Department of LABOR AND INDUSTRIES

ELECTRICAL CURRENTS

Code guidance from the Department of Labor and Industries
Office of the Chief Electrical Inspector

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Electrical code issues and answers.

● Electrical Connections

This is the third in a series of articles addressing the most frequently written electrical code corrections. The integrity of electrical connections is one of the most important elements of any electrical installation. Article 110-14 of the National Electrical code is often cited. When making electrical connections the installer must remember the following:

- Don't mix copper and aluminum conductors in the same terminal or splicing connector unless it is listed for the purpose.
- Use lugs rated for copper if using copper conductors and aluminum rated lugs for aluminum conductors.
- Use pressure connectors at wire terminations except that #10 awg conductors may terminate by means of screws or studs and nuts with upturned lugs.
- When multiple terminations are made under one lug the terminal must be rated for the combination of multiple conductors used.
- When making a splice the splicing device must be covered with insulation equivalent to that of the conductor that is being spliced.
- When making a direct burial splice use a splicing means that is rated for direct burial.
- When installing electrical circuits or feeders the lowest temperature rating of the circuit breaker, wire, or wire terminal determines the allowable ampacity of conductors in Table 310-16.

This article is intended to help identify general provisions for terminating conductors found in Article 110-14 of the National Electrical Code but should not be substituted for study of this code to fully understand all requirements.

● Provisions for Grounding Snap Switches and Faceplates

NEC 380-9(b) states *" snap switches, including dimmer switches, shall be effectively grounded and shall provide a means to ground metal faceplates, whether or not a metal faceplate is installed."*

Snap switches are considered effectively grounded under any of the following conditions:

1. Mounting the switch to a metal box with metal screws. (This method of grounding the switch requires direct metal contact between the yoke of the switch and the box.)
2. Installation of self-grounding switches listed for the purpose.
3. Mounting the switch to a nonmetallic box, which has integral means to accomplish grounding.
4. Terminating the equipment grounding conductor to the equipment ground terminal on the switch.

The exception to this rule is where no grounding means exists within the switch box or where the wiring method does not include an equipment grounding conductor. This exception applies to the replacement of switches only. Provisions for grounding the switch must be available on new installations. When this exception is allowed and exercised a nonconductive faceplate is required.

What impact does this have on nonmetallic cable systems?
WAC 296-46-336 requires that *"all electrical equipment grounding conductors for nonmetallic cable systems shall be completely made up at the time of the inspection"*. Switches are now required to be grounded. At the time of rough-in inspection non-metallic switch boxes must have equipment grounding conductors made up with a "grounding pigtail" available to terminate on the grounding terminal of the switch.

● Attention Electrical Trainee

One of the more common problems with affidavits submitted to the department for training hours is that the hours have been reported in the wrong category. **WAC 296-401A-500** requires that training hours must be reported accurately. Accurate reporting of individual trainee hours requires documenting the correct number of hours and reporting hours in the correct specialty category.

Reporting hours in the commercial/new industrial category when working as a maintenance electrician is a common mistake. Typically these trainees should place their hours in the non-residential maintenance specialty category. Maintenance trainees may compile electrical hours in the commercial/new industrial category only when the work is on **new electrical installations.**

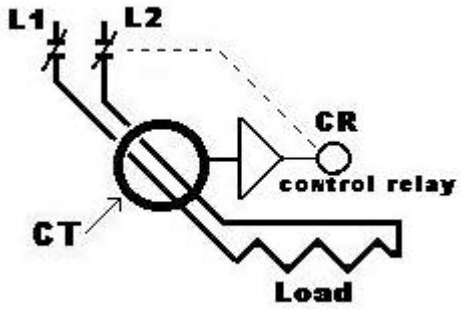
RCW 19.28.210 requires electrical work permits for all new installation work of any kind, in any category. This statute also requires electrical work permits for most of the work classified as non-residential maintenance except as exempted in WAC 296-46-495 (7). In the absence of permits and inspections it becomes difficult to establish creditable training hours.

If the reported hours have been worked without valid electrical work permits or other acceptable verification methods, the audit group may not be able to verify and credit hours. The results are often non credit of hours to the trainee and the issuance of citations to the company for non-compliance with the electrical statute. The company may be required to purchase electrical work permits for all uninspected electrical work. If the work hasn't been done as claimed by the trainee and the affidavit is false, citations and other penalties may be accessed as described in Rule 296-401A-550 of the Washington Administrative Code.

Trainees, you must maintain a current trainee card at all times. You must always work with proper supervision and in proper ratio. **You are responsible** for submitting honest and accurate affidavits if you want the hours credited to your file. If you have any questions please call the Audit Group at (360) 902-4245 or (360) 902-5742.

● How does a GFCI circuit work?

GFCI protected circuits are becoming more prevalent in the electrical industry and having a thorough understanding of their operation is essential. The basic function of a GFCI is to monitor the current delivered to the load. If the amount of current delivered is more than the amount of current received back (by 4 to 6 milli-amps), the GFCI trips disconnecting all power from the load. This method is based on Kirchhoff's Current Law (I in - I out = 0) that states that the sum of the current in a closed loop must equal zero. The most common way to achieve this monitoring is with a CT (current transformer).



When current flows through a wire it develops a magnetic field in one direction and an opposite magnetic field when the current flows in the opposite direction. When these two fields come in close proximity to each other, they cancel each other out if they are equal, and opposite, in field polarity. When the current in L1 (supply) and the current in L2 or neutral (return) are equal, there is no net magnetic field present. With no magnetic field present, the CT will produce no current, telling the GFCI sensor circuit that the circuit is balanced with no ground fault current.

Ground fault circuit interrupters are proven to be an effective tool to significantly improve the safety of personnel. **Monthly checks of GFCI products are required to verify that the device is operating properly**. If upon testing the GFCI it is found to be defective it must be replaced. Defective ground fault circuit interrupters may allow current to flow in the circuits they are installed in even when the ground fault sensing capability of the device is no longer functioning.