DIVISION

16

ELECTRICAL

SECTION 16010 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. These specifications are intended to provide for labor, materials, equipment and services and of performing all operations required for the complete electrical system as specified herein and/or shown on the accompanying drawings.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of all sections of Division 16.

1.3 DESCRIPTION OF WORK

A. Summary: Electrical work includes, but is not limited to the following:

B. General Work: General work associated with electrical systems and equipment including conduit sleeves and supports, anchors, vibration and sound isolation, access panels, identification, record drawings, installation permits, tests, inspections by governing authorities, cutting-and-patching work, utility companies connections coordination, start-up of electrical systems and equipment, training of Owner's operating personnel, operating and maintenance manuals, final cleaning of electrical and similar work.

C. Wiring and Power Distribution: Panelboards, enclosures, electrical boxes, conduit systems, raceways, wires/cables, wiring devices, overload protective devices, equipment connections, grounding systems, and similar work, all as indicated on electrical drawings and elsewhere in contract documents.

D. Lighting: General light fixtures for interior lighting, emergency lighting and exit signs.

E. Special Electric Systems: Included are an empty conduit system for portions (as indicated) of a telephone system and data (computer) system.

1.4 MATERIALS AND EQUIPMENT

A. Materials and equipment shall conform in all respects to the requirements set forth in these specifications and the accompanying drawings. The Electrical Contractor shall furnish the items as specified or an equal as listed by addendum. Review of substitutions shall be requested in writing as described in the General Specifications and shall contain all data to indicate equality to what was specified.

B. Except as otherwise specified, materials and equipment shall be new and bear the

approval label of the Underwriters' Laboratories, Incorporated and all other standards specified herein.

1.5 PHASED CONSTRUCTION; SEQUENCING: Refer to Division-1 provisions for determination of how construction phasing and sequencing requirements may affect performance of electrical work.

1.6 ALTERNATES

A. There may be certain alternates involved in the construction. The Contractor is cautioned to be aware of and to provide appropriate adjustments for all alternates described in the specifications or on the drawings.

1.7 PERMITS, INSPECTIONS AND FEES

A. Obtain all necessary permits and work orders required and pay for all fees for such permits. Upon completion, a certificate of approval from the appropriate regulatory agency shall be finished to the architect. All fees for services to be paid for by the Electrical Contractor. Include all such fees in bid.

1.8 WARRANTY

A. The Electrical Contractor shall guarantee the work installed by him for one year from the date of final acceptance of the project and shall furnish free of cost to the Owner materials and labor necessary to repair or replace defective items of workmanship. The Electrical Contractor shall guarantee all equipment to be of the quality and capacity specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All electrical products on this project shall conform, unless otherwise specifically noted, to applicable standards of the National Electrical Manufacturer's Association and shall be listed by the Underwriter's Laboratories, Inc.

B. Where materials, equipment, apparatus or other products are specified by manufacturer, brand name or type, or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the bid. Except where noted, it is implied that "or approved equal" follows all specified items. Approved for substitutions will be granted by the Architect/Engineer to the Electrical Contractor only, through the General Contractor. where two or more designations are listed, choice shall be optional with the Contractor.

C. All materials shall be in accordance with associated specifications and drawings. Where equipment is specified by manufacturer, no substitutions shall be made

without prior approval by the Architect/Engineer. SUBSTITUTION REQUESTS SHALL BE SUBMITTED TO THE ARCHITECT/ENGINEER BY THE GENERAL CONTRACTOR AT LEAST TEN (10) CALENDAR DAYS PRIOR TO BID DATE. AS PERMITTED BY THE "OR APPROVED EQUAL" CLAUSE. IF REQUESTED BY THE ENGINEER/ARCHITECT THE CONTRACTOR SHALL SUBMIT FOR INSPECTION SAMPLES OF BOTH THE SPECIFIED AND THE PROPOSED SUBSTITUTE ITEM, THE TEN DAY DEAD LINE WILL BE INCLUSIVE OF SAMPLES SUBMITTAL.

D. Any bills of materials, conduit and wire schedules, etc., will be used for identification, type, and reference. It shall be the responsibility of the Contractor to determine exact quantities and components required to effect a complete job in accordance with drawings and associated specifications.

E. Equipment shall be installed in strict accordance with manufacturer's instructions. Contractor shall obtain these instructions and they shall be considered a part of these specifications. Contractor shall furnish instructions, operation, and maintenance instructions.

2.02 SUBSTITUTIONS

A. All material, equipment, methods, and accessories entering into the work under this section of contract are subject to the approval or disapproval of the A/E. Approval of any manufacturer, material, or product shall not constitute a waiver of A/E right to demand full compliance with contract requirements, including shape, size, quality, and performance.

B. Equality of materials is that established by the opinion of A/E. Decision of A\E is final.

C. Whenever a material or article of equipment is specified by use of a proprietary name, or by naming the manufacturer or vendor, an material or article which will perform adequately the duties imposed by the design will be considered for substitution, providing it is of equal substance, and function, meets specifications, and is aesthetically acceptable to the A\E. See division 1 for prior approval requirements.

D. Literature, technical data, etc., includes complete data and samples if necassary, with submissions for substitutions. Burden of proof that material offered for substitution is equal, or superior, in construction and efficiency to that named, rests on the Contractor, unless proof is satisfactory to A/E, substitution will not be approved.

E. Approval for substitutions will be granted by the Architect/Engineer to the Electrical Contractor, only through the General Contractor.

2.03 MATERIALS AND EQUIPMENT HANDLING

A. The Electrical contractor shall be responsible for receiving, unloading, storing, protecting from weather, theft, breakage, etc., all electrical equipemnt and material either purchases by the Contractor or furnished by others. The Contractor shall remove such material from storage and transport it to the site of erection when required for construction. The Contractor shall protect his own tools and any tools on loan from the Owner in a like manner. Also, the Contractor shall protect all equipment from accidental damage due to operating and maintenance activities that will be in progress in the same area.

PART - 3 EXECUTION

3.1 REGULATORY COMPLIANCE

A. All applicable sections of the NFPA (latest edition) including the NEC, ADA (Americans with Disabilities Act) latest edition, and all state and/or local codes or ordinances shall apply as minimum standards.

3.2 WORKMANSHIP

A. All workmanship shall be of the highest quality. Any work judged substandard by the architect shall be redone at the contractors expense.

END OF SECTION 16010

SECTION 16020 - ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Shop Drawings: As soon as practicable after the contract is let, in order that work under this contract will not be delayed, submit to the Architect, for review, complete descriptive and dimensional data on those items specified in sections that follow.

B. Shop drawings shall be furnished for the following items as a minimum:

1. Panelboards, Transformers
2. Lighting Fixtures & Lamps
3. Wiring Devices & Device Cover Plates
4. Safety and/or Disconnect Switches
5. Fuses
6. Grounding Equipment
7. Raceways and Fittings
8. Boxes
9. Wiring/Cables

C. Corrections or comments made on shop drawings during the review do not relieve this Contractor from compliance with requirements of the contract documents, plans and specifications. Shop drawings will be checked for general conformance with the design concept of the project and general compliance with information given in the contract documents. Review of the shop drawings shall not relieve the Contractor from responsibility for confirming and correlating all quantities and dimensions, coordinating his work with that of all other trades, and performing his work in a safe and satisfactory manner. Review of shop drawings shall not permit any deviation from plans and specifications.

D. Submit 7 copies of shop drawings.

1.2 EQUIPMENT MANUALS

A. Furnish three bound sets of descriptive, dimensional and parts data on:

1. Switchboard, Panelboards, Busways, Transformers
2. Lighting Fixtures with Lamp Data
3. Wiring/Cables
4. Wiring Devices and Device Cover Plates
5. Safety/Disconnect Switches
6. Fuses

1.3 DELIVERY, STORAGE AND HANDLING

A. Storage Coordination: It is recognized that space at project for storage of materials and products is limited. Coordinate deliveries of electrical materials and products with scheduling and sequencing of work so that storage requirements at project are minimized. In general, do not deliver individual items of electrical equipment to project substantially ahead of time of installation.

1.4 PROTECTION OF APPARATUS

A. At all times take precautions necessary to properly protect electrical equipment from damage. Failure to comply with the above to the Architect's satisfaction shall be sufficient cause for the rejection of the particular piece of apparatus in question.

PART 2 - PRODUCTS

2.1 ELECTRICAL PRODUCT COORDINATION

A. Power Characteristics: For all items requiring power provided in sections of Division 2 through 15, the Contractor is to verify all electrical requirements, including voltages, ratings and any other electrical characteristics with actual equipment to be furnished and adjust work as required to provide proper electrical service to the particular item at not extra cost to owner. Notify the Architect before starting work if changes from the work shown on the drawings will be necessary.

B. Coordination of Options and Substitutions: Where contract documents permit selection from several product options, do not proceed with purchasing until coordination of interface requirements has been checked and satisfactorily established.

C. Raceways, Wiring, Safety/Disconnect Switches, etc. for Equipment by Others: Electrical service required for all equipment furnished under Division 15 (Mechanical), 16 (Electrical), or other Divisions of this Specification shall be furnished and connected as part of this work. It is part of the work of this Division to obtain correct roughing-in dimensions and requirements for this equipment and provide labor, materials, equipment and services for a complete installation.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Substrate Examination: Installer of each element of electrical work shall examine

condition of substrate to receive work, and conditions under which work will be performed, and shall make notification of conditions detrimental to completion of work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Existing Facilities and Conditions: The Electrical Contractor shall visit the building sites to determine existing conditions and will be held responsible for allowing for these conditions in his bid. There will be no extra consideration for work discovered as being hidden after the bid, and no change orders for extra cost that may be caused by unknown conditions after bid conditions. This area of work may have existing storm drainage, mechanical and electrical utilities, etc. located underground and within and under the buildings. It is part of this work for the Electrical Contractor to determine the scope and location of all existing utilities and the scope and location of all new utilities to be installed concurrent with this project and arrange his work around others. Damages to existing utilities by the contractor shall be corrected by him at no additional compensation. Contractor shall call 1-800-272-3020 per Louisiana statutes.

C. Layout electrical work in conformity with contract drawings, coordination drawings and other shop drawings, product data and similar requirements, so that entire mechanical/electrical plant will perform as an integrated system, properly interfaced with other work.

D. Large and Heavy Equipment: Where possible, prearrange for movement and positioning of large equipment into building structure, so that enclosing walls and roofs will neither be delayed nor need to be removed. Otherwise, make notice of opening requirements to be maintained for subsequent entry of large equipment units.

3.2 CUTTING AND PATCHING

A. Structural Limitations: Do not cut structural framing, walls, floors, decks and other members which are load bearing, except with Architect's written authorization. Authorization will be granted only where there is no other reasonable method for completing electrical work, and where proposed cutting clearly does not materially weaken the structure.

B. Other Work: Do not endanger or damage other work through procedures and processes of cutting to accommodate electrical work. Review proposed cutting with Installers of the work to be cut, and comply with their recommendations to minimize damage. Where necessary, engage original Installer or other specialists to execute cutting in recommended manner.

C. Patching: Where patching is required to restore other work, because of cutting or other damage occurring during installation of electrical work, execute patching in manner recommended by original Installer. (Original Installer, where patching of finishes existing prior to beginning of work, refers to those performing similar work in areas of new construction.) Restore other work in every respect,

including elimination of visual defects in exposed finishes, as judged by Architect. Engage original Installer to complete patching of the following categories of work:

1. Lawns, planting and unit-type paving (brick, etc.).
2. Exposed concrete finishes.
3. Exposed masonry and stonework.
4. Exposed structural metal and ornamental metal.
5. Architectural woodwork.
6. Waterproofing and vapor barriers.
7. Roofing, flashing, and accessories.
8. Exterior wall systems.
9. Sprayed-on insulation and fireproofing.
10. Interior exposed finishes and casework, where judged by Architect to be difficult to achieve an acceptable match by other means.

3.3 COORDINATION OF ELECTRICAL INSTALLATION

A. Sequence, coordinate, and integrate various elements of electrical work so that electrical system will perform as indicated and be in harmony with other work of building. Architect will not supervise coordination, which is exclusive responsibility of Contractor.

B. Install raceways straight and true, aligned with other work, close to walls and overhead structure, concealed where possible in occupied spaces, and out-of-the-way with maximum passageway and headroom remaining in each space.

C. Arrange work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on wiring devices and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work. Locate operating and control equipment and devices for easy access. Maintain NEC code clearances around all electrical equipment.

D. Install access panels where electrical work requiring access is concealed by finishes and similar work. Access panels utilized shall be approved by the Architect.

E. Integrate electrical work in ceiling plenums, including lighting fixtures, with ceiling finish, suspension, ductwork, air diffusers and other work, so that required performances of each will be achieved.

F. Where work is in close proximity to the work of other contractors, the Electrical Contractor shall review plans of other contractors and coordinate his work with theirs. The Electrical Contractor shall verify the location of lighting fixtures, beams, structural members, conduit, ductwork, pipes or other obstructions before

beginning his work in the area. Notify the Architect where proper clearances do not occur or where the work of others would interfere with the safe and/or proper operation of this work. Give right-of-way in confined-service spaces to piping which must slope for drainage, and to larger HVAC ductwork and similar services which are less conformable than electrical services.

3.4 MOUNTING HEIGHTS

A. Unless otherwise noted on the drawings or required by the Architect, the following mounting heights shall apply. Heights are to center of device unless noted otherwise:

Toggle Switches	4' - 0"
Receptacles	1' - 6"
Telephone Outlets	1' - 6"
Motor Control Equipment	5' - 0"
Panelboards	6' - 6" to top (Not more than 5' - 6" from top most operating handling to floor.)
Computer Outlets	1' - 6"

B. Upon approval of the Architect, mounting heights may be adjusted to simplify cutting of concrete blocks in block walls or to facilitate furniture, base or cabinet arrangements. All mounting heights may be field adjusted by the Architect without any additional cost.

C. Wiring devices above counters and/or benches and/or shelves and/or lavatories shall be mounted as directed by architect.

D. All mounting heights may be adjusted in the field to reduce visibility at outside and in certain inside areas. Coordinate heights of all equipment with screen walls, fencing, other equipment, etc., and with Architect before rough-in. This will include wall and rack mounted equipment inside or outside. Verify all mounting heights with Architect prior to rough-in.

E. Where designated by the Architect or otherwise shown, those rooms that are equipped for use by the physically impaired (handicapped) or to be designated adaptive for that use shall have all receptacle, telephone, and computer outlets mounted with the bottom 15 inches above the floor minimum and switches and other rough-ins (such as thermostats, dimmers, etc.) mounted with the bottom no higher than 42 inches above the floor.

3.5 EQUIPMENT LABELS

A. Panelboards, safety switches, motor starters, and all other equipment shown on the drawings and furnished and/or installed under this section of the specifications shall be labeled with laminated plastic nameplates inscribed to identify equipment with description shown on the drawings for panels, the name of the equipment

controlled for motor starters, or the system of function involved for other equipment. Nameplates shall be black with white etched letters, 1/4" minimum size lettering.

B. Other labeling shall be furnished and installed as described elsewhere in these specifications.

3.6 DRAWINGS

A. Conform with arrangement indicated by contract documents, recognizing that portions of work are shown only in diagrammatic form.

B. These specifications and accompanying drawings are intended to describe complete workable systems of the various types. Items of materials, work, or equipment not mentioned, but normally necessary for the proper execution of this work, shall be provided as if specifically called for.

C. The drawings show approximate locations only of feeders, branch circuits, outlets, etc., except where specific routing or dimensions are indicated. The Architect reserves the right to make changes in locations indicated, before roughing-in, without additional cost to the Owner.

D. Because of the small scale of the drawings, it is not possible to indicate all of the offsets, fittings, pull/junction boxes and accessories required. Investigate the structural and finish conditions and arrange work accordingly, furnishing fittings, bends, junction boxes, pull boxes, access panels, and accessories required to meet such conditions.

E. Where coordination requirements conflict with individual system requirements, comply with the Architect's decision on resolution of conflict.

3.7 MECHANICAL WORK

A. Coordinate electrical work with mechanical work (Division 15) for proper service to each item of equipment requiring electrical connection. Determine, with each mechanical equipment installer, the proper sequencing and location for disconnect switches and similar points of interface between mechanical and electrical work.

B. Except as otherwise indicated, final power connections are electrical work.

C. Power Wiring associated with DIVISION 15 - MECHANICAL shall be done as work of this Division. Except as may be hereinafter indicated, control wiring and associated raceway system will be done as work of DIVISION 15 - MECHANICAL.

D. Work of other Divisions will include furnishing and setting motors, except that V-belt drive motors shall be set as work of this Division.

E. Unless indicated otherwise, magnetic starters (including variable speed drives, etc.) will be furnished under other Divisions for installation under this Division.

F. Overload elements in starters shall be selected according to actual motor nameplate full load current. Responsibility for this coordination shall lie with the Division under which the particular starter is furnished.

G. Unless indicated otherwise, power disconnect switches and single speed manual starting switches shall be furnished and installed under this Division. Where combination magnetic starters are provided as work of another Division, the associated disconnect switch will be furnished as work of that Division. Fuses shall be furnished and installed under Division 16. Disconnect switches for control wiring will be furnished and installed under DIVISION 15 - MECHANICAL.

H. Firestats for single phase fans will be furnished and set under DIVISION 15 - MECHANICAL, and electrically connected in the branch circuit wiring as work of this Division. Other control wiring, including temperature control wiring, high voltage interlocking, start-stop wiring, together with conduit for same, will be furnished and installed under DIVISION 15 - MECHANICAL; this includes, but is not limited to, thermostats, damper motors, aquastats, push buttons, selector switches, control power transformers, control panel, etc.

I. Refer to DIVISION 15 - MECHANICAL, and to mechanical drawings for any additional electrical power work required.

3.8 UTILITY CONNECTIONS

A. Coordinate connections of electrical systems, telephone system, with exterior power and telephone services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Pay any charges for installation of their facilities.

B. Electrical and telephone services for this work will be supplied by the local utility companies. Contact the utility company to schedule and arrange for their work to be done. Pay any utility company charges for the installation of their facilities, and make arrangements for final connection of the services. Electric service shall be installed, connected, and available for full use prior to completion or acceptance of the work.

3.9 SERVICE CONTINUITY

A. At all times during the construction of the project, services (power, telephone, fire alarm, etc.) shall be maintained to the site except with prior written approval of interruptions. Any required interruptions of services (power, telephone, fire alarm, etc.) due to work being performed under this contract shall be scheduled in advance after consultation with the Architect and the Owner.

B. At least 14 days prior to the requirement of any interruption of services, the Contractor shall furnish to the Architect for approval a written plan for the work associated with the outage including a description of the installation and removal of temporary wiring and facilities necessary to be installed.

3.10 EQUIPMENT LAYOUT

A. The physical location and arrangements of electrical equipment is shown on the plans and is to be used by the Electrical Contractor to review the Plans with the proposed equipment and equipment of other contractors that are affected, and to insure that all Code required clearances, wiring distances and maintenance accesses, including equipment heights, of all items are maintained. Alternate arrangements to accomplish the above due to field conditions or changes in physical size of the equipment proposed for the project are to be submitted to the Architect for review before any work is begun or equipment ordered. The alternate arrangement is to be presented in a 1/4 inch scaled drawing showing all equipment, including those of other contractors. Include shop drawing cut sheets and applicable information. Indicate on the drawing by dimension all required Code clearances, wiring distances and maintenance access requirements. Where equipment heights are required to be coordinated with architectural or other items, indicate revised heights.

END OF SECTION 16020

SECTION 16040 - ELECTRICAL WORK CLOSEOUT

PART 1 - GENERAL

1.1 RELATED WORK

A. Removal of Temporary Facilities: Refer to Division-1 sections for termination and removal of electrical temporary facilities.

1.2 DOCUMENTATION PROCEDURES

A. Security and Protection: During electrical work closeout phase, meet with Owner's operating representative frequently and agree upon status of operational responsibility for electrical systems, including security provisions to prevent unauthorized operations, and including protective measures to ensure that systems are not neglected or misused.

1.3 RECORD DRAWINGS

A. Explanation: Except where otherwise indicated, electrical drawings (contract drawings) are diagrammatic in nature and may not show locations accurately for various components of electrical systems. Shop drawings prepared by Contractor show certain portions of work more accurately to scale and location, and in greater detail. It is recognized that actual layout of installed work may vary substantially from both contract drawings and shop drawings.

B. General Recording Procedure: Maintain white-print set (blue-line or black-line) of electrical contract drawings and shop drawings in clean, undamaged condition, for mark-up of actual installations which vary substantially from work as shown. Mark-up whatever drawings are most capable of showing installed conditions accurately; however, where shop drawings are marked, record reference note on appropriate contract drawing. Mark with erasable pencil, and use multiple colors to aid in distinguishing between work of separate electrical systems. In general, record every substantive installation of electrical work which previously is either not shown or shown inaccurately, but in any case record the following:

1. Underground conduits both interior and exterior, drawn to scale and fully dimensioned.
2. Work concealed behind or within other work, in a non-accessible arrangement.
3. Mains and branches of wiring systems, with switchboards, panelboards, and control equipment and devices located and numbered.
4. Scope of each change order, denoting addendum or C.O. number.
5. Grounding systems.

C. Corrected Drawings: Prior to transmittal of record drawings; obtain a set of erasable mylar transparent prints for each contract drawing and shop drawing set which has been used to record installed conditions. Erase incorrect information,

and transfer information marked on record drawing prints onto transparencies. Transmit corrected drawings (transparencies) as submittal to Architect for Owner's use and record.

PART 2 - PRODUCTS (not applicable.)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. General Condition: Refer to Division-1 sections for coordination of electrical closeout work with variable loads on electrical systems. Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.

B. System Performance Test Runs: Coordinate test runs of electrical systems with test runs of equipment served thereby (heating, air conditioning, plumbing, elevators, etc.). Check each item in each system to determine that it is set for proper operation. With Owner's Representative and Architect present, operate each system in test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of systems to refine and improve performances where possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as requested for Architect's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible.

C. Cleaning: After final performance test run of each electrical system, clean system both externally and internally. Touch-up minor damage to factory-painted finishes; refinish work where damage is extensive.

D. General Operating Instructions: Provide general operating instructions for each operational system and equipment item of electrical work. Coordinate instructions with instructions for mechanical work and other equipment where associated with electrical systems or equipment.

E. Maintenance Manuals: Display and conduct "thumb-through" explanation of maintenance manuals, record drawings, spare parts inventory, storage of extra materials, meter readings and similar service items.

F. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installer's tools, test facilities, construction equipment and similar devices and materials used in execution of work but not incorporated in work.

END OF SECTION 16040

SECTION 16045 - ELECTRICAL RELATED WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of CONCRETE Section apply to the work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of electrical related work required by this section is indicated on drawings and schedules, and/or specified in this or other Division-16 sections, and/or as required by applicable codes or project field conditions.

B. Types of electrical related work specified in this section include the following:

1. Access to Electrical Work:

Access doors in walls and ceilings.
Removable cover plates in walls and ceilings.

2. Concrete for Electrical Work:

Patching concrete which has been cut to accommodate electrical work.

3. Painting of Electrical Work:

Except as specified for individual items of equipment, painting of electrical work is not part of this work.

1.3 QUALITY ASSURANCE

A. Access Units Fire-Resistance Ratings: Where fire-resistance ratings are indicated for construction penetrated by access units, provide UL listed and labeled units, except for units which are smaller than minimum size requiring ratings, as recognized by governing authority.

1.4 SUBMITTALS: None required.

PART 2 - PRODUCTS

2.1 ACCESS TO ELECTRICAL WORK

A. Access Doors: General: Where floors, walls and ceilings must be penetrated for access to electrical work, provide types of access doors indicated by project conditions, including floor doors if any. Furnish sizes indicated or, where not

otherwise indicated by project conditions, furnish adequate size for intended and necessary access. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.

B. Access Door Construction: Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth; 16-gage frames and 14-gage flush panel doors, 175 degree swing with concealed spring hinges; flush screw-driver-operated cam locks; factory-applied rust-inhibitive prime-coat paint finish.

C. Removable Access Plates: General: Where switches, control devices, pull boxes, and similar elements of electrical work are located within or behind wall or ceiling construction of finishes, or below grade, and are not (cannot be) provided with integral removable access plates as specified in other Division-16 sections, provide removable access plates of types and sizes needed for access requirements. Provide manufacturer's complete units with anchorages, fasteners, and standard factory-applied finishes.

D. Wall/Ceiling Unit Construction: Except as otherwise indicated, and where adaptable to substrate, provide manufacturer's standard frameless round formed stainless steel or chrome-plated brass low-profile plate cover, with single exposed flush screw anchor, with bright polished finish.

E. Units Set at Grade: Except as otherwise indicated, provide manufacturer's standard round or square cast-iron units, complete with cast-iron pipe extension to protect electrical element being accessed; designed to be set slightly above finish grade, and to be encased in concrete; secure plate to body with bronze screws; natural mill finish on plate and body.

PART 3 - EXECUTION

3.1 ACCESS TO ELECTRICAL WORK

A. Install access units in accordance with manufacturer's written instructions, in compliance with NEC, and with recognized industry practices.

B. Coordinate with other work, including substrate construction work, as necessary to interface installation of access units with other work.

C. Locate each removable access unit accurately in relation to electrical work requiring access.

D. Provide adequate temporary support or attachment to framing or formwork so that units will not be dislocated during construction of substrates.

E. Set frames accurately in position and securely attach to supports with face panels

SECTION 16045 - ELECTRICAL RELATED WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of CONCRETE Section apply to the work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of electrical related work required by this section is indicated on drawings and schedules, and/or specified in this or other Division-16 sections, and/or as required by applicable codes or project field conditions.

B. Types of electrical related work specified in this section include the following:

1. Access to Electrical Work:

Access doors in walls and ceilings.
Removable cover plates in walls and ceilings.

2. Concrete for Electrical Work:

Patching concrete which has been cut to accommodate electrical work.

3. Painting of Electrical Work:

Except as specified for individual items of equipment, painting of electrical work is not part of this work.

1.3 QUALITY ASSURANCE

A. Access Units Fire-Resistance Ratings: Where fire-resistance ratings are indicated for construction penetrated by access units, provide UL listed and labeled units, except for units which are smaller than minimum size requiring ratings, as recognized by governing authority.

1.4 SUBMITTALS: None required.

PART 2 - PRODUCTS

2.1 ACCESS TO ELECTRICAL WORK

A. Access Doors: General: Where floors, walls and ceilings must be penetrated for access to electrical work, provide types of access doors indicated by project conditions, including floor doors if any. Furnish sizes indicated or, where not

otherwise indicated by project conditions, furnish adequate size for intended and necessary access. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.

B. Access Door Construction: Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth; 16-gage frames and 14-gage flush panel doors, 175 degree swing with concealed spring hinges; flush screw-driver-operated cam locks; factory-applied rust-inhibitive prime-coat paint finish.

C. Removable Access Plates: General: Where switches, control devices, pull boxes, and similar elements of electrical work are located within or behind wall or ceiling construction of finishes, or below grade, and are not (cannot be) provided with integral removable access plates as specified in other Division-16 sections, provide removable access plates of types and sizes needed for access requirements. Provide manufacturer's complete units with anchorages, fasteners, and standard factory-applied finishes.

D. Wall/Ceiling Unit Construction: Except as otherwise indicated, and where adaptable to substrate, provide manufacturer's standard frameless round formed stainless steel or chrome-plated brass low-profile plate cover, with single exposed flush screw anchor, with bright polished finish.

E. Units Set at Grade: Except as otherwise indicated, provide manufacturer's standard round or square cast-iron units, complete with cast-iron pipe extension to protect electrical element being accessed; designed to be set slightly above finish grade, and to be encased in concrete; secure plate to body with bronze screws; natural mill finish on plate and body.

PART 3 - EXECUTION

3.1 ACCESS TO ELECTRICAL WORK

A. Install access units in accordance with manufacturer's written instructions, in compliance with NEC, and with recognized industry practices.

B. Coordinate with other work, including substrate construction work, as necessary to interface installation of access units with other work.

C. Locate each removable access unit accurately in relation to electrical work requiring access.

D. Provide adequate temporary support or attachment to framing or formwork so that units will not be dislocated during construction of substrates.

E. Set frames accurately in position and securely attach to supports with face panels

plumb or level in relation to adjacent finish surfaces.

F. Adjust hardware and panels after installation for proper operation.

G. Remove and replace panels or frames which are warped, bowed, or damaged.

3.2 INSTALLATION OF CONCRETE WORK

A. Formwork: General: Design, construct, and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be of required size and shape and in required location. Construct formwork with joints which will not leak cement paste. Form sides and bottoms of concrete work, except where clearly indicated to be cast directly in an excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.

END OF SECTION 16045

SECTION 16110 - RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of raceways is as required by the equipment served, as indicated by drawings and schedules and/or as required by project.

B. Types of raceways in this section include the following:

1. Rigid metal conduit and fittings.
2. Electrical metallic tubing and fittings.
3. Flexible metal conduit and fittings.
4. Liquid-tight flexible metal conduit and fittings.
5. Non-metallic conduit and fittings.

1.2 QUALITY ASSURANCE

A. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

B. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled.

C. NEC Compliance: Comply with requirements as applicable to construction and installation of raceway systems.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated.

B. Rigid Steel Conduit: Galvanized heavy wall, non-intermediate, FS WW-C-0581 and ANSI C80.1.

C. Rigid Metal Conduit Fittings: FS W-F-408 and ANSI/NEMA FB1; threaded type.

D. Electrical Metallic Tubing (EMT): FS WW-C-563 and ANSI C80.3.

E. EMT Fittings: ANSI/NEMA FB1; steel or malleable iron, compression type.

F. Flexible Metal Conduit: FS WW-C-566, Zinc-coated steel, listed as an assembly for grounding as per NEC 250-91B.

G. Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 1, and Style A; ANSI/NEMA FB1, listed as an assembly for grounding as per NEC 250-91B.

H. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; constructed of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanize inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).

I. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 3, Style G; ANSI/NEMA FB1.

2.2 NONMETALLIC RACEWAYS AND FITTINGS

A. General: Provide nonmetallic conduit and fittings of types, sizes and weights (wall thicknesses) for each service indicated.

B. Non Metallic Conduit: NEMA TC2, schedule 40 Polyvinyl chloride (PVC), 90 degrees C and U.L. listed except that for telephone and cable TV the non metallic conduits may be equal to type EB, U.L. listed with concrete encasement and type DB U.L. listed where concrete encasement is indicated to be deleted.

C. Non Metallic Conduit Fittings & Conduit Bodies: ANSI/NEMA TC 3, solvent welded match to conduit type and material.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.

B. Coordinate with other work including concrete deck work, as necessary to interface installation of electrical raceways and components with other work.

C. Level and square raceway runs, and install at proper elevations/heights.

D. Route exposed raceways and raceways above accessible ceilings parallel and perpendicular to walls and adjacent piping.

E. Complete installation of electrical raceways before starting installation of cables/wires within raceways.

F. Wherever possible, install horizontal raceway runs above water piping.

G. Cut square and ream ends of all raceways. Cap open ends of raceways until

conductors are installed. Install a #14 gauge fish wire in all empty raceways except telephone or communication system. Install a nylon pull string in telephone or communication system raceways.

H. Raceways which must cross building expansion joints shall, where practicable, cross same in furred ceilings areas rather than in slabs or walls, arranged with sufficient flexibility to accommodate the building expansion. However, where such routing is not possible, expansion fittings as manufactured by OZ Electrical Manufacturing Company shall be provided in each raceway in concrete or attached to the structure whenever the raceway crosses an expansion joint in the concrete structure. Expansion fitting shall be installed on one side of the joint with its sliding sleeve end flush with the joint and with a length of bonding jumper in the expansion joint equal to at least three times the normal width of the joint. Each expansion fitting shall be zinc-coated steel and contain heavy factory installed packing and internal copper braid packing and shall be complete with UL approved bonding jumper.

I. Where raceways penetrates fire-rated walls and floors, seal opening around conduit with UL listed caulk or foam silicone elastomer compound.

J. Furnish and install pull boxes and wiring/cable supports as required for installation of wiring. Boxes shall be code gauge galvanized steel with screw attached access panels in top, side or bottom, as required. Boxes shall be NEMA type as required by box location.

K. Upon completion of installation of raceways, inspect interiors of raceways; remove burrs, dirt and construction debris.

L. Packaged flexible conduit/wire systems ("BX" systems) are not allowed.

M. Where they enter boxes or cabinets that do not have threaded hubs, conduits shall be secured in place with galvanized locknuts inside and outside the cabinet and shall have bushings inside. All raceways ends, including those for empty conduit, are to have bushings.

N. All raceways shall be installed concealed or as indicated or scheduled on the drawings and shall be of sufficient size to accommodate the required number of insulated conductors including insulated equipment grounding conductors.

O. Raceways runs shall be straight; elbows and bends shall be uniform, symmetrical and free from dents or flattening.

P. Conduits shall be located to avoid any conflicts with ceiling inserts shown on the Architectural drawings. Such inserts shall not be used for suspension of conduit installed by the Electrical Contractor. Additional inserts shall be provided by the Electrical Contractor as required for installation of conduit as specified herein.

Q. Conduit shall be run no closer than six inches to covering of hot water, steam or

process piping except where crossings are unavoidable. Conduit shall be kept at least 1 inch from covering of pipe crossed. Where several conduits (concealed and/or exposed) are run parallel to each other, they shall be grouped together on galvanized strut, with suitable clamps, which shall be attached to the wall or hung from the roof or structural ceiling. Where exposed conduit is indicated, the conduit shall be installed parallel with or at right angles to the building walls and/or ceiling (roof) and shall be supported adequately by pipe straps or other approved devices. Where a single conduit is run exposed in a damp and/or wet location, Mineralac straps of the type which permit a 1/4" air space between the conduit and the wall should be used. All raceway fasteners shall be approved for the purpose (tie wire shall not be used).

R. Conduit shall be held securely in place by hangers and fasteners of appropriate design and dimensions for the particular application. Support shall be such that no strain will be transmitted to outlet box and pull box supports. Wire shall not be used for the support of any conduit. Conduit shall not be supported by or attached to ductwork unless specifically allowed otherwise.

S. Where flexible conduit is called for, only steel flexible conduit and fittings that are specifically listed as an assembly for grounding shall be allowed as per NEC 250-91B. For lighting fixture wiring, do not loop from fixture to fixture with flexible conduit. See "Lighting" section. All flexible conduit must have a separate grounding conductor run the entire length of the circuit. This shall include all lighting, power and receptacle circuits unless otherwise noted.

3.2 RACEWAY INSTALLATION SCHEDULE

A. Underground Installations: Use rigid steel conduit or PVC conduit. Conduits installed underground shall be concrete encased. Conduit rising from horizontal underground or in slab runs shall have rigid steel conduit risers, ells and bends. Conduits installed under building slab on grade elevation shall be buried under the vapor barrier out of the concrete pour and a minimum of 12" below the top of slab and shall be concrete encased.

B. In Slab: Rigid steel conduit, 3/4" maximum size. Conduit in concrete slabs shall be located so as not to affect the structural strength of the slabs. Conduit in general shall be located in the center 1/3 thickness of concrete slabs and when installed in slabs poured on grade or fill shall have at least one inch of concrete between conduit and plastic or other waterproof membrane; conduit shall not be installed under the plastic or other waterproof membrane unless it is to be installed □In fill beneath slab□ in which case the installation shall meet the requirement indicated heretofore. The maximum size of conduit that may be run in a slab shall be as directed by the Architect. Conduit larger than 3/4", if permitted in reinforced concrete slabs, shall be parallel with or at right angles to the main reinforcement; when at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab.

C. Concrete envelopes under structural slabs shall be adequately supported from the

slab using 3/8" diameter stainless steel rods properly spaced (not greater than 5' - 0" spacing between rods) to support the load and to suitably distribute the load within the capacity of the structural slab. Exposed sections of rods shall be coated with waterproof mastic.

D. Outdoor Locations, Above Grade: Rigid steel conduit.

E. Wet & Damp Interior Locations: Rigid steel conduit.

F. Dry Interior Locations: Electrical metallic tubing.

G. Use flexible metal conduit for final connections to motors, dry type transformers, and for other electrical equipment subject to movement or vibration - 24" maximum length each connection.

H. Install liquid-tight flexible conduit for connection of motors and for other electrical equipment (24" maximum length) where subject to movement and vibration and also where subject to one or more of the following conditions:

1. Exterior location.
2. Moist or humid atmosphere where condensate can be expected to accumulate.
3. Subjected to water spray.
4. Subjected to dripping oil, grease, or water.
5. Mechanical Equipment Room containing chillers or pumps.

END OF SECTION 16110

SECTION 16120 - WIRES AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electrical wire and cable work is indicated by drawings and schedules and/or as required by project.

B. Types of electrical wire, cable, and connectors specified in this section include the following:

1. Copper conductors.
2. Fixture wires.

C. Applications of electrical wire, cable, and connectors required for project are as follows:

1. For power distribution circuits.
2. For lighting circuits.
3. For appliance and equipment circuits.
4. For motor-branch circuits.

1.2 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.

B. UL Compliance: Provide wiring/cabling and connector products which are UL listed and labeled.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Handle wire and cable carefully to avoid abrasing, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

PART 2 - PRODUCTS

2.1 WIRES, CABLES, AND CONNECTORS

A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide soft annealed copper conductors per ASTM B-3 with conductivity of not less than 98% at 20 degrees C (68 degrees F). Wires shall be of the single conductor type.

Conductors used for lighting and power sizes 10 AWG and smaller shall be solid. Sizes 8 AWG and larger shall be stranded. Conductors used for control or signaling sizes 10 AWG and smaller may be stranded.

B. Building Wires: Provide UL listed, factory-fabricated wires of sizes, ampacity ratings, and materials, for applications and services indicated. Wiring shall comply with project's installation requirements, NEC, ICEA and NEMA standards. Wiring shall be combination type THHN/THWN for dry and wet locations; max operating temperature 75 degrees C (167 degrees F) for wet locations and 90 degrees C (194 degrees F), for dry locations; Flame-retardant, moisture and heat resistant, thermoplastic insulation; Nylon jacket outer covering; Annealed copper conductor.

C. Fixture Wires: Fixture wires shall be of a type listed in Table 402-3 of the NEC, and they shall comply with all the requirements of that table.

D. Connectors General: Provide UL type factory fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards.

E. Wiring utilized in hazardous areas shall be in accordance with Articles 500, 501 & 514 of the National Electrical Code.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires and wiring connectors indicated, in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.

C. Unless specifically noted otherwise, install all wiring in raceways.

D. Pull conductors simultaneously where more than one is being installed in same raceway.

E. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.

F. Use pulling means, including fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway.

G. Throughout the system, conductors shall be identified by color coding as follows:

3Ø 480V System	3Ø 208 (or 240V)* System	1Ø 240V System
Phase 1-Brown	Phase 1-Black	Line 1-Black
Phase 2-Orange	Phase 2-Red	Line 2-Red
Phase 3-Yellow	Phase 3-Blue	Neutral-White
Neutral-Gray	Neutral-White	

* Stinger shall be orange per N.E.C.

H. Color coding shall be the same continuous color for each conductor for sizes No. 10 AWG and smaller.

I. On sizes 8 AWG and larger, identification shall be by standard electrical color coding tape at all termination junction, splice and pull locations.

J. Surface printing at regular intervals shall indicate manufacturer, size, voltage, insulation type and UL label.

K. White or gray colored insulation shall only be used for grounded (neutral) conductors.

L. Green colored insulation shall only be used for equipment grounding conductors. Insulation for isolated equipment grounding conductors shall be green with yellow tracers.

M. Unless noted otherwise, no wire shall be smaller than No. 12 for power or lighting service or for switch legs. Wire for each branch circuit shall be of a single size and type from the branch circuit protective device to the last outlet on the circuit unless noted otherwise.

N. Branch circuit home run numbers shown on the drawings shall be used as a guide for connection of circuit wiring to similarly numbered protective devices in branch circuit panelboards. Not more than three phase wires and one neutral shall be installed in any home run conduit unless otherwise specifically shown on the drawings.

O. Where the length of a home run, from panel to first outlet, exceeds 75 feet for 120 volt circuit or 175 feet for 277 volt circuits, the conductor size shall be No. 10 AWG or that shown on the drawings, whichever is larger. Additional increases in wire sizes shall be made as required to avoid excessive voltage drops.

P. All splices and terminations shall be insulated in an approved manner by an integral or separate cover or by taping to provide insulating value equal to that of

the conductors being joined.

Q. Feeders, motor circuit conductors and main service entrance conductors shall run their entire length without joints or splices.

R. Splices and joints in branch circuit wiring shall be made only at outlets or in accessible junction boxes. Joints and splices in branch circuit wiring shall be made with compression type solderless connectors or spring loaded, tapered, screw on type insulated units. Terminations or splices for conductors No. 6 AWG and larger shall utilize bolted or compression type connecting lugs. Compression type lugs shall be a factory supplied package made with a hydraulic type compression device approved by the lug manufacturer.

S. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std. 486A and B.

T. Type THWN or THHN conductors may be connected directly to recessed fixtures only when the fixtures are equipped with factory approved and supplied outlet boxes listed by Underwriters Laboratories, Inc. for use with wire having insulation rated for maximum operating temperatures of 75 degrees C (167 degrees F); otherwise, for fixtures not rated for 75 degree C direct connection, use approved high temperature insulated conductors from the fixture to a separate outlet box placed at least one foot, but not more than four feet, from the fixture.

U. An insulated equipment, grounding conductor (green insulation) shall be installed within the raceway with branch circuit and feeder conductors. Grounding conductor shall be sized in accordance with N.E.C. unless noted otherwise.

V. Conductor sizes shall be increased as required to compensate for derating of conductor ampacities due to number of current carrying conductors in raceways and ambient temperatures. Raceway sizes shall be increased where conductor sizes are increased.

3.2 FIELD QUALITY CONTROL

A. Prior to energization, test wires and cables for electrical continuity and for short circuits.

B. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 16120

SECTION 16135 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electrical box and associated fitting work is indicated by drawings and/or as required by project.

B. Types of electrical boxes and fittings specified in this section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. Bushings.
5. Locknuts.
6. Knockout closures.

1.2 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.

B. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and labeled.

C. NEMA Compliance: Comply with applicable requirements of NEMA Stds./Pub No.'s OS1, OS2 and Pub 250 pertaining to outlet and device boxes, covers and box supports.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions and compliance with the specifications on outlet boxes, pull boxes and floor boxes.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

A. Outlet Boxes (concealed conduit): Provide galvanized coated flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as required by particular application, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening

surface and device type box covers, and for equipment type grounding.

B. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations.

C. Device Boxes (concealed conduit): Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes suitable for installation at respective locations. Device boxes for switches, receptacles, telephone, computer, and communications shall be not less than 4" square and 1-1/2" deep with box extension ring as required by number of devices served. Construct device boxes for flush mounting with mounting holes, and with conduit size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide corrosion resistant screws for equipment type grounding.

D. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations.

E. Outlet and Device Boxes (exposed conduit): Provide corrosion resistant cast metal raintight outlet and wiring device boxes, of types, shapes and sizes required for each application, including depth of boxes, with threaded conduit holes for fastening electrical conduit, and cast metal face plates. Where weatherproof devices are indicated, provide spring hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion resistant plugs and fasteners.

F. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation.

G. Bushings, Knockout Closures, and Locknuts: Provide corrosion resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's

"Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide weathertight outlet boxes for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install electrical boxes in those locations required to ensure ready accessibility to enclosed electrical wiring.

F. Avoid installing boxes back-to-back in walls. Provide not less than 12" separation.

G. Position recessed outlet boxes accurately to allow for surface finish thickness.

H. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

I. In walls or ceilings of concrete, tile, or other noncombustible material, boxes and fittings shall be so installed that the front edge of the box or fitting will not set back of the finished surface more than 1/4". In walls or ceilings constructed of wood or other combustible material, outlet boxes and fittings shall be set flush with the finished surface. If a fixture canopy or pan is used as an outlet box cover, any combustible wall or ceiling finish between the edge of the canopy and the outlet box shall be covered with noncombustible material.

3.2 GROUNDING

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION 16135

SECTION 16142 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of electrical connections for equipment is indicated by drawings and schedules and/or as required by project. Provide connections for all equipment furnished or installed as part of this work.

B. Make final electrical connections for all kitchen and laundry equipment shown on the drawings whether or not such equipment is furnished as part of this work.

C. Refer to Division-15 sections for motor starters and controllers furnished integrally with equipment.

D. Refer to Division 15 sections for motor starters and controllers finished under Division 15 and installed under Division 16.

E. Refer to Division-15 sections for control system wiring, raceways, boxes, etc.

1.2 QUALITY ASSURANCE

A. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

B. IEEE Compliance: Comply with Std. 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

C. UL Compliance: Comply with UL Std. 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors". Provide electrical connection products and materials which are UL listed and labeled.

PARTS 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated and/or required, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete the work. This includes disconnect switches and/or wiring devices where required whether or not shown on the drawings.

B. Connectors and Terminals: Provide electrical connectors and terminals which

mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

C. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wire nuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway, and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 16142

SECTION 16143 - WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of wiring device work is indicated by drawings and schedules.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles.
2. Switches.
3. Coverplates.

1.2 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.

PARTS 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES

A. General: Provide factory-fabricated wiring devices, in types and electrical ratings for applications indicated and which comply with NEMA Stds. Pub. No. WD 1. The color of device shall be as selected by the Architect.

B. Wiring Devices: Wiring devices shall be as listed in the following table, or approved equal:

Single Pole Toggle Switch, silent actuating 20A, 120 or 277 volt rating as required:

G.E.	5951 series
Hubbell	1221 series
Leviton	1221 series
P&S	20AC series
Eagle	2221 series
Bryant	4901 series

Receptacles, Duplex, 20A, 125V, 3W, grounded frame (NEMA 5-20R):

G.E.	5362 series
Hubbell	5362 series
Leviton	5362 series
P&S	5362 series
Eagle	5362 series

	Bryant	5362 series

Self-Contained, Ground Fault Interrupting Duplex Receptacle (15A -125V, 20A feed through recessed mount with matching faceplate).

G.E.	TGTR215 series
Hubbell	GF5262 series
Leviton	6599 series
P&S	1591-FI series
Eagle	666-2 series
Bryant	GFR52FT series

Floor Outlets

Hubell/Walker	Combination Power/Data W/ Flush Floor Brass Coverplates

2.2 WIRING DEVICE ACCESSORIES

A. Coverplates: Unless otherwise specified, all outlets including telephone and data (computer) outlets shall be fitted with coverplates. Coverplates shall be standard size, uniform in design and finish for switches, receptacles and other outlets requiring coverplates. Plates shall be one piece of the required number of gangs. Where plates require special identification, such plates shall be factory etched in a contrasting color. Plates shall be non conductive flexible nylon or Lexan. Use Type 302 non-magnetic brushed finish stainless steel on concrete or masonry construction. Color shall be as specified or as selected by Architect.

B. Where weatherproof receptacles are indicated, provide with a hinged outlet cover/enclosure clearly marked □suitable for wet locations while in use□ and □UL Listed.□ There must be a gasket between the enclosure and the mounting surface, and between the hinged cover and mounting plate/base to assure proper seal. Unless otherwise indicated on the drawings, outlet box for weatherproof receptacles shall be mounted with long axis horizontal.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

A. Install wiring devices as indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.

D. Install wiring devices in flush mounted outlet boxes after wiring work is completed.

E. Install coverplates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A. Use properly scaled torque indicating hand tool.

G. All 20A/2 pole, 3-wire receptacles shall be mounted with a □U□ shaped grounding connection at the top, except for weatherproof receptacles.

H. Where duplex receptacles are indicated to be located as required for electric water cooler, they shall be located where indicated on electric water cooler shop drawings. All receptacles within 5 feet of water source shall be GFCI type, exposed electric water cooler receptacles shall be GFCI type.

I. Where indicated tamperproof hardware shall be used. The Contractor shall furnish two tools for each type of tamperproof hardware.

J. Use multi-gang plates where switches, receptacles, and/or devices are grouped.

K. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16" from the vertical or horizontal.

L. Plates for devices fed with exposed conduit shall be metal industrial type surface.

M. Wherever a series of switches or pilot lights and switches are grouped, the plates shall be furnished with suitable factory engravings (black filled). Where engraving of dimmer switch plates is impractical, engraved phenolic strips may be installed. Engraving shall indicate function/location names not subscript shown on drawings (name shall be approved by Architect).

3.2 PROTECTION OF COVERPLATES AND RECEPTACLES

A. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING

A. Provide equipment grounding connections for wiring devices, unless otherwise

indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.4 TESTING

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 16143

SECTION 16170 - DISCONNECT SWITCHES FOR SERVICES, CIRCUITS AND MOTORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of service, circuit and motor disconnect switch work is indicated on drawings and/or as required for project.

1.2 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.

B. UL Compliance: Comply with requirements of UL 98, "Enclosed and Dead-Front Switches". Provide circuit and motor disconnect switches which have been UL listed and labeled.

C. Special Use Markings: Provide safety/disconnect switches constructed for special use, with appropriate UL marks which indicates that special type of use/application. Switches used as service entrance equipment shall be provided with UL markings indicating □Suitable for use as service entrance equipment.□

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on service circuit and motor disconnect switches.

1.4 DRIP SHIELDS

A. A drip shield shall be installed at each disconnect switch located in a room on space containing sprinkler head. The shield shall be installed in such a manner as to prevent water damage to the electrical equipment due to a leak in the sprinkler system.

PART 2 - PRODUCTS

2.1 FABRICATED SWITCHES

A. Disconnect Switches: Provide heavy duty surface mounted, sheet-steel enclosed switches, of types, sizes and with fusing and other electrical characteristics indicated or required; rated 240 and/or 600 volts as required, 60 Hz, with blades, and poles as required; disconnects shall incorporate spring assisted, quick-make, quick-break switches which are so constructed that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable, and is

capable of being padlocked in OFF position. All switches shall have a neutral bar and equipment grounding it for terminating equipment ground conductors. Construct current carrying parts of high-conductivity plated copper. Unless noted otherwise, provide NEMA Type 1 enclosures for interior use and NEMA Type 3R enclosures for exterior use. Provide rejection kit for switches so that all fuses are rejected except for Class R fuses. Switches shall be as manufactured by Square D, General Electric, Westinghouse, Siemens or approved equal.

2.2 FUSES FOR FUSIBLE SWITCHES

A. Fuses for safety switches protecting panel boards shall be UL listed Type Class RK-1 with time delay feature. Fuses 601 amps or larger shall be UL listed Class L with time delay feature. All other fuses shall be dual element time delay type UL listed Type Class RK-1.

PART 3 - EXECUTION

3.1 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Install service, circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Install disconnect switches for use with motor-driven appliances, and motors and controllers within sight of controller position.

3.2 GROUNDING

A. Provide equipment grounding lugs in all switches with connections, sufficiently tight to assure a permanent and effective ground.

3.3 FIELD QUALITY CONTROL

A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

END OF SECTION 16170

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of supports, anchors, sleeves and seals is indicated by drawings and/or specifications and/or as required by project.

B. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. Clevis hangers.
2. Riser clamps.
3. C-clamps.
4. I-beam clamps.
5. One-hole conduit straps.
6. Two-hole conduit straps.
7. Round steel rods.
8. Lead expansion anchors.
9. Toggle bolts.
10. Wall and floor seals.

C. Supports, anchors, sleeves, and seals furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-16 sections.

1.2 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical supporting devices.

B. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA Std. Pub. No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies".

C. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.

D. UL Compliance: Provide electrical components which are UL listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES, ANCHORS, SLEEVES AND SEALS

A. General; Provide supporting devices; complying with manufacturer's standard

materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified and/or as required. Where more than one type of device meets indicated requirements, selection is Installer's option.

B. Supports: Provide supporting devices of types, sizes, and materials indicated; and having the following construction features:

1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with 1/2" diameter hole for round steel rod; approximately 54 pounds per 100 units.
2. Riser Clamps: For supporting 4" rigid metal conduit; black steel; with 2 bolts and nuts, and 4" ears; approximately 51 pounds per 100 units.
3. C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 pounds per 100 units.
4. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
5. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
6. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.
7. Round Steel Rod: Black steel; 1/2" diameter; approximately 67 pounds per 100 feet.
8. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

C. Anchors: Provide anchors of types, sizes and materials indicated; and having the following construction features:

1. Lead Expansion Anchors: 1/2" approximately 38 pounds per 100 units.
2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.

D. Sleeves and Seals: Provide sleeves and seals, of types, sizes, and materials indicated and/or required; and having the following construction features:

1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

E. Conduit Cable Supports: Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers.

F. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, minimum 16-gage hot dip galvanized steel, of types and sizes indicated and/or required; construct with 9/16" diameter holes, 8" o.c. on top surface, with standard finish, and with the following fittings which mate and

match with U-channel:

1. Fixture hangers.
2. Channel hangers.
3. End caps.
4. Beam clamps.
5. Wiring studs.
6. Thinwall conduit clamps.
7. Rigid conduit clamps.
8. Conduit hangers.
9. U-bolts.

2.2 FABRICATED SUPPORTING DEVICES

A. Conduit Sleeves: Provide conduit sleeves of one of the following:

1. Steel-Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
2. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe; remove burrs.

B. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade or in exterior walls.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hangers, anchors, sleeves and seals, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support conduit properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible.

D. Support all equipment covered by this specification directly from building structural members independent of any ceilings or any other installed item. Panelboards and switches may be attached to suitably reinforced walls. Ground or slab mounted equipment shall be mounted on a separate four inch high concrete housekeeping steel re-inforced slab.

E. Do not attach items of this specification to HVAC ductwork, ceiling grids and ceiling support members, piping or other equipment unless specifically shown

otherwise. Position all supports and equipment such that access through lay-in ceilings or panels is not impaired and all Code required clearances are maintained.

F. Where applicable, under no circumstances is the Electrical Contractor to attach to or support from any bar joist bridging. Any supports to the bar joists or any structural systems are to be approved by the Architect.

G. Wire shall not be used with or without spring steel fasteners, clips, or clamps for the support of any conduit. Wood products shall not be used for the support or attachment of conduit or electrical equipment unless specifically noted otherwise.

END OF SECTION 16190

SECTION 16195 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.

B. This section is a Division 16 Basic Materials and Methods section, and is part of each Division 16 section making reference to electrical identification specified herein.

1.02 DESCRIPTION OF WORK:

A. Extent of electrical identification is indicated by drawings, schedules and within this Section.

B. Types of electrical identification specified in this Section include the following:

1. Exposed conduit color banding.
2. Cable/Conductor identification.
3. Operational instructions and warnings.
4. Danger signs.
5. Equipment/system identification signs.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of marker):

1. W. H. Brady Co.
2. Electro Products Division/3M
3. National Band and Tag Co.