

DIVISION 260000 – ELECTRICAL

Latest Update: 05-06-2023 See Underlined Text for Edits.

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off “Underlines”)

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:

Note: Engineer to complete above paragraph.

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/design-and-construction-documents/umb-standard-project-forms---current-editions/>
- 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 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: **Note: Engineer must edit the list for the project requirements.**

- a. Article 2.2, Fire Stops & Smoke Seals for Wall & Floor Sleeve Applications
 - b. Article 2.3, Sleeves
 - c. Article 2.4, Raceway
 - d. Article 2.5, Floor Mounted Wireway Systems
 - e. Article 2.6, Boxes and Enclosures
 - f. Article 2.7, Wire and Cable
 - g. Article 2.8, Grounding
 - h. Article 2.9, Enclosed Switches and Disconnects
 - i. Article 2.10, Devices
 - j. Article 2.11, Identification
 - k. Article 2.12, Transformers
 - l. Article 2.13, Panelboards
 - m. Article 2.14, Motor Controllers
 - n. Article 2.15, Lighting
 - o. Article 2.16, Indoor Occupancy / Vacancy Sensors
 - p. Article 2.17, O & M Manual
 - q. Warranties and maintenance instructions shall be included in the O & M Manual only. Do not include this data in the Submittals.
5. Additional Submittals: Subject to project requirements, in addition to the submittals indicated above the following submittals may also be required:
<**Coordinate with UMB, delete if not required**>
 - a. Coordinated drawings
 - b. Samples
 6. 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.
- B. Obtain applicable permits from Baltimore City to do work in City Streets. The City charges a compensatory fee when parking meters are required to be out of service.
- C. Manhole Permit – Obtain permit from Baltimore City for manhole. Copy permit to UMB Environmental Health & Safety (EH&S) Group for UMB approval.

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 COMMISSIONING NEW ELECTRICAL SYSTEMS

- A. Summary: This section includes the requirements for commissioning electrical systems, assemblies and equipment related to the project area.

- B. Commissioning Agent (CxA): The CxA for the project shall be [as assigned by UMB.] [a third party consultant.] <Edit as directed by UMB>
- C. Description: The following equipment and/or accessories shall be commissioned as part of this project: <Edit for Project Requirements>
1. Distribution and branch panels.
 2. Lighting fixtures.
 3. Uninterruptible power systems.
 4. AC motors.
 5. Motor control centers/Controllers for new fans.
 6. Variable Frequency Drives.
 7. Lighting Controls.
 8. Emergency Generator & ATS.

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. 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 section, that are acceptable to UMB. Unless otherwise indicated in this Section, 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.

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. Non-Metallic Raceway: Provide expansion joints in every twenty (20) foot of run and at least once in every run in all outdoor, rooftop, and garage locations. Provide PVC 40 pipe, non-metallic NEMA 4X boxes and non-metallic NEMA 4X enclosures supported via non-metallic fiberglass strut and/or pipe clamps at the following locations:
1. All outdoor locations including, but not limited to, inside garages and on rooftops.
 2. Embedded in concrete, brick, CMU or other structural material.
 3. Below-slab and –grade.
 4. All unconditioned-air spaces/rooms in Parking Garages.
- C. Utilize PVC-Coated Rigid Galvanized Steel in exterior locations above grade where there is a potential for damage or below eight (8) feet in vehicle/cart traffic areas and where otherwise required by the NEC.
- D. Flexible Metal Conduit: Provide flexible metal conduit (liquidtight in outdoor or underfloor locations) for the following installations (consult the UMB Project Manager prior to using flexible metal conduit for any other locations):
1. Vibrating Equipment (motors, transformers, etc.) – Limited to the last thirty six (36) inches prior to termination.
 2. Embedded in CMU walls.
 3. Flexible connections to motors shall contain a 90 degree bend.
- E. Supports: For all indoor, conditioned-space locations utilize conduit clamps, conduit straps, bean clamps, etc. and/or channel strut supports. For all outdoor applications (as specified above for PVC 40) and where non-metallic raceway is provided, provide only non-metallic fiberglass (or other non-metallic material) or PVC-Coated Galvanized Steel conduit supports and/or channel strut. Support conduits at a minimum of two (2) times per ten (10) foot length and at a frequency rate as directed by the NEC.
- F. Bushings: Provide only threaded type for IMC, RGS and PVC-RGS raceway. Provide only steel compression type for all EMT raceway systems. Provide insulated-throat, threaded type bushings for all tel/data raceway systems.
- G. Raceways below raised floor shall be liquidtight flexible conduit or EMT with liquidtight compression fittings.
- H. Surface metal raceways shall be used only in finished areas and only where specifically noted on the drawings. Raceway must be compatible with UMB's standard Ortronics and/or Siemens tel/data jacks and faceplates. Surface mounted raceways shall be Wiremold 500, 700, 1000, or 4000 series or pre-approved equivalent with buff finish used as follows:
1. # 500: 2-#10 or 3-#12 wires maximum.

2. # 700: 3-#10 or 4-#12 wires maximum.
 3. #1000: 9-#10 or 12-#12 wires maximum.
 4. Other combinations of conductors shall be in accordance with the manufacturer's published data and the National Electrical Code.
 5. All elbows, boxes fittings supports, etc., shall be by the raceways manufacturer. Finish shall match that of the raceway.
 6. Wire trough shall be steel enclosed wireway meeting all UL requirements.
- I. Surface mounted raceways at laboratory benches shall be Wiremold V3000 series or pre-approved equivalent with a gray finish as follows:
1. Steel construction, gray, scratch resistant finish.
 2. Two piece separable base and cover plate.
 3. Complete with entrance junction boxes, wire retainer clips, device brackets, end plates, etc.
 4. Power outlets, NEMA type, at locations indicated on the CD's.
 5. Power outlets within six feet of the sink shall be GFCI type.
 6. 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. All new raceways in finished areas shall be concealed unless specifically noted otherwise.
- K. Grout around all conduits at ceiling, floor, and wall penetrations to provide airtight seal. All floor slab and 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.
- L. 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.
- M. All conduits shall be rigidly supported to building structure. Conduits shall not be supported from suspended ceiling support wires.
- N. 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.
- O. Core Drilling/Floor Penetrations: Coordinate with the UMB Project Manager prior to making any core drills for floor penetrations. Prior to core drilling/floor penetrations

provide X-ray examination/GPD of the floor structure to locate structural steel for avoidance. The contractor is responsible for maintaining structural integrity of all floors and walls after core drills for conduits are made.

2.5 FLOOR MOUNTED WIREWAY SYSTEMS:

- A. The floor-mounted wireway system is to be utilized in dry, interior locations only as covered in Article 386 of the National Electrical Code, as adopted by the National Fire Protection Association and as approved by the American National Standards Institute. The electrical power components of the Connectrac floor-mounted wireway system for modular furniture connectivity are listed by Underwriters Laboratories under File No. E139699, Project No. 05NK22224. Connectrac systems shall not be installed in any jurisdiction where local Codes or regulations forbid its use without specific written authorization of the governing Code official.
- B. The floor-mounted wireway system specified herein for branch circuit wiring and / or data, communications, video and other low-voltage wiring shall be the Connectrac floor-mounted wireway system for modular furniture connectivity as manufactured by Strong Products Group, Ltd. Systems of other manufacturers may be considered equal if, in the opinion and written approval of the specifier, they meet all of the performance standards specified herein.
- C. The metal device box and flexible low-profile flexible conduit which will house the supplied power wires must be UL listed. Other system components include extruded aluminum base track, extruded aluminum snap-on cap, and MDF side ramps along the entire length of the wireway system.
- D. The wireway shall be comprised of an aluminum base track and mating aluminum top cap. MDF side ramps which associate with the base track and extend the length of the system shall complete the wireway system. Power and communications wiring shall be available in 4' and 8' lengths, which shall be field-cut to the length required.
- E. Other system components shall include, but not be limited to, molded plastic end transition ramps and steel junction box(es). The junction box components shall have separate chambers to accommodate power wires and low-voltage communications. Knock-out holes in the power wiring chamber which will accept standard flexible conduit fittings shall be provided. Such knockout holes shall be located at the top and side of this chamber.
- F. Submit product data sheets with all components highlighted and shop drawings identifying all required components.
- G. Products:
 - 1. Refer to drawings for additional requirements.

2. In-carpet wireway components:
 - a. Wireway segments, field-cut to required length and combined as necessary. Refer to architectural floor plans for exact length.
 - b. Extruded Aluminum Wireway base track and top cap.
 - c. Moisture-Resistant MDF floor transition ramps.
 - d. Wire Management clip.
 - e. Concrete screws.
 - f. Divider for power and communications wiring.
3. Wireway components and accessories, base system components:
 - a. Wireway bottom track and top cap.
 - b. Side transition ramps.
 - c. End components.
4. Optional Accessories:
 - a. Transition adapter.
 - b. Grommet.
 - c. Corner kits.
 - d. Rough-in box.
 - e. Communication box.
 - f. Wall channel.
 - g. Side entry kit.
5. Single Device Power:
 - a. Duplex receptacle, Nema 5-20R.
 - b. AV duplex.
 - c. Four circuit monument.
6. Modular Power Systems:
 - a. Modular duplex.
 - b. Modular quad.
 - c. Modular power infeed.
 - d. Modular jumper cable.
7. Telecom-Single Duplex:
 - a. Standard telecom kit.
 - b. Audio/visual kit.
 - c. Voice/data kit.
8. Telecom modular kit.
9. Final finish of all components to be determined during shop drawing review.

2.6 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. Outdoor Applications: Provide NEMA 4X non-metallic weatherproof boxes and enclosures supported via non-metallic fiberglass strut at the following locations:
 - 1. All outdoor locations including, but not limited to, inside garages and on rooftops
 - 2. Where raceway is embedded in concrete, brick, CMU or other structural material
 - 3. Below slab and grade.
 - 4. All unconditioned air spaces/rooms in Parking Garages.
 - C. Boxes below raised floors shall be cast-metal, threaded hub type unless the box is mounted one and one half (1-1/2) inches or more above the slab, in which case NEMA 1 boxes or interior outlet boxes may be used.
 - D. Outlet boxes shall be rigidly and securely fastened in place. Outlet boxes in finished areas shall be flush mounted unless otherwise noted.
 - E. Boxes shall be sized in accordance with NEC Article 370.
 - F. All conduit connectors and entry hubs shall be insulated or have insulated bushings.
 - G. Outlets shown adjacent to one another on the plans at the same mounting height shall be ganged except where noted.
 - H. 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.
 - I. Floor Boxes – Provide ‘FSR’ type floor boxes for all multimedia and tel/data applications.
 - J. GEM Boxes – Recessed GEM Boxes are prohibited.
- 2.7 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

2.8 GROUNDING:

- A. Provide a complete equipment safety ground system ("greenwire" 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.
- J. Exceptions:
 - 1. Isolated ground receptacles shall have a dedicated equipment grounding conductor connected at the point where the grounded circuit conductor is connected to the grounding electrode system.
 - 2. Straps may be omitted if self-grounding devices are utilized.
- K. Bond all separately derived power sources in accordance with NEC 250. Only bond water service at no more than five (5) feet upon entering building and only to building's underground grid (i.e. do not interconnect separately derived system grounded conductor with building's water piping). For separately-derived systems/services, interconnect the grounded conductor with the building's grounding electrode via one of the following means:
 - 1. Structural Steel Structures: Interconnect with structural steel member or with common grounding electrode riser (typically in stacked electric closets).
 - 2. Poured-Concrete, Wood Framing, etc. Type Structures – Interconnect with common grounding electrode riser. If riser does not exist, provide dedicated grounding electrode conductor to electrical service entrance ground bus.
- L. Provide flexible grounding jumpers between each piece of computer equipment and the raised floor. Provide two grounding jumpers per cabinet, attached at opposite corners. If several cabinets are bolted together in a string, only one jumper at each end of the string is required. Solidly bolt each end of the grounding jumper. At the computer cabinets end, bolt to a metal frame member. At the raised floor end, bolt to a pedestal. Do not use stringer bolt for attaching grounding jumper. Grounding jumper shall be #8 stranded copper.

2.9 ENCLOSED SWITCHES AND DISCONNECTS:

- A. The Contractor is responsible for the complete installation of all equipment shown on the drawings. All manufacturers' specifications shall be followed in regard to the installation of all equipment. Any special manufacturers' requirements necessary for proper or safe installation of equipment regardless of whether the aforementioned special requirements are indicated on the drawings shall be at the expense and responsibility of the Contractor.
- B. The Contractor is responsible for the purchase, rigging, erection, installation, and functional operation of all electrical equipment except where noted. All materials and equipment shall, when a listing is normal for the particular class of material or equipment, be listed and labeled by UL or a NRTL.

- C. Make final electrical connections to all items of mechanical equipment.
- D. All locations of equipment and fixtures are approximate and may require minor adjustment to suit field conditions. All adjustments shall be submitted to the UMB Project Manager for approval.
- E. Not all locations where motor disconnect switches are required may be shown on the drawings. Provide disconnects at all locations required by code and/or by the equipment manufacturer the electric service will support whether or not they are accounted for on the contract drawings. When required, each motor shall be equipped with a two or three pole fused (or non-fused load-break), heavy-duty disconnect switch as directed on the contract drawings.
- F. Exception: Fractional HP motors shall be equipped with toggle-type disconnect switches. Equipment with integral disconnecting means that satisfy NEC and local authority requirements for motor safety disconnects shall not require a separate disconnect switch.
- G. Disconnect switches shall be heavy-duty, horsepower rated, quick-make, quick-break type with spring reinforced wire grips and self-aligning switch contacts. Switches shall be enclosed in a heavy sheet metal enclosure with hinged interlocking cover which shall prevent the cover being opened when switch is "on".
- H. Indoor Enclosure Locations and Ratings: Provide NEMA 250 switch and disconnect enclosures where only EMT, IMC and/or RGS conduit and galvanized steel support systems are utilized 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
- I. Outdoor Enclosure Locations and Ratings: Provide non-metallic NEMA 4X weatherproof switch and disconnect enclosures supported via non-metallic fiberglass strut at the following locations:
 - 1. All outdoor locations including, but not limited to, inside garages and on rooftops
 - 2. Where raceway is embedded in concrete, brick, CMU or other structural material
 - 3. Below-slab and grade.
 - 4. All unconditioned-air spaces/rooms in Parking Garages.
- J. Coordinate all receptacles, plugs, wiring and locations with the equipment provided prior to rough-in.
- K. Only provide disconnects that are sized appropriately for the application. Disconnects with spare or unused poles are strictly prohibited.

2.10 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.
- 2.11 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. Install engraved plastic-laminate nameplates on all switchboards, motor control centers, starters, panelboards, telephone cabinets, disconnect switches and other electrical boxes and cabinets installed under this contract (black letters on white background).
 - E. Install engraved plastic-laminate nameplates at each protective device in all switchboards identifying circuit service (black letters on white background).

- F. 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.
- G. 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.
- H. 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.
- I. Install warning signs at the entrances to all rooms and spaces in which electrical conductors or equipment are installed (white letters on red background).
- J. 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.
- K. 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.
- L. Dymo (or equivalent) labels shall not be used.
- M. Ceiling Markers: Provide labels on ceiling grid for accessible electrical equipment that is installed above the ceiling.

2.12 TRANSFORMERS:

- A. Transformers shall be general purpose self-cooled dry-type in indoor enclosures unless otherwise noted. Transformers installed outdoors shall be in weatherproof enclosures.
- B. 600V Class Energy Efficiency Standards - Per MD COMAR Rule #14.26.03, “the efficiencies of all low-voltage, dry-type distribution transformers may not be less than the values shown in table 4-2 NEMA Standard TP-1-2002...” This rule applies only to 600V class, ‘general purpose’ type transformers and sets efficiency performance standards for

transformers when operating at 35% rated load. Provide the following 600V transformers for the associated applications:

1. Receptacle and Lighting Loads (Cyclical): Energy Efficient Type ‘EE’ - Contains extra “compensation” windings to enable the transformer to be at its’ most efficient level when loaded at 35% (i.e. the load level most transformers see when put in service and user diversity is taken into account). Designed to operate most efficiently under light and no-load conditions. Aluminum windings are pre-approved.
 2. HVAC and Mechanical Loads (Continuous Duty): Low Temperature Rise - Slightly oversized; much less heat loss and 50% less coil loss (during 35% to 100% load conditions) than general purpose and energy efficient type ‘EE’ transformers but higher coil loss (70% to 100%) during no-load conditions. Best suited for loads in which no-load conditions rarely exist. Aluminum windings are pre-approved.
- C. Wall Mounting: Only 30kVA and smaller transformers are pre-approved for wall or ceiling mounting. Consult the UMB project manager for any exceptions.
- D. Housekeeping Pad: For all floor-mounted transformers, provide a minimum six (6) inch high concrete, poured-in-place (i.e. not prefab) housekeeping pad with a minimum three (3) inch flange or overhang.
- E. Transformers of the size and type covered in UL Standard 506 or UL Standard 1561 shall be so listed and labeled (i.e. Up to and including 250 kVA single phase and up to and including 500 kVA three phase, 600V Class).
- F. All transformers, 30 kVA and larger, shall incorporate a UL recognized class 220°C insulation system. Transformer temperature rise shall not exceed 150°C. Refer to drawings for lower temperature rise requirements.
- G. All cores are to be fabricated with high grade electrical steel. The core volume shall allow operation at 10% above rated primary voltage at no load without exceeding the temperature rise of the unit. All laminations and cores must be plated or annealed, free of burrs and properly assembled to reduce noise and ensure efficient operation of the transformer.
- H. Coil conductors must be continuous with terminations brazed or welded without auxiliary flux material. The entire core and coil assembly must be pre-dried by heat, impregnated with varnish and cured at a minimum of 350°F to reduce hot spots and seal out moisture. Coils must be protected with an outer layer of glass tape or similar quality insulation. Coils of shielded transformers must incorporate an electrostatic shield located between the primary and secondary windings.

- I. Transformers 30 kVA and larger shall be provided with NEMA standard taps (minimum of 2 FCAN and 2 FCBN). Smaller transformers shall have taps as indicated on the drawings. When not indicated, provide minimum as previously specified.
- J. All transformers must be of the quiet type, which operate at levels substantially below ANSI Standard C89.2. Sound levels shall not exceed the following:
 - 1. Up to 9 kVA 40 dB
 - 2. 10 - 50 kVA 45 dB
 - 3. 51 - 150 kVA 50 dB
 - 4. 151 - 300 kVA 55 dB
 - 5. 301 - 500 kVA 60 dB
- K. Core and coil assemblies 30 kVA and larger are to be mounted on rubber vibration isolators designed specifically to reduce 120 HZ sound and multiple harmonics.
- L. Prior to painting, the enclosures must be cleaned and degreased, paint bond treated, primed and finished with scratch and weather resistant final coats.
- M. Transformers must be warranted against defects in materials, workmanship and performance for five years from the date of manufacture. In the event that the transformers furnished do not meet specifications, they must be removed from the job site and replaced at the supplier's expense.
- N. All transformers must be constructed and rated in accordance with applicable ANSI, NEMA, OSHA, IEEE and UL standards and must meet National Electrical Code requirements.
- O. Mount transformers on pad-type vibration isolators selected for unit weight.
- P. Transformers shall not be in physical contact with walls, ductwork, piping and other building elements except for base and flexible conduit connection. Locate transformers to ensure adequate ventilation is provided to all sides.
- Q. Grounding: Unless directed otherwise on contract drawings, bond the low-voltage 'X0' terminal to the high-voltage side ground connection.
- R. Suitable Operating Environments: For projects where the transformer locations are not identified in electrical closets, coordinate with the UMB Project Manager for pre-approval on the most suitable location. Do not install transformers in mechanical equipment shafts, exposed on rooftops, outdoors, etc due to the exposure to high-humidity conditions and/or moisture.

2.13 PANELBOARDS:

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- A. Branch Circuit Panelboard Sizing and Capacity: Regardless of purpose/function, provide minimum 225amp (208V) and minimum 250amp (480V) rated panels with minimum forty two (42) poles. For panels that are greater than forty two (42) poles, provide a minimum eighty four (84) pole panel. De-rated 85, 100, or 150amp panels are prohibited.
 - B. Wall-mounted Distribution Panels/Boards: Provide distribution panels with a minimum 99” of breaker mounting space (i.e. the combined vertical mounting space on both left and right sides) and with the minimum breaker capacity or prepared spaces for installing 400A and/or 600A branch circuit breakers in the future.
 - C. 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.
 - D. Bus Bars, Sub-Feed Lugs and Grounding: Only copper bus bars are permitted with a minimum 225amp (208V) rating and 250amp (480V) rating. Each panel shall be equipped with a ground lug. All branch circuit panels designated on the contract drawings as “emergency power receptacle” panels must include sub-feed lugs for future expansion/addition of a second tub.
 - E. Cabinet and Trim and Optional Wireway Capacities: Mount panels in steel cabinets arranged for flush or surface mounting as shown on contract drawings. Cabinet and trim shall be of code gauge steel (minimum) with wiring gutter all around. Both the Inner and Outer Door Covers/Panels must be hinged. All lag-screw/self-tapping screw anchored covers will be rejected. For those branch circuit panels with 80amp and larger breakers, include the manufacturer’s optional over-sized wireway.
 - F. Where panels occur adjacent to one another, the tops of the panels shall be mounted at the same height.
 - G. Panelboards shall be painted with gray lacquer over rust preventative primer. Sides and top of surface mounted panels shall be painted to match fronts.
 - H. 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.
 - I. Panels sixty eight (68) inches or less in height shall be installed with the top of the panel six (6) feet above the finished floor. All panels shall be installed in accordance with NEC 380 and 384.
 - J. Each panel and cabinet and the units comprising same shall bear the manufacturer's nameplate and the UL label.

- K. Mount panels in locations shown, making sure that code required clearances exist.
- L. Where cabinets cannot be set fully flush due to shallowness of wall or partition, trim protruding sides with approved metal or hardwood molding fastened to cabinet so as to conceal intersection of wall and cabinet.
- M. If paint is damaged during shipping or installation, damaged portion shall be sanded smooth and entire panel repainted.
- N. Approved Manufacturer's:
 - 1. Square D/Schneider Electric:
 - a. 'NQOD' – 225amp, 208V, minimum 42pole – Branch Circuit Panel.
 - b. 'NF' – 250amp, 480V, minimum 42pole – Branch Circuit Panel.
 - c. 'I-Line' – minimum 99" breaker mounting space – Distribution Panel.
 - 2. Cutler-Hammer/Emerson:
 - a. 'Pow-R-Line 2a' – 225amp, 208V and 250amp, 480V, minimum 42pole – Both 208V and 480V Branch Circuit Panel.
 - b. 'Pow-R-Line 4B' – minimum 99" breaker mounting space – Distribution Panel.

2.14 MOTOR CONTROLLERS:

- A. Install motor starters and controllers as indicated on the Drawings, in strict accordance with the manufacturer's written instructions, and in compliance with recognized industry practices.
- B. Install fuses or current limiters when required by the equipment specifications.
- C. Tighten connections and terminations in accordance with the manufacturer's published torque tightening values or in accordance with UL Standard 486A and B when manufacturer's values are not indicated.
- D. Prior to energizing equipment, check power and control wiring for correct installation. After energizing equipment, check each motor for proper phase rotation, correct where necessary, and demonstrate operation of starter and accessories.
- E. Set all MCPs in accordance with the motor manufacturer's instructions. Set all overloads in accordance with motor manufacturer instructions.

- F. Indoor Enclosure Locations and Ratings: Provide NEMA 250 enclosures where only EMT, IMC and/or RGS conduit and galvanized steel support systems are utilized 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.
- G. Outdoor Enclosure Locations and Ratings: Provide non-metallic NEMA 4X weatherproof boxes and enclosures supported via non-metallic fiberglass strut at the following locations:
1. All outdoor locations including, but not limited to, inside garages and on rooftops
 2. Where raceway is embedded in concrete, brick, CMU or other structural material
 3. Below slab and grade.
 4. All unconditioned-air spaces/rooms in Parking Garages.
- H. Fractional Horsepower Starters:
1. Fractional horsepower manual starters shall be used for single phase motors except where otherwise indicated. Single phase starters shall provide across the line starting and overload protection. Single pole and double pole starters shall be used as required and shall be rated not less than one (1) horsepower.
 2. Single phase manual starters shall feature snap action double-break contacts, motor running indicating light and trip free melting alloy overload elements selected for the specific motor application.
 3. Starters located in finished areas shall be installed in a flush outlet box and furnished with a stainless steel plate.
 4. Manual motor starters shall be toggle-type and shall be arranged so they may be locked with a padlock in the “OFF” position.
 5. Oil-tight hand-off-auto selector switches shall be provided where starters are controlled by automatic devices.
- I. Magnetic Type Motor Starters:
1. Overload Protection: As required by the NEC, all motors 1hp and over must be provided with overload protection. Starters shall utilize protection that individually monitors all phases and is factory set for the specific motor application. Overload relays shall be field adjustable plus or minus 15% of the rated trip current. Solid state overload relays are acceptable.

2. Starters shall be furnished with the following accessories:
 - a. Hand-off-auto selector switch.
 - b. Green pilot light to indicate power available to the starter but motor not on.
 - c. Red pilot light to indicate motor running.
 - d. Transformer for 120 volt control power.
 - e. Overload trip indicator and reset.
 - f. Undervoltage monitor and release.
 - g. Coils rated 120 volts A.C.
 - h. Two (2) normally open and two (2) normally closed auxiliary contacts for customer use.
3. Starters shall be capable of withstanding the let-through short-circuit current of the protective device. Current limiters shall be provided when required to achieve adequate protection from high short-circuit currents.

J. Combination Starters:

1. Combination motor starters shall be provided with an integral motor circuit protector specifically designed for motor applications. The MCP shall have a continuous current rating in accordance with NEC Article 430 and shall provide adjustable short-circuit trip settings. The MCP shall have a minimum short-circuit rating of 42,000 amperes at 480 volts.
2. An external operating handle for the MCP shall be provided. The handle shall clearly indicate the position of the MCP and shall be padlockable in the “OFF” or OPEN position. Interlocks shall be provided to prevent opening the door when the external operating handle is in the “ON” or “CLOSED” position. An interlock defeater shall be provided for use by authorized personnel.

K. Variable Frequency Drives

1. Provide a complete variable frequency drive (VFD) (in a single enclosure) of capacity, quantity and characteristics as described in this specification and as shown and scheduled on the drawings. Acceptable manufacturers contingent on compliance with specifications are:
 - a. Above 200hp (12-Pulse or Greater Units Only; 6-pulse not permitted)
 - 1) Eaton Electrical Inc.; Cutler-Hammer Business Unit – SVX Series
 - 2) Square D – S-FLEX212 AC Drives
 - 3) Danfoss
 - 4) YASKAWA – HV600 Series

- 5) ABB drives are not acceptable to UMB.
- b. 200 hp and Less (6-Pulse):
 - 1) Eaton Electrical Inc.; Cutler-Hammer Business Unit – SVX Series
 - 2) Square D – S-FLEX212 AC Drives
 - 3) Danfoss
 - 4) YASKAWA – HV600 Series
 - 5) ABB drives are not acceptable to UMB.
2. Exception to Acceptable VFD Manufacturers: Variable frequency drives for equipment such as AHU's, chillers, cooling towers and domestic water booster pumps shall be products provided by the equipment manufacturer, be factory mounted and comply with the requirements of this section including but not limited to remote metering and BAS interface. Except for ABB products, it is UMB's desire that VFD's provided by equipment manufacturers be by one (1) of the acceptable manufacturers listed above.
3. Additional VFD Enclosure Requirement: Indoors - Provide single NEMA 1 metal enclosure (including transformer, filters, line reactor, PWM, etc.) with manufacturer's optional exhaust fan package. Provide additional cooling and/or exhaust as required to ensure enclosure ambient temperature satisfies manufacturer requirements. Assume a room ambient temperature of 104°F (40°C).
4. VFDs shall include the following system interfaces:
 - a. Remote Metering: Provide “kW” and “kWh” values via the embedded BAS Network Communications.
 - b. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFD status, alarm and energy usage. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFD's nonvolatile memory.
 - 1) Embedded BAS Protocols for Network Communications: Manufacturer shall provide one (1) of the following protocols:
 - a) BACNET MS/TP
 - b) BACNET IP
 - c) Siemens P1
 - d) MODBUS TCP
 - e) NOTE: MODBUS RTU is not an option
5. Speed reference interface with a differential amplifier or isolated input 0-10 VDC or 4-20 mADC signal.

L. Reduced-Voltage Soft-Starters (RVSS):

1. Pre-approved equipment vendors are as follows:
 - a. Siemens
 - b. Cutler-Hammer
 - c. Square D/Schneider Electric
2. Additional VFD Enclosure Requirement: Indoors - Provide single NEMA 1 metal enclosure (including transformer, filters, line reactor, PWM, etc.) with manufacturer's optional exhaust fan package. Provide additional cooling and/or exhaust as required to ensure enclosure ambient temperature satisfies manufacturer requirements. Assume a room ambient temperature of 104°F (40°C).

2.15 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. Provide footcandle plot diagrams for exterior areas indicating foot candles on grade resulting from the light sources at the locations indicated on the drawings. Indicate locations, spacing and height of fixtures.
- C. 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.
- D. 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 warranted 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 ≥ 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 ≥ 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.
- E. 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.
- F. 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.
- G. 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.
- H. Lighting Control: Provide lighting control as directed on the contract drawings.
- 2.16 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.
- 2.17 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 book mark and tree structure for accessing each submittal file in the manual.

2.18 COMMISSIONING NEW ELECTRICAL SYSTEMS

- A. Test Equipment: Refer to Division 01 Section “General Commissioning Requirements” for requirements pertaining to testing equipment.

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 Sound Proof 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 sound proof insulation material equal to the width of the opening. The sound proof insulation shall match the insulation in the partition.

3.3 FLOOR MOUNTED WIREWAY SYSTEMS:

- A. Installation: The installer shall thoroughly review and comply with the detailed manufacturer's instruction sheets which accompany the system components. Installation must be coordinated with architectural floor finishes.
- B. Mechanical Security: The aluminum base track, MDF side ramps and molded plastic end transition ramps shall be securely fastened to the floor slab in accordance with the manufacturer's instructions.
- C. Electrical Security: Metal device boxes shall be mechanically fastened to the floor slab in accordance with the manufacturer's instructions. Flexible conduit connections shall be installed with the provided conduit end fitting in accordance with National Electric Code for proper grounding.
- D. Completeness: All Connectrac systems shall be installed complete, including insulating bushings and inserts where required by the manufacturer's installation instructions. Any openings in system components shall be closed. Complete installation of the Connectrac

system includes installation of floor covering over the MDF side ramp and end transition ramps.

3.4 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.

3.5 COORDINATION:

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

3.6 FIELD INSTRUCTION:

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

3.7 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.

3.8 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 and switchboards
 - b. Emergency power off system
 - c. UPS system
 - d. Power distribution units
 - e. Emergency generator system
- 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.

3.9 COMMISSIONING NEW ELECTRICAL SYSTEMS

- A. Testing Preparation:

1. Certify in writing to the CxA 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 CxA.

B. General Testing Requirements:

1. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
2. Scope of electrical testing shall include lighting controls [and [power riser inspections]. <Coordinate with UMB and Edit for Project>
3. Test all operating modes and verify proper response of controllers and sensors.
4. The CxA 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 panels and 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, new uninterruptible power supplies (UPS) and new variable frequency drives (VFD) 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.

3.10 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.

3.11 CUTTING, WELDING, BURNING <Delete if not required>

- A. Before the contractor and/or any sub-contractor commences any cutting, welding, burning or other type of hot work at UMB, the contractor shall contact the UMB Fire Marshal's Office on the First Floor of the Pine Street Station located @ 214 N. Pine Street, or by phone @ 1-410-706-3494 to obtain a hot work permit. Office Hours are Monday – Friday.
- B. The hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to the UMB Fire Marshal.

3.12 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 finger prints. 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