

260500 Common Work Results For Electrical

Sections Included In This Standard:

- 1.0 General Electric Practices
- 1.1 Raceways
- 1.2 Fiber Optic Cable
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- 1.4 Wiring Methods
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1.0 GENERAL ELECTRIC PRACTICES

- A. Good workmanship shall be apparent in the installation of all electrical materials and equipment.
- B. Permanence and neat appearance is a part of good workmanship.
- C. Equipment shall be level, plumb and true with the structure and other equipment; also in a horizontal or vertical position as intended.
- D. All materials shall be firmly secured in place, adequately supported, and permanent.
 - a. Equipment boxes / devices shall be fastened to prevent horizontal and vertical sway.
 - b. Materials embedded in concrete or masonry or otherwise part of the structure are considered sufficiently supported.
- E. All hardware, fittings, and accessories shall be of a type designed, intended and appropriate for use and complement the items with which they are used.
- F. All materials and equipment including hangers, supports, fasteners or fittings, and accessories shall have corrosion protection suitable for the atmosphere in which they are installed (whether located indoors or outdoors). Care shall be taken during the installation to assure the integrity of the corrosion protection. Damaged corrosion protection shall be repaired during or after installation.
- G. All screws, bolts, nuts, clamps, fittings or other fastening devices shall be made up tight in accordance with manufacturers' and/or listing instructions.
- H. Plans and specifications shall be carefully followed when installing equipment.
- I. Conduit shall not be run directly below equipment unless serving said equipment.
- J. **The only E-power system that Data shall not be connected to is Standby Optional.** ~~placed on to E-Power circuits.~~
- K. Support rods or threaded rods shall not be bent or installed at an angle.

- L. New installations shall connect building ground to the metal service entry pipe, not the copper building distribution pipe. These piping systems are often separated by a dielectric system so connecting to the buildings copper pipe will not properly ground the electrical system.

1.1 RACEWAYS

A. GENERAL

1. Underground primary wiring raceways shall have 30" minimum cover. Underground secondary wiring raceways shall have minimum cover as required by the NEC. All underground duct banks shall be designed, configured and installed to eliminate standing water, directing drainage to manholes, pull boxes, switch vaults, etc.
2. New building raceways and raceways added to existing buildings shall be concealed, except in areas of Mechanical Rooms, Vaults, etc. Except for mechanical rooms, the use of all surface mounted raceways and boxes shall require the use of wire mold materials with colors matching the background as closely as possible or painting.

B. SUB-TRANSMISSION & DISTRIBUTION (> 600 Volt)

1. Raceways shall be galvanized rigid conduit or PVC. Raceways shall be encased in steel-reinforced concrete.
 - a. See 261000 for the detail on transition from duct bank to pad mounted equipment.
2. All electrical duct banks shall contain reinforcing steel run parallel with the conduits. The number, size, and locations of rebar incorporated into the duct bank shall be sufficient to allow a minimum ten foot span of undermined duct bank to be self-supporting. The minimum individual rebar size shall be 3/8 inch in diameter. Wires to hold the rebar in place shall be incorporated into the duct bank at appropriate spacing and be of sufficient size to hold the rebar. Rebar shall be bonded to the system ground in each manhole. The use of Directional Drilling and Jack & Boring will be considered on a case-by-case basis in lieu of underground duct banks.
3. Provide a minimum of one spare conduit, equal to or larger than the largest specified size.
4. Chairs for steel-reinforced concrete raceways shall not be spaced over 6' apart.
5. All concrete duct bank shall be accomplished in one continuous pour and the process observed by FS. FS needs to be on-site to witness the pouring. Multiple pours for exceptionally long runs must be coordinated with FS for approval before pouring. The use of an approved cold joint solution is required.
6. In the manhole, rebar shall be installed in a hole that has been drilled from the inside. The rebar shall be set in place using epoxy and the end shall be flush with the side wall of the manhole. The ends shall be overlapped 2' for the purpose of tying off.
7. Conduit shall be cut in a manner as to stagger the PVC pipe joints. When running multiple lengths of conduit, the stacking of joints is not allowed. The difference in joint placement shall be 6 to 8" in length.

C. FLEXIBLE CONDUIT

1. Flexible conduit shall be steel or aluminum with a minimum diameter of ½", except where supplied by a manufacturer with a lighting fixture or as part of a pre-manufactured wiring system.
 2. Separate green grounding conductors shall be installed in ANY length of flex.
 3. Flex will not be used in lengths greater than 6'.
 4. Flex will not be used inside walls, or as a replacement for EMT. A short vertical drop of a flex extension from ~~EMT~~ of a junction box, into an existing wall, to a secured box, shall be allowed to avoid having to remove a section of a wall that cannot be easily repaired.
 5. Flex will not be looped between light fixtures, except for wiring whips provided with light fixtures.
 6. Flex will not pass through walls or ceilings. A junction box is required at the point of transition.
 7. All Flexible conduit shall be supported by UL approved straps or approved methods. No zip ties or Velcro will be permitted.
- D. Metalclad (MC) cable
1. Metalclad (MC) cable ~~is not approved for use will not be used~~ without written approval from the Facilities Services Operations Engineering Division.
 2. If allowed, it shall be limited to
 1. branches for lighting and offices.
 2. access door control security systems
 3. other locations, that ½" or ¾" flex will not fit.
 4. Vertical runs inside walls. It shall **not** be run horizontally inside walls.
 4. Usage for laboratories and all homeruns to panels are not permitted.

1.2 FIBER OPTIC CABLE

- A. Refer to UF Telecomm Standards.

1.3 OVERCURRENT PROTECTION DEVICES

- A. All 600 Volt and below circuit breakers shall be bolt on type.
- a. Plug in devices are not acceptable, **except for I-line panels.**

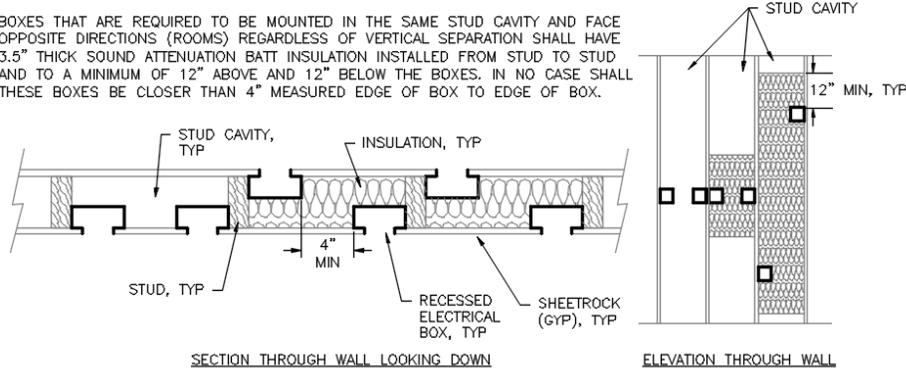
1.4 WIRING METHODS

A. BOXES

1. Location:
 - a. Through-the-wall boxes are not acceptable.
 - b. Back to back boxes. Boxes that are required to be mounted in the same stud cavity and face opposite direction (rooms) regardless of vertical separation shall have 3.5" thick sound attenuation batt insulation installed from stud to stud and a minimum of 12" above and 12" below the boxes. In no case shall these boxes be closer than 4" measured edge of box to edge of box. See

figure.

BOXES THAT ARE REQUIRED TO BE MOUNTED IN THE SAME STUD CAVITY AND FACE OPPOSITE DIRECTIONS (ROOMS) REGARDLESS OF VERTICAL SEPARATION SHALL HAVE 3.5" THICK SOUND ATTENUATION BATT INSULATION INSTALLED FROM STUD TO STUD AND TO A MINIMUM OF 12" ABOVE AND 12" BELOW THE BOXES. IN NO CASE SHALL THESE BOXES BE CLOSER THAN 4" MEASURED EDGE OF BOX TO EDGE OF BOX.



RECESSED BOXES IN STUD CAVITY DETAIL

NOT TO SCALE

- c. Boxes below suspended ceilings shall be “readily accessible” per NEC. No removal of equipment or furnishings shall be necessary for access.
 - d. Boxes above suspended ceilings shall be “accessible” per NEC. They must be accessible from below or aside, and the access opening may not be less than 18 inches from a duct or structural component (excluding the ceiling grid). Junction boxes located above ceiling shall be installed facing down and shall be accessible after installation.
 - e. Do not recess boxes deeper than 5 inches into a wall (finished/furred out or not).
 - f. Boxes shall be sized so extension rings are not needed. Any box extensions need to be approved in writing by Facilities Services. If approved the following shall always apply
 - i. Do not install multiple extension rings on one box.
 - ii. Do not install extension rings that will limit access to the back of the box, except for a trim ring.
 - iii. The extension ring shall meet the shape of the original box. i.e. If the original box has square corners the extension shall have square corners.
2. Cover plates: All cover plates shall be high abuse resistant nylon or stainless steel.
 3. All device cover plates that are served by the emergency generator shall be readily identified as an emergency circuit without removing cover. Red in color.

B. INSTALLATION

1. Surface mounted raceway systems shall allow for maintenance, without disassembly of the complete system. Raceway systems shall be fed from an accessible box, mounted over a recessed box in the wall. Surface raceway feeding is also permissible, provided it occurs through approved devices, fittings or knockouts supplied as part of a complete, approved raceway system.
2. All boxes in refrigerated areas should be sealed at points of entry to prevent thermal leaks and condensation.

3. Handiboxes shall NOT be used in any work.

C. DEVICES

1. All switches and receptacles to be specification grade.
2. When using stranded wire, connections are to be made to the back clamps of the specifications grade device. All wire strands must be under the ground screw. Other methods are the use of a fork or solid wire.
3. Push-in spring type connections are not to be used.
4. Aluminum wire found within the scope of the project shall be removed all the way back to the panel / breaker.
5. A receptacle shall not be used to feed other receptacles. Electrical connections are to be made in the box and receptacles supplied from connections.
6. Conduit and whips shall not be installed into knockouts of box extension ring.
7. Receptacles are to be installed with ground up in new construction. On a renovation match surrounding but if not adjacent to any receptacles in area install ground up.

- D. RECEPTACLES SERVING LABORATORIES: In laboratory spaces, receptacles and/or electrical equipment should not be installed within 2' from a sink. GFI's should only be installed where realistic hazards are indicated. Avoid placing equipment on outlets in these areas due to false tripping with subsequent damage to equipment and resulting loss of research information/data.

E. GFI RECEPTACLES:

1. All receptacles in toilet rooms, outside, and within 6 feet of a sink shall be a ground fault interrupter (GFI) receptacle.
2. Ground fault breakers are not permitted, unless the Manufacture or the equipment requires a GFI breaker.
 1. If a refrigerator, microwave or any other appliance requires a GFI and the appliance is within six feet of a sink a GFI Breaker will be permitted.
 2. All other situations must be approved in writing by Facilities Service.
3. Powering any receptacle through a Ground fault interrupter receptacle is not permitted.
 1. A GFI receptacle shall be line only.
4. GFI receptacles serving all water fountain coolers shall be located under cooler and be readily accessible (not behind the cooler cover). If cooler has more than two cords that plug into device it will require a Quad GFI Receptacle.

F. CONDUCTORS

1. All conductors shall be copper.
2. Provide an insulated grounding conductor in all feeder and branch circuits.
3. Crimp type connectors shall only be used on stranded wire.
4. All neutral conductors shall be considered current carrying when considering pipe fill.

5. All Branch circuit conductors (Hot & Neutral) shall be identified as a pair from the Panel thru all junction boxes to the device box before it ties into any device.
 - a. All conductors shall be numbered to identify the pairs.

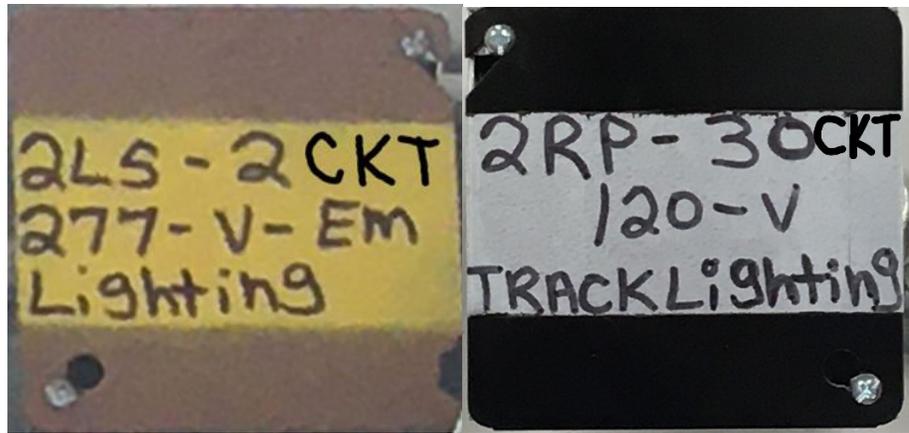
G. PANELS

1. Power from a panel shall not be provided to a floor other than the floor the panel is on.
 1. This applies for emergency power panels as well
2. Panels inside customer's space shall not feed power to circuits outside of that space.
 1. If the power MUST feed area out of this space, ALL covers and devices MUST clearly label panel's physical location.

1.5 ELECTRICAL IDENTIFICATION

A. LABELING

1. Switches & Receptacles: Each light switch & receptacle shall be labeled with circuit and panel number using numbered vinyl cloth adhesive markers, 1/4" minimum height or black marker written legibly. Locate label inside of box and on the device, so it can be readily identified by removal of the cover plate. A clear label sticker on the outside of the cover plate is also required.
2. Boxes:
 - a. All low medium voltage (<600 V) junction and pull box covers shall be painted per the following color coding.
 - i. 120 / 208 Volt : Black (see image below for example)
 - ii. 120 / 208 Volt Emergency Power (Life Safety, NEC 700) : Black with Yellow Stripe
 - iii. 120 / 208 Volt Optional Power (Non Life Safety, NEC 702) : Black with Orange Stripe
 - iv. 277 / 480 Volt : Brown
 - v. 277 / 480 Volt Emergency Power (Life Safety, NEC 700) : Brown with Yellow Stripe (see image below for example)
 - vi. 277 / 480 Volt Optional Power (Non Life Safety, NEC 702) : Brown with Orange Stripe
 - b. All low medium voltage (<600 V) junction box covers shall be marked using a printed label, stencil or be handwritten (3/4" minimum height for labels, hand writing must be legible) . Locate label so it can be readily identified (without removal of the cover plate).
 - i. Branch Circuits : label panel number and circuit (Use CKT abbreviation for circuit followed by number)
 - ii. Feeder Circuits : Label feeding panel and load panel
 - c. Auxiliary Systems junction and pull box covers
 - i. Fire Alarm Systems : Red
 - ii. Access Control Security Systems : Yellow
 - iii. Telecommunication Systems : Blue
 - iv. Other Systems : Paint a Unique Color
 1. Do not use any of the above colors, Green or White



Examples of junction box labeling. 277 / 480 Volt Emergency Power on the left and 120 / 208 Volt on the right.

3. Conduit Couplers
 - a. See labeling for junction and pull box covers above.
4. For areas with no ceilings where all systems normally above the ceiling will be painted a single color use the following for electrical labeling (i.e. a hallway where not drop ceiling is being installed.)
 - a. All junction boxes get a printed label on them with Voltage, power source if needed (e power), Panel number (or feeding and load panel numbers), circuit (s) number or with the service in the junction box (fire alarm, access control, telecom/data, HVAC/BAS, etc.).
 - i. Above information shall be written with permanent marker on the inside of the junction box cover as well.
 - b. Conduit couplers further than 2 sticks (20 feet) of conduit from a junction box will have
 - i. a label with voltage, and power source if needed (e power) or with the service in the junction box (fire alarm, access control, telecom/data, HVAC/BAS, etc.).
 - ii. or the pre colored coupler shall be wrapped with painters tape and after painting has occurred, painters tape shall be removed to expose coupler cover.
 - c. If conduit comes from or goes to a space where the conduit is accessible and not painted (i.e. with drop ceiling) paint the conduit as it come through the wall (small paint, ~6" is fine) on the drop ceiling side and begin colored conduit (above drop ceiling) after the next coupler.
 - d. If conduit comes from or goes to a space with hard ceiling or will not be visible, then add label to the conduit at the wall penetration using the labeling system above.
 - e. Labels shall be self adhesive type, with ½ tall black letters on a white or clear background.
5. Floors: Areas that pertain to section 110-26 of NEC shall have yellow striping installed diagonally with stripes being three inches wide and three inches apart. The center of the area shall have the words "Safety Zone" installed with letters at least four inches high.
6. Conductors: Standard electrical conductor coding shall be observed as follows:
 - a. For 120/208: black, red, blue, white, green

- b. For 277/480: brown, orange, yellow, gray, green with yellow stripe
- 7. Control and alarm wiring shall be identified by tags at every enclosure.
- 8. All emergency switches and outlets should be identified by the color red.
 - a. At a minimum the switches, receptacles and cover plates shall be red.
 - b. For surface mounted conduit and boxes it is preferred these be red as well.
- 9. Low voltage wiring shall be contained in EMT or run to a cable tray.
 - a. Communication conduit shall be painted blue.
 - b. BAS wiring and conduit shall be labeled per the 250553 standard.
- 10. Thermostat wiring shall be contained in EMT inside of walls and conduit extended to the top of the wall at a 90 degree termination.
 - a. Conduit shall be painted white.
- 11. Panels **and Disconnects** shall be clearly marked with phenolic labels.
 - a. Emergency panel's labels shall be red in color
 - b. All other panels shall be Factory supplied color, preferably grey.
- 12. All panel schedules will be brought up to date after working on electrical if there are circuit changes.
 - a. **Contractor to check with Facilities Services Operations Engineering to determine if an electronic copy of panel schedule exists for editing.**
- 13. All new electrical equipment panels shall have an Arc flash study completed by a qualified person per NFPA 70E. This equipment shall be labeled according to NFPA 70E equipment labeling requirements

1.6 **DESIGN LOADS**

- A. For offices, 110/120 VAC 20 AMP circuits shall be designed on the basis of
 - a. A maximum of four (4) desk locations per circuit
 - b. For new construction or entire floor renovations, offices shall have dedicated circuits.
- B. Lighting: No more than 5 offices will be powered by one circuit.
- C. Panel Loads: Load Calculations **and/or Studies** on new **loads to any electrical system and remodel projects** are required.
 - a. Show on a floor plan or a line diagram where the power source is feed from and what area it is feeding.
 - b. **The process for conducting load studies, a calculation page and the load study data sheet are currently available through Facilities Services Operations Engineering.**

1.7 **TRENCHING**

- A. All trenching shall be done by hand or directional boring unless approved by FS.

1.8 **IDENTIFICATION OF UNDERGROUND WIRING AND/OR DUCTBANKS**

- A. **WARNING TAPE:** All underground wiring and duct banks shall have metalized warning tape installed above a conduit, duct bank or electrical line that identifies the specific system buried below. Tape shall consist of a minimum 3.5 mil solid foil core encased in a protective plastic jacket (total thickness 5.5 mils) and be 6" wide with black lettering imprinted on a color coded background that conforms to APWA color code specifications. Tape shall be installed from 18" to 30" above a conduit, duct bank or electrical line and in no case less

than 6" below grade.

- B. TRACER WIRE: Tracer wire is not required for underground electrical lines.
- C. ID TAGS: ID tags shall be installed on all splices and terminations in manholes with: Name of the Splicer; Name of the Electrical Contractor performing the work; and Date of Installation of the Splice.

1.9 DEMONSTRATION OF ELECTRICAL EQUIPMENT

The following is guide to the amount of contact hours of instruction the Builder shall provide to train University maintenance personnel in the operation of new systems. The complexity of each system shall be taken into account.

- A. ELECTRICAL: 8 hours divided into two sessions.
- B. FIRE ALARM SYSTEMS: 16 hours divided into four sessions.
- C. EMERGENCY GENERATOR: 4 hours, one session.
- D. VIDEO TAPING: Provide video taping of any Builder or Manufacturer demonstrating the features for operation of generators, main switchgears, switchboard, fire alarm systems etc. during Substantial, Final Inspection, or any other training session.

1.10 CABLE TRAY

- A. Cable trays shall be adequately sized for 10% future additions (minimum). Cable trays shall be installed as high as possible, but beneath ductwork. Installed cable trays shall be accessible at all locations. Trays shall be installed with a cover only where physical protection of the installed cables is required, and where accessible. See UF Telecommunications Construction Standards for further requirements on telecommunications cable tray.
- A. Separators between different types of services shall be provided.

1.11 SAFETY SWITCHES / DISCONNECTS

- A. Switches and disconnects shall be appropriate for the location and application.
- B. Provide 10% spare fusing with a minimum of three sets spare (including new fusing for each of the three phases) of the amount installed, based on the different voltages, amperage ratings, and types of fusing installed. Spare fusing shall be provided within weatherproof containers for long-term storage (such as in ammo cans). Spray paint container with the wording 'Spare Fuses' on the side.

1.12 LIGHTNING PROTECTION

- A. All new buildings or major renovations shall install complete lightning protection system with a UL Master Label
- B. All wiring shall be compatible with the proposed or existing roofing type.
- C. The installation shall include theft preventative coverings for all accessible exposed conductors.

END OF SECTION