

JANUARY 2023
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THE MAGAZINE OF ELECTRICAL DESIGN,
CONSTRUCTION AND MAINTENANCE

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Top 10 Most Commonly Cited Electrical Code Violations

*Electrical inspectors identify which mistakes electrical professionals tend to make the most when it comes to the NEC. Read more on **pg. 16***

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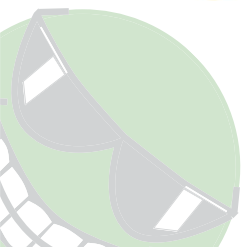


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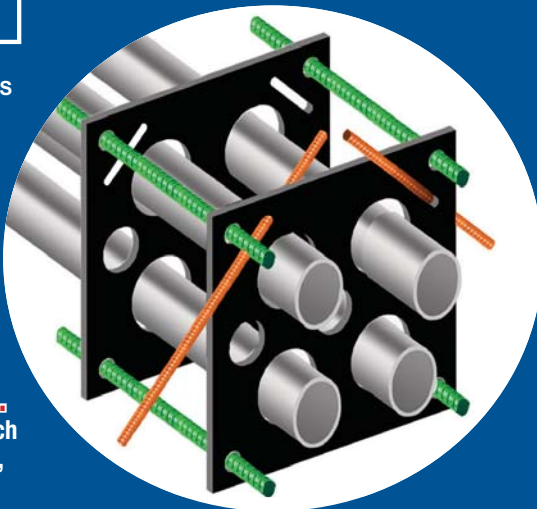
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Editorial

Group Editorial Director - Buildings & Construction: Michael Eby, meby@endeavorb2b.com

Editor-in-Chief: Ellen Parson, eparson@endeavorb2b.com

Senior Associate Editor: Ellie Coggins, ecoggins@endeavorb2b.com

Associate Editor: Michael Morris, mmorris@endeavorb2b.com

Senior Art Director: David Eckhart, deckhart@endeavorb2b.com

Consultants and Contributors

NEC Consultant: Mike Holt, mike@mikeholt.com

NEC Consultant: Russ LeBlanc, russ@russleblanc.net

Sales and Marketing

Vice President: Mike Hellmann, mhellmann@endeavorb2b.com

Regional/Territory Account Manager: Ellyn Fishman, efishman@endeavorb2b.com

Regional/Territory Account Manager: David Sevin, dsevin@endeavorb2b.com

Regional/Territory Account Manager: Jay Thompson, jthompson@endeavorb2b.com

Media Account Executive - Classifieds/Inside Sales: Steve Suarez, ssuarez@endeavorb2b.com

Production and Circulation

Production Manager: Brenda Wiley, bwiley@endeavorb2b.com

Ad Services Manager: Deanna O'Byrne, dobyne@endeavorb2b.com

User Marketing Manager: James Marinaccio, jmarinaccio@endeavorb2b.com

Classified Ad Coordinator: Terry Gann, tgann@endeavorb2b.com

Endeavor Business Media, LLC

CEO: Chris Ferrell

CFO: Mark Zadell

President: June Griffin

COO: Patrick Rains

CRO: Reggie Lawrence

Chief Administrative and Legal Officer: Tracy Kane

EVP, Group Publisher - Buildings/Lighting/Digital Infrastructure: Lester Craft

Electrical Construction & Maintenance (USPS Permit 499-790, ISSN 1082-295X print, ISSN 2771-6384 online) is published monthly by Endeavor Business Media, LLC, 1233 Janesville Ave., Fort Atkinson, WI 53538. Periodical postage paid at Fort Atkinson, WI, and additional mailing offices. POSTMASTER: Send address changes to Electrical Construction & Maintenance, PO Box 3257, Northbrook, IL 60065-3257. SUBSCRIPTIONS: Publisher reserves the right to reject non-qualified subscriptions. Subscription prices: U.S. (\$68.75 year); Canada/Mexico (\$112.50); All other countries (\$162.50). All subscriptions are payable in U.S. funds. Send subscription inquiries to Electrical Construction & Maintenance, PO Box 3257, Northbrook, IL 60065-3257. Customer service can be reached toll-free at 877-382-9187 or at electricalconstmaint@omeda.com for magazine subscription assistance or questions.

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The Ins and Outs of Working with Electrical Inspectors

By Ellen Parson, Editor-in-Chief



In the electrical trade, it's no secret that installers (electricians and electrical contractors) don't always see eye to eye with inspectors. While establishing and maintaining a good working partnership is the obvious goal/expectation, the relationship can be strained or even contentious at times. Whenever I think about the dynamic between these two groups, I always remember the analogy now-retired Keith Lofland, former director of education for the International Association of Electrical Inspectors (IAEI), used to make. He likened the role of an electrical inspector to a baseball umpire.

Outlining the concept in more detail in an article he wrote for *EC&M* a few years ago, "The Electrical Inspector and the Electrical Installer," available at <https://bit.ly/3GjLOMy>, Lofland revealed why the underlying key to this "electrical marriage" is relatively simple. Working as a master electrician for years before becoming an inspector, Lofland said his perception of inspectors as the "bad guys" quickly changed after walking in their shoes. After trying his hand as an umpire, Lofland learned that his interpretation of every pitch had a significant outcome on each batter. "What I also discovered was that consistency was critical to both teams," he wrote. "If I called a strike on a pitch a half of an inch on the outside of the plate, that was OK if I called that pitch a strike every time. That way, the batter knew they better swing at that pitch the next time they saw it coming down the pike." He went on to describe feeling that same sense of responsibility as an electrical

inspector or authority having jurisdiction (AHJ). The key was consistency in his interpretations.

Taking this topic a step further, Joseph Wages, Jr., digital education director at IAEI, who also holds state electrical licenses and several IAEI and ICC building-related certifications, reviews 10 of the most commonly cited electrical violations in the country based on feedback from electrical inspectors. To see which mistakes electrical installers tend to make the most when it comes to the NEC, turn to the cover story on page 16. This is a phenomenal piece that gets to the heart of why certain violations tend to crop up more frequently.

Speaking of great articles, I'd like to take this opportunity to thank IAEI for continuing to contribute such great content to *EC&M* from the electrical inspector's point of view. If you haven't already done so, check out the "Inspector Intel" column in print and online in which IAEI authors break down NEC guidelines for types of specific installations — and how these rules are often misapplied. These pieces have consistently performed exceptionally well with our readers online. Here are just a few of my favorites:

- Why Educating Homeowners on GFCIs Matters (<https://bit.ly/3WPUG3A>)
- Kitchen Islands and New Receptacle Requirements in the 2020 NEC (<https://bit.ly/3ikmduX>)
- Brushing Up on Your Box Fill Calculations Skills (<https://bit.ly/3IogoqP>)
- How Well Do You Know Your Electrical Service Point? (<https://bit.ly/3GEYK0N>)
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Ellen Parson

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How Estimators Can Avoid Costly Mistakes

Nine ways estimators leave time on the table

By Don Kiper, Electrical Estimating 101



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Estimating electrical projects requires expensive resources. This involves the costs of software, proper training, and salaries. The project selection process requires time from upper management to be sure the best projects are being bid.

Leaving time on the table may be as important, if not more important, than leaving money on the table. Leaving money on the table means you may not be getting fair value for your work. One of the best ways to alleviate this problem is to STOP competing on price. Chasing a competitor's price can be detrimental. On bid day, you must follow solid bidding principles; if not, you may win a project that you'll regret you did.

Time is either used wisely or unwisely. Wasted time can never be recovered. Following are some ways that estimating departments and estimators leave time on the table.

1. Not having an estimating sequence — Having a step-by-step order of the estimating process keeps the momentum going forward and prevents regression. This sequence should be arranged by the following headings: 1) estimate preparation, 2) the takeoff, and 3) the extension. Having a sequence will prevent errors/omissions and save time.

2. Bidding the wrong projects — Every contractor has a market or sector in which they perform better

than others. A project's complexity may require a top-notch foreman and project manager. If you don't have the qualified personnel to execute a project properly, it might be best not to bid. The wise contractor will track historical data of successful bids. The adage "stay in your lane" applies here.

3. Using untrained employees — Just because an employee is "eligible" to be an estimator, doesn't make them "qualified" for the position. Being an electrician and an estimator are two different positions, and each requires proper training. Successful contracting begins with successful estimating. Quality estimates are typically prepared by quality estimators.

Annual Estimating Payroll	Potential Annual Overhead Savings			
	25%	30%	35%	40%
\$100,000	\$25,000	\$30,000	\$35,000	\$40,000
\$125,000	\$31,250	\$37,500	\$43,750	\$50,000
\$150,000	\$37,500	\$45,000	\$52,500	\$60,000
\$200,000	\$50,000	\$60,000	\$70,000	\$80,000
\$250,000	\$62,500	\$75,000	\$87,500	\$100,000
\$300,000	\$75,000	\$90,000	\$105,000	\$120,000
\$400,000	\$100,000	\$120,000	\$140,000	\$160,000
\$500,000	\$125,000	\$150,000	\$175,000	\$200,000

Increasing estimating productivity and efficiency by 25% to 40% will provide considerable savings.

4. Writing takeoff quantities on drawings and/or takeoff sheets —

There is no value in writing device or fixture quantities on the drawings. This adds time to the process. These hand-written counts must be tabulated and entered into an estimating software program or written on pricing sheets. This becomes a breeding ground for errors and mistakes. There are several on-screen takeoff programs available to simplify this part of estimating.

5. Not using quality estimating software —

Estimating with pencil and paper is outdated and inefficient. It wastes valuable time. There is a myth in estimating that all estimating software does the same thing. This is not true. The wise contractor will choose software that provides the best efficiencies and best outcomes.

6. Estimators not proficient in using estimating software —

Many times, employees are left to themselves to figure out how to use the software. Most programs are not complicated, just complex. This complexity is best learned through proper training rather than “trial and error.”

7. Failure to provide company standard reports for all employees —

Standard reports create consistency and save time. Uniform standard companywide reports will prove the best outcome. Most software programs allow the user to create and share reports. Failure to provide these will require each estimator to create their own reports.

8. Failed “in-house” training —

Typically when estimators convey to me that they had in-house training,

this means that a seasoned estimator shared a few tips and tricks related to estimating. Proper training will require a qualified instructor, a curriculum, and a scope/sequence. Most contractors have employees with varying levels of knowledge and experience. Very few in-house training programs properly address these challenges.

Working late and long hours are not a badge of honor due to poor company structure and bad processes. Accomplishing more in less time should be your goal.

9. Project turnover failure —

The estimator must have project management in view to prepare for the bid. The estimate must be organized by bid item, system, area, and building to provide project management with the necessary reports for executing the project profitably. The goal of project management is to have the right materials, labor, tools, and information at the right place at the right time. Proper detailed

and organized material lists and labor reports are necessary for efficient project management.

Working late and long hours are not a badge of honor due to poor company structure and bad processes. Accomplishing more in less time should be your goal. No employee deserves praise for doing seven hours of work in 12 hours. The goal should be to provide estimators with the necessary tools, training, and organizational structure that allow them to do 12 hours of work in seven hours.

Organization and establishing non-negotiable guidelines that provide efficiency are vital to stop leaving time on the table. Increasing estimating productivity and efficiency by 25% to 40% will provide considerable savings. However, the real prize in increased efficiency is increased bid volume. See the **Table** above to determine the ROI in increased efficiency and stop leaving time on the table.

Estimating departments should be well organized to provide maximum efficiency and production. Estimating time is too expensive (and too valuable) to waste. Using the best software, bidding on the best projects, and providing the best organizational structure with properly trained estimators will allow you to stop leaving time on the table.

Remember, you can always make another dollar; you can never make another minute.

EC&M

Don Kiper is an independent electrical estimating trainer and consultant based in Niagara Falls, N.Y. He can be reached at don@electrical estimating101.com.

Working Safely With Circuit Breakers

Understanding the risks is essential for electrical workers.

By Ron Widup, Shermco Industries

Large circuit breakers in service today at industrial and commercial facilities come in many shapes, sizes, configurations, and voltage ratings — with the primary purpose of protecting electrical power circuits 24 hours a day, seven days a week. Understanding the types (and more importantly the risks) of these watchdogs of the industry is essential for electrical professionals.

There are several types of operating styles, differentiated by what medium they use to safely extinguish an arc



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Photo 1. A technician working on a low-voltage power circuit breaker.



Photo 2. This is a typical winch arrangement found on an LVPCB line-up.



Photos 3a and 3b. This circuit breaker is ready to be lifted from its extension arms.

in an electrical power circuit; including air, air-magnetic, vacuum, and SF6. While most older circuit breakers were manufactured in the United States, mostly by companies such as Westinghouse Electric, General Electric, and Federal Pacific, today many of the circuit breakers are imported from outside of the United States. And while the older circuit breaker manufacturers may have merged with others, were bought out, or might have simply gone out of business due to competition... a large portion of their products are still in use today. The good news is that the operation of these older units (and newer ones currently in production) is similar. That reduces the risk.

Air and air-magnetic circuit breakers are commonly molded-case, insulated-case, and low-voltage power circuit breakers. They use arc chutes to extinguish the arc — nothing fancy, but they have become more sophisticated through the years. Large metal-framed low-voltage power circuit breakers (LVPCBs), once the workhorse of the industrial sector, are not as common as they once were, likely due to cost and the maintenance required.

While LVPCBs were the industry standard for years (**Photo 1** on page 10) and insulated-case circuit breakers have, for the most part, taken their place in the industry, there are still thousands of

LVPCBs still in operation. You need to understand their operation and maintenance requirements if you encounter them in the field.

NFPA 70E REQUIREMENTS

The first task involved when working on a circuit breaker is to take it out of service and tackle the necessary paperwork. Many technicians dislike paperwork, but it serves its purpose to promote safety if it's completed properly. Remember that NFPA 70E supplies the minimum requirements, not the best practices. Article 110 includes several requirements for circuit breaker operation, although it focuses on the electrical safety program.

Everything in Art. 110 is from the 2021 edition of NFPA 70E. Beginning with Sec. 110.5(C) [Condition of Maintenance], safe work practices are presented in Sec. 110.5(D) [Awareness and Self-Discipline], Sec. 110.5(H) [Risk Assessment Procedure], Sec. 110.5(H)(2) [Human Error], Sec. 110.5(H)(3) [Hierarchy of Risk Control Methods], Sec. 110.5(I) [Job Safety Planning and Job Briefing], Sec. 110.5(K) [Electrically Safe Work Condition Policy], and Sec. 110.5(L) [Lockout/Tagout Program]. Sections throughout 70E explain each of these electrical safety program requirements, but that's for another article and another day.

THE JOB SAFETY PLAN

The first step when working on a circuit breaker is to complete a job safety plan, where all steps are planned out and recorded. There are good reasons for this step:

- A job safety plan forces you to reason out what needs to be done: What equipment is needed? What steps will be followed as the task is performed? What personal protective equipment (PPE) may be needed? And what condition is the equipment in?
- It allows a second qualified person to read over the job safety plan and verify that it is accurate, safely doable, and complete.

PERFORM A RISK EVALUATION

The next step is to evaluate the risk and determine which risk control methods are needed. People tend to underplay this step, but it has tremendous importance. NFPA 70E defines risk as “a combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard.” The goal is to reduce the likelihood of an incident as much as possible.

The risk of a task cannot be driven to zero unless the equipment is placed into an electrically safe work condition by de-energizing the entire circuit. This may not be convenient for many reasons, but



Photo 4a. Here's an example of a vacuum circuit breaker lifting platform.

it may be possible during a facility's maintenance or emergency shutdown, after normal work hours, or during the weekend. Turning off a circuit breaker before performing any task on it should always be what you do.

OSHA regulation 1910.333(a)(1) states: "Live parts to which an employee may be exposed shall be de-energized before an employee works on or near them, ..." To avoid this requirement of being exposed to live parts, the employee must be removed from the area of danger, such as by using remote operating devices or remote racking devices, wearing the proper arc-rated clothing and PPE, or other methods provided by 70E. Some circuit breakers are just not safe to operate with just the use of PPE, so remote devices are needed. Again, it's up to you to assess the risk and make that determination.

RISK FACTORS

When working with circuit breakers, risk increases with higher voltages, higher ampacities, higher fault currents, longer tripping delays (such as short time delay), and unknown operating conditions (e.g., past-due maintenance intervals, repeated misoperation).

At some point, those contribution factors of increased risk may require the bus to be de-energized. As an example, opening and resetting a tripped 20A molded-case circuit breaker (MCCB) in your house would likely not require any special steps. Ramp that up to a 1,000A MCCB, and the risk increases substantially.



Photo 4b. This technician is using the lifting platform to install a medium-voltage draw-out type vacuum circuit breaker.

PPE may be necessary due to the current rating of the circuit breaker, even though it is not specifically required in 70E. Determining the risk involved in operating that circuit breaker must be made by the worker in the field, as they are encountering factors the 70E Committee cannot foresee or codify.

With medium-voltage circuit breakers and older, draw-out low-voltage power circuit breakers. The risk can increase greatly because the voltage is higher (except for the LVPCB), the current being handled is usually greater, there is no built-in overcurrent device in a medium-voltage breaker, and they tend to run slower. For example, molded-case and insulated-case circuit breakers typically open in 1.5 to three cycles; in the current-limiting type of MCCBs, that time drops to 0.5 cycles. Medium-voltage circuit breakers typically open in three to eight cycles, plus the operating time for protective relaying. LVPCBs open in about four cycles. These are their respective "instantaneous" operating times.

If an incident energy analysis has been performed, higher incident energy indicates greater risk. This is due not only to the incident energy exposures but also to the increased risk of arc blasts at higher incident energies. This is why the 70E Committee deleted the informational note that indicated 40 cal/cm² was a maximum exposure level. While that is not what it stated, that is the way it was being interpreted by users of 70E. If the overcurrent device, such as the circuit breaker, was not maintained properly and its lubricants began to dry

out, its operating time would increase. How much would it increase? There's no way to tell. In an arc flash, time is critical, as incident energy is proportional to opening time. Double the opening time, and the incident energy is doubled.

Another risk factor is human error. It may be someone else's human error, not yours. It's necessary to list all things human error could cause and what the result of each error would be. Unfortunately, people tend to make errors. It's not that they want to, but distractions, sleepiness, multi-tasking (people have a tendency to think they excel at this, which may not be true), performing the task incorrectly (what doesn't injure or kill us becomes *our way* to do things), or dropping a tool, just to name a few, could cause an incident. It's like getting on a roller coaster: Once the ride starts, there's no getting off. Once an incident begins, there's no stopping it until it's over.

REDUCING THE RISK

Tools are available that can help reduce the risk.

Lifting Winch

Technicians often overlook using a winch to lower the circuit breaker from its cubicle. This accessory is provided on many draw-out LVPCB installations, and it is convenient if appropriately used. Understand the proper maintenance, operation, and limitations of lifting winch assemblies before using them.

Photo 2 on page 10 shows a winch as it is typically found. Looks ready to go, doesn't it? It is, but not the way one would think. Notice anything wrong with the cable? Each winding of the cable is overlapping the one underneath. It looks innocent, but add the weight of a circuit breaker, and it becomes hazardous.

As the cable unwinds, it can pop or snap, causing the circuit breaker to bounce — and often it bounces hard. Beyond the physical shock (if there's any weakness in the cable) it could snap, letting the circuit breaker fall where it may. Trying to stop an LVPCB from falling would crush Superman, and it happens fast.

A simple fix is to take just a few minutes to unwind the cable from the reel and wind it back while pulling on it slightly so it is straight on the reel. The cable cannot be let loose until it is connected to the circuit breaker's lifting bars.

Circuit Breaker Lifting Bars

Photo 3a on page 11 shows the lifting bars from one manufacturer, but they are all similar in the way they work. **Photo 3b** on page 11 shows a typical LVPCB ready to be lowered properly by lifting it off its extension arms. The circuit breaker rollers must be checked before they are rolled out of their cubicle to verify they are on the extension arms and attached properly to the circuit breaker. The cable is just out of sight in **Photo 3b**. It has been unwound from its reel and rewound, so it is straight — and any wound cable does not overlap.

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Photo 5. Note how this circuit breaker has some bent bus connection arms



Photo 6. This image shows the aftermath of what happens when a vacuum bottle fails.

Be careful when attaching the lifting bars to the carriage of the circuit breaker. It's easy to see in **Photo 3a** that, as one side is attached, the other side may release.

Lift Platform

It's no fun seeing a circuit breaker hit the floor. If no cable mechanism is available, a hydraulic lift or mechanical lift platform can help you prevent this from

happening. As **Photo 4a** and **Photo 4b** on page 12 show, many medium-voltage manufacturers supply such a lift to install and remove their equipment. The equipment is de-energized, and the technician is wearing the correct PPE for this task.

Remote Operating and Racking Devices
Photo 5 and **Photo 6** illustrate why a remote operating device and a remote racking device should be used when



Photo 7. Care must be taken not to rack too hard.

operating and racking a draw out circuit breaker while it is energized. **Photo 5** shows that the arms of the bus connectors are out of alignment on this medium-voltage vacuum circuit breaker. If gone undetected — and the breaker is racked in locally by a person in front of the unit — a failure could cause injury to the operator performing the task.

Photo 6 (the same circuit breaker) shows the results of a vacuum bottle failure, probably due to a racking incident. Any type of draw-out circuit breaker can fail when the circuit breaker bus connection makes inadvertent contact with the bus. There's no time to get out of the way. Remember the roller coaster analogy.

Circuit breakers can also fail from being operated (i.e., racking them in or out of an enclosure). **Photo 7** shows a bent racking gear pin from a low-voltage draw-out power circuit breaker. Superman must have found his calling when he racked this circuit breaker. As a result of this abuse, if the pin had sheared off, the circuit breaker would not stop where it should have at the fully connected position; it would continue to move past that position and begin to rack out again. That's amazing and dangerous, as it would break contact if the technician kept racking.

Photo 8 shows a medium-voltage air-magnetic circuit breaker. Note the light bulb on top of the contacts. This is not uncommon; foreign objects such as tools or maintenance items are often

left on circuit breaker assemblies, which is why a visual inspection is important. Note also how the contact clusters have fallen apart, causing the circuit breaker to fault. This is likely due to improper lubrication of the contact clusters, which is a good indication no maintenance had been performed on either of the circuit breakers.

CONCLUSION

Operating and racking circuit breakers should be done with care as well as the proper equipment and PPE. Understanding pertinent NFPA 70E requirements that apply to any task that could cause injury or even death is the first step in a good safety plan. As we've shown above, the consequences of not following accepted industry safety practices and/or neglecting equipment maintenance can result in damaged or destroyed equipment.

As qualified electrical workers in the field, take special care when

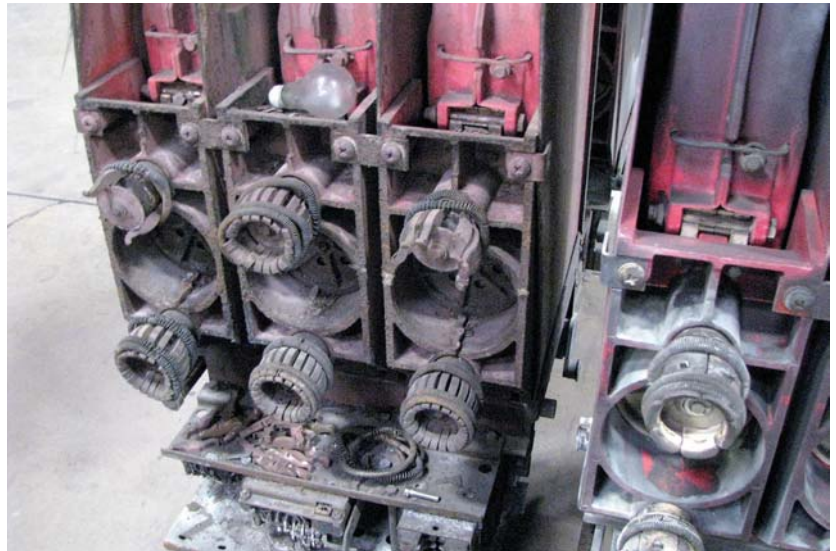


Photo 8. Note the results of serious maintenance neglect.

performing tasks that could cause an incident. Remember the roller coaster analogy: Once it begins, there's no stopping it.

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Ron Widup is the vice chairman, board of directors, and senior advisor of technical services for Shermco Industries. He can be reached at rwidup@shermco.com.



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THE TOP 10 MOST COMMONLY CITED ELECTRICAL CODE VIOLATIONS

Electrical inspectors identify which mistakes electrical professionals tend to make the most when it comes to the National Electrical Code.

Electrical inspectors are an important safeguard toward the safety of an electrical installation. Today, we are seeing various individuals who conduct electrical inspections. Some are multi-hat inspectors who are tasked (in many cases, not by their choosing) with inspecting all aspects of building-related construction within their jurisdictions. Others are true electrical inspectors, building inspectors, industrial facility engineers, fire marshals, or commanding officers at a military base. All of these individuals make up the authority having jurisdiction (AHJ), which is a defined term found in Art. 100 of the National Electrical Code (NEC).

During the daily duties of their jobs, electrical inspectors inspect several types of electrical installations. Whether it's residential, commercial, or industrial applications, these individuals must have a keen understanding of the NEC rules in all of these areas of construction. To be proficient at their work, they must have a working knowledge of the NEC and several other industry documents that govern or provide insight into electrical safety. The International Association of Electrical Inspectors (IAEI) as well as other industry associations in the electrical industry provide certification opportunities for individuals to demonstrate they have a firm understanding of these various requirements.



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This article will review 10 of the top-cited violations from around the country based on feedback from electrical inspectors. In many instances, these violations are consistent in many regions.

VIOLATION #1. CONDUCTOR BOX FILL ISSUES

Ask some installers how many conductors an electrical device box can contain, and you might get the answer “as many as I can get in the box and still get the switch or receptacle to fit.” Hopefully, this is not the case in your area of the



country. All boxes must be large enough to provide sufficient free space for all enclosed conductors to prevent overcrowding and possible physical damage. Information is provided in Sec. 314.16 to assist the installer and the inspector in determining the correct conductor fill for these installations. Table 314.16(A) provides box dimension and trade sizes (in inches) for standard metal boxes.

All nonmetallic boxes must have their cubic inch capacity durably and legibly marked by the manufacturer inside the box. **Figure 1** on page 18 shows an

example of how to work through a box fill calculation.

VIOLATION # 2. BORED HOLES IN WOOD FRAMING

One of the most common violations in residential installations involves the installation of nonmetallic (NM) cables through wood framing. The International Residential Code (IRC) contains a lot of information about the removal of framing material through notching or boring methods. This information is needed to ensure that the tradesperson

does not remove too much of the framing material, thus weakening the structural integrity of the building. The NEC also provides guidance in Sec. 300.4 on protecting these cables against physical damage. A steel plate is needed where the edge of the hole is less than 1¼ in. from the nearest edge of the wood member. The steel plate must be at least ⅛ in. thick (unless the plate is listed), and long/wide enough to cover the area of the NM cable. **Figures 2 and 3** on page 18 provide additional guidance concerning this requirement.

VIOLATION # 3. IMPROPER TORQUING OF TERMINATIONS

The tightening of conductors is sometimes taken for granted. Many electricians have been taught that their elbow contains this “magical” ability to sense when the appropriate amount of force has been applied to the tool tightening the electrical termination. This was tested a few years ago at a trade show by a wiring manufacturer. The attendees were mostly all seasoned electricians. They were given an opportunity to tighten electrical terminations with a standard wrench to the level they thought it was tightened properly. A staggering 78% of these terminations were under torqued. Now think how many times you have done exactly that same thing. This is why torquing and using the proper tools is important to the electrical safety of the installation.

Requirements located in Sec. 110.14(D) specify an approved means to be used to reach the torque value for electrical terminations. These values are indicated on the electrical equipment or can be found within the installation instructions provided by the manufacturer. Examples to determine that the proper torque has been applied include torque tools or devices such as shear bolts or breakaway-style devices with visual indicators.

Each state or electrical jurisdiction will need to be consulted on how they want to verify the installer has conducted the required torquing of termination for their electrical installation. This varies from watching an installer use a torquing tool correctly on some of the terminations to requiring a signed document attesting that the electrical terminations have been torqued per the manufacturer’s requirements. It is imperative that the electrical professional knows how to properly utilize these tools. **Figures 4 and 5** on page 19 show information concerning torquing requirements.

VIOLATION #4. LACK OF PROPER CIRCUIT IDENTIFICATIONS FOR PANELBOARD SCHEDULES

One critical item that needs to be completed on most electrical projects is a properly and legibly labeled circuit directory. This ensures that the homeowner,

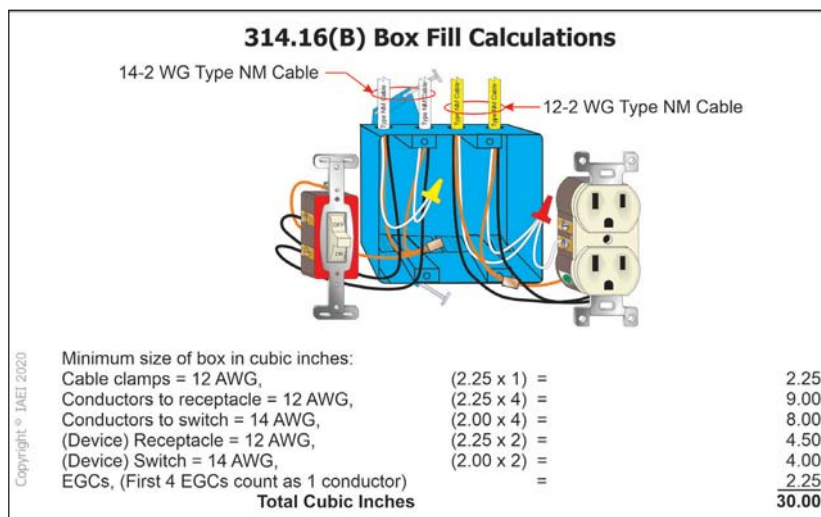


Fig. 1. This is an example of how to work your way through a hypothetical box fill calculation.

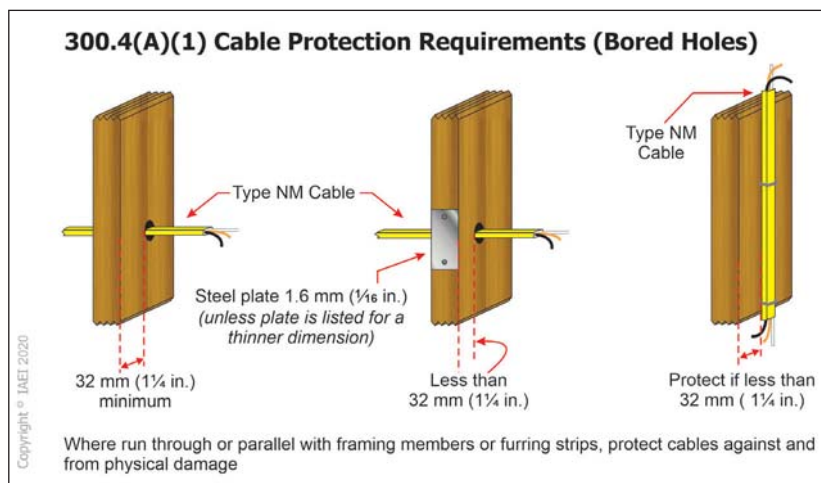


Fig. 2. Section 300.4 of the NEC provides guidance on how to protect cables against physical damage.

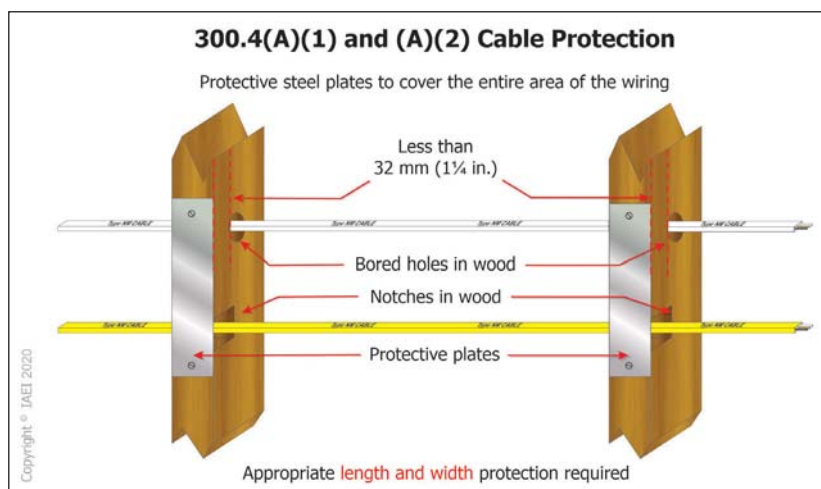


Fig. 3. Diving in a bit further, this graphic demonstrates the appropriate length and width protection required.

110.14(D) Electrical Terminal Connection Torque

An **approved means** shall be used to achieve the indicated torque value where tightening torque values for terminal connections are indicated on equipment or in installation instructions provided by the manufacturer



Examples of **approved means of achieving the indicated torque values** include torque tools or devices such as shear bolts or breakaway-style devices with visual indicators that demonstrate that the proper torque has been applied

Fig. 4. Depending on the jurisdiction, different approaches are used to ensure installers have conducted proper torquing of electrical terminations.

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Wire Size AWG	Wire Size Lb x In. (N x M)	Terminal Size Lb x In. (N x M)	Torque Lb x In. (N x M)	Bus Size Lb x In. (N x M)	Torque Lb x In. (N x M)
14-10	36 (4.0)	1/8"	45 (5.1)	1/4"	30 (3.4)
8	45 (5.1)	5/32"	100 (11.3)	1/4"	30 (3.4)
6-4	45 (5.1)	3/16"	120 (13.6)	1/4"	68 (7.7)
2-2/0	70 (8.7)	7/16"	150 (17.0)	1/4"	10 (1.1)
			1/4"	5/16"	20 (2.2)
			5/16"	3/8"	27 (3.0)
			3/8"	1/2"	37 (4.2)
			1/2"	3/4"	50 (5.6)
			3/4"	1"	60 (6.7)

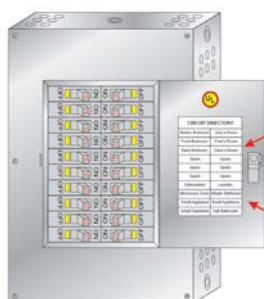
*Use Working On Device For Their Torque

Any Space On This Panel Will Accept A Breaker Of The Same Frame Size As The Opposite Breaker.

Breaker - Switch Spaces On This Panel Will Accept One Of The Following Breakers Or Switches Along With Their Respective Connector Kit.

Fig. 5. This example shows torque values for copper or aluminum bus bar connections per the manufacturer's requirements.

408.4(A) Circuit Directory or Circuit Identification



All panelboard circuits and any circuit modifications are required to be **legibly identified** as to its clear, evident, and specific purpose or use

CIRCUIT DIRECTORY

Master Bedroom	David's Room
Front Bedroom	Tim's Room
Back Bedroom	Thomas's Room
Spare	Spare
Spare	Spare

Circuit directory required to be located on the face, inside of, or in an approved location adjacent to the panel doors

The circuit identification shall have an **approved degree of detail** to distinguish each circuit from all others

Spare positions containing unused overcurrent devices or switches required to be marked accordingly

Circuits shall not be identified in a manner that depends on transient conditions of occupancy

Fig. 6. One critical item that needs to be completed on most electrical projects is a properly and legibly labeled circuit directory.

business owner, or maintenance person knows which circuit breaker controls each of the branch circuits in the dwelling/building. Requirements found in the Sec. 404.4(A) will help you with this process. Make sure that the labels do not depend on transient conditions. For example, David, Tim, or Thomas may currently occupy a bedroom in the house but may not in the future. If these are bedrooms or office locations, label the circuit directory appropriately, such as NW second-floor bedroom or first-floor master bedroom. In addition, do not put the symbols used by the electrical industry down for receptacles and switches. It is almost guaranteed that the homeowner or office tenant will not know the meaning of these symbols. See **Fig. 6** for additional information.

VIOLATION #5. GROUNDING AND BONDING BETWEEN THE SERVICE DISCONNECT AND FEEDER PANELBOARD

Grounding and bonding of electrical equipment is by far one of the most misunderstood requirements in the NEC. Many times, it is because someone was taught something incorrectly, and they have continued doing it over and over throughout their careers. It starts with the use of properly defined terms for the various components.

Not everything used for grounding and bonding can be referred to as "that ground wire." Many questions asked during IAEI meetings or via email must first go through the proper use of definitions, which are listed in Art. 100 of the NEC. An additional graphic, which contains the proper names of many of the components that are encountered when bonding and grounding a system, is available at <https://ecmweb.com/21256591>.

Improper bonding of the neutral in the feeder panelboard is a common violation. As can be seen in **Fig. 7** on page 20, the grounded conductor (neutral), the grounding electrode conductor (GEC), and the main bonding jumper are connected at the service disconnect.

Once the feeder conductors are installed from the service disconnect to the feeder panelboard, these connections are different. In our case, the ungrounded conductors are terminated

at a main lug-only (MLO) feeder panelboard. The grounded conductor (neutral) is installed on the neutral terminal bar that is intentionally isolated from the metal panelboard cabinet. The EGC from the service disconnect to the feeder panelboard is installed on the EGC terminal bar that is solidly attached to the metal panelboard cabinet.

VIOLATION #6. MISSING OR IMPROPER FIELD LABELING

The NEC contains field labeling requirements for new and reconditioned equipment. If labels are not provided or are illegible, maintenance personnel and other electrical professionals who are called on to troubleshoot electrical problems will struggle when trying to disconnect pieces of equipment from the system.

Some facilities operate with the same electrical crew for decades. These individuals have installed and maintained the electrical system for years. Then, the unthinkable happens. The maintenance staff is no longer there. Some have retired, others have experienced a life-changing event and are no longer available, and some have passed away. This information was embedded in their brains or in files that have been discarded. With the absence of a simple label, many hours are spent trying to figure out how to isolate or disconnect electrical equipment.

Proper labeling is important to ensure that future electrical professionals can work safely and efficiently on the electrical system. It only takes a few minutes longer to make a label or order one for the equipment. This small act is important and can save time, reduce downtime, and increase worker safety (see Fig. 8).

VIOLATION #7. GFCI PROTECTION FOR KITCHENS (OTHER THAN DWELLING UNITS)

Many electrical professionals understand the GFCI protection requirements for kitchens when it pertains to dwelling units [Sec. 210.8(A)(6)]. But there are instances where inspectors are finding violations when it comes to requirements in Sec. 210.8(B)(2) for other than dwelling unit kitchen areas. This commonly involves the 208V receptacle outlets

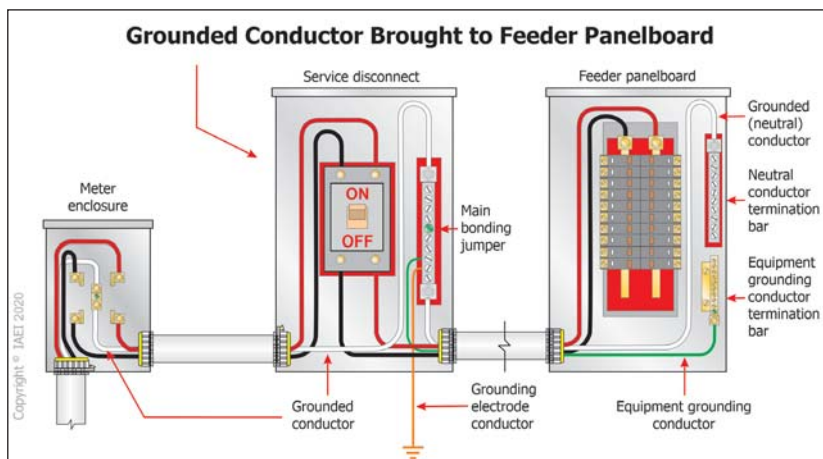


Fig. 7. As can be seen in the above arrangement, the grounded conductor (neutral), the grounding electrode conductor (GEC), and the main bonding jumper are connected together at the service disconnect.

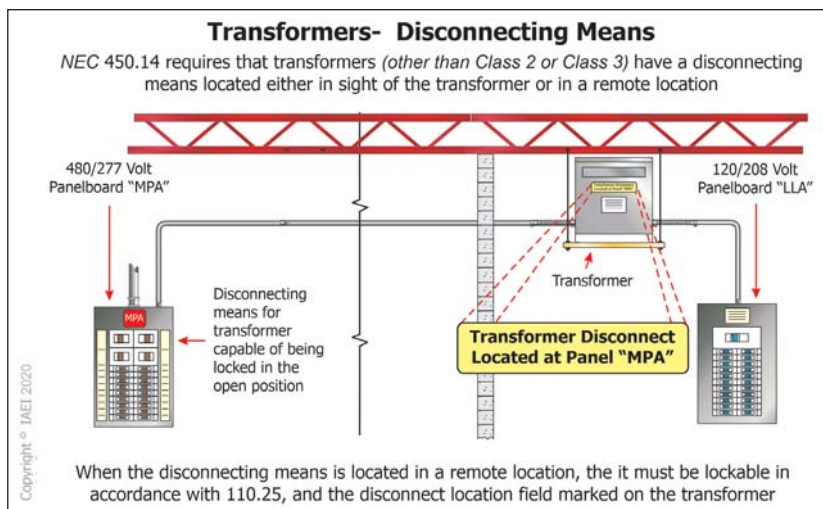


Fig. 8. This graphic shows an example of equipment labeling requirements found in the NEC.

GFCI Protection for Kitchens

A neighborhood pizza shop may be an example of a kitchen area that might have permanent provisions for either food preparation or cooking where the GFCI requirement for receptacles from 210.8(B)(2) will need to be enforced.

GFCI protection required for all 125-volt through 250-volt receptacles supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less

GFCI protection required for all receptacles supplied by three-phase branch circuits rated 150 volts or less to ground, 100 amperes or less

A kitchen is an area with a sink and permanent provisions for either food preparation or cooking. See Article 100 of the 2020 NEC

Photo from IAEI Archives

Fig. 9. This graphic further demonstrates why, in some cases, the GFCI protection for these locations is difficult to find or more expensive than conventional GFCI protection means.

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up to 150V, exceeding 50A. In some cases, the GFCI protection for these locations is difficult to find or more expensive than conventional GFCI protection means. **Figure 9** further explains these requirements.

VIOLATION #8. WORKING SPACE VIOLATIONS

This violation is common after a building has received its final inspection and been occupied. Very few times does the electrical professional knowingly violate these requirements because deep down they are conscious of the dangerous effects of electricity. Let's face it — they are the ones being called to work on this electrical equipment and know they need sufficient room to do so in a safe manner.

Many times, this is violated by the building occupants that see a nice clear space in a closet that looks perfect to store paper towels, cleaning supplies (including the cart), or holiday decorations. A yearly fire inspection might flag this and point out the violation to the occupants who honestly were unaware they were violating any safety rules.

Electrical equipment is required to have working space per the requirements found in Sec. 110.26. This space is to be provided and maintained for safe operation and maintenance of the equipment. Electrical equipment is not just panelboards and switchgear. It is equipment that is operating at 1,000V nominal or less that is likely to require examination, adjustment, servicing, or maintenance while energized (see **Fig. 10**).

VIOLATION #9. GFCI DEVICES INSTALLED IN NON-READILY ACCESSIBLE LOCATIONS

While waiting on my baggage at the airport recently, I observed a gentleman getting physical with a vending machine. At first, I thought he was upset that his product had not been dispensed and was trying to shake it loose. The more I observed the situation, the more I saw he was trying to work the machine out of a wooden display frame enclosure that contained four individual vending machines. This gentleman did not weigh more than 180 pounds. He reminded me of a small frail football player trying to move a huge offensive lineman. He



Fig. 10. This graphic shows the importance of providing and maintaining working clearance for electrical equipment.



Photo 1. Section 210.8 of the NEC specifies ground-fault circuit interrupters (GFCIs) must be installed in a readily accessible location, such as in the case of vending machines.

was not having very much luck. After receiving my luggage, I went in his direction and offered to help him. In speaking with him, he told me he was an electrician. I asked if he was moving the machine to get to the GFCI protective device behind the unit. He was surprised that I knew what he was doing and said yes. He said that two of the machines were not working, and, in the past, it was a tripped GFCI receptacle behind the machines. He squeezed behind the vending machine and used the flashlight on his phone to find the receptacle. He pushed the reset button, and both vending machines came on.

There is language in Sec. 210.8 specifying ground-fault circuit interrupters (GFCIs) to be installed in a readily accessible location. The definition of readily accessible can be found in Article 100 of the NEC. This was a perfect example of why NEC Code-Making Panel 2 put this requirement into the Code. The installer should have provided GFCI protection in a location that would not require equipment such as vending machines (**Photo 1**), ice machines, or refrigerators full of items to be moved to access the receptacle. This GFCI protection could have been installed within the electrical panel or readily accessible on the



Courtesy of IAE Archives (Scott Humphrey)

Photo 2. This photo shows an installation of underground raceways that should be inspected before being covered with concrete or backfill material.

outside of the wooden display frame enclosure. I'm sure the electricians or technicians out there that have to move this heavy equipment will greatly appreciate this rule.

VIOLATION #10. COVERING OR CONCEALING ELECTRICAL WORK BEFORE ELECTRICAL INSPECTION

Many times, the electrical contractor is under tremendous pressure to get their installations inspected so that backfill or wall covering can be installed. It is important to make sure that inspections are completed and any corrections necessary are finished before covering up the electrical system components. Typically, this occurs only once because the contractor does not want to uncover the conduit or remove the wall covering materials so that the inspection can be completed and approved (see **Photo 2**).

FINAL THOUGHTS

Contrary to what is discussed on construction sites, the electrical inspector is not out to give the electrical contractor or installer a hard time. Although I'm sure there are exceptions, electrical inspectors are tasked with a job — and are responsible for making sure electrical installations meet the minimum requirements stated in the NEC.

Many of these inspectors were employed as electricians and installed electrical equipment before becoming electrical inspectors. They have been on both sides of this relationship and understand the needs of the installer and requirements of the NEC. They are an instrument in place to assure that your installation meets the minimum requirements found in the NEC.

But make no mistake, the installer is the first set of eyes that ensures electrical safety. The electrical inspector is a second set of eyes that helps assure the public is safe while in the presence of electrical installations. In many cases, they are expecting the installation you have completed to be correct as they usually do not have time to make reinspections. Just as there is a shortage of skilled electrical installers, there are often shortages of inspectors due to budget constraints within state and municipal inspection departments.

It's also important to note that some states and jurisdictions enact other electrical ordinance requirements that supersede the NEC. These requirements must also be met. For example, a popular ordinance in many areas of the country is for deeper ditch requirements for underground electrical installations. This is required due to damage from other contractors or the homeowner when installing other utilities, sprinkler systems, or fence posts. Before starting any underground installation, call for utility locations to be marked. This will give you guidance on where these underground services are located and help you avoid them — and the cost associated with repairing these damaged systems.

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Joseph Wages, Jr., is the digital education director at IAEI. Previously he has held the positions of technical advisor, education, codes and standards, and seminar coordinator at IAEI. He represents IAEI on NFPA's NEC Code Making Panel 2 for the 2020 and 2023 NEC code cycles. He previously represented IAEI on NFPA's NEC Code Making Panel 3 for the 2014 and 2017 NEC. He serves on the Underwriters Laboratories (UL) Electrical Council and several UL Technical Standard Panels. Joseph continues to hold state electrical licenses and several IAEI and ICC building-related certifications. He can be reached at jwages@iaei.org.

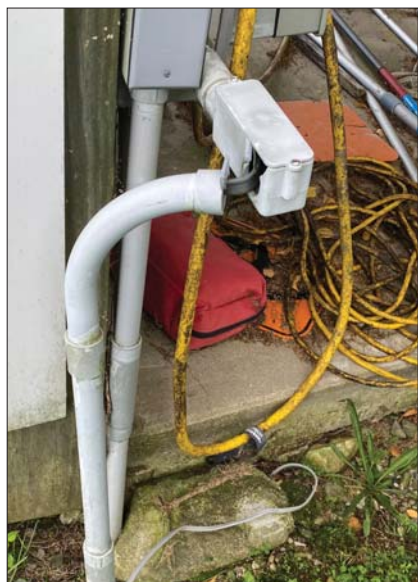


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The 10 Craziest Code Violations of 2022

Presenting the most bizarre electrical installation mishaps of last year that violated the 2020 NEC.

By Russ LeBlanc, NEC Consultant

As they do every year, *EC&M* readers ranked the National Electrical Code (NEC) as the No. 1 most-important topic we cover. So, it's no surprise that the "Top 10 Craziest Code Violations of 2021" was one of our most popular photo galleries of last year — ranking up there with the "Top Changes to the 2023 National Electrical Code" article and the accompanying photo gallery.

Back by popular demand, here are the most extraordinary Code violations uncovered by our NEC Consultant Russ LeBlanc in 2022. Shoddy electrical installers beware. If you're behind an electrical installation gone wrong like those featured here, there's a good chance your handiwork may turn up in the pages of *EC&M* or on our website someday soon. *Note: All references are based on the 2020 edition of the NEC.*

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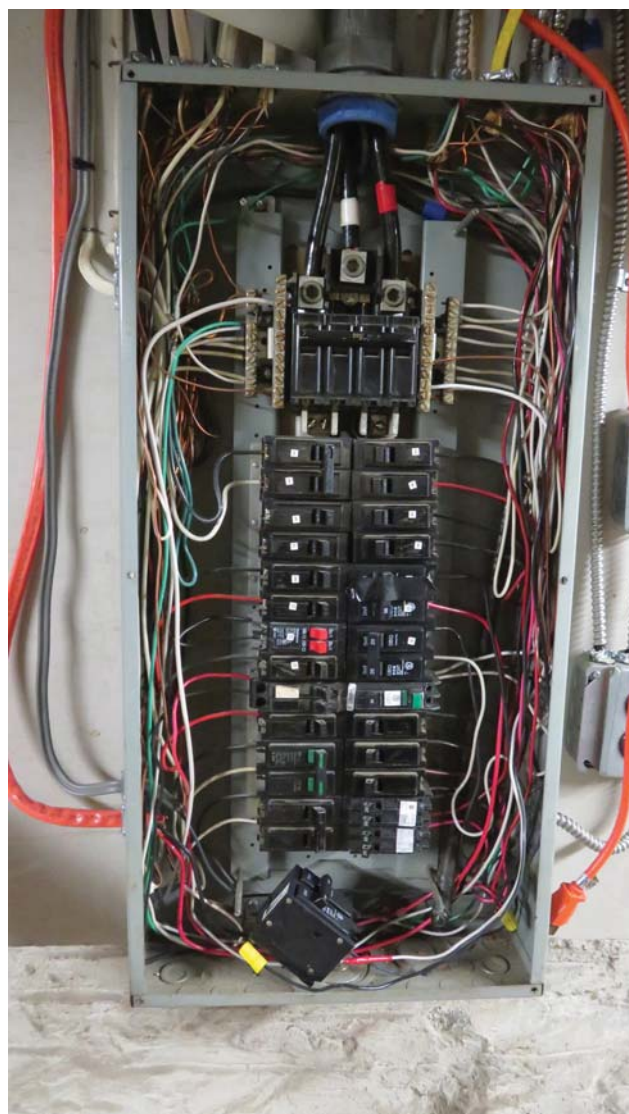


KOOKY PANELBOARD LOCATION

This photo was sent in by Chuck Cole. He says, “I found this in a hunting cabin in New Jersey. It had open holes in the panel (guess they ran out of duct tape for the upper opening). No support on the MC cable within 12 in. (top). The toilet was within the clearance. The top breaker looked to be over 6 ft, 7 in. The best part is, I was standing in the shower when I took the photo.” There are lots of violations to cite here. The lack of clear working space violates Sec. 110.26(A). Circuit breakers are required to be readily accessible as specified in Sec. 240.24(A). That same Section of the Code generally does not permit the operating handle of a circuit breaker, when in its highest position, to be more than 6 ft, 7 in. above the floor. Russ wasn’t sure if this hunting cabin would qualify as a dwelling unit, but if so, Sec. 240.24(E) would prohibit these overcurrent devices from being in the bathroom. The missing knockout seal is a violation of Sec. 110.12(A). Unused openings must be closed in a manner that provides protection substantially equivalent to the wall of the enclosure. Duct tape certainly would not suffice for this purpose. Improperly supported MC cables violate Sec. 330.30(B).

OVERPACKED PANELBOARD

Thomas Carlins, P.E., LC for Carlins Consulting LLC of Pittsburgh, shared this photo with us. “The panel looks innocent from the front (except for the tandem circuit breakers),” says Carlins. “When I took the cover off, I discovered a 2-pole circuit breaker in the bottom gutter of the panel. It was hot and in use. We are now including the replacement of the panelboard in the construction documents.” Russ agreed that replacing this panelboard is a great idea. Panelboards must not have more overcurrent devices than the amount for which the panelboard is designed, rated, and listed. Installing too many overcurrent devices is a violation of Sec. 110.3(B). Section 408.54 requires a panelboard to be provided with means to prevent the installation of too many overcurrent devices. The free-floating breaker in the bottom of the enclosure is very dangerous because this type of device is designed to be plugged onto the busbars of the panelboard. This type of installation is a recipe for poor connections and an elevated risk of fire and shock. Misusing this breaker in this manner is also another violation of Sec. 110.3(B).





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PERFECT FOR HOME THEATER SYSTEMS

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PLASTIC TV BOX™



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- Box mounts to stud in new work; for retrofit, mounting wing screws secure box in wall

includes box, trim plate,
duplex receptacle, line
voltage box, wall plates,
cable entry device,
knockout plugs



Mounts to
stud in NEW work



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in RETROFIT



Product info aifittings.com/landing/TVBU810

PHOTOVOLTAIC



CABLE CONNECTORS

CONNECTS, PROTECTS MULTIPLE PV1000 CABLES



Arlington's non-metallic NMPV series photovoltaic cable connectors are ideal for solar, and other jobs, requiring the connection of multiple cables into raceways, fittings, and combiner or junction boxes. This connector series is perfect for PV1000 cable.

NO Sealant Required. No need to seal off raceway where wires exit fitting. Grommet (included) seals and separates wires and prevents moisture, debris and insects from entering the raceway.

Larger
Holes



3/4" NMPV753



1-1/4" NMPV1257



1" NMPV1005



- For PV1000 and other cables from .245 to .280
- 3/4" NMPV753 holds up to 3 cables...
- 1" NMPV1005 holds up to 5...
- 1-1/4" NMPV1257 holds up to 7



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Product info aifittings.com/landing/nmpv



WACKY ANTENNA WIRING

Jon Turpin, Turpin Electric, Inc., Cambridge City, Ind., was kind enough to share this photo with us. Here's what he had to say: "Russ, I came across this 'multi-tasked' receptacle while looking over a home for sale by a local realtor. It appears the previous homeowner wanted his TV antenna cable very close to the 120V power source. I was amazed to find the receptacle live!" Russ was amazed too. He wasn't so sure this method of wiring was a suitable method as recognized

by Sec. 110.8. Section 110.3(B) requires equipment to be installed and used in accordance with its listing or labeling instructions. Drilling out a receptacle so an antenna cable can be shoved through the hole certainly does not comply with any instructions included in the listing or labeling for this duplex receptacle. The damage done to this receptacle makes Russ question the safety and integrity of this installation. Section 110.12(B)

A SCARY DISCOVERY IN THE ATTIC

Russ spotted this scary wiring while he was crawling around in a customer's attic trying to snake some cables down to the basement. He was hoping to find some space for snaking his cables near the chimney. Instead, he discovered this mess of NM cables strewn everywhere. For NM cables installed in accessible attics, Sec. 334.23 requires compliance with Sec. 320.23. Where cables are run across the top of floor joists or within 7 ft of the floor joists across the face of rafters or studding, guard strips at least as high as the cable must be installed to protect the cables. For attics accessible only by portable ladders or stairs (rather than permanently installed ladders or stairs) this protection is only required within 6 ft of the nearest edge of the scuttle hole or attic entrance. We may be able to debate whether these sections of the Code are applicable here because these cables are run on top of the flooring rather than on top of the floor joists, but Russ didn't think there's any questioning the applica-

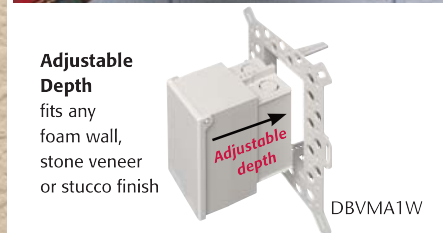


bility of Sec. 300.4, which requires these cables to be protected where subject to physical damage. Where NM cable is run exposed, Sec. 334.15(B) requires RMC, IMC, RTRC-XW, Schedule 80 PVC

conduit, EMT, or other approved means of protection for the NM cables (where necessary). The lack of any securing and supporting of the NM cables is a violation of Sec. 334.30.

IN BOX[®] RECESSED BOX

EXTRA-DUTY, LOW PROFILE COVER



No extra parts to buy or handle mean you save big on labor and materials!

One-piece **IN BOX[®]**, the recessed, EXTERIOR electrical box, eliminates installing multiple pieces: the box, then the bubble cover assembly, and a mounting block on siding. Plus, the job looks great because IN BOX installs *in the wall*. It's that simple.

Cost savings. Time savings. UL Listing. Great Looks. Get it all in Arlington's one-piece IN BOX!

- Non-metallic, 22.0 cu. inch electrical box with *extra duty* weatherproof-while-in-use white or clear cover
- Single and two-gang, vertical and horizontal, for a variety of new and old work applications
- Accepts single-gang devices - no gaskets required

IN BOX meets 2020 NEC, Section 406.9 for the protection of exterior outlets which require the use of an extra-duty weatherproof while-in-use cover for all outdoor 15 or 20 AMP receptacles.



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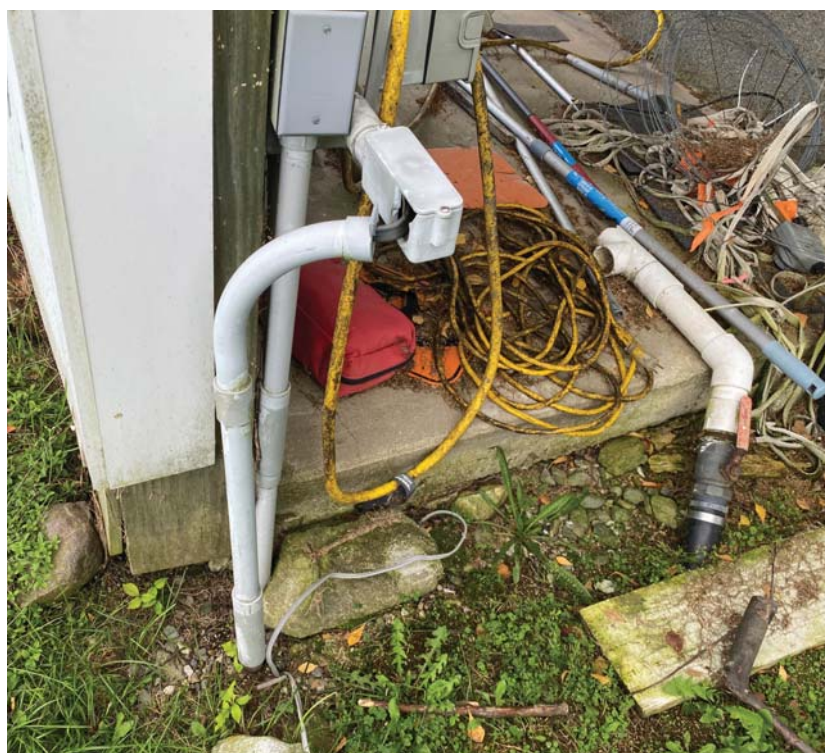


LOUSY LIGHT FIXTURE WIRING

Henry Caratura was kind enough to share this photo with us. He found this on a rehab job where he rewired the whole house. "When the plug is plugged in, the outside light comes on," says Caratura. While this may be a quick and easy way to provide power to the outside light, it certainly does not mean this installation is Code-compliant or safe. While Sec. 400.10(A)(2) does permit flexible cords and flexible cables for wiring of luminaires, Sec. 400.12(1)-(7) imposes many restrictions on the use of flexible cords, flexible cables, cord sets, and power supply cords, including: (1) As a substitute for fixed wiring; (2) Where run through holes in walls, ceilings, or floors; and (5) Where concealed by walls, floors, or ceilings. It seems like all those restrictions were ignored here. Another concern that Russ has with this installation is the lack of connection to an equipment grounding conductor (EGC) for the outside luminaire. If the luminaire is metal, Sec. 410.42 requires either a connection to an EGC or a listed system of double insulation. After seeing this photo, Russ felt neither of those options was implemented here.

PICK YOUR POISON

Russ spotted this mess while visiting an apple orchard. The UF cable emerging from the ground without any protection is a violation of Sec. 340.12(10). UF is not permitted to be used where subject to physical damage. The broken rigid PVC conduit is a clue that physical damage is occurring at this location. When rigid PVC conduit is installed in areas where it is subject to physical damage, Sec. 352.10(F) requires the PVC conduit to be identified for that use. Schedule 40 PVC conduit should not be used in this area. Similarly, Sec. 352.12(C) prohibits using PVC conduit where subject to physical damage unless the conduit is identified for that use. Schedule 80 PVC conduit is identified for use in areas exposed to physical damage. The broken PVC conduit can allow moisture, water, dust, insects, and all kinds of other critters and contaminants into the raceway. In Russ's interpretation, this would be a violation of Sec. 110.12(B), which prohibits damaged parts that may adversely affect the safe operation or mechanical strength



of the equipment. On a positive note, at least the installer used expansion fittings where the PVC conduit emerges

from the ground to accommodate for ground movement in accordance with Sec. 300.5(J).

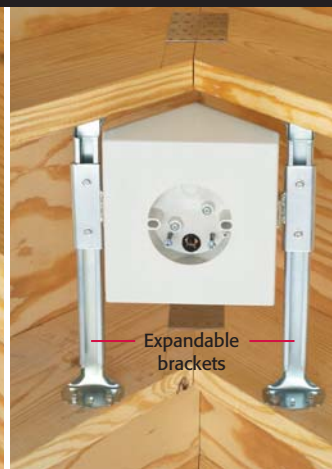
FOR CATHEDRAL CEILINGS IN NEW CONSTRUCTION

CENTERED. SIMPLE.

WITH ARLINGTON'S FAN/FIXTURE BOX



Position box between framing members by sliding it along the expandable brackets



Expandable brackets



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Get a centered, safe installation with Arlington's one-piece FBX900 Fan and Fixture Box. *Save time and money too.*

FBX900 has expandable brackets that mount securely between joists, eliminating the need to cut and nail 2X4s to center a fan or fixture in the room.

- Self-contained – No loose parts
- Supplied template levels, positions bracket between rafters
- Fits cathedral ceilings with angles greater than 80°
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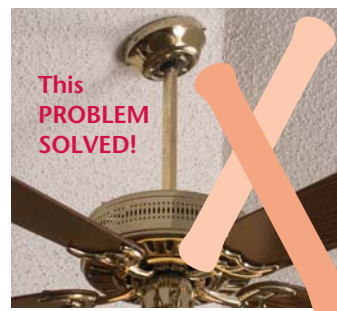
UL Ratings

FBX900 Fan/Fixture: 70 lbs

FB900 Fan: 70 lbs, Fixture: 200 lbs



Use FB900 to install a fan/fixture box next to a rafter



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LEAN ON ME

This tilted service mast is trending toward a complete failure. The weight and tension from the service-drop conductors are causing the rigid metal conduit (RMC) to bend significantly. While the NEC does not specify a minimum size requirement for raceways used as service masts to support service-drop conductors or overhead service conductors, Sec. 230.28(A) requires these masts to be of adequate strength or otherwise be supported by guy wires or braces to safely withstand any strain caused by the service-drop conductors or overhead service conductors. Many electric utilities also have specifications for installations of masts where used to support their service drop conductors. Perhaps some guy wires or braces should have been used on this installation to provide additional strength and support. When masts are used for support of overhead branch circuit or feeder conductors, Sec. 225.17(A) has the same requirements for mast strength and support as Sec. 230.28(A). One more concern that Russ had is the lack of an expansion fitting



on the horizontal section of rigid PVC conduit below the garden hose. Section 352.44 requires expansion fittings to be

used where thermal expansion and contraction would cause a length change of $\frac{1}{4}$ in. or more in the conduit.



THE PERFECT NAME

The name of this local ice cream shop is also the perfect description of the luminaire installed to light up its sign. When done correctly, a rigid metal conduit (RMC) can be used to support a box or other enclosure supporting a lampholder or luminaire. This installation, however, is not done correctly. Section 314.23(F) permits enclosures that support lampholders, luminaires, or other equipment to be supported by threaded raceways, such as RMC or intermediate metal conduit (IMC), under the following specific conditions: the enclosure must have a volume of 100 cu in. or less; two conduits must be treaded wrench tight into the enclosure; and each conduit must be secured within 18 in. of the enclosure. The conduits supporting the luminaire in this photo do not comply with Sec. 314.23(F). Exception No. 2 in Sec. 314.24(F) provides alternative support requirements for boxes supporting luminaires, but the installer did not follow those rules either. To comply with Exception No. 2, six specific conditions must be met. While this installation may comply with conditions 3 through 6, it does not comply with conditions 1 and 2.



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EASY TO INSTALL...FOR TV INSTALLATIONS

TV BRIDGE™ KIT

GOOD LOOKS • A GREAT FINISH IN RETROFIT PROJECTS

No messy
wires
running down
the wall

TVBR2505K
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Arlington's **TVBR2505K TV Bridge™ kit** includes TWO recessed power/low voltage combo boxes and all the connections needed *except NM cable* to install a TV in an existing wall.

There's no need to run cable from a panel box *or to cut into the framing members*. Just cut two openings in the wall to access power from an existing, nearby source.

- Fast, easy, convenient; saves time and money!
- **Cables stay hidden behind the wall – no wires running down the wall from TV to components.**
- Plugs stay inside electrical box without protruding past the wall
- Mounting wing screws pull boxes snug against wall
- 18.0 cu. inch recessed boxes with paintable trim plate(s)



TVBR2505K



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THE INDUSTRY STANDARD

FROM ARLINGTON

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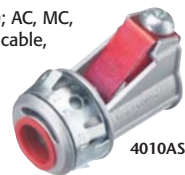
SNAP²IT® CONNECTORS

NO TOOLS, SNAP IN • EASIEST CABLE INSERTION • SECURE HOLD



SAVE **17**
seconds
per connector!

- **Widest total cable ranges** for our ENTIRE line: 14/2 to 3/3
Larger Snap2It connectors also available.
- **Widest variety of cables** AC90 and ACG90; AC, MC, HCF, MC continuous corrugated aluminum cable, MCL-A cables (steel/aluminum)
- **Easiest cable installation**
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WIDEST CABLE RANGES FASTEST INSTALLATION!

CATALOG NUMBER	SNAP2IT® CONNECTORS w/ insulated throat	CABLE OUTSIDE DIA (OD)
38AST	Snap in, 1/2" KO	.405 to .605
3838AST	DUPLEX Snap in, 1/2" KO	.405 to .605, 3/8" Flex*
40AST	RED TINT Snap in, 1/2" KO	.485 to .610
4040AST	RED TINT, DUPLEX Snap in, 1/2" KO	.485 to .610, 3/8" Flex*
4010AST	ANGLED CLIP Snap in, 1/2" KO	.405 to .610

* Flex CSA Listed with anti-short bushing



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Product info aifittings.com/landing/snap2it-complete-series



VINEYARD VIOLATIONS

EC&M reader Brian shared this photo with us. He says, "While walking along a vineyard road in Northern California, I noticed some conduit becoming exposed along a roadbed. The conduit looks to be 1½ in., and the conductors might be #10. Sure wasn't buried to the required depth even when installed!" Direct buried conduits and raceways must be installed deep enough to meet the minimum coverage requirements outlined in Table 300.5. Column 3 of this table provides the minimum cover required for nonmetallic raceways, including rigid PVC conduit. Under streets, roads, alleys, parking lots, and driveways, the minimum depth of cover for rigid PVC conduit is 24 in. This raceway appears to have been buried only a few inches deep. The tire impressions in the dirt indicate a tractor or large truck travels along this roadway and has finally worn down the dirt enough to destroy the raceway and damage the enclosed conductors. This raceway will need serious repair work, and new conductors will probably need to be pulled through the raceway to make this safe again. Perhaps the raceway could be encased in concrete, buried deeper, or re-routed to provide some much-needed protection.

ROGUE RV PARK WIRING

Thanks to Mike Allen from Erwin, Tenn., for sharing this photo with us. He discovered this mess when his company was asked by a local excavating contractor to "assess the electrical supply to an existing RV park in the mountains of Upper East Tennessee." Generally speaking, protecting 10/2 UF cables with a 200A overcurrent device would typically be a violation of Sec. 240.4(D)(7). These cables should be protected at 30A maximum unless otherwise permitted in Sec. 240.4(E) or (G). Section 240.4(E)(3) permits tap conductors to be protected per Sec. 240.21. If these wires are considered feeder taps, Sec. 240.21(B)(5)(2) permits them to terminate at a single circuit breaker or fuse that limits the load to the ampacity of these tap conductors. Mike did not mention whether each of these wires was connected to overcurrent devices in RV site equipment at the load end of the circuits, so we can't determine if these wires are considered properly protected against overcurrent. One thing Russ was certain about is the number of conductors landed in each terminal is a violation of Sec. 110.14(A). Terminating more than one conductor in a terminal is only permitted if the terminal is specifically identified for that purpose.





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A NEAT COVER UP...

Made in USA

NON-METALLIC BOX COVER

FOR UNUSED FAN/FIXTURE BOXES – FITS PAN BOXES TOO!



CP3540 Box Cover

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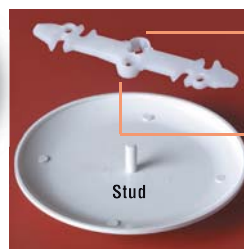
Our non-metallic, paintable **CP3540** Box Cover is the neatest way to cover unused fan/fixture boxes, pan boxes or poorly cut drywall.

- No visible screws on ceiling plate
- Fits 3.5", 4" round or octagonal boxes

Versatile bracket design with 'A' and 'B' openings for use on flat or uneven ceilings.

Easy installation. Attach the bracket to the box with #8 or #10 screws. Back the screws out enough to slip the bracket on.

Versatile Bracket Design



'A' for flat ceilings
Push stud into opening to seat cover

'B' for uneven or textured ceilings
Thread stud into opening until tight

Stud



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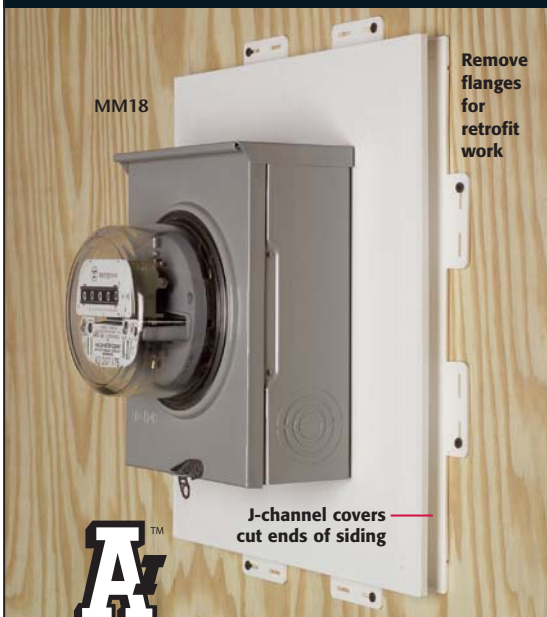
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ONE-PIECE • NON-METALLIC

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METER MOUNTING BASE

INSTALLS ON SIDING – AND OTHER SURFACES



MM18

Remove flanges for retrofit work

J-channel covers cut ends of siding



Arlington's one-piece, non-metallic Mounting Bases provide a smooth, flat mounting surface for most electric meters, *including the largest sizes* – as well as a variety of other products such as timers, disconnects, inlet boxes and more.

UV rated, paintable plastic for long outdoor life.

Available with squared-off corners, they're *gangable* so you can create the mounting base you need for the product you're installing.

NEW 5x7



MM23 → ← MM18

Gangable...for custom sizing

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5" X 7"
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Advancements *in* Commercial Vehicles *for* 2023

Equipment breakthroughs target emissions regulations

Truck equipment challenges that began at the start of the pandemic in 2020 have continued through 2022, with OEM backlogs and allocations expected to linger through 2023. Every year, *FleetOwner* publishes its new models report that details new light-, medium-, and heavy-duty straight trucks and tractors for the following model year. This year, they tried something a little different.

Over the following pages, readers absolutely will see some of the model year 2023 vehicles that they might consider adding to their fleets. Keep in mind, however, that many of the advancements being made by OEMs aren't simply cosmetic in nature. Truck and engine OEMs are strategically gearing toward producing equipment that will help fleets meet California Air Resources Board (CARB) 2024 emissions regulations and the U.S. Environmental Protection Agency's new, stronger standards for heavy-duty vehicles and engines starting in model year 2027.

"There are a lot of developments with trying to meet the CARB compliance — aerodynamics, engine technologies to try to improve fuel economy, cylinder deactivation, and things of that nature," Al Barner, Fleet Advantage's SVP of strategic fleet solutions, told *FleetOwner*. "This is all in an attempt to improve fuel economy and reduce the NOx coming out of the engine. While there



© Fergy | Dreamstime.com

is probably not much aesthetically other than aerodynamics, there are an awful lot of technology changes that will occur to meet those 2024 regulations."

Whether it's developing a "clean-sheet" design from the ground up for internal combustion engines or focusing on battery-electric and hydrogen fuel cells for certain segments, truck and engine manufacturers have their hands full and are in a rush to comply with these future mandates. On top of that, even as the market stabilizes a bit, the reality is that fleets are still waiting longer periods of time for their new equipment.

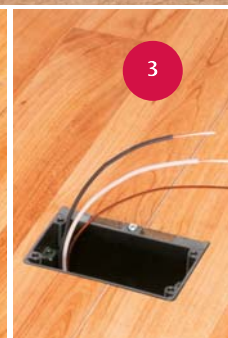
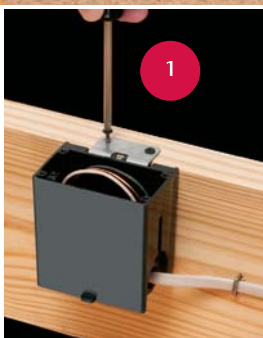
"In 2022, OEMs only built 182,000 Class 8 tractors, so we're still trying to catch up from that slowdown back in 2020," Barner explained. "If you look at all the changes we've had since about that time, we've had about 200,000 tractors below demand. So, our indications are that it's about nine to 12 months behind production. We've got a long way to go to catch up with the demand, so we think it will go all the way into 2024."

Check out some of *FleetOwner's* "new model" and advancement picks in the light- and medium-duty segments heading into 2023.

Cristina Commendatore is the Editor in Chief of FleetOwner magazine. She has reported on the transportation industry since 2015, covering topics such as business operational challenges, driver and technician shortages, truck safety, and new vehicle technologies. She holds a master's degree in journalism from Quinnipiac University in Hamden, Conn.

FLOOR BOX KITS

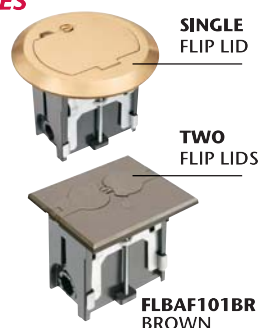
FLUSH-TO-THE-FLOOR RECEPTACLE INSTALLATIONS THE EASY WAY!



Designed for New or Retrofit work, Arlington's
UL LISTED ADJUSTABLE FLOOR BOXES
fit varying floor heights up to 2".

They're the low cost, easy way to install a duplex receptacle flush with the floor.

- **Gasketed covers with ONE or TWO FLIP LIDS** prevent water intrusion and protect the box when not in use
- **Non-Metallic Covers** Black, brown, light almond and **Metal Covers** in brass and nickel-plated brass.



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FORD COMMERCIAL EVs

This year, Ford Motor Co. began shipping its E-Transit van from the company's Kansas City-area assembly plant, which is the first such facility to build both batteries and vehicles in-house. The new E-Transit is the first of two EVs purpose-built for Ford Pro commercial customers. The second will be the F-150 Lightning and Lightning Pro — all-electric versions of the company's popular pickup truck.

According to the company, Ford will have global capacity to produce 600,000 battery-electric vehicles annually by late 2023, including 150,000 F-150 Lightning trucks. Ford views the F-150 Lightning lineup and its Ford Pro business unit as the vehicles that will carry commercial and government fleets into a sustainable future.



Ford Motor Co.

Ford began shipping the new E-Transit from its Kansas City-area assembly plant this year.

FORD SUPER DUTY



Ford Motor Co.

The 2023 Ford Super Duty lineup includes the F-250 Tremor off-road package, F-350 Limited, F-350 Lariat, and XL ST appearance package.

Ford's all-new 2023 F-Series Super Duty lineup is expected to go on sale in early 2023. Every Super Duty features a Ford-designed and -built 10-speed Torq-Shift automatic transmission, and every chassis cab model comes standard with a power take-off connection to run added equipment, like boom lifts and plows. Additional features include onboard scales for measuring payload weight, box steps with handholds on the side rails for

easier cargo box access, a lowered rear tailgate step, driver-assistance technology like lane centering and intelligent adaptive cruise control, head-up displays that can project trailer or offroad information onto the windshield, and an integrated work surface.

Towing capabilities include Pro Trailer Hitch Assist, which automatically steers and backs up the truck to the trailer; Smart Hitch, which uses

the truck's onboard scales to measure a trailer's tongue weight for perfect balance; a tailgate with cameras and sensors on top that provide visibility while the gate is lowered; and 14 total cameras that can deliver 360-degree, bird's eye views of the truck, cargo box, and trailer. In addition, embedded 5G connectivity enables over-the-air software updates and supports Ford Pro telematics and vehicle security.

GENERAL MOTORS

For 2023, the Chevrolet Silverado 3500 HD's max towing remains at 36,000 lb, with a max of 910 lb-ft of torque. Available safety features of the truck — offered with four cab configurations (regular cab, long bed; double cab, long bed; crew cab, standard bed; and crew cab, long bed) — include automatic emergency braking, hill descent control, auxiliary trailer camera, lane-departure warning, following distance indicator, forward collision alert, safety alert seat, and trailer tire pressure and temperature sensors. The truck is equipped with the Duramax 6.6-L turbo-diesel V8 (10-speed Allison automatic transmission) or 6.6-L V8 (6-speed automatic transmission) gas engines. The 2024 Silverado HD will arrive with powertrain upgrades, an overhauled interior, enhancements to its trailering technology, and infotainment and active safety technology upgrades. The lineup includes 2500HD and 3500HD models in regular cab, double cab, and crew cab configurations. Production for the 2024 model is slated to begin the first half of 2023.



General Motors Corp.

Chevrolet Silverado 3500 HD.

NO TOOLS! • EASY CABLE INSERTION

Made in USA 

SNAP²IT[®] 90° CONNECTORS

WITH and WITHOUT INSULATED THROAT



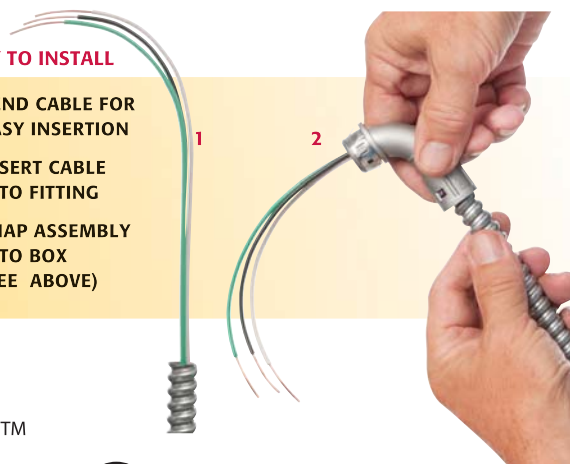
- Easy snap-in cable installation...SAVES A MINUTE each over 2-screw 90° styles
- Handles widest range & variety of cables: 14/2 to 10/2 AC, MC, HCF, MC continuous corrugated aluminum cable, MCI-A cables (steel and aluminum), AC90 and ACG90
- Fast, super-secure installation...No pullout
- Easy to remove from box...reusable

90° SNAP2IT[®] CABLE RANGES

CABLE TYPE	38900AST 38900ST		4010900AST 40900ST	
	Dia. Range	Cable Range	Dia. Range	Cable Range
MC/HCF/AC Steel & Aluminum	.380 to .600	14/2, and 12/2 with & w/o ground.	.490 to .600	14/3, 12/2, and 12/3 with & w/o ground.
MCI-A Steel & Aluminum	.440 to .550	14/3, 14/4	.480 to .550	14/4
AC90, ACG90		12/3, 12/4 10/2	.480 to .550	12/4 10/2
Flexible Metal Conduit Steel & Aluminum (RWFMCI)	3/8" Flex* *CSA Listed w anti-short bushing ONLY			

EASY TO INSTALL

- 1 BEND CABLE FOR EASY INSERTION
- 2 INSERT CABLE INTO FITTING
- 3 SNAP ASSEMBLY INTO BOX (SEE ABOVE)



with and without insulated throat

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LORDSTOWN MOTORS

This year, Lordstown Motors Corp., the embattled Ohio-based startup, says it will finally begin producing the Endurance, its fleet-focused electric pickup truck. Lordstown Motors started with loads of promise when it acquired an expansive plant from General Motors and announced the Endurance in 2020, but two years later, it teetered on the brink of insolvency. The company's new leadership, however, recently closed a deal with Foxconn to launch the fledgling electric truck maker's potential comeback story. The Endurance has a gross vehicle weight of 7,500 lb. It offers a 1,000-lb payload and 8,000-lb towing capacity. Lordstown said it offers up to 200 miles per charge, based on testing. The Endurance uses four hub motors to provide better traction and drive more like a sports car, according to the company. Each hub motor has a 110kW output, translating to 550 hp.



Lordstown Motors Corp.

Cincinnati Bengals quarterback Joe Burrow walks to the passenger seat of the Lordstown Endurance EV pickup during a marketing event in June.

RAM COMMERCIAL



Ram Commercial

2023 Ram ProMaster lineup from Ram Commercial.

The new 2023 Ram ProMaster from Ram Commercial contains features designed to meet specific customer needs. Adding to the upfit adaptability of

the Ram ProMaster, Mopar offers a portfolio of quality-tested, factory-backed accessories for vocational, delivery, and lifestyle users. Select Mopar accessories

available for the new 2023 Ram ProMaster include a cargo-load floor that features an anti-slip surface coupled with integrated rails, carriage bolts, and D-ring hardware; crew-van package that includes a rear bench seat that provides three additional seat spaces while leaving the rear cargo area open for other uses and separated with a built-in safety partition; paint-protection film that protects exterior paint in high-usage areas; upper side panels that include upper interior trim panels for multiple wheel-base models; a cargo compartment floor mat; cargo lighting; passenger-side step; and a set of two heavy-duty (left-hand and right-hand sides) handles for interior D-pillar (rear cargo doors).

WORKHORSE

Workhorse, a U.S. manufacturer of EVs for last-mile delivery, and GreenPower Motor Co. of Canada, a cargo, delivery, shuttle, and transit zero-emission maker, signed a multi-year deal to jointly make medium-duty Class 4 step vans for the North American market. The chassis will be used in the production of Workhorse's new W750 step van. Workhorse will finish off the manufacturing process and deliver step vans to its customers in the United States and Canada. The agreement includes deposits based on delivery thresholds and contains a renewal option. The W750 will feature up to 150 miles of all-electric range, with a payload capacity of 5,000 lb as well as standard 60kW DC fast-charging and optional 60kW wireless-charging capabilities.



Workhorse

Workhorse's new W750 step van.



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CABLE WAY™

CABLE SUPPORT SYSTEM FOR NEW WORK OR RETROFIT



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Support System

Try Arlington's easy to install **CableWay™**, for a secure, UL Listed cable runway support system.

System components get the job done quickly and easily.

Support Brackets attach directly to framing members, without structural damage. They hold cables securely in place, and open for easy cable insertion!

The **Slide-On Trough** holds and protects cable.

To add length, install more sections that join together with **Coupling**.

Angles and Tees make turning corners a breeze.

Push-on **End Caps** complete the job!

FLAT SURFACE
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T23F

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SUPPORT BRACKET
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SUPPORT BRACKET
T23H OPEN

T23H CLOSED

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GALVANIZED STEEL

Made in USA



CABLE SUPPORT

ECONOMICAL...HOLDS UP TO FOUR MC CABLES • EASY TO INSTALL



Nail or screw on **CUS6**

Foldline
(centerline)

Locking tab

Nail or screw to stud
through these holes

Bend right side
of strap in and
over cable

Arlington's economical CUS6 galvanized steel Cable Support holds cable secure and centered on a metal or wood stud.

It's perfect for fastening and positioning *up to four* individual metal clad cables – or six NM cables on a 2x4.

Installation is quick and easy. Nail or screw **CUS6** to a wood or metal stud, and position the cables. Next bend the strap at the foldline (centerline). Fold the strap over the cables and insert the locking tab in the opening as shown to hold them securely in place.

• Complies with 2020 NEC, article 300.4(D)



*Holds up to four MC cables
centered on a 2x4!*

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CUS6 holds FOUR metal cables...or SIX NM cables

Product info aifittings.com/landing/cus6/



FREIGHTLINER



Daimler Truck North America

Freightliner's new Plus Series includes the M2 106 Plus, M2 112 Plus, 108SD Plus, and 114SD Plus.

Freightliner's new Plus Series — enhanced versions of its M2 and SD models — includes the M2 106 Plus, M2 112 Plus, 108SD Plus, and 114SD Plus. The enhanced models provide a major update to the interior and electrical systems of the M2 and SD models. The new Plus Series will succeed the legacy M2 and SD products. Production is set to begin in Q3 2023.

The new Plus Series features an all-new interior with enhancements that include all-new trim levels designed for preference and applications; improved insulation that muffles exterior noise and provides greater thermal efficiency; a driver-centric dash and information center; a customizable switch layout; ergonomic seating; steering wheel with integrated

controls; a transmission control stalk that allows automated manual and automatic shifting and engine braking functions from the column for safer operation; and a configurable dash panel featuring 2.5 times more space for truck equipment manufacturers to utilize.

For the first time, the Detroit Assurance 5.0 suite of safety systems is now available across Freightliner's entire vocational and medium-duty truck lineup. Fleets selecting the combination of Detroit engine and DT12 transmission have access to the Detroit Assurance 5.0 suite of safety systems. In addition, customers will (for the first time) be able to order certain Detroit Assurance features when spec'ing a Cummins engine.

HINO



Four Door Crew



Hino

The all-new Hino L Series trucks replace Hino's conventional lineup.

The all-new Hino L Series trucks replace Hino's conventional lineup. Now known as the L6 and L7, a new exterior design includes a bolder front fascia and optional LED headlights. The series touts a re-engineered interior with automotive-grade finishes built with commercial-use durability, new steering wheel controls, a 7-in. LCD multi-information display, more storage, and increased legroom.

The Hino L Series has integrated an entire suite of new safety systems, including electronic stability control,

collision mitigation, lane-departure warning, active cruise control, and a driver's seatbelt sensor. In addition, new wheelbase options include extended cab and crew cab configurations.

The trucks also come standard with the Cummins B6.7 engine, featuring upgrades that allow for extended engine maintenance intervals, including longer oil drain intervals, more time between fuel filter changes, and a maintenance-free crankcase ventilation filter.



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w Brush
opening



CED135
(with wall plate,
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Arlington's
TVBU505 TV BOX



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The **SCOOP™** series of reversible, non-metallic ENTRANCE HOODS, PLATES AND DEVICES protect cable while delivering good looks and installation versatility. They also reduce labor and eliminate extra connections.

Our newest **CABLE ENTRY DEVICES** come with *or without* a wall plate for efficient cable management.

HOODS for decorator-style wall plates, single and two-gang **PLATES** install facing in or out...and save time!

- Low voltage cable protection
- Best way to run cable



CED130
entry device
w slotted cover



CED1
facing OUT



CER1



CE1
facing
IN



CE2
facing
OUT

Product info aifittings.com/landing/scoop-series/

ADJUSTABLE BRACKET • EASY INSTALLATION IN EXISTING CEILING

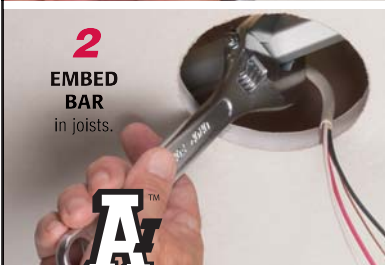
FAN/FIXTURE BOX

HIGHER WEIGHT RATINGS

**EASY
TO INSTALL
1-2-3!**



1
REMOVE BOX
from bar.
Insert in opening.



2
EMBED
BAR
in joists.



3
REATTACH
BOX
to bar.

Arlington's extra heavy-duty, plated steel fan/fixture box with adjustable bracket has **higher UL Weight Ratings:**
at 24" on-center: **70 lb Fan, 90 lb fixture**
at 16" on-center: **70 lb Fan, 150 lb fixture**

The 20.0 cu. inch FBR54200R installs *between* rafters with 16" to 24" on-center spacing, holding a fan or fixture securely in place. It's easy...

REMOVE BOX from bar.

INSERT BAR in opening. Embed bracket ends in joist. Tighten hex, first by hand then with a wrench. Pull wire.

REATTACH BOX to bar.

No parts to lose. Installation screws ship captive, along with a mud cover and installed NM cable connector.



FBR54200R
Patented



CSA Rated: at 16" or 24" oc 50 lb fan or fixture

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INTERNATIONAL



International eMV Series trucks are built to the same standards as the diesel International MV Series.

Navistar's recently updated International MV Series medium-duty trucks now support snowplow applications. Redesigned in 2021, the vehicle now offers a chassis configuration specifically focused on plows, along with improved packaging for integration and a suite of safety features and uptime enhancements. The 14,700-lb front axle and suspension were designed with the snowplow application in mind. A hood that can be opened partway allows for daily fluid checks. The integral front frame extension provides reinforced strength

while reducing weight compared to bolt-on solutions, according to the OEM. The design also allows for multiple configurations, including hose reel and winch applications. Corrosion protection is enhanced with standard Intercoat Chem Guard on floor panels and a newly available Line-X interior floor coating option.

In addition, Navistar's new fully electric International eMV Series trucks, built to the same standards as the diesel International MV Series, have a battery-electric motor that provides peak power of over 335 hp or 250kW, with

continuous power of 215 hp or 160kW. The eMV has a 210kW capacity high-voltage battery that provides a 135-mile range when fully charged. Batteries are packaged between the frame rails for added protection and are under warranty for five years or 100,000 miles. The eMV is also equipped with three levels of regenerative braking, allowing the vehicle to collect kinetic energy from braking and store it in the battery for use. The International eMV also offers both AC and DC charging capabilities as standard equipment.



Navistar's recently updated International MV Series medium-duty trucks now support snowplow applications.

ISUZU

Isuzu Commercial Truck of America, distributor of low cab forward trucks, has begun production for its 2023 model-year editions of its N-Series gasoline- and diesel-powered trucks. Class 3 and Class 4 Isuzu N-Series trucks are powered by a direct-injected, 6.6-L V8 gasoline engine with variable valve timing that generates 350 hp and 425 lb-ft of torque. They are available in both standard cab and crew cab configurations, with gross vehicle weight ratings (GVWR) from 12,000 lb to 14,500 lb and wheelbases ranging from 109 in. to 176 in. to accommodate bodies from 10 ft to 20 ft.

Class 4 and 5 Isuzu N-Series diesel trucks are powered by Isuzu's 5.2-liter 4HK1-TC turbocharged, intercooled four-cylinder diesel engine with four valves per cylinder and direct injection. This powerplant produces 215 hp and 452 lb-ft of torque with 50-state emission certification. They offer both



Isuzu Commercial Truck of America has begun production for its 2023 model-year editions of its N-Series gasoline- and diesel-powered N-Series trucks.

standard cab and crew cab body styles, with GVWR from 14,500 lb to 19,500

lb and wheelbases ranging from 109 in. to 212 in. for bodies from 10 ft to 24 ft.



STEEL BOX WITH BRASS COVER

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SINGLE GANG

FLOOR BOX KITS

CONVENIENT, FLUSH-TO-THE-FLOOR RECEPTACLE INSTALLATION



FLB5331NL
Single gang
steel box kit
w nickel-plated brass cover



FLB5331MB
Single gang Kit
w brass cover

Arlington's **STEEL FLOOR BOX KITS** give installers a low cost, *convenient* way to install a receptacle in a *new* or *existing* floor.

Our Listed Single Gang Steel Floor Boxes deliver *easy, flush-to-the-floor* installation.

- Brass covers hide miscut flooring; gaskets prevent water intrusion; flip lids protect the box when it's not in use.
- Single gang brass and nickel-plated **Brass Covers** fit our boxes and other manufacturers' single gang boxes.

Covers also sold separately.



FLB5331MB
Single gang
steel box kit w brass cover



for **NEW** or
existing floors



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IN BOX® RECESSED COVER KITS

INSTALLS INSIDE 4.5" CONCRETE BOXES

NEW!



Plugs
stay inside
recessed
cover

FLBC4560DNL



Slotted in-use cover



Easy to install
in concrete box

FLBC4560

FLOOR BOX
FOR NEW
CONCRETE

Arlington's **IN BOX® Recessed Cover Kits** are the neat way to install a receptacle in an installed 4.5" concrete floor box, including our FLBC4500 or FLBC4502 boxes.

IN BOX covers install fast, *inside the can* reducing trip hazards caused by plugs sticking out of the box. They look great. And, you can have power and low voltage in the same box.

Assembled IN BOX, comes with matching in-use slotted cover and cover blank for unused boxes in **brass** or **nickel-plated brass**

FLBC4560DMB
Brass

FLBC4560DNL
Nickel-plated

Cover blank

Slotted cover

FLBC4560DBR
Brown

...and plastic in FIVE colors.

FLBC4560DGY
Gray

FLBC4560DCA
Caramel

FLBC4560DBL
Black

FLBC4560DLA
Light almond



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Product info aifittings.com/landing/inbox-cover-kits/

KENWORTH



Kenworth's new K270E Class 6 battery-electric vehicle.

The medium-duty conventional lineup from Kenworth Trucks features the T180 (Class 5), T280 (Class 6), T380 (Class 7), and T480 (light Class 8). In addition, the Kenworth T380V and T480V are vocational models. The models are offered with the 6.7-liter Paccar PX-7 and 8.9-liter Paccar PX-9 engines. The near-zero emission Cummins 8.9-L L9N and 6.7-L B6.7N natural-gas engines also are available.

Kenworth's new K270E Class 6 and K370E Class 7 battery-electric vehicles offer direct-drive motors rated at 355 hp for the K270E and 469 hp for the K370E. The electric powertrain is available with high-density battery packs of 141kWh, 209kWh, and 282kWh that deliver up to a 100-, 150-, and 200-mile range.

The new models utilize a DC fast-charging system capable of fast recharge in as quick as one hour, which make the Kenworth K270E and K370E cabovers ideal for local pickup and delivery as well as short regional haul operations. End-of-shift and overnight AC charging are also offered.

MACK

Mack Trucks has expanded its vocational offerings to medium-duty customers by making the Allison 3000 RDS transmission optional on new MD Series models. The Allison 3000 RDS transmission offers greater versatility for 4x2 refuse, tank, and dump applications. The MD Series equipped with an Allison 3000 RDS transmission is approved at a 33,000-lb gross vehicle weight rating for refuse and recycling applications. The Allison 3000 also allows for a live power takeoff (PTO) for MD Series tanker trucks that deliver heating oil, water, fuel and propane, and dump trucks, enabling the vehicle to move while using the PTO at the same time.

The Allison 3000 RDS also offers a higher gross combination weight rating (GCWR), allowing customers to drive the Mack MD Series model and pull utility trailers with small excavators. The Mack MD Series equipped with an Allison 3000 RDS will



The Allison 3000 RDS transmission is optional on new Mack MD Series models.

have a GCWR of 45,000 lb. The MD Series can be spec'd as a Class 6 with 25,995 lb GVWR and as a Class 7 with 33,000 lb GVWR.

PETERBILT



The Cummins B6.7N natural gas engine is available on the Peterbilt 536 MD model.

Peterbilt Motors announced this year that the Cummins B6.7N natural gas engine will be available on the OEM's medium-duty models 536 and 537. The two MD models were introduced last year and are aimed at the lease/rental segment and the vocational markets, respectively.

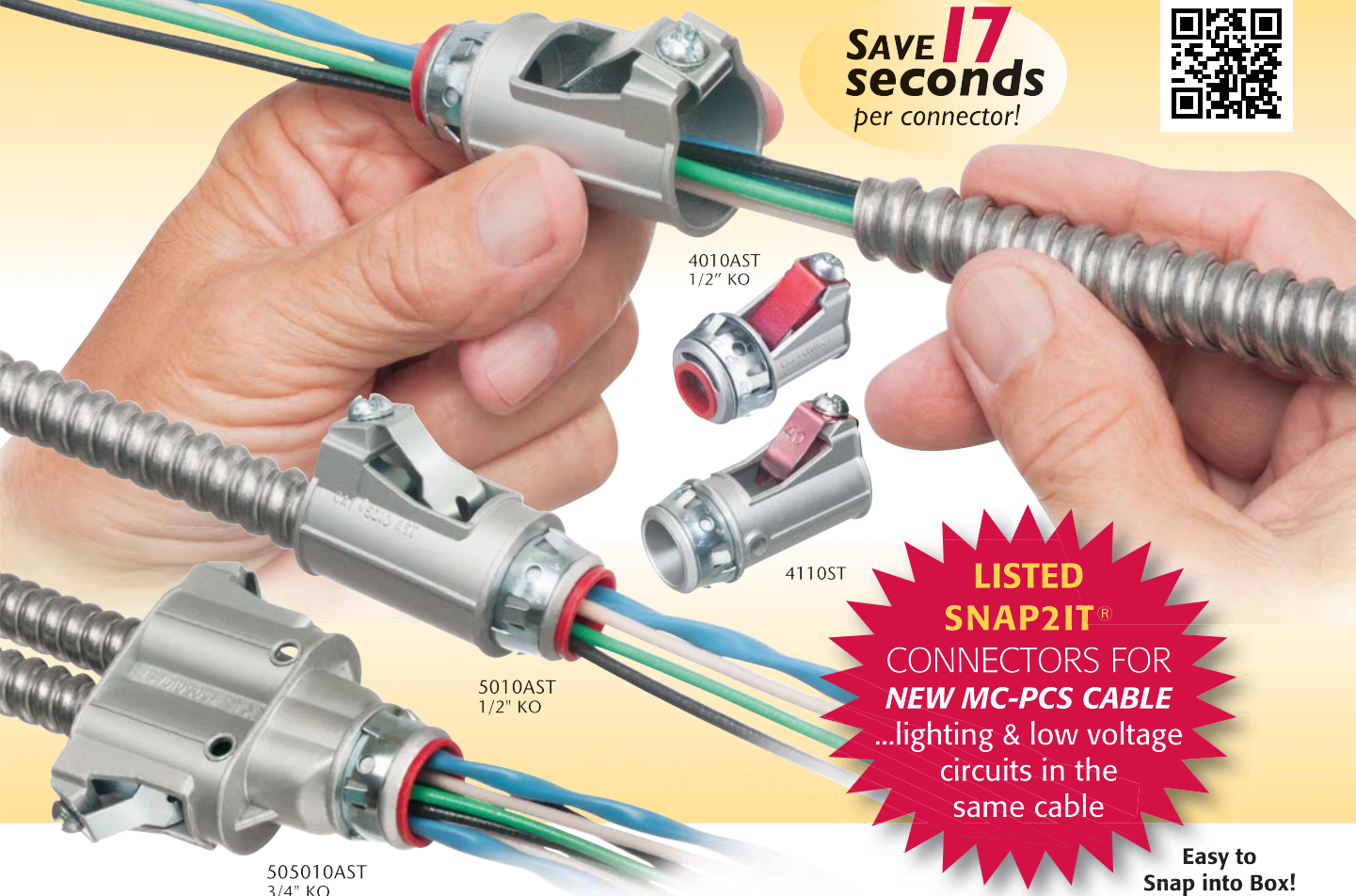
Peterbilt advertises the MD 536 as the "perfect truck to showcase the latest B6.7N engine," with 200 hp to 240 hp and 520 lb-ft to 560 lb-ft of torque available while expelling 50% lower NOx emissions than required under current U.S. Environmental Protection Agency standards. The Class 6 model 536, which doesn't require a CDL to operate, is designed to provide drivers a low cab entry height, good visibility, low noise, vibration and harshness, and room for three people within a cab that is 2.1 m (6.88 ft) wide. The 536 also has a 7-in. digital display located in the instrument cluster and features a digital card system integrated with the latest Peterbilt safety systems.

Medium-duty trucks can be configured with the just-introduced B6.7N and the L9N featuring 300 to 320 hp and 860 to 1,000 lb-ft of torque.

SNAP²IT[®] CONNECTORS

EASIEST CABLE INSERTION • NO TOOLS • SECURE HOLD

SAVE **17**
seconds
per connector!



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SNAP2IT[®]
CONNECTORS FOR
NEW MC-PCS CABLE
...lighting & low voltage
circuits in the
same cable

Easy to
Snap into Box!

Fully assembled, **SNAP²IT[®]** fittings handle the widest variety of MC cable **AND THE NEW MC-PCS cables.**

Compared to fittings with a locknut and screw, you can't beat these snap in connectors for time-savings!

- **Fits widest range and variety of MC cable** 14/2 to 3/3 AC, MC, HCF, MC continuous corrugated aluminum cable and MCI-A cables (steel and aluminum)...including the new MC-PCS cable that combines power and low voltage in the same MC cable **ANY Snap2It Connectors LISTED for MC cable are also LISTED for MC-PCS cable!** These products offer the greatest time-savings.
- **Fast, secure snap-on installation**
- **Easy to remove, reusable connector**
From cable Loosen screw on top. Remove connector from cable.
From box Slip screwdriver under notch in Snap-Tite[®] ring. Twist. Remove connector.



Arlington[®]

CATALOG NUMBER	DESCRIPTION Snap2It [®] connectors	CABLE OUTSIDE DIA (OD)
4010AST	Snap in, 1/2" KO w insulated throat	.405 to .610
5010AST	Snap in, 1/2" KO w insulated throat	.580 to .780
505010AST	Duplex Snap in, 3/4" KO w insulated throat	(2) .590 to .820
4110ST	Snap in, 1/2" KO	.525 to .705
414110ST	Duplex Snap in, 1/2" KO	(2) .525 to .640
NEW! 4141107ST	Duplex Snap in, 3/4" KO	(2) .525 to .690

NEW!
4141107ST

Patented. Other patents pending.

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Wiring Methods, Part 2 of 2

Following the conductor and raceway installation rules makes for a safer installation process and a better final product.

By Mike Holt, NEC Consultant

Continuity of the neutral conductor of a multiwire branch circuit must not be interrupted by the removal of a wiring device [Sec. 300.13(B)]. So, splice the neutral wires, and run a pigtail to the device. However, you cannot do this with a GFCI device because it must sense the current in the neutral.

The opening of the phase conductors (or the neutral conductor of a 2-wire circuit while a device is replaced) does not cause a safety hazard, so pigtail these conductors is not required [Sec. 110.14(B)].

At least 6 in. of conductor, measured from the point in the box where the conductors enter the enclosure, must be available for conductor splices or terminations [Sec. 300.14]. The 6-in. free conductor is permitted to be spliced or un-spliced. Boxes with openings less than 8 in. at any dimension must have at least 6 in. of conductor, measured from the point where the conductors enter the box and at least 3 in. of conductor outside the box.

Conductor splices and taps must be installed inside enclosures per Sec. 300.15. Splices are not permitted in raceways, except as permitted in Sec. 376.56 for wireways [Sec. 300.13(A)].

BOXES OR FITTINGS

Fittings and connectors must be used only with the specific wiring methods for which they are designed and listed. You cannot use Type NM cable connectors with Type AC cable, and you cannot use electrical metallic tubing fittings with rigid metal conduit or intermediate metal conduit unless listed for the purpose.

PVC conduit couplings and connectors are permitted with electrical nonmetallic tubing (ENT) if the proper glue is used

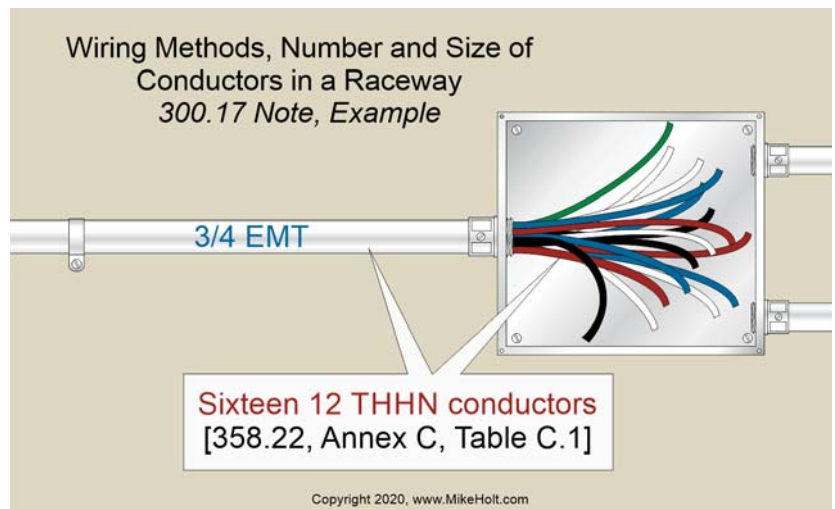


Fig. 1. When all conductors within a raceway are the same size and have the same insulation type, you can use Annex C (Table 1) to determine the number of conductors permitted for a specific raceway size.

per the manufacturer's instructions [Sec. 110.3(B)]. See Sec. 362.48.

Conductors can be spliced in a conduit body per Sec. 314.16(C). A box must be installed at each splice or termination point, except as permitted by Sec. 300.15(A) through (L). For example:

- A box is not required for wiring methods with removable covers such as wireways, multioutlet assemblies, and surface raceways [Sec. 300.15(A)].
- A fitting identified for the use is permitted instead of a box or conduit body where conductors are not spliced or terminated within the fitting. The fitting must be accessible after installation unless it is listed for concealed installation [Sec. 300.15(F)].
- A box is not required where a listed nonmetallic-sheathed cable interconnector device is used for exposed cable wiring or concealed repair wiring in an existing building per Sec. 334.40(B) [Sec. 300.15(H)].

NUMBER AND SIZE OF CONDUCTORS IN A RACEWAY

Raceways must be large enough to permit the installation and removal of conductors without damaging the conductor insulation [Sec. 300.17]. When all conductors within a raceway are the same size and of the same insulation type, you can use Annex C (Table 1) to determine the number of conductors permitted for a specific raceway size (Fig. 1).

If you install different size conductors in a raceway, conductor fill is limited to the percentages in Table 1 and Note (6) of Chapter 9. Those percentages are based on conditions where the length of the conductor and the number of raceway bends are within reasonable limits [Chapter 9, Table 1, Table Note 1].

Follow these steps for sizing raceways:

Step 1: Determine the total area needed for the conductors (Chapter 9,

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FOR NEW CONCRETE FLOORS



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Connections on sides lock single gang FLBC8500 boxes securely together



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**NOW IN PLASTIC,
FIVE Colors!**



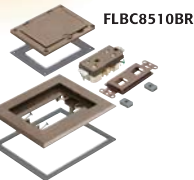
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Plastic Cover/frame Kit
Single gang

FLBC8510BR Brown
FLBC8510BL Black
FLBC8510GY Gray
FLBC8510CA Caramel
FLBC8510LA Lt Almond

Two-gang

FLBC8520BR Brown
FLBC8520BL Black
FLBC8520GY Gray
FLBC8520CA Caramel
FLBC8520LA Lt Almond



Three-gang

FLBC8530BR Brown
FLBC8530BL Black
FLBC8530GY Gray
FLBC8530CA Caramel
FLBC8530LA Lt Almond



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Build a two- or three-gang concrete floor box by simply locking *single gang* boxes together!

Then buy the UL LISTED single, two- or three-gang cover/frame kit, *with devices included*, in **PLASTIC, FIVE COLORS** – or in *economical diecast zinc with a brass or nickel finish*.

Fast and easy installation. Cover installs with hinge on either side.



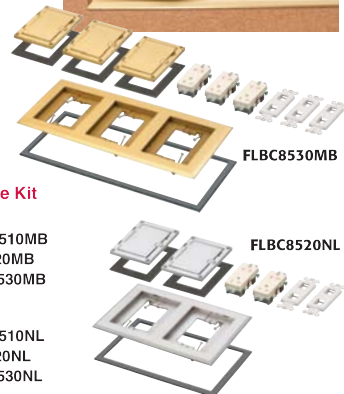
Metal Cover/frame Kit

Brass finish

Single gang FLBC8510MB
Two-gang FLBC8520MB
Three-gang FLBC8530MB

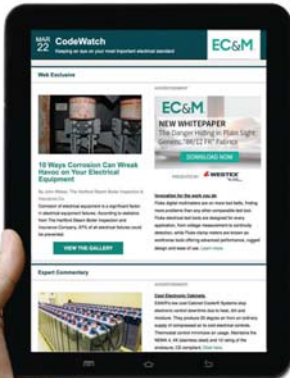
Nickel finish

Single gang FLBC8510NL
Two-gang FLBC8520NL
Three-gang FLBC8530NL



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CodeWatch

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- Explain how to properly apply the Code
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Wiring Methods, Number and Size of Conductors in a Raceway 300.17 Example



Step 1. Determine the conductor area, Chapter 9, Table 5.

$$\begin{aligned}
 500 \text{ kcmil} &= 0.7073 \text{ in}^2 \times 3 \text{ conductors} = 2.1219 \text{ in}^2 \\
 250 \text{ kcmil} &= 0.3970 \text{ in}^2 \times 1 \text{ conductor} = 0.3970 \text{ in}^2 \\
 3 \text{ AWG} &= 0.0973 \text{ in}^2 \times 1 \text{ conductor} = 0.0973 \text{ in}^2 \\
 \text{Total area of the conductors} &= 2.6162 \text{ in}^2
 \end{aligned}$$

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Step 2. Size the raceway at 40% fill, Chapter 9, Table 4.

$$\text{Trade Size 3 PVC at 40 percent fill} = 2.907 \text{ in}^2$$

Fig. 2. This example shows you how to determine the proper size PVC conduit for conductors of varying sizes.

Table 5 for insulated conductors and Chapter 9, Table 8 for bare conductors).

Step 2: Select the raceway from Chapter 9, Table 4 per the percent fill listed in Chapter 9, Table 1.

Here's an example problem to show how this works.

What size Schedule 40 PVC conduit is required for the following conductors: 3 – 500 THHN, 1 – 250 THHN, and 1 – 3 THHN? See **Fig. 2**.

Solution:

Step 1: Determine the total area needed for the conductors [Chapter 9, Table 5].

500 THHN ($0.7073 \times 3 = 2.1219 \text{ in}^2$)
250 THHN ($0.3970 \times 1 = 0.3970 \text{ in}^2$)
3 THHN ($0.0973 \times 1 = 0.0973 \text{ in}^2$) Total Area = 2.6162 in^2

Step 2: Select the raceway at 40% fill [Chapter 9, Table 1 and Table Note (6), and Table 4].

Use trade size 3 Schedule 40 PVC because there is 2.907 sq in. of conductor fill at 40%.

CONDUCTORS IN RACEWAYS

To protect conductor insulation during installation, raceways must be mechanically completed between the pulling points before pulling the wires [Sec. 300.18(A)]. See Sec. 300.10 and Sec. 300.12 for electrical

and mechanical continuity of raceways. Short sections of raceways used for protecting cables from physical damage don't have to be complete.

If a raceway's vertical rise exceeds Table 300.19(A) values, each conductor must be supported at the top (or as close to the top as practical). Intermediate support must also be provided in increments not exceeding the values of Table 300.19(A) [Sec. 300.19(A)].

To minimize the induction heating of ferrous metal raceways and enclosures — and to maintain an effective ground-fault current path — all conductors of a circuit (including neutral and equipment grounding conductors) must be in the same raceway, cable, trench, cord, or cable tray [Sec. 300.20(A)]. See Sec. 250.102(E), Sec. 300.3(B), Sec. 300.5(I), and Sec. 392.20(C).

Where a single conductor carrying alternating current passes through metal with magnetic properties, the inductive effect must be minimized by either:

1. Cutting slots in the metal between the individual holes through which the individual conductors pass, or
2. Passing all the conductors in the circuit through an insulating wall large enough for all the circuit conductors [Sec. 300.20(B)].



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PVC JACKETED MC CABLE

ONE FITTING FITS MULTIPLE CABLE SIZES



NEW DESIGN!

Save time and money with Arlington's *rain-tight, concrete-tight* fittings for PVC jacketed MC cable.

ONE fitting FITS MULTIPLE cable sizes!

LTMCS0 ships ready to use on #10, #12 or #14 PVC jacketed MC cable. Try the NEW SIZES too... LTMCS07 and LTMCS75.

Because they fit more than one cable size, these fittings reduce inventory, saving the cost of stocking several *different* fittings.

**Ideal for Parking Decks,
High-rise Residential**



Catalog Number	Cable Ranges (Outer Cable Diameter)
LTMCS0	.415" - .565"
LTMCS07	.550" - .765" goes into 1/2" KO
LTMCS75	.725" - .980" goes into 3/4" KO

Patented



1/2"
LTMCS0
(components)

Arlington®

800/233-4717 • www.aifittings.com

Product Info aifittings.com/landing/ltmc507-ltmc75/

LOWEST COST • L-SHAPED

Made in USA

FAN/FIXTURE BOX

SECURE MOUNTING TO SINGLE, DOUBLE JOISTS



**UL rated
fans up
to 70 lbs;
fixtures
to 200 lbs.**

FB442
13.4
cu. inch



Super-secure installation!
Our lowest cost, L-shaped
fan/fixture box mounts to
single or double joists
with a captive center screw.

No loose parts! Installation
screws ship captive, ready
to install box and bracket.

- For 1/2" or 5/8" drywall
- Fast, easy installation
- Locator posts assure proper positioning of fan/fixture bracket
- 2-hour Fire Rating



Product info
aifittings.com/landing/joist-mount-fan-fixture-box

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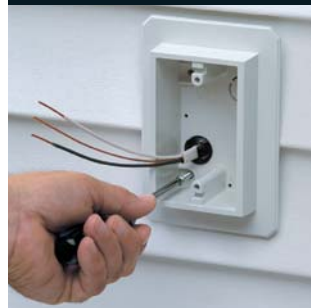
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WEATHERPROOF

Made in USA

OUTLET BOX

EASY TO INSTALL ON ANY SIDING TYPE



Our one-piece FS8091F outlet box is your best buy for a fast, easy device installation on siding.

- Works with all single-gang devices, including GFCIs
- Installs on any siding, before or after it's up



- For use where a weatherproof-in-use cover is not required – Accommodates a weatherproof-in-use cover for wet locations



FS8091F



Arlington®

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Product info aifittings.com/catalog/siding-mounting-blocks/weatherproof-fs-outlet-box/FS8091F

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NEW CONCRETE

FLOOR BOX

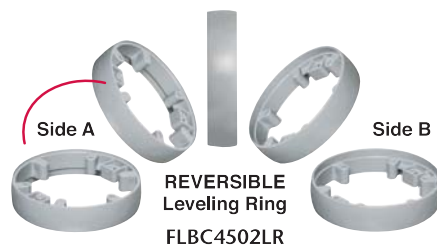
REVERSIBLE LEVELING RING • SIX CONDUIT HUBS • OPTIONS FOR DIVIDER POSITION



Arlington's FLOOR BOXES, COVER KITS, and accessories **FOR NEW CONCRETE** are the low cost, *convenient* way to install a receptacle flush with a new floor.

Made of heavy-duty plastic, our FLBC4502 4.5" non-metallic **concrete floor box** has more: SIX conduit hubs and FOUR plugs and THREE options for positioning the low voltage divider in the box.

The NEW FLBC4502LR leveling ring makes installing a cover easy on ANY 4.5" concrete box including our FLBC4500 and the new FLBC4502. **It's REVERSIBLE!** *Side A* fits any 6" round cover with a 3-1/2" screw hole pattern. *Side B* has a second set of holes that fits 6" covers with a 3-3/8" screw hole pattern.



ARLINGTON Cover KITS for FLBC4502, FLBC4500 boxes



Arlington offers a variety of **cover kits** for our concrete boxes: round with flip lids or threaded plugs in brass or nickel-plated brass. Metal trapdoor covers with three device options. *And in plastic, in six colors.*

Get a great-looking, time-saving receptacle installation in new concrete with floor box kits, covers and more – from Arlington!



PLASTIC SINGLE FLIP COVERS in 6 COLORS



Brass or Nickel-Plated Trapdoor, 3 DEVICE OPTIONS

ULTRA THIN FLANGES, METAL COVERS

RECESSED **IN BOX**[®] COVER KITS

FOR 4.5" CONCRETE BOXES



FLBC4580MB
brass-plated covers
stamped steel flange



IN BOX[®] with Ultra-Thin Stamped Steel Flange

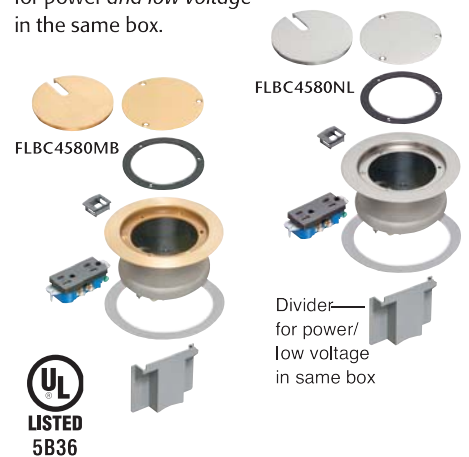
Arlington's NEW recessed FLBC4580 **IN BOX**[®] Cover Kits are the solution to installing a receptacle in a 4.5" concrete floor box, like our FLBC4500 or FLBC4502 boxes. They install *into* the box so they look great and reduce the trip hazard caused by protruding plugs.

Our UL Listed
FLBC4580 IN BOX
Cover Kits

COST 20% LESS
than **SOLID brass and nickel-plated brass covers**. This new series has brass-plated or nickel-plated diecast zinc covers with plated-to-match **ULTRA-THIN, STAMPED STEEL FLANGES** for cost-saving, flush-to-the-floor installation.

Use the *blank* cover when not in use; substitute the *slotted* cover when cords are plugged in.

Easy to install, IN BOX Cover Kits have a divider for power and low voltage in the same box.

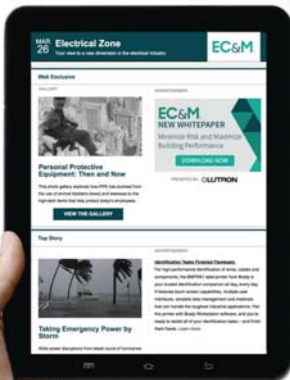


Arlington[®]

www.aifittings.com • Scranton, PA 18517 • 800/233-4717

PRODUCT INFO aifittings.com/landing/flbc4580

Patent pending



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- Code Quiz of the Week
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Electrical circuits and equipment must be installed in such a way that the spread of fire or products of combustion will not be substantially increased [Sec. 300.21]. Openings around electrical penetrations of fire-resistant-rated walls, partitions, floors, or ceilings must be firestopped using approved methods to maintain the fire-resistance rating.

WIRING IN DUCTS

Wiring methods cannot be installed in ducts that transport dust, loose stock, or flammable vapors [Sec. 300.22(A)]. Equipment is permitted within a duct fabricated to transport environmental air only if the equipment is necessary for the direct action upon, or sensing of, the contained air [Sec. 300.22(B)].

Type MC Cable without an overall nonmetallic covering and metal raceways can be installed in ducts fabricated to transport environmental air. Flexible metal conduits in lengths not exceeding 4 ft can be used to connect equipment and devices within the fabricated duct.

WIRING IN ENVIRONMENTAL AIR PLENUMS

For these spaces, you can use Type AC cable, Type MC cable without a nonmetallic cover, electrical metallic tubing, intermediate metal conduit, rigid metal conduit, flexible metal conduit, or (where accessible) surface metal raceways or metal wireways with metal covers [Sec. 300.22(C)(1)]. Cable ties for securing and supporting must be listed for use in a plenum space.

Metal cable tray systems can be installed to support the wiring methods and equipment permitted in a plenum space [Sec. 300.22(C)(2)(a)]. Electrical equipment with a metal enclosure or a nonmetallic enclosure listed for use in an air-handling space can be installed in a plenum space [Sec. 300.22(C)(3)].

ACCESS PANELS AND EXIT ENCLOSURES

Cables, raceways, and equipment installed behind suspended ceiling panels must be installed such that the panels can be removed to give access to electrical equipment [Sec. 300.23].

Where an exit enclosure is required to be separated from the building, you cannot install any wiring methods other than those serving the equipment that the authority having jurisdiction permits in the exit enclosure [Sec. 300.25]. As used here, “separated from the building” does not necessarily mean detached. Article 100 defines a “building” as “a structure that stands alone or that is separated from adjoining structures by fire walls.” For more information, see NFPA 101, *Life Safety Code*, 7.1.3.2.1(10)(b).

Wiring methods cannot be installed in ducts that transport dust, loose stock, or flammable vapors [Sec. 300.22(A)].

COLLECTIVE WISDOM

Why must vertically run conductors be supported at specific intervals? The substantial weight that accumulates in long vertical runs of unsecured conductors can cause them to drop out of the raceway (sometimes called a “run-away”). All too often, conductors in a vertical raceway have slipped from the pulling “basket” or “grip” (at the top) before being secured. Sheer weight and gravity take over, accelerating the conductors down and out of the raceway and injuring those at the bottom of the installation.

By following a specific rule for installing conductors and raceways, you prevent the known specific problem the rule exists to prevent. Every installer benefits from the collective wisdom, which, in some cases, was gained at the cost of human life. **EC&M**

These materials are provided by Mike Holt Enterprises in Leesburg, Fla. To view Code training materials offered by this company, visit www.mikeholt.com/code.



ARLINGTON

SECURE, JOIST-MOUNT INSTALLATION

Made in USA

FAN/FIXTURE PAN BOX

FOR 1/2" OR 5/8" DRYWALL WITH FURRING STRIPS OR HAT CHANNEL

* 2-HOUR FIRE RATING

Captive fan bracket
installation screws



UL rated
70 lb fan • 200 lb fixture
CSA
50 lb fan/fixture

Arlington® 800/233-4717 • www.aifittings.com

Arlington's convenient fan/fixture pan box works with 1/2", and single or double 5/8" drywall – on furring strips or hat channel.

- Easy mounting in new work
- Fan bracket installation screws ship captive until ready for use
- Secure joist-mount installation
- 14.4 cu. in. **UL/CSA Listed**



FB412



FB412 with 5/8" double drywall



Patented

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ADJUSTABLE • NON-METALLIC

Made in USA

IN/OUT™ BOX for Fans & Fixtures

EASY TO INSTALL... IN NEW CONSTRUCTION

NEW

FBA426
Adjustable
Fan/Fixture
21.0 cu in
Box

Bracket
installation
screws
ship captive

Underside

Depth
adjustment
screw



Arlington's IN/OUT BOX for fans and fixtures adjusts up to 1-1/2" to accommodate varying ceiling thicknesses, like single or double drywall.

- Pre-set for 1/2" ceiling...use depth adjustment screw *after the ceiling's in place* to position the box flush with the ceiling
- Complies with 2020 NEC, 314.20 for set back boxes
- (4) screws attach box securely to joist in new work
- **2-Hour Fire Rating** *Listed for fans up to 70 lbs; fixtures up to 100 lbs*



- 1 Cutaway: Box set back in double drywall
- 2 After ceiling's installed, (if necessary) use the depth adjustment screw to position box flush with ceiling.



Product info aifittings.com/landing/fba426



Patented



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Stumped by the Code?

By Mike Holt, NEC Consultant

All questions and answers are based on the 2020 NEC.

Q. What are the rules related to the electrical continuity of metal raceways and metal parts?

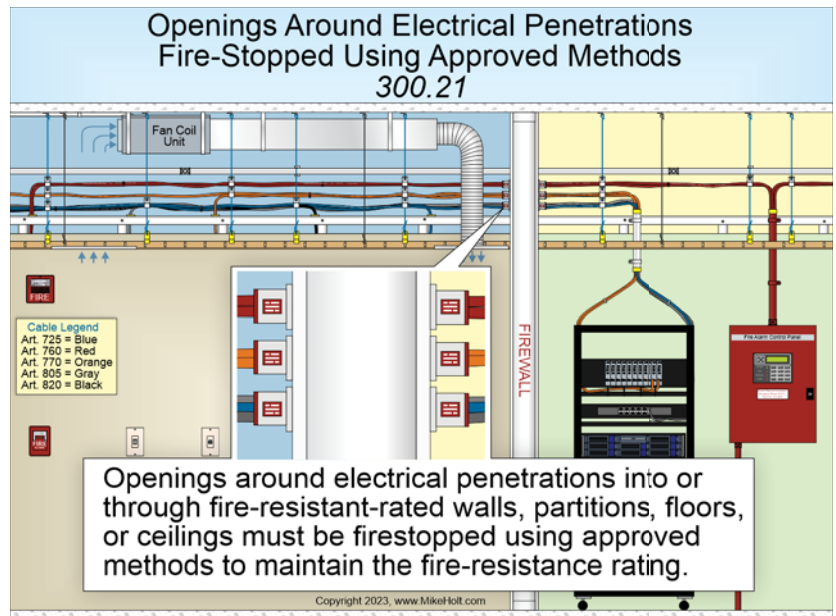
A. As per Sec. 300.10 [Electrical Continuity], metal raceways, cable armor, and other metal enclosures must be metallically joined into a continuous electrical conductor to provide effective electrical continuity [Sec. 110.10 and Sec. 250.4(A)].

Exception No. 1: Short lengths of metal raceways used for the support or protection of cables are not required to be electrically continuous, nor are they required to be connected to an equipment grounding conductor (EGC) [Sec. 250.86 Exception No. 2 and Sec. 300.12 Exception No. 1].

Q. What are the basic rules related to electrical circuits and equipment installed to reduce the spread of fire or products of combustion?

A. Electrical circuits and equipment must be installed in such a way that the spread of fire or products of combustion will not be substantially increased. Openings around electrical penetrations into or through fire-resistant-rated walls, partitions, floors, or ceilings must be firestopped using approved methods to maintain the fire-resistance rating (Sec. 300.21), as shown in the **Figure**.

Note: Directories of electrical construction materials published by recognized testing laboratories contain listing and installation restrictions necessary to maintain the fire-resistive rating of assemblies. Building codes also have restrictions on penetrations on opposite sides of a fire-resistance-rated wall. Outlet boxes must have a horizontal separation of not less than 24 in. when installed on opposite sides in a fire-rated assembly, unless an outlet box is listed for closer spacing or protected by



Openings around electrical penetrations into or through fire-resistant-rated walls, partitions, floors, or ceilings must be firestopped using approved methods to maintain the fire-resistance rating.

Electrical circuits and equipment must be installed in such a way that the spread of fire or products of combustion will not be substantially increased.

fire-resistant “putty pads” in accordance with the manufacturer’s instructions.

Boxes installed in fire-resistance-rated assemblies must be listed for the

purpose. If steel boxes are used, they must be secured to the framing member. Cut-in type boxes are not permitted.

Building code requirements restrict penetrations on a fire-rated assembly section of 100 sq ft to 100 sq in. of allowable penetrations. Therefore if a 4 × 4 metal box has 16 sq in., then only six boxes ($100 \div 16 = 6.25$) are allowed in that section of fire wall in accordance with IBC 714.4.2, International Building Code.

This requirement also applies to:

- Class 2 Power-Limited Circuits [Sec. 725.3(B)]
- Coaxial Cable [Sec. 800.26]
- Fire Alarms [Sec. 760.3(A)]
- Optical Fiber Cable [Sec. 770.26]

EC&M

These materials are provided to us by Mike Holt Enterprises in Leesburg, Fla. To view Code training materials offered by this company, visit www.mikeholt.com/code.



ONE-PIECE • NON-METALLIC

Made in USA

METER MOUNTING BASE

INSTALLS ON SIDING – AND OTHER SURFACES



Arlington's one-piece, non-metallic Mounting Bases provide a smooth, flat mounting surface for most electric meters, *including the largest sizes* – as well as a variety of other products such as timers, disconnects, inlet boxes and more.

UV rated, paintable plastic for long outdoor life.

Available with squared-off corners, they're *gangable* so you can create the mounting base you need for the product you're installing.

NEW
5x7



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MM7 info aifittings.com/landing/mm7
Other aifittings.com/landing/meter-mounting-bases

NEW

MM7 5" X 7"	MM18 15-7/8" X 17-5/8"
MM10 7" X 10"	MM23 17-5/8" X 23"

LOW PROFILE • 4" DIAMETER

Made in USA

SCONCE BOX

FOR SHALLOW WALL CAVITIES OR OBSTRUCTIONS



Arlington's **Low Profile Sconce Box** is perfect for retrofit installations with shallow wall cavities or obstructions in the wall.

This non-metallic box installs **FAST** in an existing 1/2" or 5/8" wall with a 4" hole saw.

- Mounting wing screws hold it firmly in place
- Accommodates most sconce light canopies

FSC40SR
Sconce Box



Patented



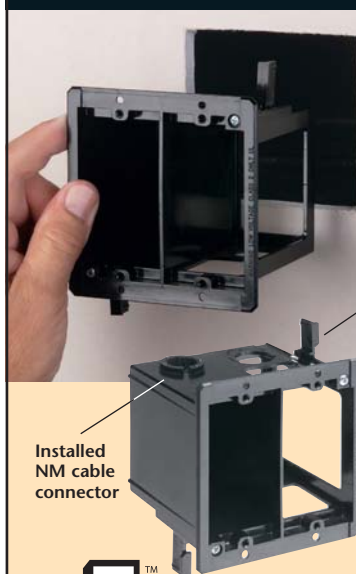
Product info aifittings.com/landing/sconce-box

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POWER & LOW VOLTAGE

COMBO BOX

FOR RETROFIT PROJECTS



This convenient combo box has power and low voltage openings in the *same box* for a neat, time-saving installation.

The box adjusts to fit wall thicknesses from 1/4" to 1-1/2". Mounting wing screws hold it securely in place.

- 2-Hour Fire Rating
- Low voltage side has a combo 1/2" and 3/4" KO for raceway
- Includes NM cable connector (power side)

Installed
NM cable
connector

LVDR2

Patented



Product info
aifittings.com/landing/combo-boxes



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Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

All references are based on the 2023 edition of the NEC.

LOUSY USE OF LAMP CORD



These two photos show what I found when the maintenance manager for an apartment building called me to check out some curious wiring he found inside one of the apartments. The tenant had apparently taken matters into his own hands when installing a chandelier over his dining table. The tenant bought some 2-wire, flexible lamp cord at the local hardware store and used that for wiring the chandelier. He anchored the flexible cord and the chandelier directly to the concrete ceiling using anchors. If you look closely, you can see that the

anchors are installed between the two conductors of the cord and are pinching the cord to the ceiling. Amazingly, it never short-circuited. The other end of the cord was snaked down a sheetrock wall and connected to a receptacle using a cord cap. Using a flexible cord in this manner violates several list items of Sec. 400.12, including (1), (4), and (5). The other huge problem is the lack of bonding and grounding of this luminaire. Section 410.42 requires exposed conductive surfaces of this luminaire to be connected to an equipment grounding conductor.

A STRING OF VIOLATIONS

I spotted this string of lights at a seafood restaurant located at a local marina. The lights were installed to provide some additional lighting for an outside dining area. Unfortunately, whoever installed this string of lights secured it to raceways, cables, electrical boxes, and whatever other electrical equipment happened to be nearby. As specified in Sec. 300.11(C), raceways can only be used to support cables, raceways, and other equipment in accordance with any of the following three conditions: (1) when the raceway is identified as a means of support; (2) when the raceway contains power conductors and is used to support Class 2 or Class 3 control circuit cables or conductors; or (3) where the raceway is supporting boxes or conduit bodies as specified in Sec. 314.23 or is supporting luminaires as specified in Sec. 410.36(E). None of those conditions applies here. Additionally, Sec. 352.12(B) prohibits using PVC conduit to support luminaires or equipment other than conduit bodies. For temporary installations, Art. 590 sometimes modifies requirements for permanent wiring. Section 590.4(J) provides general support requirements for flexible cords and cables but does not specifically lift the restrictions in Sec. 300.11(C) for using raceways as a means of support.





LOW COST • ZINC

Made in USA

MC CABLE FITTINGS

**NEW
SIZE!**

3-1/2"

THAT FIT SEVERAL CABLE SIZES

Save time and money! Arlington's low cost MC cable fittings, *for dry locations only*, are super-convenient and cost-effective. End stop bushings vary the size of the opening so *ONE trade size fits several cable sizes!*

Changing end stop bushings is fast and easy. *No need to remove the strap.* Insert the bushing that works the best with the cables you're installing.

**Reduce inventory –
Costs much less than steel
and malleable iron fittings**

Built-in end stop



3-1/2"
8418



Arlington®

8418 for 1000 Mcm wire and TECK90

Catalog Number	Trade Size	Cable O.D. Min	Cable O.D. Max	Wire Bundle O.D. Min	Wire Bundle O.D. Max	Conductor size # of Conductors* (AWG/KCMIL)	Patented
8412	1"	.780	1.120	.660	1.000	6/3, 6/4, 4-3, 4-4, 2-3, 2-4, 1-3	
8413	1-1/4"	1.000	1.460	.870	1.370	2-3, 2-4, 1-3, 1-4, 1/0-3, 1/0-4, 2/0-3, 2/0-4, 3/0-3	
8414	1-1/2"	1.360	1.770	1.250	1.590	2/0-4, 3/0-3, 3/0-4, 4/0-3, 4/0-4, 250-3, 250-4	
8415	2"	1.700	2.200	1.550	2.050	250-4, 300-4, 350-3, 350-4, 500-3	
8416	2-1/2"	2.100	2.700	1.950	2.400	500-3, 500-4, 600-3, 600-4, 750-3	
8417	3"	2.500	3.300	2.350	3.000	600-4, 750-3, 750-4	
8418	3-1/2"	3.300	3.600	3.031	3.500	750-3, 750-4, 1000-4	

* Examples of 3- and 4-conductor cables accommodated.

800/233-4717

www.aifittings.com

Product info aifittings.com/landing/8412

NEW

NON-METALLIC • VENTED FOR EASIER STACKABILITY

Made in USA

CONCRETE PIPE SLEEVE

THE EASY, ECONOMICAL WAY TO SLEEVE THROUGH CONCRETE POURS!

Arlington's **Concrete Pipe Sleeves** are the economical way to sleeve through concrete pours in tilt-up construction WALLS – and FLOORS *allowing cable and conduit to run easily from one floor to the next.*

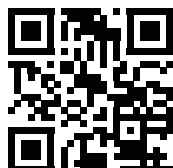
No costly core drilling – No cutting holes in the form. Plus, you can position the hole prior to pouring the concrete.

- Attaches to form with nails or screws
- Stackable up to 23" h for extra deep pours
- Vents keep wet pipe sleeves from sticking together
- Multiple hole sizes: 1-1/2" • 2" • 3" • 4" • 5" • 6"



CPS40

CPS40
Pipe Sleeve
for 4" hole



Nail sleeve to form.



After concrete sets, cut sleeve flush with surface.



Insert conduit into sleeve.



Arlington®

800/233-4717 • www.aifittings.com

Product info aifittings.com/landing/concrete-pipe-sleeve

Focus on Wiring Devices

Touchless Switch

The company has introduced a new line of CW low-profile touchless switches suitable for hygienic industrial and public automation applications. The switches are designed with a sleek and nearly flush (just 2-mm rise) low-profile surface silhouette. They are built for an industry standard 22-mm mounting hole and require only a shallow 35-mm space behind the panel face, plus room for the wiring connector. According to the company, the typical installation pitch is 30-mm width and 50-mm height. In addition, the switch front face contains a central emitter and receiver sensing lens — and an LED indicator ring that utilizes infrared LED diffuse reflection technology to detect objects.

IDEC Corp.



Receptacle

PlugTail commercial specification grade USB charging receptacles provide the convenience of mobile charging without the need for a AC adapter. They come equipped with two UL fed spec AC receptacles and two USB charging ports for mobile devices, one Type-A port, and one Type-C port for newer products. The product is equipped with a 15.5W power supply sufficient for charging mobile phones and tablets. According to the company, the PlugTail termination provides a more productive, secure, and safer installation.

Legrand

Receptacle

Type A/C USB weather-resistant charger/receptacle is an outdoor addition to the company's in-wall USB Chargers and can be installed on any GFCI-protected circuit. Made for residential and commercial applications, it is a weather-resistant USB that provides added protection to electrical components for long-lasting durability. The device features easy-to-install wire lead termination and can be paired with the company's durable horizontal or vertical while-in-use (WIU) outdoor covers to meet the requirements of NEC Sec. 406.9(B).

Leviton



Keypad

The Sunnata RF hybrid keypads can instantly transform a space into a comfort zone by activating scenes, such as pre-set levels of light, music, and more. The hybrid keypads have both dimmer and keypad functionality all in one device. One keypad can control groups of devices such as dimmers, light switches, ceiling fans, automated shades, and other integrated devices like audio systems. Additionally, each button of the keypad can be customized with personalized text or icons.

Lutron

including MANAGING
GREEN
BUILDINGS

WHERE FACILITY CHALLENGES FIND SOLUTIONS

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FIBERGLASS

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"Don is a subject matter expert with the ability to teach with passion. The industry needs this man."

— Dennis Harter Sr. — V.P. of Operations, Kaiser Electric — Fenton, MO

"Don, you exceeded our expectations. We knew we had a need for training. The good news is that you took that head on and provided great insight."

— Joel Kahn — COO, Converse Electric, Columbus, OH

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Vice President

Mike Hellmann

Andover, MA

Phone: (978) 289-0098

E-mail: mhellmann@endeavorb2b.com

Western U.S. & Western Canada

Ellyn Fishman

Key Account Manager

(949) 239-6030

Email: efishman@endeavorb2b.com

Northeast U.S. & Eastern Canada

David Sevin

Account Manager

24 Houghton Street

Barrington, RI 02806

Phone: (401) 246-1903

E-mail: dsevin@endeavorb2b.com

Midwest, Southeast, and Southwest

Jay Thompson

Account Manager

10955 Lowell Ave., 7th Floor

Overland Park, KS 66210

Phone: (913) 967-7543

E-mail: jthompson@endeavorb2b.com

Classifieds/Inside Sales

Steve Suarez

Media Account Exec

10955 Lowell Ave., 7th Floor

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What's Wrong Here?

By Russ LeBlanc, NEC Consultant

How well do you know the Code? Think you can spot violations the original installer either ignored or couldn't identify? Here's your chance to moonlight as an electrical inspector and second-guess someone else's work from the safety of your living room or office. Can you identify the specific Code violation(s) in this photo? *Note:* Submitted comments must include specific references from the 2023 NEC.

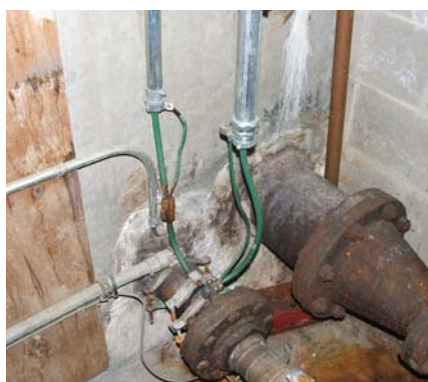
Hint: A not-so-weatherproof cover



'TELL THEM WHAT THEY'VE WON...'

Using the 2023 NEC, correctly identify the Code violation(s) in this month's photo — in 200 words or less — and you could win an Arlington Industries 18-in. Slider Bar and plastic box for mounting between studs with non-standard spacing. E-mail your response, including your name and mailing address, to russ@russleblanc.net, and Russ will select three winners (excluding manufacturers and prior winners) at random from the correct submissions. Note that submissions without an address will not be eligible to win.

NOVEMBER WINNER



Unfortunately, we had no winners this month. Perhaps our readers were too busy with the holiday season to respond. In any case, here's what is wrong with this installation.

Bonding the grounding electrode conductor (GEC) to the metal raceway protecting the GEC is a great idea and is required by Sec. 250.64(E)(1). However, Sec. 250.64(E)(3) requires the size of the bonding jumper used to make this bonding connection to be the same size as (or larger than) the GEC inside the raceway. The installers of these GECs inside the vertical raceways in the photo only got it half right. They did establish a bonding connection from the enclosed GEC to the end of each raceway enclosing each GEC, but the bonding jumper for each raceway is significantly smaller than the GEC inside each raceway. The top horizontal raceway does not appear to be bonded to the GEC inside the raceway.

BETTER
IDEAS



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