

**DIVISION 26 – ELECTRICAL****26 01 00 – Operation and Maintenance of Electrical Systems**

1. Fire stopping shall be performed by Electrical Contractor if the work is only electrical. For new buildings, fire stopping shall be performed by one fire stopping contractor for all trades.
2. When performing demolition work, all conduit and wire not being re-used shall be removed back to the source.
3. Do not use motorized shades.
4. Lighting is not to be controlled by Building Automation Systems, unless approved by the Director of Building Operation and Maintenance. Lighting control systems are to be kept as simple as possible, code compliant, and shall be reviewed by the Director of Building Operation and Maintenance.
5. In new construction, addition, or major renovation, provide a closet in project for a lamp cart, new and waste lamp (Universal Waste) storage.
6. All panelboards must be in a location accessible by electrical staff (FA key).
7. Emergency power gensets are to be located inside a room within the building. Exterior and roof mounted gensets are not acceptable.
8. Gensets to be natural gas Onan or Generac with a two (2) year warranty.
9. On genset muffler and piping drain(s), provide ball valve and piping to within 12 inches of floor or nearby floor drain.  $\frac{3}{4}$ " copper minimum size.
10. All new buildings, additions, major renovations, and new panelboard installations must have short circuit and coordination study work performed with results submitted to the Electrical Department. In addition, an Arc Flash analysis must be performed and labels made. Results and labels are to be submitted to the Electrical Department.
11. Building Entrance
  - a. ADA door operator push button and card reader shall be mounted in an aluminum 4 inch X 4 inch and 50 inch total height light pole (powder coat black finish) mounted to an 18 inch diameter (four feet deep, 2 inch reveal) cast concrete base (Uni-base or cast on site with four 1 inch Schedule 80 PVC conduits (two in – two out) using pole manufacturers anchor bolts) at the main entrance of the building (see 26 05 00 – Devices for device heights).
  - b. If Code or local building department regulations require unlocked roof access exits, then any such exits shall be normally held electrically locked, have a by-pass key switch, and be released by the fire alarm system during an activation. The doors shall be posted indicating exit for emergency use only.
  - c. At least two lighting fixtures at each building entrance shall be powered by the Life Safety (Emergency) power circuit.
12. Fire Alarm
  - a. Refer to Division 28 – Electronic Safety and Security for fire alarm system guidelines.
  - b. Refer to Division 21 – Fire Suppression for fire suppression and protection guidelines.
  - c. Place Fire Alarm systems on separate dedicated sheets in drawing set (not on the "Systems" sheets with the rest of the systems i.e. tele/data). As-built Fire Alarm drawings to show conduit routing, devices, address for each device, battery calculations, panel information, conductor quantity, types, and sizes. Drawings to be black and white only, no color.
  - d. Smoke detectors shall be a minimum of 3 feet from HVAC Diffusers.
  - e. Smoke detectors shall be installed in all rooms designated for student occupancy.
  - f. All fire alarm system wiring shall be installed in RED EMT conduit, no free air wiring.

**26 05 00 – Common Work Results for Electrical**

1. Conduits and Boxes
  - a. **No conduit less than  $\frac{3}{4}$  inch without Owner approval.**
  - b. Do not run conduits in or under concrete slabs or floors.
  - c. Conduit for Back Up and/or Life Safety Power circuits shall be GREEN EMT. Panelboards for Back Up and/or Life Safety Power circuits shall be painted GREEN. Junction boxes and covers on Back Up and/or Life Safety Power circuits shall be painted Orange/Green for 277/480 volt circuits or Blue/Green for 120/208 volt circuits.
  - d. Junction boxes and covers on Fire Alarm circuits shall be painted Red.
  - e. Junction boxes and covers on 277/480 volt circuits shall be painted Orange.
  - f. Junction boxes and covers on 120/208 volt circuits shall be painted Blue.
  - g. Include 120 volt circuits for HVAC control panels and to each VAV box with a toggle switch (regular light switch) in a single gang box mounted at each panel and VAV box.
  - h. Include  $\frac{3}{4}$  inch EMT conduit and single gang box in wall for HVAC temperature sensor.

- i. Use only Scotch 33+ tape.
  - j. Use Ideal or 3M (but not 3M Scotch Lock) wire nuts.
  - k. In areas where free air wiring (Telecom/Data) pass over non-accessible ceiling (GWB), install those wires in conduit pathway so that future wires may be added or deleted.
  - l. No horizontal conduit runs in walls. All runs in walls shall be vertical and have a junction box at the top of the run in the ceiling area above the ACT ceiling.
  - m. Install appropriate size junction box above accessible ceiling at top of vertical wall conduit runs.
  - n. All equipment shall have a lockable local disconnect (for LOTO) regardless of panelboard location.
  - o. Install toggle switch in single gang handy box at each 120 VAC operated smoke damper. This makes for a means disconnect when changing a damper motor.
  - p. Hand dryers in restrooms require dedicated 120 volt 20A circuit to each dryer.
  - q. Hand dryers shall be Mitsubishi, Model# JT-S1AP-S-NA.
  - r. Coordinate 120 volt duplex outlets with furniture layout. Advise Owner of any problems.
  - s. Pitch pockets shall NOT be used for roof penetrations for conduit or piping. Cones or "Witches Hats" with a stainless steel "radiator hose" style clamp (with stainless steel worm screw) shall be used. For multiple or large conduits, a "dog house" box shall be used with conduits exiting the side wall of the box.
  - t. Telecom pathways:
    - i. 1 inch EMT conduit from double gang boxes with single gang raised cover mud ring to be stubbed up above ceiling.
    - ii. Use a minimum of 1 inch sleeved pathways into spaces from main hallways.
    - iii. Review electrical contractor responsibility for Telecom with RIT Project Manager.
  - u. All conduits (Telecom, low voltage (600v) or medium voltage (12Kv)) entering a building shall be pitched away from the building and shall immediately enter a pullbox in the building. Conduits leaving the pull box shall be higher so that any water entering the pull box via the exterior conduits cannot flow to conduits or equipment inside the building.
  - v. Include ¾ inch EMT conduit and single gang box for card reader at building entrance.
  - w. Use Liquidtight Flexible Metallic Conduit (LFMC) for outdoor and damp area applications (motors, rooftop units, lights, etc.). Do not use Liquidtight Flexible Nonmetallic Conduit (LFNC).
  - x. Conduit colors to be use on all work:
 

i.	<b>RED</b>	Fire Alarm
ii.	<b>GREEN</b>	Stand by and/or Life Safety Power
iii.	<b>BLUE</b>	120/208 volts
iv.	<b>ORANGE</b>	277/480 volts
v.	<b>YELLOW</b>	Telecom
vi.	<b>PURPLE/VIOLET</b>	HVAC Controls.
  - y. Wiremold series 4000 or 5400 shall be used for surface raceway. Other surface raceway systems must be approved by Planning and Design and the Director of Building Operation and Maintenance.
2. Devices
- a. Provide at least one 120 volt electrical outlet connected to emergency power genset in every mechanical, boiler, and electrical room.
  - b. Device covers shall be unbreakable nylon in Ivory or PandS Light Almond unless otherwise approved by Electrical Department.
  - c. Construction of new buildings shall include an exterior 120VAC GFCI duplex outlet at each entrance and one outlet on each face of the exterior.
  - d. Device and Equipment mounting heights (AFF measured from finished floor to device centerline unless noted as otherwise:
    - i. Toggle switches (up is "on") 46 inch.
    - ii. Receptacles (ground pin up or to the left) 18 inch.
    - iii. Receptacles above counters 8 inch.
    - iv. Receptacles above hot water baseboard heat 30 inch.
    - v. Receptacles in hazardous areas, or for refrigerators 48 inch.
    - vi. Receptacles, weatherproof, above grade 24 inch.
    - vii. Telephone/data outlets 18 inch.
    - viii. Telephone outlets, wall mounted 46 inch.
    - ix. Fire Alarm Pull Stations 46 inch.
    - x. Fire Alarm horns and strobes (match existing or) 80 inch to bottom of device
    - xi. Distribution Panels (to top of back box) 72 inch.
    - xii. Terminal cabinets (to top of back box) 72 inch.

- xiii. Disconnect switches, motor starters, enclosed breakers 48 inch.
- xiv. Temperature sensors 54 inch.
- xv. ADA door operator push buttons 40 inch.
- xvi. Card reader 40 inch.
- xvii. Outdoor pedestal for card reader and ADA door button 50 inch total height.
- e. Provide circuit information (panel number and breaker number) on the front of all outlet and switch covers using printed label tape.
- f. Duplex outlets on 120 volt circuit shall be 20A and equal to Pass and Seymour Industrial Spec. Grade #5362 (Warning: Device manufacturers do not use the same terms to describe similar device grades). #5362-AL or #5362-A or equal.
- g. Duplex outlets that are included with furniture shall comply with the device requirements in these guidelines.
- h. Pig tail duplex outlets on all circuits so that neutral and hot conductors are maintained when changing duplex device. Second duplex in quad box need not be pig tailed, daisy chain from 1<sup>st</sup> duplex.
- i. Provide GFCI 120v service outlets on roof.
- j. Provide weather resistant GFCI outlets for outside GFCI outlets, or outlets subjected to water spray.
- k. Doorbell strobes to be mounted at least 6 feet away from nearest Fire Alarm strobe. Doorbell strobes for offices shall have "auto three flash", residence hall doorbell strobes shall be "push and hold".

### 26 10 00 – Medium-Voltage Electrical Distribution (15Kv)

1. Use liquid filled transformers on all 12kv service and place inside electrical transformer vault inside building. The use of pad mount transformers is to be avoided and requires the approval of the Director of Building Operation and Maintenance.
2. Use single-phase liquid filled transformers on 12kv service of 150kva and higher.
3. Provide containment for oil spills in transformer vault.
4. Transformers to have HV connections on rear side, LV on top.
5. Transformers to have oil sample port, oil fill port, oil level indicator, oil temperature (with max) indicator, oil vac/pressure indicator on opposite side from HV Connections. Removable top.
6. Transformers to be covered by 5 year warranty.
7. Use type SM-5, or SMU-20 type fuses in 15kv metal clad switchgear inside electrical secondary switchgear room.
8. 15kv cable shall be General Cable, Kerite, Perelli (Prysmian), or Okonite and shall be 500Kcmil between manholes.
9. 15kv cable shall be EPR 133% insulation level (220 mil), MV-105, with 5 mil copper tape with a minimum of 20% overlap, and with flame retardant, moisture and sunlight resistant PVC jacket.
10. Use only Elastimold Series 600 Deadbreak bolt-together tee type splices in 12kv manholes.
11. For underground conduits, use 5 inch Schedule 40 PVC conduit. Transition to RGS sweeping elbow when rising above grade or entering building. Encase with 6 inch of concrete on all four sides. Provide 4 feet of cover by backfilling in 12 inch lifts with compaction between lifts. Provide 8 inch of top soil in lawn areas.
12. No medium voltage equipment is to be placed against building walls, minimum spacing from wall shall be 18 inches.
13. All medium voltage wiring used for connections between transformers (feeds and interconnections) and switchgear shall be a shielded type.
14. Load Interrupters shall be located in a separate room from the transformers (locate load interrupters in secondary switchgear room). Load Interrupters shall have IR inspection windows.
15. Always install double the number of conduits needed for 12kv service (if 4 are required, install 8 conduits).
16. Use only fiberglass and stainless steel hardware on 12kv wire racking materials in manholes.

### 26 20 00 – Low-Voltage Electrical Distribution

1. Class 1 (50-600 volts)
  - a. No shared neutrals (unless in plug mold and approved by Owner).
  - b. Properly sized grounding conductor shall be run with power conductors in all conduits.
  - c. No conduit less than  $\frac{3}{4}$  inch without Owner approval.
  - d. No cast fittings for conduit.
  - e. Use acceptable Manufacturers list for electrical products (Contact RIT for latest list).
  - f. MC cable or flex shall not be used in new or renovation work except for light fixture whips no longer than 6 feet in length. MC cable may be used with Electrical Department Foreman or Director for approval in old work.

- g. For new buildings, additions, or major renovations, install Square-D power logic electric meter (tie-in to Square-D server system, use Belden 3107A E34972 2pr 22ga shielded cable with drain wire). Do not use split core CTs, check phasing, direction, and verify accuracy at installation.
  - h. No secondary switchboards shall be placed against building walls, minimum spacing from wall shall be 18 inches.
  - i. Provide at least one 120v duplex outlet on e-power in each mechanical, electrical, and boiler room.
  - j. Use stranded copper wire on #14 and larger sizes.
  - k. Use terminals on #14 wire when used for low voltage (Class II) control work.
  - l. Transformers shall be floor mounted on a 4 inch concrete housekeeping pad. Exceptions to floor mounting require Owner approval.
  - m. Include enough 120 VAC 20A single pole breakers in panels for HVAC Control Panels.
  - n. Include enough space on mechanical room walls for HVAC Control Panels.
  - o. Do not use electric in-sink disposal units – require owner approval to be considered.
  - p. Provide ball valve(s) on genset muffler drain(s), run to within 12 inches of floor or run to nearest floor drain. Use 3/4" copper minimum size.
  - q. Do not use aluminum conductors.
2. Class 2 (0-50 volts including Fire Alarm Systems)
    - a. Use plenum rated wiring for all low voltage applications not in metal conduit.

### 26 24 16 – Panelboards

1. Panelboard schedules shall include loads in terms of Horse Power and Amps with total load for the panel indicated per phase.
2. Design firm shall include fuse/ breaker coordination study and Arc Flash study information in close out documents to Owner in both hardcopy and electronic form.
3. Use only bolt-in breakers in panel boards (plug in breakers require approval from Owner).
4. All panelboards shall have lockable door-in-door hinged trim.
5. No panelboards shall be directly surface mounted to walls in mechanical or electrical rooms. Panelboards shall be spaced from the wall using Kindorf (vertically mounted) such that water running down wall will not affect panel.
6. Installing contractor shall provide Owner with panelboard directories in MS Word format on a CD.
7. Rotation shall be clockwise at main distribution panel (and marked on outside of MDP) and at all panelboards.
8. Panelboards shall have copper busses.
9. Use De-Ox or equal on conductors to panelboards 100A and higher.
10. Panelboards shall be Square D, Cutler Hammer, or Siemens.
11. Do not put panelboards in custodial closets.
12. Add (3) empty 3/4" conduits and (6) empty 1" conduits to flush mounted panelboards.
13. No stuffing two conductors on single pole breakers.
14. Consult with Electrical Manager for panel nomenclature.

### 26 27 13 – Electricity Metering

1. Do not use Split CT without Owners Approval.
2. Run both CT leads to shorting switch – **DO NOT** common any leads.
3. Meters shall be Square-D 5563 with external display.
4. Consult with owner for metering enclosure and 9 pole switch.

### 26 29 23 – Variable Frequency Motor Controllers (VSD)

1. Do not mount any disconnects or motor starters above the ceiling unless approved by Owner.
2. Motor controls shall use LED lamps.
3. VSDs approved for use on campus:
  - a. Danfoss HVAC Class, such as the FC102
  - b. ABB ACH550 series
  - c. Square-D E-Flex
    - i. Square-D S-Flex are unacceptable for any application at RIT.
    - ii. S-Flex drives that are installed shall be removed and replaced with an approved drive at the contractor's expense.
4. All VSDs shall be supplied with BACNet capability (BACNet/MSTP or BACNet/ARCNet)
  - i. It is acceptable to use an add-in module for the BACNet capability, but the module shall be provided with the drive and the module cost shall be included with the contractor's bid or quote.

- ii. If a VSD is installed without BACNet capability, the contractor is responsible to add the BACNet capability at no additional cost to RIT.
5. All VSDs shall have capability for the following hard wired control points:
  - a. AI VSD Speed Control Signal (0-10V or 0-5V)
  - b. AO VSD Speed Feedback Signal (0-10V or 0-5V)
  - c. DI VSD Start/Stop (to External Dry Contact)
  - d. DI VSD Safety Interlock (to External Dry Contact)
  - e. DO VSD Run Status (Dry Contact)
  - f. DO VSD Alarm Status (Dry Contact)
  - g. It is acceptable to use an add-in module for the IO Point capability, but the module shall be provided with the drive and the module cost shall be included with the contractor's bid or quote.
  - h. If a VSD is installed without the above IO capability, the contractor is responsible to add the IO capability at no additional cost to RIT.
6. VSDs shall be stand-alone, not incorporated into a Motor Control Centre.
7. Start-up of new VSDs shall be performed by the drive manufacturer or their designated representative. Start-up personnel shall supply Owner wiring diagram showing connections of all auxiliary inputs, outputs, and optional cards (communications, i/o) specific to that installation. Start-up personnel shall also supply Owner with a printout and software copy of attributes programmed into drive.
8. A list of values (other than default) programmed into a VSD shall be supplied to the Owner.
9. Use output chokes (load reactors) on VSD where distance between VSD and motor is greater than 50 feet.
10. VSD shall have removable LCD programming module/display that also stores drive attributes.

#### 26 50 00 – Lighting

1. Switching of lighting, and lighting controls, shall be designed with flexibility of operation, maintenance, and energy conservation as primary goals. Constant operation lighting should be minimized per Code requirement and safety needs.
2. Exit Signs
  - a. No batteries in exit lights or emergency lights (except for emergency light by emergency genset).
  - b. Approved exit signs shall be LED Exitronic 450, AC Only, Red Letters, Brushed Aluminum face and trim.
3. Decorative exterior wall sconces to be: Shaper, 695-WP Series; half pyramid with direct illumination (consult with Owner on lamp type to be used).
4. Install occupancy sensors in corridors for corridor lighting control along with wall switches.
5. Install timer switches on light switches for all closets, mechanical, and electrical rooms.
6. For larger mechanical, electrical, or boiler rooms, provide at least one night light (on 24/7) on emergency power circuit near door.
7. Do not use fluorescent lighting fixtures requiring U-tubes, T-12 lamps, or T-5 lamps.
8. Ensure contract language contains disposal information for waste lamps and ballasts.
  - a. Lamps removed from existing fixtures are to be placed in boxes supplied by Owner. Apply tape to the bottom of the boxes to protect from opening. Boxes must be labeled with "Universal Waste - Lamps" (labels supplied by Owner) and dated by writing on the preprinted label. Also indicate lamp type - fluorescent, HID, incandescent. Pack different lamp types (fluorescent, HID, incandescent) in separate boxes. When a box of waste lamps is full, close the flaps and seal with tape. Labeled and sealed boxes of used/waste lamps shall be delivered to Building 99 (Facilities Management Services. Call Project Manager to make arrangements.
  - b. Old ballasts with cloth covered wires or old ballasts that do not have "No PCBs" on the label are to be boxed only with like kind and returned to Owner at Building 99 (call Project Manager to make arrangements). Boxes are to be labeled with RIT Project Number, RIT building number, and Contractor Name. Magnetic ballasts marked with "No PCBs" on the label are to be boxed only with like kind (no PCBs) and will be picked up by the Owner (call Project Manager to make arrangements). Ballasts labeled "Electronic" are to be boxed only with like kind (Electronic) and returned to Owner at Building 99 (Facilities Management Services). Call Project Manager to make arrangements. Boxes are to be labeled with RIT Project Number, RIT building number, and Contractor Name.
9. New fluorescent light ballasts shall be Programmed Start (Rapid Start) type.
10. Return LED tubes in fixtures to be removed to Owner.
11. Lighting fixtures using fluorescent lamps of any length other than 4 feet must be approved by Director of Building Operation and Maintenance.
12. Coordinate light fixture locations with fixed furniture to allow access for lamp replacement.

13. Do not mount light fixtures in high areas where lamp replacement requires more than an 8 foot step ladder. Any fixtures that must be higher require Owner approval.
14. Classroom lighting to include:
  - a. Locate 3-way light switches for all lighting circuits near teaching station and room entry. If dimmers are used, place dimmer(s) at teaching station only.
  - b. First row of fixtures nearest white board shall have all three lamps on dimmer. Balance of fixtures to be inboard/outboard switched, no dimming.
  - c. Appropriate window covering for redirection of ambient light when needed.
  - d. Vacancy Sensor.
15. Classroom Podium information: (No lighting or up/down screen control in podium, use wall switches only.)
  - a. Location and installation by ETC (after telecom and AV integrator completed).
  - b. Provide 3 conduits from podium to projector (through floor (except slab on grade), up wall, above ceiling):
    - i. One 1 inch conduit for power to feed a 20 amp duplex outlet, same leg as projector, on floor under podium.
    - ii. One 2 inch conduit for Telecom\*\* – 2 live Ethernet, 1 classroom voice line, and 1 CATV line at standard signal level (terminated in standard telecom box with jack and labels).
    - iii. One 2 inch for AV cables to/from projector and wall speakers – will be terminated in RIT standard patch plate/panel box on floor by AV integrator.
    - iv. Projector coordinates with telecom – must be wired terminated, labeled, and activated before podium installation.
16. Occupancy/Vacancy sensors shall be Watt Stopper or Hubbell NX Series. Use of any other occupancy sensor requires Owner approval.
17. Vacancy sensors shall be used in offices, conference rooms, and other non-public areas where an occupancy sensor has been traditionally used (except hallways, see above).
18. Install switchpacks or lighting control modules for Vacancy or Occupancy sensors in accessible ceiling location above associated wall switch (not on the deck).
19. Provide an HVAC set of contacts on each Vacancy and Occupancy Sensor (OS). Temperature Controls Contractor to tie-in (provide wiring and programming) HVAC OS contacts with VAV for the area served.
20. MC cable may only be used in accessible areas on whips for light fixtures and may not exceed 6 feet in length.
21. Tie-off points shall be provided for compliance with OSHA Fall Protection for servicing any rooftop mounted lighting or other electrical or mechanical equipment.
22. Occupancy and Vacancy sensors shall be set for 10 minutes.
23. Place an adhesive Green Dot on the ceiling grid at each light fixture that is connected to genset power. For fixtures not grid mounted, place dot on fixture as per Owner direction.
24. Avoid the use of dimming systems. Dimming systems require approval from the Director of Building Operation and Maintenance.
25. Use of Bodine relay (or equal) requires Director of Building Operation and Maintenance approval, and must only be installed in the fixture it serves (label cover).
26. Use twist-lock connectors on each fixture in large assembly areas (gym, etc.) or high bay applications.
27. All fluorescent or LED lamps installed shall be 4100K.
28. Do not use any ballasts manufactured by Triad.
29. Do not use Dimming LED can fixtures (they do not work yet).
30. For fixtures using 4 foot LED retrofit lamps, mark power tombstone using a black Sharpie pen with the voltage being supplied.
31. Do not use low voltage (12 volt) track lighting systems or MR-16 lamps.
32. Track lighting to be 120 volt by Halo. No multi-circuit tracks.
33. Do not use integrated LED fixtures. New fixtures are to be fluorescent (4 ft. T-8 or CFL) or incandescent with retrofit LED lamps installed. Contact Owner Project Manager with questions.
34. Coordinate furniture and light fixture location to provide for lamp changes in light fixtures.
35. LED lamps to be Direct Wire type, where applicable.

#### **26 55 00 – Special Purpose Lighting**

1. Indoor Blue light phone light fixture shall be RAB Lighting VX1F26-3/4, VX100D6, or VBR200DG/F26277.
2. Alertus