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Electrical Licensing Concerns
And
Commonly Found Installation Deficiencies in the State of New Hampshire
2011

The Bureau of Electrical Safety and Licensing (Bureau) and 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 Bureau's office staff relative to the State's electricians licensing law RSA 319-C and the Bureau Rules Electrician's Board administrative rules. The Bureau welcomes any input from instructors, inspectors, licensees and other concerned parties relative to this list or any other items of concern.

The Bureau would like to remind all concerned parties that the newest edition of the National Electrical Code (NEC) generally becomes effective in the State of New Hampshire on July 1 of the Code change year. The 2011 NEC will likely become effective July 1, 2011 as part of the State Building Code RSA 155-A, specifically 155-A:1 IV. Some local municipalities may adopt the 2011 NEC at an earlier date therefore it is advisable to check with the local authority before starting an installation. Regardless of which edition of the NEC is enforced by the local municipality, installations in the State of New Hampshire must meet the minimum requirements of the current edition of the NEC as adopted by the Building Code Review Board as part of RSA 155-A.

Although adopting electrical installation Codes and Standards is the responsibility of the Building Code Review Board, Journeyman and Master electricians should be aware that continuing education for license renewal is the responsibility of the Bureau of Electrical Safety and Licensing. No matter which edition of the NEC has been adopted as the State's electrical installation Code, the Electrician's Licensing Board will base the continuing education requirements for license renewal on the most current edition of the NEC as published by the National Fire Protection Association. Only Board approved continuing education courses based on the changes to the 2011 NEC will be accepted for license renewal in 2011, 2012 and 2013.

Effective December 30, 2009, the Electricians' Licensing Board administrative rules (Elec) were replaced with Saf-C 9200 and Saf-C 9300. Saf-C 9200 provides the Board of Electricians Practice and Procedural Rules (formally Elec 100 & 200) and the Bureau of Electrical Safety and Licensing Rules (formally Elec 300 & 400). Saf-C 9200 & 9300 are provided for viewing and downloading on the Bureau of Electrical Safety and Licensing website at http://www.nh.gov/safety/divisions/firesafety/building/electrician/.

Licensing Concerns

1.) Licensees must notify the Bureau office if you have a change of address within **30 days**.

2.) Journeyman licensees and registered apprentices should be aware that in order to perform electrical installations for heat, light and power purposes they must be employed by a master electrician. **They cannot perform installations on their own or as a subcontractor.**

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 in their employ are current; verifying that apprentices they employ are properly registered with the Bureau of Electrical Safety and Licensing and that the ratio of licenses to apprentices performing electrical installations on the job site is proper (one apprentice to one license). Registration with the Bureau of Apprentice and Training/State Apprentice Council is recommended but not mandatory.

4.) All licensees and apprentices should be aware that when paying fees for licensure or renewal and apprentice registration or renewal the payment must be made in the form of a check, money order or credit card. The Bureau office cannot 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 electricians should be advised they are not required to submit proof of the 15 hour update course when they renew their license. Submitting proof of continuing education will be done electronically and is the responsibility of the provider. Master and journeyman electricians should verify that the provider is approved by the Electrician's Licensing Board prior to attending a continuing education seminar. All providers are required to be approved by the Electrician's Licensing Board whether they are conducting courses in or outside of the State of New Hampshire. Master and journeyman electricians must still receive a certificate from the provider. The Bureau of Electrical Safety and Licensing will be randomly auditing continuing education programs by asking a percentage of the licensees to submit information related to their 15-hour course including a copy of the certificate they were issued.

6.) Master electricians should be aware that they **cannot procure a permit** for a journeyman electrician to perform an electrical installation when the journeyman is not in their employ. Even if the journeyman is receiving direction and supervision from the master electrician, as defined in RSA 319-C:2 a journeyman electrician must be employed by a master electrician. Procuring a permit for a journeyman electrician who is not employed by the master electrician is considered as unprofessional conduct that affects the practice of the trade by the Electrician's Licensing Board. As noted in RSA 319-C:12 II, misconduct sufficient to support disciplinary proceedings includes; (c) any unprofessional conduct or dishonorable conduct unworthy of, and affecting the practice of the trade.

7.) 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). Apprentice electricians must be aware they are responsible to conduct themselves in accordance with RSA 319-C and Saf-C 9300 the Bureau of Electrical Safety and Licensing Rules.

For example; Saf-C 9309.05(f) requires installations made by apprentice electricians without the direct supervision of a master, journeyman or high/medium voltage electrician to be recorded for future consideration by the Electricians' Licensing Board. This will likely be at the time the apprentice is applying to take the journeyman exam.

8.) Bonding of Corrugated Stainless Steel Tubing (CSST)

In response to questions from the industry, the Electricians' Licensing Board has considered the matter of whether the bonding of corrugated Stainless Steel Tubing (CSST) falls under the scope of RSA 319-C. The main question considered was whether the additional bonding conductor required by the manufacturer of the piping system was required to be installed by a licensed electrician.

The Board concluded at the October 28, 2008 meeting that the bonding conductor required by the manufacturer's product installation instructions was installed for the purpose of lightning protection and therefore was not part of an electrical installation as defined in RSA 319-C:3. The Board further concluded the bonding required as part of an electrical installation was addressed in 250.104(B) which recognizes the equipment grounding conductor of the circuit that is likely to energize the piping as the boning means required by that section.

The Electricians' Licensing Board considered this matter carefully and does not disagree that the level of expertise required for this type of installation should be that of a licensed electrician. This is especially true where work is performed around exposed energized equipment such as the busing of panelboards where the appropriate level of personal protection equipment and safe work practices are necessary. There is nothing that would prohibit a licensed electrician from bonding CSST and in any case special consideration must be given to the manufacturer's installation instructions and to any manufacturer's installation certification requirements. Further information regarding CSST installations can be obtained from a Technical Bulletin at http://www.nh.gov/safety/divisions/firesafety/building/electrician/documents/TechnicalBulletinonCSST7-16-09.pdf

Decisions of the Electricians' Licensing Board regarding licensure do not affect the permitting requirements at the local level. Therefore it is prudent to check with local official prior to performing this installation when determining the need to procure a permit at the local level.

Most Common Electrical Installation Deficiencies in the State of New Hampshire 2011

The following is a list of the most common deficiencies found with electrical installations in the State of New Hampshire. The list has been formatted to the **2011** edition of the **National Electrical Code (NFPA 70-2011)**.

1.) The improper installation and securing of expansion fittings in runs of Rigid Polyvinyl Chloride (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 fittings are installed they are secured on the wrong end. The manufacturer's listing requires that the expansion fitting be secured on the "bell" (fixed) end. Notice should be taken when mounting the fitting in a vertical position: the fitting must be installed with the "bell" end above the sliding or expanding end. On one final note, the conduit must meet the securing requirements of the applicable raceway article.

2.) The use of electrical equipment without following the manufacturer's 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 disregard and not install according to the manufacturer's instructions so read and apply them as they pertain to the installation.

3.) Tightening of electrical connections.

One of the more commonly overlooked requirements for making terminations is applying the proper torque value to a connection. With that thought in mind, when was the last time you used a screwdriver or any tool with torque capabilities? A better question may be do you have torque tools in your tool box?

Manufacturers of connection equipment (i.e. lugs, terminal bars, etc.) generally include recommended torque values on the equipment and/or in the installation instructions. In some cases the NEC has specific torque requirements. An example of this is 430.9(C) which requires control circuit devices with screw-type pressure terminals used with 14 AWG or smaller conductors to be torqued to a minimum of 7 lb-in unless identified for a different torque value.

The 2011 NEC explains the importance of making proper field connections in a new Annex I which includes two tables that are based on UL 486A-B, Wire Connections. Although not enforceable text, this new annex material will provide recommended torque values in the absence of connector or equipment manufacturer's information.

4.) Clearances: working space, clear spaces, headroom and dedicated equipment space.

A number of concerns relating to the clearance requirements **of 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 **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 notes.

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 in all cases the door or hinged panel of the equipment must 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. Other equipment associated with the installation that is located within the working space is not permitted to extend more than 6 inches beyond the front of the electrical equipment. A new Exception No. 2 has been added to the 2011 NEC to permit meters installed in meter sockets to extend beyond the equipment however, the meter socket must comply with the rules of the section including the 6 inch rule.
Section 110.26(B) "Clear Spaces" requires the working space to be kept clear by not allowing it to be used for storage.
Section 110.26(E) "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(E)(1)(a) mandates a clear space that is the depth and width of the equipment that extends to a height of 6 feet above the equipment or the structural ceiling which ever is lower for equipment installed in indoor locations. Only equipment associated with the electrical installation is permitted in this space.
In indoor installations where the structural ceiling height is greater than 6 feet, **100.26(E)(1)(b)** permits foreign systems above the six foot space where protection from leaks, breaks or condensation has been provided.

5.) Identifying grounded and equipment grounding conductors 200.6 and 250.119.

Individual conductors are provided in various sizes, insulations, and colors. Colors can be used to identify conductors of differing voltage systems, ungrounded phases, or for grounded or equipment grounding purposes. The rules of identification vary depending upon the designated function of the conductor. Ungrounded conductors are permitted to carry almost any color along the entire length of exposed insulation. Their color can be re-identified (changed from the original manufactured choice) to any color other than white, gray or green by a tag or marker, such as different colored tape, placed wherever the conductor is accessible regardless of the size. On the other hand, insulated grounded conductors must be must be white or gray and insulated equipment grounding conductors must be green.

Conductors with other than white or gray insulation used as grounded conductors or conductors with other than green insulation used as equipment grounding conductors can only be identified as grounded or equipment grounding conductors when they meet a minimum size. In accordance with **200.6(B)(4)** a conductor 4 AWG or larger can be identified as a grounded conductor by a distinctive white or gray marking at its terminations. **Section 250.119(A)(1)** permits conductors larger than 6 AWG to be identified as an equipment grounding conductor and 250.119(A)(2) permits the identification to be by green adhesive labels or tape at the terminations and at every point where the conductor is accessible.

Generally insulated grounded conductors 6 AWG and smaller must be identified by the color white or gray along their entire length (end to end). Any equipment grounding conductor 6 AWG and smaller with insulation must be identified by the color green or green with one or more yellow stripes along its entire length (end to end).

All too often installations are found where the feeder or branch circuit conductors include a 6 or 8 AWG conductor with green tape at each end identifying it as an equipment grounding conductor or white or gray tape at each end identifying it as a grounded conductor. This method of identification would be a misunderstanding of the prescribed methods of identification in **250.119 and 200.6**. The only way to correct this mistake is to remove the conductors and replace the equipment grounding or grounded conductor with a properly identified conductor.

Sections 200.7(C)(1) and (2) provide specific alternative uses for conductors in cable assemblies with white or gray insulation and for conductors with three continuous white stripes. Where the conditions of maintenance and supervision ensure that qualified persons service the installation, **250.119(B)** provides prescriptive methods of identifying one or more insulated conductors in a multiconductor cable as an equipment grounding conductor.

6.) The identification of ungrounded branch circuit conductors when there is more than one nominal voltage system on the premise.

Section 210.5(C) requires all ungrounded conductors to be identified by **phase or line and system** where there is more than one nominal voltage system on the premises. The State of New Hampshire amended the 2008 NEC language by removing the words "phase or line." This amendment essentially returns the identification requirements to that of the 2005 NEC which only required identification by the system. The remainder of 210.5(C) is not changed by this amendment. This amendment will likely continue into the 2011 NEC cycle however it is not automatic as it must be proposed as an amendment to the 2011 NEC and voted. Therefore, licensees are encouraged to check the Bureau of Electrical Safety website or the Building Code Review Board website to verify any amendments to the 2011 NEC.

The identification must be provided at **all terminations, connections and splice points.** There is no mandatory requirement to provide identification at pull boxes that do not contain splices or other terminations. The system identification shall be posted at each branch-circuit panelboard or similar branch-circuit distribution equipment or documented in a manner that is readily available. Please see Article 100 for the definition of "Premises Wiring (System)." In existing applications with multiple systems any new wiring installed would have to meet the above requirements. It would be a good design to include a date of installation for the newly identified wiring at the same location as the system identification. This would provide a start date of the newly determined system identification for any future wiring installations.

7.) The sealing of underground raceways.

Although they are often overlooked, there are specific requirements in the NEC with regard to sealing underground raceways entering buildings or where condensation is created in raceways or sleeves by the exposure to different temperatures within buildings or where a raceway passes from outdoor to indoor locations.

Section 230.8 requires a service raceway entering a building or structure from an underground distribution system to be sealed in accordance with **300.5(G)** (at either or both ends where moisture can contact live parts). Water can enter raceways through couplings or it can build up from condensation resulting from the exposure to different temperatures. However when water accumulates within the raceway, the intent of the requirement is to prevent water from entering the service equipment via the underground raceway system. A sealant such as duct seal or other types of sealants identified for use with the conductor or cable insulation, shield or other components must be used to seal the ends of raceway. Any type of sealing material used cannot have a deteriorating effect on the conductor insulation.

Section 300.5 provides requirements for underground installations and **300.5(G)** states that conduits or raceways through which moisture can contact live parts shall be sealed or plugged at either or both ends. The requirements of this section are specific to where moisture can contact live parts so consideration must be given to how the conduit or raceway is installed. Not all underground conduits or raceways are installed in a manner that moisture would actually contact a live part. An example of this application would be where an underground raceway enters the building below the equipment and then is connected to the enclosure below the live parts.

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

250.104 Bonding of Piping Systems and Exposed Structural Steel.

(D) Separately Derived Systems.

(1) Metal Water Piping System(s). The grounded conductor of each separately derived system shall be bonded to the nearest available point of the 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** based on the largest ungrounded conductor of the separately derived system.

Exception No. 1: A separate bonding jumper connected to the metal water piping system shall not be required where the metal water piping system is used as the grounding electrode for the separately derived system and the water piping system is in the area served.

Exception No 2: A separate water piping bonding jumper shall not be required where the 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 vicinity served by the separately derived system must be bonded to the grounded conductor of the separately derived source. The connection must be made at the same point as the grounding electrode conductor. The metal water piping serving an office kitchenette with 120-volt power provided from a nearby transformer must be bonded to the transformer grounded conductor at the same point as the grounding electrode conductor connection.

9.) Wireways and consideration of 310.15(B)(3)(a)

In many cases the wireway can be very useful because it affords the installer flexibility with respect to the location of entering and exiting raceways. A wireway installed above adjacent panelboards can permit the crisscrossing of conductors intended to supply field branch circuits. It allows last minute adjustments without complicated intervening raceway junctions and undesirable raceway "zigzagging."

It is not, however, the answer to the search for a "universal landing zone." Although wireways come in all different sizes and we all know that we are restricted by the NEC to a "percentage fill" or "capacity," just how many of us pay attention to the second part of **376.22** "Number of Conductors and Ampacity?"

All too often the number of current carrying conductors in a cross section of a wireway is not considered with regard to **310.15(B)(3)(a)**. The first sentence in **376.22** identifies concern for the percentage of fill in any cross section of conductors of a wireway.

The remainder of the paragraph, however, relates to a limit of 30 current carrying conductors before applying adjustment factors as determined in **310.15(B)(3)(a)**. A 12 AWG conductor with type "THHN" insulation in a wireway of 30 or fewer current carrying conductors is permitted to be protected with an overcurrent device of 20 amperes or less as determined by Table **310.15(B)16** and **240.4(D)**. The same conductor when located within a wireway with 31 current carrying conductors is limited to 40% of its current carrying capacity as adjusted by **310.15(B)(3)(a)**. 40% of the ampacity from the 90° C column of **Table 310.15(B)16** (30 amperes) is only 12 amperes. The 12 AWG conductor would certainly not be suited to supply the intended 20 ampere branch circuit.

We are quick to take advantage of the permission to disregard the need to observe the ampacity adjustment factors prescribed in **310.15(B)(3)(a)** but fall short when understanding that use of those adjustment factors is necessary when the cross section number of current-carrying conductors exceeds 30.

Pay attention to your raceway entry location and conductor destination. When using a wireway do not fill any cross section of the wireway to more than 20% or it will cost you in the long run. Try to locate your raceway drops directly above the intended distribution so that you don't have to travel horizontally inside the wireway.

Remember the intention is to provide a means to distribute any heat that may be produced from adjacent current carrying conductors inside the metal wireway, so limit your number of current carrying conductors and understand that the permission to install up to 30 current carrying conductors inside a metal wireway without applying adjustment factors does not apply to **nonmetallic wireways.** The last sentence in **378.22** requires the adjustment factors of **310.15(B)(3)(a)** to apply to the current carrying conductors up to and including the 20% fill for a nonmetallic wireway.

10.) The use of NM cable in other structures permitted to be Types III, IV or V construction.

Unlike the states bordering New Hampshire, the State of New Hampshire has no amendment to Section 334.10(3) with regard to NM cable installed in “other structures.”

Section 334.10, Uses Permitted for Type NM, Type NMC, and Type NMS cables permits these cables to be installed in other structures that are permitted to be of Types III, IV, and V construction except as prohibited in 334.12. However, the cables must be **concealed** within walls, floors, or ceilings that provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies. Quite often the focus of the reader of this section is on the 15-minute finish rating and the requirement for wiring method to be concealed is overlooked. The term “concealed” is defined in Article 100 as rendered **inaccessible** by the structure or **finish of the building**.

Examples of where NM cable is installed in a non-compliant manner with regard to being "concealed" is where it has been installed in an attic space of an "other structure" that is accessible through a scuttle hole or permanent stairway or above a suspended ceiling. Although the NM cable is not visible from below the sheetrock ceiling or the suspended ceiling, it has not rendered inaccessible by the building finish or structure and therefore does not meet the definition of "concealed."

11.) The Improper installation of exposed vertical risers from fixed equipment.

Sections 342.30(B)(3) and 344.30(B)(3) for Intermediate Metal Conduit and Rigid Metal Conduit respectively permit exposed vertical risers from industrial machinery or fixed equipment to be supported at intervals not exceeding 20' provided there is no intermediate means of support available, the conduit is made up with treaded couplings and it is rigidly supported at the top and bottom of the riser. Essentially, this permits an intermediate or rigid metal conduit with threaded couplings to be run up 20' from fixed equipment. Quite often vertical riser installations are made using electrical metallic tubing (EMT). There is no allowance in Article 358 for exposed vertical risers to be installed in this manner.

A common application of this installation method occurs in open areas of retail stores when power is required for displays, cash registers or copying equipment and no power is readily available. Where installing a raceway in or under the floor is not an option an exposed vertical riser is run from the fixed equipment, which in many cases is a receptacle outlet, to the bottom of the metal structural framing member. It is not uncommon to find that EMT has been installed instead of intermediate or rigid metal conduit for the exposed vertical riser.

12.) 404.8(A) The mounting height of switches

Switches and circuit breakers used as switches shall be located… "such that the center of the grip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 2.0 m (6 ft 7 in.) above the floor or working platform." We must be careful when installing equipment that contains switches and circuit breakers, particularly a "motor control center." These manufactured packages are built with the intention to get as much as possible within the width and height manufacturing restrictions. The switch height limitation is considered and therefore will influence the height of the switch when it is in its highest position.

The problem begins when the contractor decides to install the motor control center upon a 4" raised maintenance pad which elevates the switch height beyond the limit of 2.0 m (6 ft 7 in.). The pad usually does not extend into the working area in front of the equipment and therefore in most cases a working platform has to be added to meet compliance regulations according to **404.8(A)** of the NEC.

13.) 408.4(A) Circuit Directories or Circuit Identification

We should take a close look at all of the requirements of **408.4(A)** to be sure that we understand the prescribed method. This section has evolved over the past few code cycles. In the not too distant past we could identify circuits in simple terms such as: "stove, dw, hot water, lights, lights, lights, outlets, outlets or bath." Even commercial panels could contain such elaborate descriptions as: "office lights, office lights, office outlets, outlets, lights and HVAC, HVAC, HVAC." The 2005 NEC incorporated an important change in **408.4**. "The identification shall include sufficient detail to allow each circuit to be distinguished from all others." The latter sentence was added to the 2005 NEC and has increased a challenge to the electrician to be more specific in order to distinguish each circuit breaker from all others located within the same panelboard. Be careful to identify each circuit as to its "clear, evident, and specific purpose or use."

The 2008 NEC prohibited the description to include "transient conditions of occupancy." In other words the description cannot include such terms as: "Betty's room" or "Jack's office."

A new 408.4(B) was added to the 2011 NEC to require all switchboards and panelboards supplied by feeders in other than one or two-family dwellings, to be marked to indicate the device or equipment where the power supply originates.

14.) The terminating of more than one grounded conductor under a single terminal.

408.41 Grounded Conductor Terminations.

It is not uncommon to find the termination of more than one grounded conductor under a single terminal, in a panelboard. The NEC, as well as the manufacturer, limits terminating the grounded conductor in a panelboard to a single conductor per terminal. Unless you are dealing with parallel grounded conductors under a terminal designed for the purpose, each grounded conductor shall terminate within the panelboard in an individual terminal that is not used for another conductor.

15.) The improper connection of septic pumps.

There are several different problems that can stem from septic pump installations. First, **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. In this case it is possible to satisfy both requirements with one disconnecting means located at the tank as the controller and the motor are both within site of the disconnecting means. Article **100** defines "in sight from" to be visible and within 50'. So there must be a disconnecting means that is visible and located no more than 50' from the pump tank. In most residential cases the cords for the pump and controller (float switch) are supplied from a receptacle located near the tank so the attachment cap for the controller and pump cord can serve as the disconnecting means.

Most often the homeowner does not want to see a pedestal with a receptacle and the 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 some cases the manufacturer prohibits the removal of the cord cap and float assembly end so this would be a violation of **110.3(B)** installing in accordance with the manufacturer's requirements. In other cases the receptacle has been installed inside the pump tank. Before making this kind of installation, consideration should be given to the issues of accessibility and corrosion. Also, depending on the size and type of the system, there may be sufficient hazardous vapor in the pump chamber to consider classification of the location. Classified locations are more common in commercial and industrial applications.

16.) The flexible connection to emergency system equipment in hospitals.

517.30(C)(3) Mechanical Protection of the Emergency System

Too often there is a failure to recognize and install a compliant wiring method delivering power for emergency system luminaires in locations covered under applications defined in **517.30(A).** The use of unprotected flexible metal raceway or cable methods is only permitted under specific conditions.

The failure to recognize this requirement appears to come from a misunderstanding of the language found in Section **517.30(C)(3)d**. The intent is to protect the integrity of the emergency system from adverse conditions, particularly potential physical damage.

517.30(C)(3)(3)d

The wiring of the emergency system in hospitals shall be mechanically protected. Where installed as branch circuits in patient care areas, the installation shall comply with the requirements of 517.13(A) and (B). The following methods shall be permitted:

(3) Listed flexible metal raceways and listed metal sheathed cable assemblies in any of the following:

d. Where necessary for flexible connection to equipment

*An example of the abuse of the permission to install a flexible cabling method is when luminaires fed from the emergency branch circuits are connected from ceiling outlets using a flexible wiring method. The language specifically indicates: "where necessary for flexible connection to equipment." The intent is clear that it is only permitted "**where necessary"** not where convenient, possible, preferred or easier! The option to use a flexible wiring method would have to be "identified" as **"necessary" where it relates to the connection of the equipment and** "approved" by both State and Local Authorities Having Jurisdiction.*

*If the intention to use a flexible wiring method in this application to connect emergency luminaires is for reasons of convenience, preference, ease of installation, or financial, it is not considered "**NECESSARY!"***

An application where flexibility would be "necessary for the connection of equipment" is where the luminaire is installed in a dropped or existing ceiling (both are sheetrock ceilings). In these applications the luminaire is generally secured to cleats that are attached to the sides of framing members. The luminaire would have to be wired with a flexible method in order to be raised into a position where the securing mechanisms would grab the top of the cleats after it is wired.

17.) The continued failure to install signs that are listed by a recognized third party testing agency (600.3).

"Electric signs, section signs, and outline lighting — fixed, mobile, or portable, regardless of the voltage — shall be listed and installed in conformance with that listing, unless otherwise approved by special permission." It cannot be spelled out any more clearly; however, electric signs continue to be installed without the required listing. Several fires and sign failures substantiate the importance of this requirement and it is incumbent upon us to communicate this specific requirement to sign manufacturers, installers, customers, inspectors and electricians before permitting, ordering or connecting power to any sign without the necessary "seal of approval."

18.) Emergency, Legally Required and Optional Standby Signs
700.7, 701.7 and 702.7; Signs

There are two types of signs required when there is an on-site emergency, legally required standby or optional standby source. The first sign is a requirement of "**(A)**" in **700.7**, **701.7** and **702.7**. It must be placed at the location of the service entrance equipment and identify the location and type of the onsite power source. Both **700.7(A)** and **701.7(A)** include an exception for the sign where individual unit equipment (battery packs) are the onsite power source. 702.7(A) addresses the exemption for the sign as positive text in the last sentence of the paragraph.

The second sign is a requirement of "**(B)**" in all three sections and it was revised for the 2011 NEC to more specifically address the hazard. The section applies where the removal of a grounding or bonding connection interrupts the connection of the grounding electrode conductor to the alternate power source(s) grounded conductor at the normal power source equipment a warning sign must be provided.

The warning sign must state: “Warning: Shock Hazard Exists if Grounding Electrode Conductor or Bonding Jumper Connection in this Equipment is Removed While the Alternate Source(s) is Energized.” A common installation where the connection of the grounding electrode conductor to the alternate source grounded conductor could be interrupted at the normal service equipment is where the alternate source is installed as a “non-separately derived system” (see **Article 100** definition of separately derived system).

In this application the grounded conductor from the alternate source is solidly connected to the normal system grounded conductor (not switched by the transfer switch) and the grounding connection (point of connection to the grounding electrode conductor) is typically being made at the service equipment or other normal power source equipment location.

19.) The separation of Emergency System Conductors from other conductors.

700.10 Wiring, Emergency Systems

Section 700.10(B) requires that wiring from an emergency source or emergency source distribution overcurrent protection to the loads be kept entirely independent of all other wiring and equipment unless it is otherwise permitted in **700.10(B)(1)–(5)**. These numbered paragraphs permit the emergency system wiring to be combined with: **(1)** The wiring from the normal source in transfer switches; **(2)** The wiring from another source in exit or emergency luminaires; **(3)** The wiring from two sources in a listed load control relay supplying exit or emergency luminaires or in a common junction box, attached to exit or emergency luminaries; **(4)** The wiring from a branch circuit supplying unit equipment in a common junction box where the emergency circuit wiring is supplied by the unit equipment; **(5)** Legally required standby and optional standby in a common feeder. The common feeder can supply: **a** Separate vertical switchboard sections, with or without a common bus, or individual enclosures; **b** The common bus or separate switchboard sections can be supplied by single or multiple feeders without overcurrent protection at the source; **c** The legally required standby or optional standby circuits to originate from separate switchboard sections, panelboard enclosures or individual disconnect enclosures that do not include emergency circuits and d It is permissible to utilize single or multiple feeders to supply distribution equipment between an emergency source and the point where the combination of emergency, legally required, or optional loads are separated. In accordance with the **Exception to (5)(b)**, overcurrent protection is allowed at the source and/or for the equipment where coordinated with the downstream overcurrent protection as specified in 700.27.

There is often confusion related to the phrase “wiring from the emergency source to the loads or source distribution overcurrent protection to the emergency loads shall be kept entirely independent of all other wiring.” This was especially true from the source to the distribution equipment.

Although a much debated topic, this phrase means that we must keep the wiring from the emergency source to the emergency loads entirely independent of all other wiring or we must keep the wiring from the emergency source distribution overcurrent protection to the emergency loads entirely independent from all other wiring. The widely varying interpretations of: “keeping the emergency wiring entirely independent of all other wiring” was significantly reduced by the 2008 language in **700.9(B)(5)**. The revision of that section in the 2008 NEC clarified how the separation should take place.

One of the common misapplications is to run a feeder from the source to one distribution panelboard while combining the emergency system overcurrent protection in the same enclosure with the legally required standby and/or optional standby overcurrent protection. Under this circumstance the "wiring" to the emergency loads has been combined in the same enclosure with legally required standby and/or the optional standby wiring. Therefore, the wiring to the emergency loads has not been kept "entirely independent of all other wiring."

Note that none of the previously discussed items in **700.10(B)(1)-(5)** permit this application. In fact, the language in **700.10(B)(5)c** specifically prohibits emergency wiring from originating in the same panelboard enclosure with the either the legally required standby or the optional standby wiring. You would, however, be allowed to run two or more feeders from the source to separate panelboards. The first panelboard would contain strictly emergency system overcurrent protection and wiring and the other panelboard(s) could contain the legally required standby and/or the optional standby system overcurrent protection and wiring. In this case, the wiring to the emergency loads has been kept "entirely independent of all other wiring."

Where there is no overcurrent protection located at the source or the equipment or where those overcurrent devices have been coordinated with the downstream overcurrent protection, it is permitted to run one feeder to separate sections of switchgear with a common bus containing emergency, legally required standby and optional standby system overcurrent protection where the emergency source distribution overcurrent protection and wiring to the emergency load(s) is located in a separate section of the switchgear. Installed in this manner, the wiring from the emergency source distribution overcurrent protection to the emergency loads has been kept entirely independent of all other wiring.

Although the new language in **700.10(B)(5)** brings substantial clarity to the separation requirements, there is still one issue that is not specifically addressed that requires careful consideration and may still be subject to varying interpretations. The question is: how is the separation to take place when there is more than one overcurrent device located at the source? The example would be where a generator has been provided with two or more overcurrent devices and at least one is supplying emergency wiring and the other(s) is supplying legally required standby or optional standby. In this example the separation requirements of **700.10(B)** take place at the source as the delineation of the emergency wiring from the other wiring (legally required standby or optional standby) is at the source. Therefore, the emergency circuit wiring (which is connected to the load side of the overcurrent device) must be separated from the other system's circuit wiring in order to meet the requirement that the emergency circuit wiring be kept entirely independent of all other wiring. This could be by a permanent barrier or by mounting the overcurrent devices in separate enclosures.

20.) The location of the disconnecting means for Emergency Systems.

225.31 Disconnecting Means, 225.32 Location and 700.12(B)(6) Outdoor Generator Sets

It is not uncommon to find a disconnecting means that has been improperly located for an Emergency System (Article **700**) feeder which has been supplied from an outdoor housed generator. By the definition in **Article 100,** the conductors supplying an emergency system from a "separately derived system," in this case a generator, are considered as "feeder" conductors. Where the generator is located outdoors, the conductors would be considered as "outdoor feeder conductors" which are subject to the requirements of Article **225**, **Outdoor Feeders and Branch Circuits.**

The scope of Article **225** (**225.1**) notes that the Article covers the requirements for outside branch circuits and feeders run on or between buildings, structures, or poles on the premises. It also includes electric equipment and wiring for the supply of utilization equipment that is located in or attached to the outside of buildings, structures or poles. **Section 225.31** states that a means shall be provided for disconnecting all ungrounded conductors that supply or pass through the building or structure. The first sentence of **225.32** requires the disconnecting means to be located either inside or outside of the building or structure served or where the conductors pass through the building or structure. The second sentence in this section notes that the disconnecting means must be at a readily accessible location nearest the point of entrance of the conductors.

The confusion typically comes in when the language in **700.12(B)(6)** is applied improperly. This section, by the format of Code in **90.3**, can supplement or amend Chapters One through Four. At first glance, one gets the impression that a disconnecting means that is located under or within the housing of an outdoor generator set can be used as the disconnecting means required by **225.31**.

700.12(A) – (F) provide the general requirements for the acceptable sources of power supplying Emergency Systems. **700.12(B)(6)** is titled "Outdoor generator sets" and states that "where an outdoor housed generator set is equipped with a readily accessible disconnecting means located within sight of the building or structure supplied, an additional disconnecting means shall not be required where ungrounded conductors serve or pass through the building or structure. One must further recognize that Article **100** defines the term "within sight of" and it means that the specified equipment is visible and not more than 50' away. In the case of **700.12(B)(6)**, the "specified equipment" is the disconnecting means at the generator and it must be visible and not more than 50' away from the building served. The definition of "within sight of" in **Article 100** does not preclude the use of a window in a panel of the generator housing. However, the disconnecting means must be completely visible through the panel window from the building. One final important note, **225.36** requires the disconnecting means to be suitable for use as service equipment and this requirement is not amended by **Article 700**. This requirement was clarified in the 2008 NEC as a new last sentence was added to **700.12(B)(6)** to recognize that the disconnecting means must meet the requirements of **225.36**.

21.) The installation of branch circuits supplying emergency lighting.

The most common misunderstanding of the requirements for the installation of branch circuits that supply emergency lighting occurs in stairwells. An example of this would be where a single branch circuit has been utilized to supply all the luminaires in a stairwell from an emergency panelboard. This section was revised for 2011to clarify how emergency lighting branch circuits are to be installed and to more clearly identify the section applies to branch circuits.

Section 700.17 requires branch circuits supplying emergency lighting to provide service from a source complying with **700.12** when the normal supply for lighting is interrupted. Such installations shall provide either:

(1) An emergency lighting supply, independent of the general lighting supply, with provisions for automatically transferring the emergency lights upon the event of a failure of the normal lighting branch circuit.

The most common application of **700.17(1)** is where a single branch circuit has been used to supply the normal lighting in a stairwell and unit equipment or luminaires with self contained ballasts have been installed to provide the emergency lighting. In this case, there are provisions for automatically transferring to the emergency lighting upon failure of the normal lighting branch circuit.

(2) Two or more branch circuits supplied from separate and complete systems with independent power sources. One of the two power sources and systems shall be part of the emergency system, and the other shall be permitted to be part of the normal power source and system. Each system shall provide sufficient power for emergency lighting purposes.

The section goes on to explain that unless both systems are used for regular lighting purposes and both are kept lighted, means shall be provided for automatically energizing either system upon the failure of the other system. Either or both systems are permitted to be part of the general lighting of the protected occupancy if circuits supplying lights for emergency illumination are installed in accordance with other sections of **Article 700**.

*The most common compliant application of **700.17(2)** is where two branch circuits have been installed to supply the lighting in a stairwell. One branch circuit is supplied from the normal lighting panelboard and the other is supplied from the emergency lighting panelboard. Each of the circuits individually must supply a sufficient number of luminaires to provide the minimum required emergency egress lighting. In this case we have independent power supplies and because we have two branch circuits supplied by independent power we have complete and separate systems.*

*A common misapplication of **700.17(2)** is where a single branch circuit has been run from the emergency lighting panelboard to the stairwell. There is independent power supply because one power system originates from the normal supply and the other originates from the emergency power source. However, they are sharing a common transfer switch, a common feeder from the transfer switch to emergency panelboard and a common panelboard so they are not "separate and complete systems."*