Commonly Found Electrical Licensing Concerns And Installation Deficiencies

The Electricians' Licensing Board in conjunction with the State Electrical Inspectors, municipal electrical and building inspectors and other representatives of the electrical industry in the State of New Hampshire have put together this list of common installation deficiencies and problems encountered by the Board's office staff relative to the State's licensing law RSA 319-C and the administrative rules.
The Board welcomes any input from instructors, inspectors, licensees and other concerned parties relative to this list or any other items of concern. The Board would like to remind all concerned parties that the 2002 NEC becomes effective July 1, 2002 as part of the Board's administrative rules. Some local municipalities may adopt the 2002 NEC at an earlier date therefore, it is advisable to check with the local authority before starting an installation. However, no matter what edition of the NEC the local municipality is under installations in the State of New Hampshire must be performed to the current edition of the NEC as adopted by the Electricians' Board.

Licensing Concerns

1.) Licensees and apprentices should notify the Board office if you have a change of address and/or telephone number.
2.) Journeyman licensees should be aware that in order to perform electrical installations for heat, light and power purposes they must be employed by a master electrician. You can not perform installations on your own.
3.) Master licensees should be aware that they are responsible for; periodically inspecting the work of the journeyman licensees in their employ and performing a final inspection of the journeyman's completed installation; verifying that the licenses of the master and journeyman electricians are current; verifying that their apprentices are properly registered with the Electricians' Licensing Board and that the ratio of licenses to apprentices on the job site is proper.
4.) All licensees and apprentices should be aware that when paying fees for licensure, licensure renewal, apprentice registration or renewal **the payment must be made in the form of a check or money order. The Board's office can not accept cash**. The office sends out renewal forms as a courtesy but you are responsible for renewing your license or apprentice card on time. Apprentices must renew before the expiration date on the apprentice card. If you haven't received a renewal form in the mail you should contact the office.
5.) Master and journeyman should be advised that the proof of the 15 hour update course is not due until their renewal in the year 2003. Please do not send in proof of completion certificate until that time. You must renew by the last day of your birthday month each year. Currently, if you renew within 30 days of the expiration date there is no penalty and you may renew for up to one year with a late fee. However, the license is not valid the day after it expires. If you fail to renew within one year you must be examined. The newly adopted Administrative Rules will now allow a lapsed license to be renewed up to ten years with varying degrees of continuing education and a 20 question exam on the current code changes.
6.) Apprentices should be aware that when filing an application for apprenticeship or apprenticeship renewal the application must be signed by the master. Each apprentice must be under the direct supervision of a licensed master or journeyman electrician when performing electrical installations. (One to one supervision ratio)

Most Common Installation Deficiencies

ELECTRICIAN BOARD

Most Common Installation Deficiencies in the State of New Hampshire

The following is a list of the most common deficiencies found with electrical installations in the State of New Hampshire. The list is in random order and it has been formatted to the 2002 edition of the National Electrical Code (NFPA 70-2002).

1.) A grounding electrode conductor that is attached to the grounded conductor or equipment grounding terminal bar of a remote panelboard.

"250.24(A) System Grounding Connections. A premises wiring system supplied by a grounded ac service shall have a grounding electrode conductor connected to the grounded service conductor, at each service, in accordance with 250.24(A)(1) through (A)(5).

(1) General. The connection shall be made at any accessible point from the load end of the service drop or service lateral to and including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means."

Example: A single family dwelling with an attached garage has a 200 ampere main disconnect located in the garage and a 4/0 aluminum SER Cable has been run to a panelboard located in the basement. A grounding electrode conductor has been attached to the metal water pipe feeding the dwelling and run to the panelboard located in the basement. The grounding electrode conductor has been terminated on the grounded conductor (neutral) or equipment grounding bus of the panelboard. This panelboard, being a remote panelboard, has been supplied by a feeder and is not part of the service. Therefore, the grounding electrode conductor should have been run to the 200 ampere service disconnect in the garage. In this application the connection to the grounded conductor on the load side of the main disconnect enclosure is prohibited.

2.) The bonding of metal water piping in the vicinity of separately derived systems.

250.104 Bonding of Piping Systems and Exposed Structural Steel.

(A) Metal Water Piping.

(4) Separately Derived Systems. The grounded conductor of each separately derived system shall be bonded to the nearest available point of the interior metal water piping system(s) in the area served by each separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is connected. Each bonding jumper shall be sized in accordance with Table 250.66.

Exception: A separate water piping bonding jumper shall not be required where the effectively grounded metal frame of a building or structure is used as the grounding electrode for a separately derived system and is bonded to the metallic water piping in the area served by the separately derived system.

Example: Any metallic water pipe located in the area served by the separately derived system must be bonded to the grounded conductor connection of the separately derived source. The metal water piping serving an office lunchroom with 120-volt power provided from a nearby transformer must be bonded to the transformer grounded connection.

3.) The non-use of expansion fittings in Rigid Non-Metallic (PVC) conduits that are subject to thermal expansion and contraction.

Sections 300.7(B) and 352.44 require the use of an expansion fitting in exposed straight runs between securely mounted items such as boxes, conduit bodies and elbows of non-metallic raceways that are subject to large temperature variations. The expansion fitting is required when the length change, in accordance with Table 352.44(A), is 0.25" or greater.
Example: in a 100' run of Rigid Non-Metallic Conduit, that is exposed to a 100 degree difference in temperature, the computed expansion is 4.1". With a 100 degree difference of temperature and in an area not exposed to direct sunlight the length change in a 6' 1" section of Non-Metallic conduit will be more than 0.25". However, any manufacturer's requirements included must be considered.

4.) The improper supporting and securing of Rigid Non-Metallic (PVC) raceways.
Section 352.30(B) requires that runs of Rigid Non-Metallic Conduit be supported in accordance with Table 352.30(B). Section 352.30(A) requires that the conduit be securely fastened within 3' of junction boxes, conduit bodies, etc. Section 352.44 also requires that the fastening method must be designed to allow for expansion and contraction of the raceway system. This means that a fitting that is designed for use with Rigid Non-Metallic Conduit should be used.
Example: Table 352.30(B) requires that a run of 1/2" RMC (PVC) be supported at intervals not exceeding 3' and a run of 2" be supported at intervals not exceeding 5'. The distance between supports varies depending upon the size of the conduit. The issue of the clips used to support the raceway always raises some questions. There are but only a few clips, available at the supply houses that are actually designed to secure RMC (PVC) conduits and still allow for the expansion and contraction of the raceway. Two commonly used methods are the "two hole" and the "snap-in" type plastic clips. Two hole metallic clips, hangers and strut type clips that are designed to be used with Rigid Metallic Conduit may not be suitable for use with rigid nonmetallic conduit (PVC raceways) that are subject to thermal expansion and contraction. They may not allow for the expansion and contraction of the raceway.

5.) The non-use of expansion fittings on conduits emerging from the earth that are attached to fixed equipment and are installed in locations that are subject to ground movement.
Section 300.5(J) requires that conduits in these locations be arranged to prevent damage to the enclosed conductors. The Fine Print Note below 300.5(J) recognizes the use of expansion fittings in conduits as one method to achieve this purpose.
Example: An underground service (lateral) to a dwelling unit installed in 2" Rigid Non-Metallic Conduit that is directly attached to a meter enclosure mounted, outside, on the dwelling unit wall. The issue of areas that are subject to ground movement has always been and will continue to be difficult to define due to varying conditions.
*There are many factors that come into play when you consider whether or not the conductors enclosed in the raceway are subject to damage by ground movement. Some of the things that come to mind are; how deep the frost penetration is, has the earth around the conduit been backfilled and compacted or just backfilled and how deep the conduits are buried in the earth. Depending on where you are located in the State of New Hampshire the conditions will vary. Many times this issue is left to the local authority. He/she would be most familiar with the conditions in their area***.**

6.) The improper installation and securing of expansion fittings in runs of Rigid Non-Metallic (PVC) Conduit.

Section 110.3 (B) requires that listed or labeled products be installed in accordance with their listing or labeling. Quite often when the expansion fitting, mentioned in items # 3 & 5, is installed it is secured on the wrong end. The manufacturer's listing requires that the expansion fitting be secured on the "bell" (fixed) end. If they must be installed in a vertical application, the open end must be securely fastened in the down position. This will minimize the infiltration of foreign material into the fitting.

7.) The lack of "in use" type covers on outdoor receptacles.

Section 406.8(B) Wet Locations.

(1) 15- and 20-Ampere Outdoor Receptacles. 15- and 20-ampere, 125- and 250-volt receptacles Installed outdoors in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted.

(2) Other Receptacles. All other receptacles installed in a wet location shall comply with (a) or (b):

(a) A receptacle installed in a wet location where the product intended to be plugged into it is not attended while in use (e.g., sprinkler system controller, landscape lighting, holiday lights, and so forth) shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(b) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools and so forth) shall have an enclosure that is weatherproof when the attachment plug is removed.

8.) Use of electrical equipment without following the manufacturer's installation instructions.

All too often the information provided on or with electrical equipment is overlooked by the installers. If specific installation requirements are provided by the manufacturer they must be adhered to by the installer. Section 110.3(B) requires that electrical equipment be installed in accordance with any installation instructions that may be included in the listing or labeling. It would be a Code violation to not follow these instructions so don't throw them away until you have read them.

9.) The non-bonding of service raceways and equipment.

Section 250.92(A) requires the non-current carrying metal parts of service equipment, indicated in Section 250-92(A) (1), (2) and (3), to be effectively bonded together. Section 250.92(A)(1) speaks to service raceways and Section 250.92(A)(2) speaks to all service equipment enclosures containing service conductors, including meter fittings, boxes, and the like interposed in the service raceway. Section 250.92(B) describes the methods that will ensure the electrical continuity of the service equipment. As described in Section 250.92(B) **standard locknuts or bushings are not an acceptable means for the bonding required by this section.**

Example: A structure has an overhead service. The service entrance conductors splice to the service drop and run down an EMT raceway to the meter enclosure. The EMT raceway is secured to the hub on top of the meter enclosure with a compression connector. The EMT raceway runs from the back of the meter enclosure directly through the wall and attaches to the service disconnect enclosure with standard connectors, locknuts and plastic bushings on both ends.

The problem here is a bonding fitting should have been used on one end of the EMT raceway running from the meter enclosure to the service disconnect enclosure to bond the raceway. The EMT riser is effectively bonded by the threaded hub on the top of the meter enclosure. If there were any metallic enclosures installed in the raceway system they would be required to be bonded as well. Section 250.102(C) requires equipment bonding conductors on the supply side of the service to not be smaller than the sizes shown in Table 250.66.

10.) The non-use of a locking type disconnect for submersible well pump motors.

Section 430.102(A) requires the installation of a disconnecting means in sight from the motor controller location that disconnects the controller. In the case of the typical residential submersible well pump installation the controller would be the pressure switch on the water storage tank. Section 430.102(B) requires a disconnecting means in sight from the motor location to disconnect the motor. Article 100 defines "in sight from" to be visible and within 50'. So there should be a disconnecting means that is visible and located no more than 50' from the well head unless the installation qualifies to meet exception No. 1 to 430.102(B) which allows you to eliminate the motor disconnect if the controller disconnect is capable of being locked in the open position.

Example: a submersible well pump has been installed to supply the domestic water for a dwelling unit. The pump cable runs from the well head to the dwelling unit basement where it connects to the load side terminals of the pressure switch located on the water storage tank. A branch-circuit has been run about 35' from a panelboard, that is not visible from the water storage tank location, to a snap switch located next to the water storage tank. The conductors on the load side of the snap switch run to the line side terminals of the pressure switch. In this case the snap switch would be the controller disconnect switch required by 430.102(A). If the panelboard were visible for the entire 35' from the water storage tank location the circuit breaker could also serve as the controller disconnect.

In the installation described, it is impracticable to mount the disconnecting means within sight from the pump motor so the exception to 430.102(B) is applicable. Note that provision for locking or adding a lock to the disconnecting means must be permanently installed on or at the switch. There are products available on the market that will allow a lock to be placed on a standard snap switch assembly or circuit breaker.

11.) The improper connection of septic pumps.

There are several different problems that can stem from septic pump installations. First, Section 430.102(A) requires the installation of a disconnecting means in sight from a motor controller location that disconnects the controller. In the case of the typical residential septic pump installation the controller would be the float switch in the pump tank. Section 430.102(B) requires a disconnecting means in sight from a motor location to disconnect the motor. Unlike the well pump scenario above the motor and controller are located in the same location so the exception to 430.102(B) which allows you to eliminate the motor disconnect if the controller disconnect is capable of being locked in the open position won't do any good in this case.
Article 100 defines "in sight from" to be visible and within 50'. So there should be a disconnecting means that is visible and located no more than 50' from the pump tank. In most cases the cord and attachment cap of the pump and controller (float switch) are inserted into a receptacle located near the tank so the attachment cap for the controller and pump cord can serve as the disconnecting means. Note in the sentence above the disconnecting means must be visible.

Most often the homeowner does not want to see a pedestal with a receptacle and cords so the attachment caps are cut off and the cords are wired directly (hard wired) into a junction box that is located in the tank. If the pump and controller have been hard wired many times there is no disconnect at all located within site from the motor or controller.
In many cases the receptacle has been installed inside the pump tank. Before making this kind of installation consideration should be given the issues of accessibility and corrosion. Also depending on the size of the system there may be sufficient enough hazardous vapors in the pump chamber to classify the location. The classified locations are more common in commercial and industrial applications.

12.) The spaces about electrical equipment.

A number of concerns relating to the clearance issues **of Section 110.26** are often overlooked in the field. This section requires that sufficient access and working space be provided about electrical equipment to provide ready and safe operation and maintenance of the equipment.
The depth of working space described in Section **110.26(A)(1)** is required about equipment operating at 600 volts or less to ground that may require examination, adjustment, servicing, or maintenance while energized. The depth of the space must be determined in accordance with **Table 110.26(A)(1)** which is based on the conditions described in the table note.
Section 110.26(A)(2) "Width of Working Space" requires the working space to be at least 30 inches in width or the width of the equipment whichever is greater. This section further requires that the space permit the door or hinged panel of the equipment to open at least 90 degrees.
Section 110-26(A)(3) "Height of Working Space" requires the height of the working space to be at least 6 feet 6 inches, measured from the floor, grade, or platform, or the actual height of the equipment itself which ever is greater. Associated equipment that is located within the working space is not permitted to extend more than 6 inches beyond the front of the electrical equipment.
Section 110.26(B) "Clear Spaces" requires that space about electrical equipment be kept clear and by not allowing the space to be used for storage.
Section 110.26(F) "Dedicated Equipment Space" requires that switchboards, panelboards, distribution boards, and motor control centers be located in dedicated spaces and be protected from damage. **Section 110.26(F)(1)(a)** mandates a clear space that is the depth and width of the equipment that extends to height of 6 feet above the equipment or the structural ceiling which ever is lower. Revised for the 2002 NEC it is now clear that only equipment associated with the electrical installation is permitted in this space. Where the structural ceiling height is greater than 6 feet, foreign systems are allowed above the six foot space as long as protection from leaks, breaks or condensation has been provided.

13.) The improper supply for emergency unit equipment.

This problem is most common where battery units are used to supply power to emergency lighting and exit signs. Section 700.12(E) requires that a branch circuit supplying unit equipment must originate from the same branch circuit that feeds the normal lighting in the area where the emergency equipment is located. It also must be connected ahead of any local switches. The exception allows the branch circuit, supplying power to unit equipment, to be connected directly to a panelboard that is serving the normal lighting for an uninterrupted area that has at least 3 normal lighting circuits serving the area.

Example: Emergency lighting and exit signs have been provided for a small restaurant that has two separate dining rooms which are off of a common hallway. The hallway leads to the counter eating area where the main entrance/exit is located. The emergency power is supplied by a battery unit that is located in the hallway.

There are two heads on the unit for the hallway and remote heads and exit signs in each of the dining rooms and the counter eating area. The normal lighting for the hallway and one dining room is supplied from the same branch circuit. The normal lighting for the other dining room and counter eating area are supplied from another branch circuit. Both branch circuits originate from the same panelboard. An individual branch circuit has been run to the panelboard to supply power to the battery unit. The problem with this installation is that the battery unit is not supplied by the same branch circuit that is serving the normal lighting in the areas where the emergency lighting and exit signs are located. Two separate units, one unit connected to each normal lighting branch circuit, would meet the intent of Section 700.12(E). Even if the areas in the example were not separated by walls (uninterrupted area) an individual branch circuit would not meet Code because there are only 2 normal lighting branch circuits. Most often the exception, which allows for the individual branch circuit to be supplied directly from the lighting panelboard, comes into play in large office areas, telecommunication areas, assembly areas, etc..

14.) Failure to re-identify the white conductor in cables installed for the purpose of switching, employing the white conductor as an ungrounded conductor.

200.7 Use of Insulation of a White or Gray Color or with Three Continuous White Stripes.

Section 200.7(A) requires that grounded conductors be identified by white, gray, or a conductor with three continuous white strips on a color other than green. Section 200.7(C), covering circuits of 50 volts or more, allows a cable assembly containing a conductor marked with white, gray or that has three continuous white stripes to be used as an ungrounded conductor to supply the switch in a single-pole, three-way, or four-way switch loop. This is allowed provided that the conductor has been permanently re-identified at all terminations and at each location where the conductor is visible and accessible indicating its use as an ungrounded conductor. Note that this conductor shall not be used as a return conductor from the switch to the switched outlet.

Where a cable assembly contains an insulated conductor for single-pole, 3-way or 4-way switch loops and the conductor with white or gray insulation or a marking of three continuous white stripes is used for the supply to the switch but not as a return conductor from the switch to the switched outlet. In these applications, the conductor with white or gray insulation or with three continuous white stripes shall be permanently re-identified to indicate its use by painting or other effective means at its terminations and at each location where the conductor is visible and accessible.

15.) Swimming Pool filter motors with attached cords that contain an equipment grounding conductor smaller than 12 AWG.

The cord that is typically supplied (as attached to filter pump motors) by pool companies does not always contain a correctly sized equipment grounding conductor. The cord could be designed “for use as testing purpose only.”

Section 680.21(A) Wiring Methods

(1) General “…Any wiring method employed to supply a pool-associated motor shall contain a copper equipment grounding conductor sized in accordance with 250.122 but not smaller than 12 AWG.”

(5) Cord-and-Plug Connections. “The flexible cord shall include an equipment grounding conductor sized in accordance with 250.122 and shall terminate in a grounding-type attachment plug.”

16.) Portions of raceways installed connecting varying temperate atmospheres without vapor transfer seals.

300.7 Raceways Exposed to Different Temperatures.

(A) Sealing. Where portions of a raceway or sleeve are installed and subjected to different temperatures and where condensation is known to be a problem, the raceway or sleeve shall be filled with an approved material to prevent the circulation of air through the raceway or sleeve. The section does not require the seal to be explosionproof.