

## **DIVISION 260000 – ELECTRICAL**

### **PART 1 – GENERAL REQUIREMENTS:**

#### **1.1 RELATED DOCUMENTS:**

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

#### **1.2 SCOPE:**

- A. The electrical contractor shall furnish all labor, material, tools, equipment and services necessary and incidental for installing all electrical systems shown on the drawings, indicated in the specifications, or necessary to provide a finished installation. The finished installation shall be in perfect working condition and be ready for continuous and satisfactory operation. The project area is located in the School of Nursing, Floor 6.

#### **1.3 CODES & REGULATIONS:**

- A. All materials furnished and all work installed shall comply with the latest rules, regulations, and recommendations of the following bodies:
  - 1. International Building Code
  - 2. International Mechanical Code
  - 3. National Electric Code
  - 4. Maryland State Health Department
  - 5. National Fire Protection Association
  - 6. Fire Prevention Bureau Baltimore City
  - 7. Fire Protection Bureau State of Maryland
  - 8. Underwriters Laboratories
  - 9. National Electrical Manufacturer Association
  - 10. National Electrical Testing Agency
  - 11. Insulated Power Cable Engineers Association

#### **1.4 RESPONSIBILITY**

- A. The construction manager/general contractor (CM/GC) shall be responsible for all work included in Division 26. The delegation of work to contractors shall not relieve him of this responsibility. Contractors who perform work under these sections shall be responsible to the CM/GC.

#### **1.5 SITE EXAMINATION:**

- A. Failure to visit the site and become familiar with existing project conditions prior to bidding will not relieve the Contractor of responsibility for complying with the Contract Documents.

#### 1.6 OUTAGES:

- A. For all work requiring an outage, the electrical contractor shall submit an outage request to the UMB Project Manager, using the UMB Standard Request for Outage Form which is available through the UMB Design and Construction Web Site at <https://www.umaryland.edu/designandconstruction/resources/contractors/>
- B. The existing electrical systems shall remain operational unless turned off by University personnel during the construction of the project. For each electrical outage request include a photograph of the panel index schedule for each panel affected by the outage.
- C. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled at least ten business (10) days in advance with the UMB Design and Construction Department. Outages shall be performed during normal duty hours. If necessary, some outage work may be performed outside normal hours if approved by UMB.
- D. The electrical contractor shall include in his price the cost of all premium time required for outages and other work which interferes with the normal use of the building, which will be performed, in most cases, during other than normal work time and at the convenience of the University.
- E. The operation of electrical panels or power switches; required to achieve an outage must be accomplished by the university personnel only. Unauthorized operation of electric panels, power switches, by contractors their personnel will result in extremely serious consequences for which the contractor will be held accountable.

#### 1.7 SUBMITTALS:

- A. General Requirements: For general requirements see Architectural Specification Division 01 Section "Submittal Procedures".
  - 1. After contract award and before material is ordered, submit electrically all shop drawings, drawings and such other descriptive data as the Engineer may require to demonstrate compliance with the contract documents as required by the contract clauses, plus the number required for himself and his subcontractors, for review and approval.
  - 2. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification

and paragraph reference, applicable publication references, years of satisfactory service, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish.

3. All electrical equipment shall be approved and listed by Underwriters' Laboratories (UL) and shall bear nameplate indicating same.
4. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

Submittals shall include the following items:

- a. Article 2.2, Fire Stops & Smoke Seals for Wall & Floor Sleeve Applications
  - b. Article 2.4, Raceway
  - c. Article 2.6, Boxes and Enclosures
  - d. Article 2.7, Wire and Cable
  - e. Article 2.8, Grounding
  - f. Article 2.9, Enclosed Switches and Disconnects
  - g. Article 2.10, Devices
  - h. Article 2.11, Identification
  - i. Article 2.13, Panelboards
  - j. Article 2.15, Lighting
  - k. Article 2.16, Indoor Occupancy / Vacancy Sensors
  - l. Article 2.17, O & M Manual
  - m. Warranties and maintenance instructions shall be included in the O & M Manual only. Do not include this data in the Submittals.
5. Submittal File Format: File formats and names for each submittal shall be electronically as follows:
    - a. File Formats:
      - 1) Product Data: “pdf” file format.
      - 2) Design Shop Drawings: “pdf” and “dwg” file formats.
      - 3) Coordinated Drawings: “pdf” or “dwg” file formats.
      - 4) Schedules: “xl” file format.

#### 1.8 SAMPLES:

- A. Samples of materials to be used on the work shall be submitted when requested and shall be subject to approval by the A/E and the UMB Design and Construction Department.

#### 1.9 REGULATIONS AND PERMITS:

- A. The Contractor shall obtain and pay for all permits, certificates of inspection, etc., required by the authorities having jurisdiction over this work. The certificates shall be delivered to the Engineer before the date of final acceptance of the project.

#### 1.10 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by the contract.
- B. Before initiating any work, a job specific work plan must be developed by the contractor. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, and safety equipment to be used and exit pathways.
- C. Job site and worker safety are the responsibility of the contractor. Compliance with the requirements of NFPA 70E is subject to ongoing inspection by University personnel and failure to comply will result in an immediate Stop Work order being issued and enforced at the contractor's expense.
- D. Energized electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee performs work any time the employee is within the limited approach boundary or, where an increased risk of injury from an exposure to an arc flash hazard exists.
- E. Mandatory Requirements: The following requirements are mandatory:
  - 1. Protective Equipment: Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
  - 2. UMB Energized Work Permit: A UMB Energized Work Permit is required for any work on energized circuits or equipment. Permit must be approved by UMB Department of Operations and Maintenance prior to performing energized work. Submit the work permit with the outage request.

#### 1.11 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of electrical products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. Installer's Qualifications: Electrical Installer shall submit the following evidence:

1. Five (5) comparable completed projects.
2. Copy of Maryland Master Electrician's License.
3. Local or State license where required.
4. BICSI and NICET certification, where required by these specifications.

1.12 IDENTIFICATION BADGES:

- A. Contractors must obtain photo identification cards for all employees who will be at the construction site. The University will charge the contractor twenty five dollars (\$25.00) for each badge as a deposit of which twenty dollars (\$20.00) will be returned when the badge is returned. Lost photo I.D. card will cost twenty five dollars (\$25.00) for another replacement card. (The above charges are subject to change without notice.)

1.13 HAZARDOUS MATERIALS:

- A. Identification and removal of hazardous materials (asbestos, lead paint, PCBs) is not part of this contract. If questionable material is encountered, notify the University Project Manager and the University Environmental Health and Safety in writing immediately. The University shall then arrange for investigation and possible abatement of the material. Contractor shall schedule his work to accommodate hazardous material removal by the Owner.

1.14 FUNCTIONAL TESTING OF NEW ELECTRICAL SYSTEMS

- A. Summary: This section includes the requirements for functional testing of electrical systems, assemblies and equipment related to the project area.
- B. Functional Testing will be performed by UMB staff
- C. Description: The following equipment and/or accessories shall be tested as part of this project:
  1. Branch panels.
  2. Lighting fixtures.
  3. AC motors.
  4. Lighting Controls.

1.15 GUARANTEE/WARRANTEE:

- A. All materials, equipment, etc. provided by the general contractor and/or his subcontractors shall be guaranteed and warranted to be free from defects in workmanship and materials for a period of two (2) years from the date of substantial completion and acceptance of work by UMB. Any defects in workmanship, materials, or performance which appear within the guarantee period shall be corrected by the contractor without cost to the owner,

within a reasonable time, to be specified by UMB. In default thereof, owner may have such work done and charge the cost of same to the contractor. In addition to the above statement the Guarantee/Warranty Period shall include all labor cost related to all warranty work. For compressorized equipment include an additional three (3) year Guarantee/Warranty Period. LED lighting fixtures and equipment include an additional five (5) year Guarantee/Warranty Period.

- B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be delivered to the Owner.

## **PART 2 – PRODUCTS:**

### **2.1 LISTED MANUFACTURERS:**

- A. Listed Manufacturers: The manufacturers indicated in Part 2 represent the basis for design and identify the minimum level of quality for materials and equipment, specified in this Division, that are acceptable to UMB. Unless “or equal” is included as an option, substitutions are not allowed, except under the following condition. During bid phase, contractors may submit material and equipment by non-listed manufacturers provided said submittals meet the requirements of these specifications. All submitted materials and equipment are subject to approval by the A/E and UMB. Reference: Division 1 Substitution Section.

### **2.2 FIRE STOPS & SMOKE SEALS FOR WALL & FLOOR SLEEVE APPLICATIONS**

- A. General: Provide fire stops, and smoke sealant materials for all electrical services penetrating through rated assemblies. See Architectural Specification Division 07, Section “Penetration Firestopping” for sealant material requirements. Services include:
  - 1. Electrical penetrations include conduits and cables.
- B. New Construction: All new penetrations shall be provided with a pipe sleeve and sealant materials.
- C. Existing Construction: All new service penetrations through existing rated assemblies shall be provided with a pipe sleeve and sealant materials. All existing unsealed penetrations for services passing through existing rated assemblies within the project area shall be provided with sealant materials.
- D. Project Area: The project area shall include the finished spaces and related sections of the utility shafts within the project area footprint.
- E. Wall Pipe Sleeve Applications: Pipe sleeves shall be required for all new conduit penetrations through rated wall assemblies and non-rated CMU walls. Where pipe sleeves

are installed in non-rated CMU walls fire rated sealant materials are not required. Provide acoustical caulking to seal the annular spaces between the sleeve and the bare pipe or pipe insulation on each end with one half (1/2) inch caulking all around the annular space.

- F. Floor Pipe Sleeves Applications: Pipe sleeves are required for all new conduit risers passing through floor slabs.

## 2.3 SLEEVES

- A. Steel Pipe Sleeves: Steel pipe sleeves shall be standard black steel pipe Type E, Grade B, with plain ends conforming to ASTM A53/A53M.

## 2.4 RACEWAY:

- A. For indoors above floor slab, use EMT conduit with compression fittings with a minimum size of three quarter (3/4) inch (regardless of function/purpose) and maximum size of two (2) inches. Above two (2) inches, conduit shall be rigid steel conduit, zinc coated with threaded type fittings.

- 1. For low-voltage, special systems provide the following color-coated EMT raceway:

- a. Fire Alarm - Red.
- b. Telecommunications - Green.
- c. Security - White.

- B. Flexible Metal Conduit: Provide flexible metal conduit for the following installations (consult the UMB Project Manager prior to using flexible metal conduit for any other locations):

- 1. Vibrating Equipment (motors, etc.) – Limited to the last thirty six (36) inches prior to termination.

- 2. Flexible connections to motors shall contain a 90 degree bend.

- C. Supports: For all indoor, conditioned-space locations utilize conduit clamps, conduit straps, bean clamps, etc. and/or channel strut supports. Support conduits at a minimum of two (2) times per ten (10) foot length and at a frequency rate as directed by the NEC.

- D. Bushings: Provide only threaded type for IMC, and RGS raceway. Provide only steel compression type for all EMT raceway systems. Provide insulated-throat, threaded type bushings for all tel/data raceway systems.

- E. All new raceways in finished areas shall be concealed unless specifically noted otherwise.
- F. Grout around all conduits at ceiling, floor, and wall penetrations to provide airtight seal. All fire-rated wall penetrations shall be sealed with a rated system/installation that is pre-approved by the UMB Fire Marshal. Submit manufacturer's engineering drawing of the proposed fire-proofing system to the UMB Project Manager for approval.
- G. Group together exposed conduit insofar as possible. Install all conduits parallel or perpendicular to the building surfaces. Maintain minimum six (6) inch spacing from parallel flues, steam pipes, or hot water pipes and two (2) inches from perpendicular flues, steam or hot water pipes.
- H. All conduits shall be rigidly supported to building structure. Conduits shall not be supported from suspended ceiling support wires.
- I. All conduit bends shall be made with an approved conduit bender and no bend shall have a centerline radius less than six times the diameter of the conduit.

## 2.5 BOXES AND ENCLOSURES:

- A. Indoor Applications: Provide NEMA 250 interior galvanized steel, minimum 14 gauge, outlet boxes, no less than four (4) inches square with extension rings and mounting brackets at the following locations:
  - 1. Dry and Clean Locations: NEMA Type 1.
  - 2. Locations with Dust, Falling Dirt and Dripping Noncorrosive Liquids: NEMA Type 12.
  - 3. Mechanical and Electrical Rooms: NEMA Type 12.
- B. Outlet boxes shall be rigidly and securely fastened in place. Outlet boxes in finished areas shall be flush mounted unless otherwise noted.
- C. Boxes shall be sized in accordance with NEC Article 370.
- D. All conduit connectors and entry hubs shall be insulated or have insulated bushings.
- E. Outlets shown adjacent to one another on the plans at the same mounting height shall be ganged except where noted.
- F. Outlets shown adjacent to one another on the plans at different mounting heights shall be located with the upper outlet centered directly over the lower outlet.



- G. GEM Boxes – Recessed GEM Boxes are prohibited.

## 2.6 WIRE AND CABLE:

- A. All wire shall be copper with insulation rated at 600 volts, 75°C minimum. **Aluminum wire is strictly prohibited.**
- B. Minimum wire sizes shall be #12 for power wiring, #14 for control wiring and as specially noted for systems wiring.
- C. Wire shall be solid type THHN or THWN up to size 10 AWG and stranded type THWN, XHHW, or THHN for size 8 AWG and larger. (Unless noted otherwise.) Do not use “BX” type cable (unless directed otherwise in writing by UMB Project Manager). For high temperature equipment connections use type TFE wire. Unless directed otherwise, do not exceed 40% conduit fill.
- D. MC Cable - Type steel-clad MC cable with separate, isolated ground conductor (i.e. do not use the jacket for the ground conductor) may be used in concealed locations for lighting and receptacle circuits or as otherwise directed on the contract drawings. Individual conductor color-coding scheme must follow color-code scheme described below. For renovation projects, the application of MC Cable shall mirror the standards followed for the building’s original electrical raceway system fit-out. Do NOT run MC Cable in exposed locations (e.g. all open ceiling locations, Mechanical and Electrical Equipment Rooms, IT Rooms, etc.).
- E. Type MC cable for branch circuit applications:
1. Interlocking galvanized steel armor, steel strip.
  2. Conductor insulation – THHN/THWN solid copper, 90 degree rated.
  3. Copper insulated green grounding conductor.
  4. Polyester assembly tape.
  5. Neutral conductor.
  6. Rated for use in plenums.
  7. Rated for through penetration of 1, 2, and 3-hour fire walls.
  8. UL 83, 1479, 1569, 1581, and 2556 listed.
  9. NEC 230.43, 250.118, 300.22, 392, 396, 330, 501, 502, 503, 530, 504, 505, 518, 530, 645, 725, 760, 760.154(A) compliant
  10. AFC Type MC, MC-Tuff Lightweight Steel
- F. Fire Alarm Control Cable Type MC
1. For use on fire alarm circuits as required and as recommended by the manufacturer.
  2. Interlocking galvanized steel armor, steel strip (painted red).

3. Conductor insulation – TFN/THHN solid copper.
4. Copper grounding conductor.
5. Polyester assembly tape.
6. Neutral conductor.
7. UL Listed Fire Alarm Cable.
8. Rated for use in plenums.
9. Rated for through penetration of 1, 2, and 3-hour fire walls.
10. Individual twisted pairs and shielding, as required per fire alarm system manufacturer.
11. UL 66, 83, 1424, 1569, 1581, and 2556 listed.
12. NEC 300.22, 362, 330, 430.2, 501, 502, 503, 530, 504, 505, 518, 530, 645, 725, 760, 760.154(A) compliant
13. AFC Type MC Fire Alarm/Control Cable.

G. MC Cable Installation Requirements:

1. Install in compliance with NFPA 70.
2. Locations: In dry wall partitions and above accessible ceilings. Do not install in masonry partitions or walls.
3. Independently support all MC Cable runs; do not piggy-back on plumbing/HVAC, lighting fixture, and/or ceiling grid supports.
4. Do not bundle more than three (3) runs together for supporting purposes.
5. MC cable shall be installed in a neat and orderly fashion using batwings type supports.
6. Minimum bend radius shall be as recommended by the manufacturer.
7. MC cable run to switches shall have a neutral conductor.
8. Cable larger than #8AWG shall not be permitted.
9. All acceptable homeruns from panels in electrical rooms shall be installed in EMT conduit to a junction box/wire trough outside electrical rooms in accessible ceiling of corridor.
10. Homeruns from panelboard to junction box outside of electrical room: wire in EMT or IMC raceway.
11. Do NOT run MC Cable in exposed locations (e.g. all open ceiling locations, Mechanical and Electrical Equipment Rooms, IT Rooms, etc.).
12. MC cable shall be secured at intervals not exceeding six (6) feet and within twelve (12) inches of every outlet box or fitting. Luminaire whips may be six (6) feet maximum without support.

H. Molded connectors (wire nuts) may be used for splicing size 10 AWG or smaller wires on lighting and receptacle circuits only. “Scotch Blocks” must be submitted for prior approval. All other wiring shall be spliced only with lugs and/or terminal blocks.

I. Terminal lugs shall be mechanical clamp or compression type unless part of a circuit breaker or switch assembly.

- J. Special lugs may be required to accommodate conductor sizes shown on the drawings. Contractor shall verify lug requirements for all circuit breakers and equipment terminals and shall provide correct lugs as required.
- K. Pre-insulated crimp connectors and terminals shall be used on alarm wiring.
- L. Under no circumstances shall feeders be spliced and/or tapped.
- M. Lighting and receptacle branch circuit homeruns over one hundred (100) feet long shall be size 10 AWG minimum.
- N. Color code the entire power wiring system as follows:
  - 1. 120/208 Volt System
    - a. Phase A - black
    - b. Phase B - red
    - c. Phase C - blue
    - d. Neutral - white
    - e. Ground - green
  - 2. 277/480 Volt System
    - a. Phase A - brown
    - b. Phase B - orange
    - c. Phase C – yellow
    - d. Neutral - gray
    - e. Ground - green

## 2.7 GROUNDING:

- A. Provide a complete equipment safety ground system ("green wire" ground) for the entire electrical system as required by Article 250 of the NEC, and as specified herein.
- B. Provide additional grounding as indicated on the plans.
- C. All grounding wire, lugs, jumpers and bus shall be copper.
- D. All feeder and branch circuits shall contain an equipment ground wire. No conduit or raceway of any kind or length shall be used as the equipment grounding conductor.
- E. Equipment grounding conductors and straps shall be sized in accordance with the NEC. Refer to feeder schedules for ground wire requirements which may exceed the NEC. All equipment grounding conductors shall be provided with green insulation equivalent to the insulation on the associated phase conductors.

- F. The equipment grounding system shall be installed so all metallic structures, enclosures, raceways, piping, systems, junction boxes, outlet boxes, cabinets, machine frames and portable equipment frames operate continuously at ground potential and provide a low impedance path for ground fault currents.
- G. Where parallel feeders are used, each raceway shall contain an equipment ground conductor sized in accordance with NEC 250 for the combined parallel circuit amperage.
- H. Grounding conductors shall be continuous, and no splicing shall be allowed.
- I. Receptacles shall be bonded to their outlet boxes with #12 copper straps.

## 2.8 DEVICES:

- A. All wiring devices shall be Specification Grade.
- B. The Contractor shall verify color, location and mounting height of all devices prior to installation.
- C. Receptacles shall be flush, duplex, grounding type, 20A, 2P, 3W, 125VAC, NEMA 5-20R straight blade, ivory nylon or high-strength thermoplastic material unless indicated as special purpose outlet. Receptacles shall be designed to accept standard two-wire parallel connector caps and shall grip both sides of the connector wire.
- D. Single throw lighting switches shall be quiet type, 20A, 1P, 120/277VAC, ivory handle able to accommodate up to #10 conductors and designed for inductive lighting loads. For renovation projects, match existing switches.
- E. Three (3) way and four (4) way toggle switches shall be quiet type, 20A, 120/277VAC, ivory handle. Switches shall be positive action type and shall not permit a maintained neutral position. For renovation projects, match existing switches.
- F. Convenience receptacles serving bathrooms, toilets, outdoor and wet locations and construction sites shall be ground fault (where required by the NEC) interrupter type, 20A, 2P, 3W, 125VAC, NEMA 5-20R, straight blade, ivory handle or high-strength thermoplastic material.
- G. Provide 0.04 inch thick satin finish, Type 302, stainless steel plates at all receptacle and switch outlets unless otherwise specified. Provide galvanized steel plates in unfinished spaces.
- H. LED Dimmer Switch shall be compatible with LED lighting fixture dimming driver.

1. Switch Type as indicated on the drawings.
  2. Dimming Control: 0-10VDC: 200mA Sink, Sink Dimming.
  3. Electrical Ratings: 120 VAC, Maximum Load: 10 amps, 1200W, 60 Hz – 277VAC, Maximum Load: 6 amps, 1660W, 60 Hz.
  4. Light Intensity Control: Full-range, continuously variable dimming. Adjustable High-level trim setting.
  5. Power Failure Memory: Light returns to same level prior to power interruption.
  6. Wiring Type: As recommended by manufacturer.
  7. Flammability: Meets UL 94 requirements, V2 rated.
  8. Temperature: -4°F to 158°F.
- I. Receptacles shall be mounted with the bottom of the receptacle 18 inches above the finished floor unless otherwise noted. Gang multiple outlets at one location under a single multi-gang cover plate.
- J. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- K. Switches shall be vertically aligned with Thermostats, other wall switches, fire alarm devices with the top of the switch 48 inches above the finished floor unless otherwise indicated. Notify engineer of any discrepancies before roughing in outlet and obtain a new location. Gang multiple switches at one location under a single multi-gang plate. Locate switches on strike side of door between six (6) inches and twelve (12) inches from edge of door frame.
- L. Device plates shall be fitted tight to the wall.
- M. Delay installation of device plates until painting is complete.
- N. Provide RED devices when supplied by emergency power. Coordinate with UMB Project Manager to confirm. For special type receptacles on emergency power, provide RED cover plate.
- 2.9 IDENTIFICATION:
- A. Coordinate names, abbreviations and other designations used in electrical work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment.
  - B. Delay installation of identification until painting is complete.

- C. Comply with governing regulations and requests of governing authorities for identification of electrical work.
- D. Where electrical conduit is exposed, apply identification (e.g. noting voltage, service/signal type, emergency power, etc.) on conduit. Except as otherwise indicated, use permanent vinyl, self-adhering markers with black letters on orange background.
- E. Apply self-adhering vinyl or heat-shrink plastic cable/conductor identification markers on each cable and conductor in each box, enclosure or cabinet where wires of more than one circuit are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings and contract documents.
- F. Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems and electrically connected mechanical systems, install self-adhesive plastic signs with appropriate instructions or warnings. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.
- G. Install warning signs at the entrances to all rooms and spaces in which electrical conductors or equipment are installed (white letters on red background).
- H. All field installed control circuits shall have tubular sleeve-type wire markers at each end of the circuit and at all splice points. Wire markers shall be permanently stamped with a numbering system selected by the Contractor. The numbering system shall be thoroughly documented and provided to the Engineer.
- I. Each receptacle shall be neatly marked on the inside cover with indelible marker identifying the panel and breaker from which it is fed and durable markers or tag inside outlet box. This to ensure the correct covers are restored after room renovations and/or painting. In addition to marking circuit identification inside the cover, also provide laminated label with circuit number on device cover plates.
- J. Dymo (or equivalent) labels shall not be used.
- K. Ceiling Markers: Provide labels on ceiling grid for accessible electrical equipment that is installed above the ceiling.

## 2.10 PANELBOARDS:

- A. Branch Circuit Breakers: Provide only bolt-on type branch circuit breakers of the ambient-compensated, thermal-magnetic type, which will provide inverse time delay overload and instantaneous short circuit protection. Voltage and current ratings as indicated on the contract drawings. Plug-in and/or tandem breakers are prohibited.

- B. Provide a typewritten directory for each panel, placed inside the panel door. The directory shall list all rooms served by each breaker, using the "Owner's" room numbers. Directories shall be installed in a metal directory frame with clear protective cover. Spares and spaces shall be written in pencil.

## 2.11 LIGHTING:

- A. Provide LED lighting fixtures of the sizes, types and ratings indicated on the drawings and in the schedules. Fixtures shall be complete with housings, energy efficient lamps, lamps/drivers, lenses, louvers and reflectors. LED lighting fixtures scheduled on the drawings are found to offer products similar to the basis of design product, including performance, appearance, and quality. Listed equals must comply with minimum performance criteria. Additional documentation and calculations for LED lighting fixtures compliance should be made available upon request.

- B. Exit Signs:

- 1. General Requirements for Exit Signs: Comply with UL 924; for, visibility, luminance, and lettering size, comply with authorities having jurisdiction. Provide RED color sign.

- C. LED Lighting Products:

- 1. Luminaires:

- a. Refer to Luminaire Schedule for specified parameters such as correlated color temperature (CCT) value(s), lumen output, efficiency, etc.
    - b. Products shall be fabricated to be Reduction of Hazardous Substances (RoHS) compliant.
    - c. Must maintain their warrantied life while operating within the manufacturers' specified environmental parameters.
    - d. The lumen value specification listed in the Luminaire Schedule is a delivered lumen value specification. Products supplied shall deliver not less than the lumen value specified.
    - e. The lumen maintenance specification of any assembled LED based chip, array, module, driver, and luminaire combination shall be a minimum of L70, at fifty thousand (50,000) hours, as tested and measured in compliance with IES documents LM-79 and LM-80.
    - f. Except as otherwise stated in the Luminaire Schedule, the light source shall provide a minimum CRI of 80.

- 2. Acceptable Manufacturers:

- a. Refer to the Luminaire Schedule.
3. Drivers: Listed and so labeled per UL 8750 and UL 1310, and shall meet or exceed the following general specification criteria:
- a. Designed and tested to be compatible with the luminaire light source operating current, voltage, and output power requirements.
  - b. Inaudible above 27 dBA ambient sound level.
  - c. Designed, fabricated, and tested to operate at an input voltage of 120 – 277VAC,  $\pm 10\%$ , at 60 Hz, with no perceptible change in light source output.
  - d. Contribute less than 20% total harmonic distortion, operating at full rated load, and shall not exceed the maximum allowable THD requirements allowed per standard ANSI C82.11.
  - e. Provided with integral short circuit, open circuit, and overload protection.
  - f. Have an operating power factor  $\geq 0.9$ .
  - g. Limit conducted and radiated interference in compliance with FCC 47 CFR Part 15.
  - h. Housed in a UL compliant and listed enclosure, suitable for remote installation where required, and listed for installation within spaces used for environmental air (plenum), as defined in NFPA 70 – the National Electrical Code.
  - i. Acceptable Manufacturers:
    - 1) Cree.
    - 2) EldoLED.
    - 3) Philips/Advance.
    - 4) Thomas Research Products.
    - 5) Or as supplied by the luminaire manufacturer, in compliance with these Specifications.
4. Dimmable Drivers - In addition to the general specification criteria specified above:
- a. Have an operating power factor of  $\geq 0.9$  at full load, and not less than 0.8 at dimmed level.
  - b. Provide smooth, flicker-free, dimmable light output from 100% to less than 1%.
  - c. 0-10VDC "sinking" type dimming control protocol per enforced version of IEC Standard 60929, unless otherwise noted or required.
  - d. Acceptable Manufacturers:
    - 1) Cree.
    - 2) EldoLED.
    - 3) Philips/Advance.
    - 4) Thomas Research Products.



- 5) Or as supplied by the luminaire manufacturer, in compliance with these Specifications.
- D. Fixtures shall be secured to structural supports and shall not rely on ceiling systems for support. Pendant fixtures shall be plumb and level. Pendant mounted fixtures, larger than two (2) feet shall be installed with two (2) stem hangers. Stem hangers shall have ball aligners and provisions for minimum one (1) inch vertical adjustment. Plaster frames shall be provided for all recessed fixtures, installed in other than a suspended access ceiling system.
- E. Surface mounted fixtures greater than two (2) feet in length shall be supported from at least one point in addition to the fixture outlet box stud.
- F. Set, aim and adjust adjustable fixtures in accordance with instruction and guidelines provided by the Architect. Adjust light level of photo control relays in accordance with instructions from the Architect.
- G. Lighting Control: Provide lighting control as directed on the contract drawings.

## 2.12 INDOOR OCCUPANCY/VACANCY SENSORS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Lithonia Lighting, Acuity Lighting Group, Inc.
  - 2. Sensor Switch, Inc.
  - 3. Leviton.
  - 4. Lutron.
- B. General Description: Wall- or ceiling-mounting, solid-state multi technology units with a separate relay unit.
  - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of one (1) minute to fifteen (15) minutes.
  - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  - 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, and Class 2 power source as defined by NFPA 70.
  - 4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a one half (1/2) inch knockout in a standard electrical enclosure.

- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  - 6. Bypass Switch: Override the on function in case of sensor failure.
  - 7. Automatic Light-Level Sensor: Adjustable from two (2) foot candles to two hundred (200) foot candles; keep lighting off when selected lighting level is present.
  - 8. Auxiliary Contacts: Ceiling mounted occupancy sensors shall have two sets of dry contacts.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
- 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of six (6) inch-minimum movement of any portion of a human body that presents a target of not less than thirty six (36) square inches, and detect a person of average size and weight moving not less than twelve (12) inches in either a horizontal or a vertical manner at an approximate speed of twelve (12) inches/s.
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of one thousand (1,000) square feet when mounted on a ninety six (96) inch high ceiling.

## 2.13 PROJECT OPERATION AND MAINTENANCE MANUAL – ELECTRONIC FILES

- A. Project O & M Manual File: The project OM Manual shall include one (1) electronic copy of each approved submittal and any manufacturer's maintenance manuals, and all warranty certificates included in Division 27. Also include the address, phone number and contact person for each supplier. Using the UMB Standard O&M Manual Template referenced in Division 01 Closeout Procedures insert the submittal files include both a bookmark and tree structure for accessing each submittal file in the manual.

## PART 3 – EXECUTION:

### 3.1 GENERAL REQUIREMENTS – EXECUTION

- A. All construction work that creates excessive noise will not be permitted during normal business hours. See Division 01 Specification Section "Cutting and Patching" for requirements.
- B. General provisions of the contract apply. All work performed and materials provided shall conform to all applicable codes and standards and the National Electrical Code (NEC).

- C. Prior to starting work, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- D. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing all doors and passageways.
- E. Confirm the locations of all existing utilities. Repair any damage to existing utilities caused by construction forces.
- F. Leave all areas broom clean daily. Remove all construction debris and trash from the site daily.
- G. Before ordering any materials or equipment, submit to the engineer data for all materials and equipment. Check equipment dimensions of proposed substitute equipment. The cost of any redesigning caused by a substitution shall be borne by the Contractor.
- H. Contractor shall do all cutting, drilling and patching required by his work. All repairs to finish shall be of like kind, color and quality as existing. Structural members shall not be cut without approval from the architect.
- I. Provide temporary power as may be required for construction or as may be required to maintain critical operations during changeover of feeders or services. Provide all equipment, make all arrangements, and make all connections required for temporary power. Remove all provisions for temporary power upon completion of the project.
- J. Schedule in advance all outages of building utilities. Outages shall be as short as possible. All services shall be restored and placed in operation when Contractor's personnel leave the site each day.
- K. Take necessary precautions to protect building's occupants and contents and prevent the spread of dust and dirt into occupied areas.
- L. Electrical contractor shall identify existing circuits and existing panels for the renovation area and trace and identify existing circuits. Identifying and tracing of the circuits shall be done with machinery and appropriate safety gear. Should an outage become necessary, it will need to be requested a minimum of ten (10) working days in advance through the UMB Project Manager.
- M. Contractor shall update panel board circuit directory cards. Contractor shall also provide an electronic copy of new and/or revised schedule in excel or word format to Operations & Maintenance work management system thru Director of Operations & Maintenance.

### 3.2 SLEEVES

- A. Non-Fire-Rated Soundproof Partition Penetrations: Where new and existing conduits pass through interior partitions with sound proofing provide a pipe sleeves. Seal the annular spaces between construction openings, the sleeves, and conduits with soundproof insulation material equal to the width of the opening. The soundproof insulation shall match the insulation in the partition.

### 3.3 CONTRACT DOCUMENTS:

- A. Contract drawings for electrical work are diagrammatic, intended to convey scope and general arrangement.
- B. Correction of faulty work due to resolving discrepancies without authorization shall be the responsibility of the Contractor.
- C. Should the Contractor discover any discrepancies or omissions on the drawings or in the specifications, he shall notify the Engineer of such conditions prior to the bid date. Otherwise, it will be understood that the drawings and specifications are clear as to what is intended and shall be as interpreted by the Engineer.

### 3.4 COORDINATION:

- A. Coordinate all work and cooperate with all other trades to facilitate execution of work.

### 3.5 FIELD INSTRUCTION:

- A. Upon completion of work, instruct Owner's representative in the proper operation and maintenance of the electrical systems.

### 3.6 DEMOLITION:

- A. The electrical demolition in the renovation areas indicated on the drawings shall be complete and include all electrical work in the area unless noted otherwise.
- B. Existing electrical systems passing through areas of demolition to serve equipment beyond the demolition areas shall remain in service, or be suitably relocated and restored to normal operation, throughout the demolition and reconstruction of the area. The Contractor shall investigate and identify such equipment prior to demolition.
- C. Provide temporary electrical service to equipment disturbed by the demolition until such time as the permanent service can be restored.

- D. Where conduit and wiring to remain are inadvertently damaged or disturbed, cut out and remove damaged portion and all damaged wiring from the source switchboard, panelboard or pull box to the destination connection point. Provide new wiring of equal capacity.
- E. Exposed conduit to be demolished shall be removed in its entirety. Concealed conduit, abandoned in place, shall be cut out approximately two (2) inches beyond the face of adjacent construction, plugged, and the adjacent surface patched to match existing.
- F. Wiring to be demolished shall be removed from both concealed and exposed conduit. No wiring which becomes unused as a result of the contract shall be abandoned in place.
- G. Equipment specified or indicated to be demolished, shall be removed from the project site and shall not be reused.

### 3.7 TESTING:

- A. Thoroughly clean the electrical equipment and associated electrical materials before energization of any part of the electrical system. It is the Contractor's responsibility to have all the electrical equipment, raceways, cabling, cable insulation and other related electrical systems tested. All test results shall be recorded, dated and submitted to the Engineer and Owner for record. Test procedures and results shall be per NETA standards. In the absence of relevant NETA standards, the Contractor shall substitute appropriate test procedures from IEEE or ANSI. The substitute test procedures shall be submitted to the engineer for approval before conducting the tests.
- B. During the course of and after completion of installation, the Engineer shall:
  - 1. Inspect the installation, workmanship, testing and operation of key electrical systems.
  - 2. Key electrical systems include:
    - a. Panels
- C. The Contractor shall verify that each key system interfaces correctly with all related systems. The Contractor shall furnish all test data to the Engineer verifying that all systems have been installed correctly and work together to provide a completely operational electrical power system as designed.
- D. The Engineer reserves the right to accept or reject test data which does not conform to the manufacturer's data or is not obtained in accordance with these specifications.

### 3.8 FUNCTIONAL TESTING OF NEW ELECTRICAL SYSTEMS

A. Testing Preparation:

1. Certify in writing to the UMB testing agent that electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
2. Place systems, subsystems, and equipment into operating mode to be tested.
3. Inspect and verify the position of each device and interlock identified on checklists.
4. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the UMB testing agent.

B. General Testing Requirements:

1. Provide technicians, instrumentation, and tools to perform testing at the direction of the UMB testing agent.
2. Scope of electrical testing shall include all lighting controls.
3. Test all operating modes and verify proper response of controllers and sensors.
4. The UMB testing agent along with the lighting contractor shall prepare detailed testing plans, procedures, and checklists for applicable new lighting systems, subsystems, and equipment.
5. Tests will be performed using design conditions whenever possible.

C. Electrical Systems, Subsystems, And Equipment Testing Procedures:

1. Procedures: Where applicable follow manufacturer's written procedures. If no procedures are prescribed by the manufacturer, proceed as follows:
  - a. Electrical Distribution Systems: Includes existing and/or new panels and circuit breakers for power and lighting.
  - b. Verify that all new panel components have been installed correctly, are accessible and operate as intended.
  - c. Where existing panel spares are used for new circuits verify the installation is correct and the panel index has been revised.
  - d. Verify that specified tests are complete.
2. Electrical Equipment: Includes new lighting and controls where indicated.
  - a. Verify that all new equipment has been installed in accordance with the manufactures recommendations and all equipment can be easily accessed for maintenance and operates as intended.

- b. Verify that all new connections, controls, and accessories have been installed correctly and operates as intended.
- c. Verify that all new equipment test, training, and startup procedures have been completed per the specifications.
- d. Verify that all required new interfaces with for Life Safety the BAS have been installed correctly and operates as intended.
- e. Operate new equipment as intended to ensure the design conditions can be obtained.

### 3.9 CUTTING AND PATCHING:

- A. Cutting and patching associated with the work in the existing structure shall be performed a neat and workmanlike manner. Existing surfaces that are damaged by the contractor shall be repaired or provided with new materials to match existing.
- B. Structural members shall not be cut or penetrated. Holes cut through concrete and/or masonry to accommodate new work shall be cut by reciprocating or rotary, non-percussive methods.
- C. Patching of areas disturbed by installation of new work and/or required demolition shall match existing adjacent surfaces as to material, texture and color.

### 3.10 CLEAN – UP:

- A. Excessive debris and dirt, such as occurs from cutting through masonry or plaster walls shall be cleaned up from the equipment and removed immediately after the work of cutting through the walls.
- B. Debris shall be removed from UMB property.
- C. Ceiling panels shall be replaced as soon as work is finished in the area and shall be kept free of dirty fingerprints. Where work is being done in corridors used by patients and visitors, ceiling panels shall be replaced at the close of the day's work even if work is at the particular location is incomplete.
- D. All areas shall be left broom-clean at the end of the work period.

END OF DIVISION 260000