture body.

E. Conductors within enclosures, i.e., panels, motor control center, switchboard, terminal cabinet, fire alarm cabinets, program instruments and control cabinets shall be grouped and identified with nylon tie straps with circuit identification tag.

F. Splices in conductors shall be made only within junction box, wiring troughs and other enclosures as permitted by the National Electrical Code. Do not splice conductors in panelboards, safety switches, switchboard, or motor control enclosures.

G. All branch circuit conductors shall be connected as indicated on the drawings. Not more than three branch circuits, of opposite phases, shall be installed in any one conduit on 3 phase, 4 wire systems and no more than two branch circuits, of opposite phase, shall be installed in any one conduit on 1 phase, 3 wire system.

H. Conductors shall not be spliced in pull boxes used for vertical cable supports unless permission for splicing is obtained in writing. Where splicing is permitted, splices

shall be made with sleeve type fitting applied to conductor with hydraulic operated crimping tool. Such splices shall be taped with No. 88 plastic electric tape built up to a thickness not less than conductor insulation.

I. Phase rotation established at service equipment shall be maintained throughout entire project.

END OF SECTION

SECTION 16130
BOXES

PART 1 - GENERAL

1.1 SCOPE:

A. This Section describes the type, size, and installation of boxes to be used.

1.2 LOCATION OF OUTLETS:

A. Unless specifically indicated, all outlets are located diagramatically on the drawings. Outlets shall be located so that they will be symmetrical with architectural details and power outlets shall be so located as to properly serve the equipment.

PART 2 - PRODUCTS

2.1 PULL BOXES:

A. All pull boxes shall be constructed to code gauge galvanized sheet steel of the dimensions required by Article 370-18 of the National Electrical Code, for the number size and position of conduits entering the box.

B. Pull boxes for installation of vertical conductors shall be provided with Red Seal type VVC or approved equal cable support as required by by Article 300-19 of the N.E.C.

C. Pull boxes required for horizontal feeders containing more than one feeder shall be provided with reinforced flange and removable 12 gauge 1-1/2" x 1-1/2" galvanized channel for support of conductors. Wood supports within pull boxes are not acceptable.

D. Pull boxes installed in finished spaces shall be flush mounted and shall be provided with trim, hinged door and flush latch and lock to match panel trim for flush mounted electrical panels.

2.2 OUTLET BOXES:

A. Outlet boxes specified herein are minimum size boxes; larger boxes of the same type shall be provided if required by Article 370 of the National Electrical Code for the number and size of conductors installed.

B. Outlet boxes for surface mounted and pendant mounted lighting fixtures shall be four inch octagon boxes, 1-1/2"

deep. Provide fixture stud where outlet box is used for support of incandescent fixture.

C. Outlet boxes for flush mounted lighting fixtures shall be four inch square boxes 1-1/2" deep, with blank cover.

D. Outlet boxes for switches, receptacles and wall mounted junction boxes shall be four inch square boxes 1-1/2" deep with square edge tile type cover. Where only one conduit enters box, 3-1/2" deep single gang switch box may be used. Outlet boxes for GFI receptacle shall be 2-3/4" deep.

E. Outlet boxes for individual switches and receptacles flush mounted in exposed concrete block shall be single gang masonry boxes 3-1/2" deep.

F. Floor outlet boxes shall be adjustable, sheet steel, concrete type unless water tight is specified. Boxes installed in carpeted floor shall be provided with adjustable, brass carpet flange furnished with floor box. Unless indicated otherwise on the drawings, boxes installed in slabs less than four inches thick shall be Hubbell B-2529, Walker 801 or Thomas & Betts 1753. Boxes installed in slabs more than four inches thick shall be Hubbell B-2557, Walker 800 or Thomas & Betts 1754. Watertight boxes shall be cast metal, adjustable with rubber gasket and bronze disk and shall be Hubbell B-2536, Walker 800-C1 or Thomas & Betts 1810. Covers for all floor boxes shall be provided in accordance with use of box.

G. Where special purpose device specified requires larger outlet box than specified herein, provide outlet box suitable for specific device. These outlet boxes shall be of the same type as specified herein for the installation required.

H. Boxes in wet locations shall be cast steel conduit boxes.

PART 3 - EXECUTION

3.1 PULL BOXES:

A. Pull boxes shall be provided where indicated on the drawings and where required to facilitate the installation of conductors. Pull boxes shall be installed exposed only in unfinished spaces, unless otherwise indicated on the drawings, and shall be installed to be accessible.

B. Feeders within pull boxes shall be individually laced with nylon tie straps of the type with enlarged tab to permit identification of each feeder within pull box.

C. Splices are not permitted in pull boxes except when approved in writing by the Architect or where shown on the drawings. Where splices are permitted, splices shall be made with splicing sleeves attached to conductors with hydraulic crimping tool. Split bolt connectors are not acceptable for splices within pull boxes.

3.2 OUTLET BOXES

A. Outlet boxes shall be provided for each lighting fixture and for each device. Where lighting fixtures are installed on continuous rows, only one outlet box shall be required for each row.

B. All outlet boxes shall be accessible. Flush mounted boxes shall be set to within 1/8" of finished wall.

C. Outlet boxes for use with flush mounted lighting fixtures shall be installed adjacent to fixtures in a position to be accessible when fixture is removed.

D. Where low voltage device is to be installed in common outlet box with line voltage device, provide metal barrier within outlet box to establish two separate compartments.

E. Where drawings indicate ganged installation of switches controlling 277 volt lighting circuits of opposite phase, switches shall be separated by one ful gang width, or separated with a permanently installed non-metallic barrier. Where space available for horizontal ganged installation is not adequate, switches shall be vertically installed.

F. Boxes shall be supported by light weight channel spanning between and attached to main ceiling support member. Attached to ceiling support members with galvanized tie wire or nylon tie straps.

G. Outlet boxes shall not be used for support of fluorescent fixtures; boxes shall be used only as junction boxes.

H. The location of any outlet may be moved ten feet with the prior approval of the Architect and before it is installed without any additional expense to the Owner.

I. Where outlets of different levels are shown adjacent, they shall be installed in one vertical line.

J. Contractor shall check the location of all wall outlets including light fixtures, receptacles and switches, to verify that the outlets will clear any wall fixture, shelving, work tables, sinks or similar equipment that will be

installed.

K. Outlets occurring in architectural features shall be accurately centered in same. Space wall switch outlets equidistance from door trims on the strike side of door.

L. Outlet boxes in partitions shall never be set back to back. Boxes set side by side facing separate rooms or spaces, shall be nippled together by not less than a 6" long offset nipple; after conductors are pulled, the nipples shall be tightly packed with an acceptable fire proof material.

M. The drawings are diagrammatic and are intended to show the locations of outlets, devices, fixtures, and arrangement and control of circuits only. Exact location shall be determined by actual measurement at the building and/or by reference to the architectural drawings.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Related work specified elsewhere:
1. General Provisions for Electrical Work: Section 16010.

1.02 REFERENCE STANDARDS

A. All devices shall be made in compliance with NEMA, ANSI and UL standards.

1.03 SUBMITTALS

A. Materials list and equipment list: Provide as specified in Section 16010.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturer: Devices in each category shall be the product of a single manufacturer.

B. Color: Devices and plates shall be White with the following exceptions:
1. Provide the color when it is specifically noted on plans.
2. Provide brown devices and plates when installed in dark panelled or wall paper covered walls.

C. Switches and Receptacles:
1. Select from the following listed devices:

| | HUBBELL | SYLVANIA | SLATER | LEVITON |
|---|---|---|---|---|
| Switch, SP | 1221 | 1221 | 720AG | 1221 |
| Switch,3 Way | 1223 | 1223 | 723AG | 1223 |
| Switch, Key | 1221L | 1221L | 720AGL | 1221L |
| Switch, Pilot | 1221PL | 1221PL | 720AGLH | - |
| Recep., Sngl | 5351 | 5351 | S330 | 5351 |
| Recep., Dupl | 5252 | 5252 | 5252AG | 5252 |
| Recep., GFI | - | 1591FS | SIR15 | 6399 |

1. Select from the following listed devices:

| | P & S | SYLVANIA | SLATER | LEVITON |
|---|---|---|---|---|
| Switch, SP | 15AC1 | 3401 | 810AG | 1101 |
| Switch,3 Way | 15AC3 | 3403 | 813AG | 1103 |

| | | | | |
|---|---|---|---|---|
| Switch, Key | 15C1L | 5061L | 712AG | 1101L |
| Switch, Pilot | - | 1221PL | 711AGLH | - |
| Recep., Sngl | 5221 | 2514 | S321 | 5015 |
| Recep., Dupl | 5250 | 2515 | 3200 | 5014 |
| Recep., GFI | - | 1591FS | SIR15 | 6399 |
| Recep., Clock | - | 557 | S371-3 | - |

2. Isolated ground receptacles for computer circuits shall be provided with and insulating barrier which isolates the grounding screw from the mounting yoke and bonding circuit. Use orange color devices Slater IG-8300-OR for 125v 15a device and Slater IG-8210-OR for 125v 20a device, or equivalent 5262 and 5362 orange devices by Hubbell.

3. Special devices shall be NEMA standard configuration as shown on plans and shall be manufactured by Hubbell, Leviton, Sierra or Slater.

D. Device Plates:

1. Device plates shall be of gang sizes and configuration required by application. Telephone outlet plates shall be blank type or single hole type - as determined most suitable by telephone system installer and approved by Architect. Television system antenna outlet plates and other specialty system device covers shall be furnished under this section if the device is made to accept a device cover.

2. Device plates for interior areas shall be of 0.10 inch thick smooth plastic, matching the device color exactly.

3. Device plates for exterior areas shall be die cast aluminum with corrosion resistant finish, stainless steel mounting screws, gasketed and self-closing lids, Leviton Style 6196.

## PART 3 - EXECUTION

### 3.01 STORAGE

A. Prior to installation, store devices on job site in original manufacturer's cartons.

### 3.02 INSTALLATION

A. Install devices in outlets as soon as wire is pulled, but do not install any device in a box which is not installed in accordance with the box installation requirements of Section 16050. After installation, cover devices temporarily using device packaging material, leaving covers in place until painting and finishing operations are completed.

B. Install grounding receptacles as follows:
   1. Installed vertically, grounding slot at top.
   2. Installed horizontally, grounding slot to left.
   3. Install with pigtail to box.

C. Make final adjustments when installing plates so that device and plate are true and parallel to building lines. Devices and device plates that are stained or paint splashed.

D. Replace switches in multiple gang boxes, where adjacent switches have a potential between conductors in excess of 250 volts, shall have metal barriers between gangs, or shall be Slater series 720AG with screwless terminals.

3.03 GROUNDING

A. Outlet box to device strap or yoke grounding connection is not sufficient. Install an insulated jumper between the grounding pole of each receptacle and outlet box or conduit. The jumper size shall be 14 AWG for 15, 20 and 30 ampere devices; 12 AWG for 40 amp devices; and 10 AWG for 50 and 60 amp devices.

B. Isolated ground receptacles shall be wired with a #12 AWG green grounding conductor to the associated panelboard, terminating at the grounding bar.

END OF SECTION

SECTION 16160
PANELBOARDS



PART 1 - GENERAL

1.01 SCOPE

A. In accordance with Contract Documents, furnish all labor, equipment, material, and supervision associated with furnishing panelboards.

B. This Section describes the type and construction of panelboards to be used.

1.02 STANDARDS

A. Equipment provided under this Section shall be designed, manufactured and tested in accordance with the following standards:

1. NEMA PBI-199 - Panelboards.
2. U.L. #67 - Panelboards.
3. ANSI #C33.38 - Safety Standards for Panelboards.

PART 2 - PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

A. Panelboards designated as distribution panels shall conform to this paragraph of these Specifications. Panelboards shall be the dead front type equipped with molded case circuit breakers. Panel mains shall be rated as shown on the drawings. Neutral shall be fully rated unless otherwise indicated or specified. Panelboard shall contain a copper equipment grounding bus and tin plated copper bussing. **Aluminum will not be accepted.**

B. Panelboards shall contain circuit breakers as described under OVER-CURRENT PROTECTION Section and as sized on the drawings.

C. Main lugs of panel or main circuit breaker shall be U.L. listed for copper conductors. Lugs shall be of the range for feeder conductors indicated on the drawings.

D. All panels throughout project shall be keyed alike.

E. Each panel shall have a two column circuit index card set under clear plastic on inside of door. Each circuit shall be identified as to use and room or area.

F. Distribution panelboards shall be Westinghouse Type CDP,

Square D I-line, General Electric type CCP or Siemens C.D.P. conforming to these Specifications. Panel width shall not exceed forty one inches except where two section panel is specifically indicated on the drawings. Where two section panels are required, both sections shall have fully rated bus and shall be interconnected by copper conductor with total ampacity equal to main bus rating. Flush mounted panels shall be provided with concealed trim clamps and hinges and flush door latch.

2.02 PANELBOARDS

A. Panels designated as lighting and receptacle panels shall comply with this Section of these Specifications.

B. Panelboards shall be provided where indicated on the drawings in accordance with the panelboard schedule on drawings. All panels shall be of safety dead front type and shall be labeled by U.L.

C. Panelboard shall contain circuit breakers as described under OVERCURRENT PROTECTION section and as sized on the drawings.

D. Main lugs and Main breakers shall be U.L. approved for copper conductors and shall be of the range for conductors indicated on the drawings. Each panel shall contain a full size neutral bus and an equipment grounding bus. Equipment grounding bus shall be copper and tin plated copper bussing. **Aluminum will not be accepted.**

E. Flush mounted panels shall have concealed captive clamping devices, concealed hinges and chrome lock. All panels throughout project shall be keyed alike. Panelboard width shall not be less than twenty inches, nor more than twenty two inches unless spescific width is indicated on the drawings. Panelboard depths shall not exceed 5-3/4 inches.

F. All panelboards shall be the product of Westinghouse, Square D, General Electric, Crouse-Hinds, or Siemens complying with these Specifications.

2.03 SURGE AND LIGHTNING PROTECTION

A. All low voltage panels indicated shall be provided with surge and lightning protection as follows:

1. Low voltage panels 120/208V, 3 phase, 4 wire "Wye".
   a. Service size maximum 225 amperes, Leviton #51120-3 Surge Panel Protector, Class "B".
   b. Service size maximum 400 amperes, Leviton #52120-M3 Surge Panel Protectors, Class "B".

B. Surge Panel Protectors shall be installed adjacent to each panel on wall maximum of 12" away.

C. Acceptable manufacturers may be "EFI", "Electra Guard" or any other supplier that is UL listed and tested meeting standard 1449.

PART 3 - EXECUTION

3.01 DISTRIBUTION PANELBOARDS

A. Distribution panelboards shall be mounted with top circuit breaker handle not more than 6'-6" above finished floor.

B. Conductors within panels shall be grouped and laced with nylon tie straps. Only one conductor shall be installed under terminal of individual circuit breaker.

C. Each circuit protective device shall be identified with numeral designation, cross referenced with typewritten circuit directory on interior of panel door. A copy of each panel directory, reflecting all field changes shall be included in the bound data to be provided by the Contractor at the time of final inspection.

3.02 PANELBOARDS

A. Panelboards shall be mounted with top circuit breaker not more than 6'-6" above finished floor.

B. Conductors installed in panels shall be grouped and laced with nylon tie straps. Only one conductor shall be installed under terminal of individual circuit breakers.

C. Each panelboard shall be provided with typewritten circuit directory mounted under clear plastic on interior of panel door. Directory shall reflect any field changes or additions. A copy of each circuit directory shall be included in the bound data to be submitted at the time of final inspection.

3.03 SHOP DRAWINGS

A. Shop drawings shall indicate that all of the function requirements off the specifications have been met. In addition, the UL approved RMS symmetrical interrupting capacity shall be indicated for each circuit breaker, and a certification that these are UL ratings shall be attached.

END OF SECTION

SECTION 16180
OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SCOPE:

A. This Section describes requirements for fuses and circuit breakers to be used.

1.2 STANDARDS:

A. Equipment provided under this Section shall be designed, manufacturered and tested in accordance with the following standards:

1. NEMA AB-1-1975 - Molded Case Circuit Breakers.
2. U.L. 489 - Branch Circuit and Service Circuit Breakers.
3. U.L. - Requirements for Class "L" Current Limiting and High Interrupting Fuses.

PART 2 - PRODUCTS

2.1 CIRCUIT BREAKERS - MOLDED CASE:

A. Branch circuit breakers shall be quick-break, thermal magnetic type bolted to the bus. Plug in breakers are not acceptable. Two and Three pole breakers shall be common trip operated by a single handle. Tie handles are not acceptable. G.F.I. (GROUND FAULT INTERRUPTING) breakers shall be provided where indicated on the drawings or specified herein. Breakers shall have permanently affixed circuit indentification; stick-on labels are not acceptable.

B. For power panels, lighting panels, receptacle panels, or for individual mounting, circuit breakers shall have an interrupting rating not less than the available duty at the breaker. The following minimum duties shall apply where not otherwise specified:

| TRIP SIZE | FRAME SIZE | RMS SYMMETRICAL |
|---|---|---|
| 15A to 100A | 100A Frame | 18,000A @ 240V<br>14,000A @ 480V |
| 70A to 225A | 225A Frame<br>Permanent Trip | 25,000A @ 240V<br>22,000A @ 480V |
| 250A to 400A | 400A<br>Permanent Trip | 42,000A @ 240V<br>30,000A @ 480V |

C. Circuit breakers in 120/208 volt branch circuit panels shall have an interrupting rating of 10,000 amps, RMS Symmetrical unless otherwise noted.

2.2 FUSES:

A. Fuses in main switchboard, 800 amp and larger, shall be current limiting, time delay type, 600 volt, with an interrupting rating of 200,000 amps, RMS.

B. Fuses protecting lighting panels shall be current limiting, 600 or 250 volt, with interrupting rating of 200,000 amps, RMS for 110 amps and larger and low peak, dual element time lag for 100 amps and smaller.

C. Fuses protecting motor centers and transformers shall be low peak, dual element, 600 or 250 volt.

D. Fuses protecting motor branch circuits shall be dual element type, 250 or 600 volt, 100,000 amps RMS interrupting rating, sized for motor nameplate data per manufacturer's recommendations.

E. Provide a fuse in each fuse-holder.

F. Fuses shall be Bussman or approved equal.

PART 3 - EXECUTION

3.1 CIRCUIT BREAKERS:

A. See Panelboard Section of the Specifications for mounting of breakers. Individually mounted breakers shall be installed under DISCONNECT SWITCHES.

3.2 FUSES:

A. Furnish 10% spare fuses with not less than 3 of any one size and type.

B. Fuses shall be mounted in sheet metal cabinet with hinged door and lock. Cabinet shall be located near electrical service entrance.

C. Where used in current limiting applications, fuses shall be rejection type (Type R).

END OF SECTION

SECTION 16410
ELECTRIC SERVICE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description of System: arrange for and make electrical service connection at the location and in a manner prescribed by the utility providing service.

B. Related work specified elsewhere:
1. Temporary Electricity: Section 01500
2. Excavation and Backfilling: Section 02220
3. Permanent Connection: Division Zero
4. Controls: Section 15900
5. General Provisions, Electrical Work: Section 16010
6. Basic Materials and Methods: Section 16050

1.02 QUALITY ASSURANCE

A. Electrical service characteristics shall be as indicated on drawings. Consult with representatives of the utility Immediately after award of con-struction contract and reach agreement with its representatives as to details of providing service.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduit: rigid steel or PVC

B. Wire: copper type THW

PART 3 - INSTALLATION

3.01 GENERAL REQUIREMENTS

A. Comply with applicable provisions of Sections listed under "Related work specified elsewhere".

3.02 OIL INSULATED PAD MOUNTED TRANSFORMERS

A. In addition to the requirements imposed by the utility providing service, locate the transformers in accordance with the following established general criteria:
1. A minimum of 10' from any window, door or building opening.

2. A minimum of 10' measured horizontally or vertically from any combustible building or building construction. This shall include any building or building projection, roof overhang or balcony.

3. A minimum of 6' from any non-combustible building, roof overhang, pro-jection or balcony.

4. A minimum of 10' from any walkway or pathway designed for pedestrian use.

5. Protect transformers from possible damage from external causes. When required by Architect or authority having jurisdiction, provide guard rails, walls, curbs or posts.

6. Transformers may be located 2' from any masonry wall with a minimum thickness of 8".

END OF SECTION

SECTION 16450
GROUNDING

PART 1 - GENERAL

1.1 SCOPE:

A. The work included under this Section consists of providing a complete building grounding system.

B. The building electrical system shall be a grounded wye supplemented with equipment grounding systems. All panelboard cabinets, equipment and enclosures, and complete conduit system shall be grounded securely to provide a low impedance path for potential ground faults.

C. All work under this Section shall be in accordance with Article 250 of the National Electrical Code.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

A. All grounding conductors shall be copper. Conductors smaller than No. 8 AWG shall be solid; all other conductors shall be bare copper or type THW with green insulation.

B. Equipment grounding conductors for branch circuits shall be sized in accordance with table 250-95 of the NEC.

C. Grounding electrode conductors shall be sized in accordance with table 250-94 of the NEC. Refer to Section 16110 - 2.5-H for additional requirements.

2.2 GROUND RODS:

A. Ground rods shall be 3/4" x 10'0" copper clad, sectional, solid steel rods.

2.3 CONNECTIONS:

A. Grounding conductor connections to ground rods and counterpoise conductors shall be made by Cadweld process. Coat all such connections with bituminous coating.

B. Grounding conductors terminating on grounding box of electrical equipment shall be terminated with lug furnished with equipment.

C. Grounding conductor termination on water pipe shall be made with U.L. listed grounding clamp.

D. Grounding conductor termination on building steel shall be made with grounding lug.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. The neutral conductor of the 480/277 volt, 3 phase 4 wire system shall be grounded to the cold water system and to the ground rod system. Connection to cold water pipe shall be made to the main waterline entering the building.

B. Ground rods shall be installed with top of ground rods 12" below finished grade.

C. The neutral of all dry type transformers shall be grounded to main building ground and to building steel. Connection to building steel shall be made in a location in unfinished space where the connection will not be subjected to physical abuse.

D. All electrically operated equipment shall be bonded to the ground conduit system.

E. All ground connection shall have clean contact surfaces.

F. Install all grounding conductors in conduit and make connections readily accessible for inspection.

END OF SECTION

SECTION 16500
LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description of System: Provide lighting fixtures, accessories and materials for lighting systems, with lamps. Schedule on drawings governs the specific types and is the identifier of marks used on layouts. The manufacturer and catalog number scheduled is the specified product.

B. Related work specified elsewhere:
1. Acoustical Ceilings: Section 09510
2. General Provisions, Electrical: Section 16010
3. Basic Materials and Methods: Section 16050

1.02 QUALITY ASSURANCE

A. Provide fixtures with accessories needed by ceiling material, method of support, and attachment of circuit conductors required by job conditions.

B. Where fixture layout includes a reflected ceiling plan, such plan shall be followed. Any deviations shall be called to the attention of the Architect before installation of fixtures.

C. Where fixture layout does not include a reflected ceiling plan, the final installation shall be symetrical in proportions shown on plans.

D. Lighting fixtures shall be UL labelled for the application. Shop drawings shall include application limitations placed on the fixtures by the label.

1.03 CODES AND ORDINANCES

A. Comply with requirements of local code enforcing agencies, including fusing of ballast leads and suspension of fixtures, as required.

PART 2 - PRODUCTS

2.01 DESIGN REQUIREMENT

A. Lamps: bulb to be as recommended by manufacturer to product design performance. Voltage to be 120 unless otherwise scheduled. Schedule indicates either General Electric or ANSI designation.

2.02 INCANDESCENT FIXTURES

A. Safety: provide all fixtures with suitable latches, safety chains, clips, etc. to ensure that lenses, diffusers and other fixture parts do not become detached and fall. This requirement applied to all parts of the fixture that may be detached by Owner's normal maintenance procedures, such as relamping and cleaning, and in instances where there is a possibility of misalignment during maintenance.

B. Plaster frames for plaster ceilings shall be with corrosion resistant finish.

2.02 HIGH INTENSITY DISCHARGE FIXTURES

A. Lamps: Schedule indicates either General Electric or ANSI designation. Provide as recommended by manufacturer to produce design performance with the furnished ballast.

B. Ballasts, unless otherwise noted, shall be high power factor, fused, auto-regulator type ballasts. Ballasts shall maintain light within plus or minus 10 percent of line voltage variation and a 40 percent input voltage variation dip for four (4) seconds.

2.03 FLUORESCENT FIXTURES

A. Lamps: Schedule indicates General Electric designation.

B. The design of lighting systems using F40 lamps is based on the following acceptable lamp/ballast combinations. One of these combinations shall be furnished for this project:

1.G.E. F40LW/RS/WMII lamp (3050L) with G.E. Maxi-Miser II ballast.

2. G.E. F40LW/RS/WMII lamp (3050L) with Advance Mark III ballast.

C. Air Handling Fixtures:

1. Air supply type to have side slots that will accept the boot specified in Division 15. Design values are up to 120 CFM per side. Cover side slots with removable black insert. When the insert is removed each fixture side slot shall be capable of returning 50 CFM at .02 inches of water negative static pressure.

2. For fixtures with plastic light diffusers and doors the heat extracting air flow through the lamp compartment shall be designed to provide at least 30 CFM at .02 inches of water negative static pressure. At this flow rate the air shall remove 60% of heat input as determined by IES Project 28 procedures.

3. All air handling fixtures shall be heat extract type.

PART 3 - EXECUTION

3.01 ACOUSTICAL CEILINGS

A. Securely mount and support all fixtures. Fixture support hanger wires, when installed in or to acoustical ceilings, shall be provided by the ceiling installer. Each fluorescent fixture shall be supported at all four corners with hanger wires capable of supporting twice the weight of fixture.

B. Verify that the acoustical ceiling suspension is installed and supported in accordance with manufacturer's specifications to carry the lighting fixtures before installing fixtures.

C. Cutting of acoustical tile to accommodate non-modular fixtures, including round and square incandescent units, shall be made under Section 09510 to tolerances required by the fixture that is to be installed.

D. Provide "earthquake clips" or similar and compatible devices to fasten fixtures to ceiling framing members.

E. Where batt insulation is installed above suspended ceiling, install 12" high spacers above recessed fixtures to keep batts spaced away from ballast compartment and punch approximately 4 square inch opening in insulation into ceiling space to ventilate space between fixture and insulation.

3.02 EXPOSED STRUCTURE

A. Fixture supports shall conform, as a minimum, to structural support provisions of Section 16010.

3.03 WIRING

A. Connections to individual fixtures or rows shall be made with flexible conduit, length to be between four (4) and six (6) feet. Fixtures shall be solidly grounded.

B. The outlet box to fixture conduit is considered a branch circuit and shall be #12 AWG minimum when more than two ballasts are connected to this "whip". For single fixture, and for up to two ballasts, the "whip" may contain fixture wires as permitted in NEC 1987, paragraphs 402-5 and 402-9.

3.04 FLOOD LIGHT AIMING

A. Adjustable flood lights shall be aimed after dark to Architect's satisfaction. After adjustment drill and install self-tapping stainless steel screws to lock adjustment brackets into place.

3.05 AIR HANDLING

A. Air handling fixtures, unless otherwise specified, shall be installed as follows:

1. Remove supply slot blank-off strips only where supply boots are to be installed. Support of boot shall be part of work under this section.
2. Leave heat extract dampers wide open.
3. When preliminary or final test and balance indicates the need for additional return air openings to the plenum, remove sufficient (but no more) supply slot blank-off strips.

END OF SECTION