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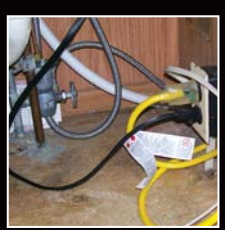
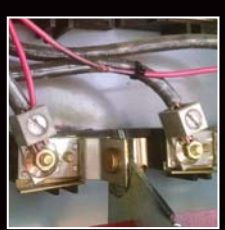
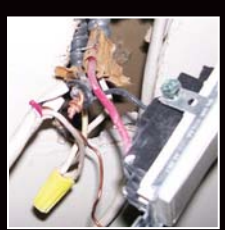
FRIGHTENING FINDS

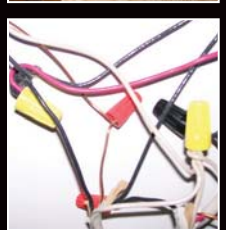
A close-up look at some **seriously scary electrical blunders** the installer before you left behind. Read more on **pg. 20.**

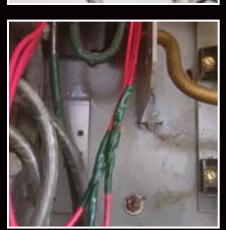








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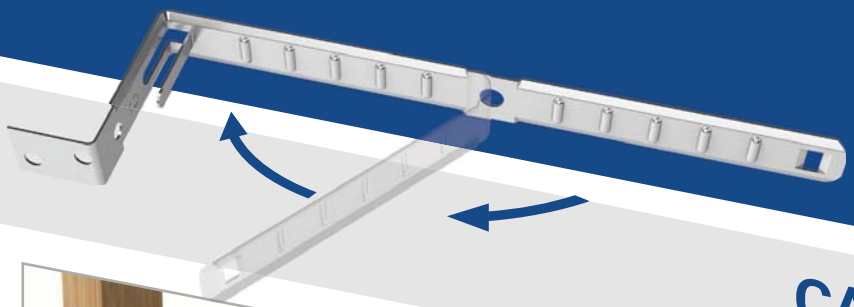

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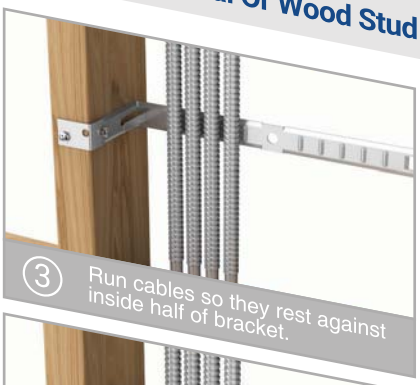

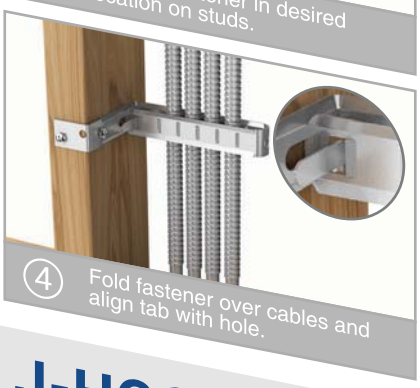

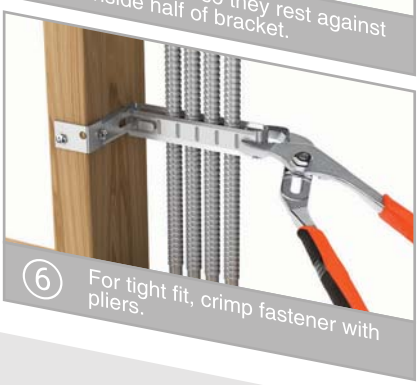

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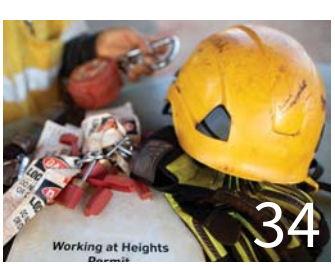

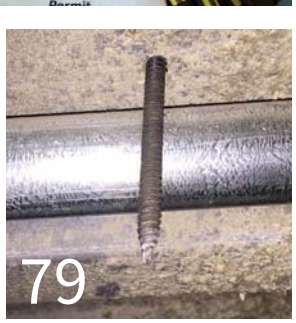

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DEPARTMENTS

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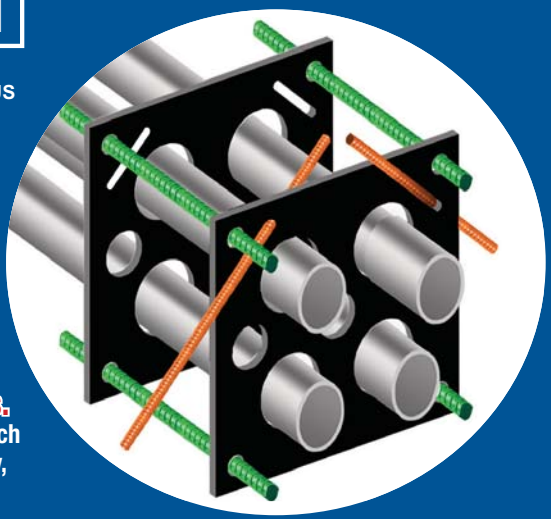

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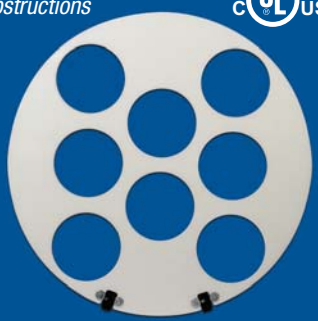

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Making Electrical Safety a Priority Every Single Day

By Ellen Parson, Editor-in-Chief

There's never a wrong time to put safety first. Every May, the Electrical Safety Foundation International (ESFI), a non-profit organization dedicated to promoting electrical safety in the home, school, and workplace, markets its annual campaign to educate key audiences about specific steps that can be taken to reduce the number of electrically related fires, fatalities, injuries, and property loss. In response, the team at *EC&M* has always dedicated our May issue to health and safety. However, that definitely doesn't mean we only cover safety once a year. After the "National Electrical Code," content on "electrical safety" topics consistently ranks as one of our audience's most sought-after subject area searches on our website — and rightly so. As a result, we feature safety-related articles in every print issue, e-newsletter, and frequently online.

This month, we've got a full assortment of articles that puts safety front and center. Starting with the cover story on page 20, John Kostick, an industry veteran, master electrician, and volunteer firefighter, chronicles some of his most "Frightening Finds" on the job, offering a fascinating look at some seriously scary electrical blunders the installer before him left behind. I'm betting many of you have similar shocking scenarios like this to share. If so, please drop me an email at eparson@endeavorb2b.com. One thing we've determined from all of the feedback we've received from our safety content over the years is that learning from others' mistakes can really make a difference because it helps to prevent similar tragedies from happening in the future. That's the underlying focus of our Forensic Casebook department. Taking an in-depth look at specific electrical accidents from a forensic engineering perspective, this column demonstrates real-life consequences of carelessness, shortcuts, or failure to follow proper safety procedures. Most of all, it gives a face and a voice to the victims, telling their stories and reinforcing how critical safety is in the electrical industry. In "The Case of the Deadly Downed Power Line," starting on page 14, the Kentucky FACE Program goes over the contributing factors that led to the electrocution of an employee surveying utility pole placement as well as offers three recommendations to prevent a similar incident. Next we have "OSHA's Top 10 Violations of 2020" on page 34. Although this annual list historically tends to highlight mostly "repeat offenders" when it comes to the most common violations, our readers still like to see which categories maintained their positions, contemplate why certain ones went up or down in the rankings, and reflect on what we as an industry can do better to reduce these numbers — notice that the totals decreased from 2019 to 2020. And don't miss Electrical Consultant Mark Lamendola's "Six Ways to Make Lockout/Tagout More Efficient" on page 8. Offering real-world tips for properly identifying all related energy sources in a work environment, this piece walks readers through best practices for preventing human error when performing this ever-important task.

In addition to this month's print content, *EC&M* also recently wrapped up a great members-only webinar on "Arc Flash Myths: Fact or Fiction" in which the presenter, Tommy Northcott, PE, a senior power engineer and branch manager with Jacobs Technology, discussed when and where arc flash hazards exist, how to determine what type of PPE to wear in what conditions, outlined the impact of maintenance on risk, examined employee and employer responsibilities for ensuring the safest work environment, and dispelled some of the most comment misconceptions out there to set the record straight. If you haven't already, I highly recommend that you register for and view this free webinar, which is currently available on demand on our website at https://bit.ly/2RccPvF.

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Six Ways to Make Lockout/Tagout More Efficient

How to make lockout/tagout safer in less time

By Mark Lamendola, Electrical Consultant

Traditionally, lockout/tagout is treated as a one-off encounter each time. Even if six maintenance electricians have each performed lockout/tagout on the same machine several times, the "new guy" seventh electrician will have to duplicate all their work. This often includes obtaining drawings, carefully going through them to identify all energy sources, and then physically locating them.

Properly and completely identifying all related energy sources takes time. People can feel that spending time doing this gets in the way of getting work done. This feeling is somewhat justified when lockout/tagout has been performed repeatedly on the same equipment, yet the wheel must be reinvented each time.

This leads to shortcutting the process (skipping steps, doing things from memory, or going with assumptions). It also means that each time this procedure is performed, there is danger of human error.

TIP 1: DO IT ONCE, AUDIT, AND PUBLISH.

Identify the equipment most likely to need maintenance or repair. If you have equipment history (for example, in a CMMS), create a report that sorts by most instances of equipment shutdown.

Starting with the highest number, have someone perform a lockout/tagout procedure for that equipment. Verify its effectiveness and completeness with measurements. Next, document what has been done and the location of each energy source. This document package is then attached to the asset number in the CMMS so the next person simply has to follow this sequence and verify with a meter. The document package should include the relevant drawings with the energy sources marked on them.

Going forward, anyone performing lockout/tagout on this equipment:

- Does not have to chase down drawings or spend time analyzing them. An assembled package of pre-marked drawings eliminates that rework.
- Will not introduce a human error such as missing an energy source, since these have already been identified in the plant and on the drawings.
- Re-verifies this specific sequence each time via measurement rather than creating a new sequence on the fly.

However, things change. Maybe since this procedure was documented, a variable-frequency drive was added, and it also must be locked out. You cannot completely rely on verification to flag that the procedure for this specific equipment is not complete because how will the electrician know what to test?

A good solution is to adopt the practice of using controlled drawings and controlled procedures. Any time a drawing related to an asset is updated, its lockout/tagout procedure is automatically flagged for review. Make it clear on the procedure the flag means the procedure is not considered current and complete.

TIP 2: MAKE IT MORE EASILY LOCKABLE.

Why make someone open a panel, lock out a breaker (if it's even lockable), and hang a tag in that crowded space? It is worse when three other crews have lockout/tagout going on in that panel. Where practical, create a lockout/tagout point with a disconnecting switch.

Use the same strategy where crowding of any sort can complicate lockout/tagout.

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Remember, it is a system not only of energy isolation, but also of communication. You need room for tags, not just locks. In some cases, multiple crews or departments will need simultaneous access to de-energized equipment. For lockout/tagout, that means hanging a hasp onto which individual locks then get hung.

If operations, a mechanic, two electricians, and three outside contractors need to hang their locks, do you really have room for seven locks and tags and possibly two hasps in that enclosure?

When lockout/tagout is not even an afterthought in equipment design and installation, it is never going to be efficient — and you are relying on luck that it will be effective.

TIP 3: SEPARATE POWER AND CONTROL.

Typically, lockout/tagout is primarily concerned with power sources and lockout/tagout of control sources is an afterthought. Although it is true that if you have no power you have no control, this doesn't mean you should "save time" by ignoring the control sources. It is also true that if controls are locked to the OFF position, then you're not going to accidentally operate any equipment. Use both layers of protection.

If you divide the job so that you identify and isolate the power and then turn your attention to controls (or vice versa), you are less likely to overlook something in either job.

Another advantage of addressing these separately is that to understand which controls to lock out, you usually must understand how the system functions. This means as you review the drawings and walk through the operation (perhaps with the help of an operator), you will also see non-electrical sources of energy you had previously overlooked. Most of these are every bit as deadly as electricity.

In many cases, control lockout can be accomplished in software. The problem there becomes how to tag the lock. There is not, thus far, a standard answer that fits all situations. There are plenty of opinions on how to do this, but OSHA has not yet embraced software lockout as equivalent to mechanically locking something out. Treat this as an extra layer of protection, not as one that can replace mechanical lockout.

TIP 4: LIGHT 'EM UP.

It is common to have barely adequate lighting at panels. One traditional solution was to request a project to add task lighting, and it was traditional for management to reject the project as unnecessary.

Another traditional solution was to run portable cords for temporary lights. This could add half an hour to the schedule, so having someone stand there with a flashlight often seemed more efficient.

A better solution is to buy battery-powered magnetic LED lights and stick one on each panel. These don't cost much, and having one right there eliminates the problem of needing to make yet another trip back to the shop.

If there's a suitable power source nearby, another solution is to permanently install LED strip lighting. This is inexpensive and easy to install, plus you don't need to run raceway from that panel halfway across the building as you might to hang some fluorescent fixtures.

TIP 5: REDUCE DEMAND.

A lockout/tagout can't go wrong if you don't have to do it. Use a strong monitoring program to alert you to conditions that cause the failures that require lockout/tagout. For example:

- *Power monitoring*. The system alerts you to a voltage imbalance condition. While correcting this may require a lockout or two, it's going to prevent replacing all of the motors on that feeder.
- *Vibration monitoring*. Bearing failure is the number one cause of motor failure. Causes include errors in lubrication methods, alignment deficiencies, and "soft foot" (from improperly tightening mounting bolts). The causes can often be addressed without lockout/tagout — especially if you pay attention to the advance warning and act promptly.
- *Vibration analysis*. With a premium capability vibration analyzer, a properly trained person can predict motor bearing failure months out from now. It's worthwhile to hire a specialist to check all of your motors if you lack the resources in-house. You can tag that motor for replacement when a lockout/tagout of that motor or the equipment it drives is necessary for some other purpose.
- *Insulation resistance testing*. If you have automatic IR testers installed on motors where it's practical to install them, then the failure prediction and scheduling advantage are similar to what you get with vibration analysis.
- *Temperature monitoring*. For critical motors and for motors that run in difficult applications, temperature monitoring can help prevent premature failure. Corrective measures can include filter changes, additional ventilation, gearbox oil changes, or even cleaning.

TIP 6: TRAIN HARD.

At many plants, the training for lockout/tagout seems to be based on the idea that good luck will attend every maintenance or repair job. Training must be more rigorous than that. If you're using the "do-it-once" method, then you need three types of lockout/tagout training:

- The foundation, including why lockout/tagout is done and what the general rules are.
- Specific training for the "do-it-once" method with hands-on demonstration.
- Training for lockout/tagout where no "do it once" procedure exists.

If you follow the other five tips, then you will significantly reduce the time needed to perform lockout/tagout. Use some of that savings to better train people in how to perform lockout/tagout.

THINKING OUTSIDE THE LOCK

Reducing the need for lockout/tagout can pay big dividends. What tasks can be automated or done remotely? How can you leverage predictive technologies to schedule replacements and repairs in a way that "piggybacks" onto a scheduled task for that equipment and eliminate a duplicated lockout/tagout?

While lockout/tagout is only one of many safety concerns, it deserves more attention than it gets in many facilities. It can be more efficient and more effective than the traditional method of "doing it for the first time" every time. That means more consistency, lower cost, less room for human error, and increased safety. EC&M

Mark Lamendola is an electrical consultant located in Merriam, Kan. He can be reached at comments@mindconnection.

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Receptacle Deterioration Issues in Wet or Damp Locations

Do you know the difference between weather-resistant and weatherproof receptacles?

By Joseph Wages, Jr., IAEI

I remember working on a residential remodel project, troubleshooting a front porch electrical outlet that was not working. I first tested the receptacle to make sure there was no electricity present. Once verified, I removed the cover. As I began to remove the 6/32 screws holding the receptacle to the metal box, the screws broke. I received a bigger surprise when I began to remove the receptacle from the box. It was split into two pieces, and the back piece remained in the box. At this point, I decided to again test for the presence of electricity. To my astonishment, the remaining part of the receptacle in the box was indeed energized. Perplexed, I wondered why this receptacle had deteriorated in such a fashion. Little did I know that the electrical industry was already aware of these problems and bringing a solution to market.

Photo 1. A close-up view of a receptacle that employs a weather-resistant (WR) rating.

The weather-resistant (WR) receptacle was first required in the 2008 edition of the National Electrical Code (NEC). Prior to it being published, complaints had been submitted to manufacturers and proposals submitted to NEC Code-Making Panels (CMPs) regarding receptacle failures in outdoor damp and wet locations. Thus, precautions needed to be taken when installing receptacles in indoor and outdoor damp or wet locations.

The current edition of the NEC requires all 15A and 20A, 125V and 250V nonlocking-type receptacles installed in damp or wet locations to be of the listed WR type (**Photo 1**).

Notice I didn't say weatherproof type, but you'll hear that inaccurate terminology used in the industry.

WR receptacles installed outdoors in wet and damp locations are subject to more demanding temperature variations, direct sunlight (UV rays), and possible mechanical abuse. WR receptacles are specifically designed to withstand these harsh environments and conditions. Several manufacturers have produced these receptacles with a "WR" designation on the face, readily identifying it as the WR type (although this is not a Code requirement).

Examples of outdoor damp locations include partially protected locations, such as under canopies, open-roofed porches, etc. Who determines if an area is a damp or wet location? That determination is made by the authority having jurisdiction (AHJ), which is a defined term in Art. 100 of the NEC. A receptacle installed in such a location will not be directly subjected to a beating rain or runoff.

A receptacle installed outdoors in a damp location is required to have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap may not be inserted and receptacle's cover is closed).

Photo 2. A weather-resistant (WR) receptacle located in a wet location based on the protection afforded by the in-use extra-duty cover.

An installation suitable for wet locations is also suitable for damp locations. Examples of a wet location include locations subject to direct saturation with water or other liquids (such as vehicle washing areas) and in unprotected locations exposed to weather (such as outside a dwelling unit on an outside brick wall). Some indoor locations may also call for the installation of WR receptacles (**Photo 2**).

Why get hung up on the use of "weather resistant" versus the term "weatherproof?" Because they are different terms with different meanings. Weatherproof is defined in Art. 100 as being so constructed or protected that exposure to the weather will not interfere with successful operation. Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness (snow, ice, dust, temperature extremes, etc.) are not a factor. These terms are also defined in Art. 100. The WR receptacle will still get wet and be exposed to deterioration, but manufacturers have made them more durable to operate in these environments. One way is to add specific chemicals during the molding process that make the plastic more resistant to UV rays from the sun.

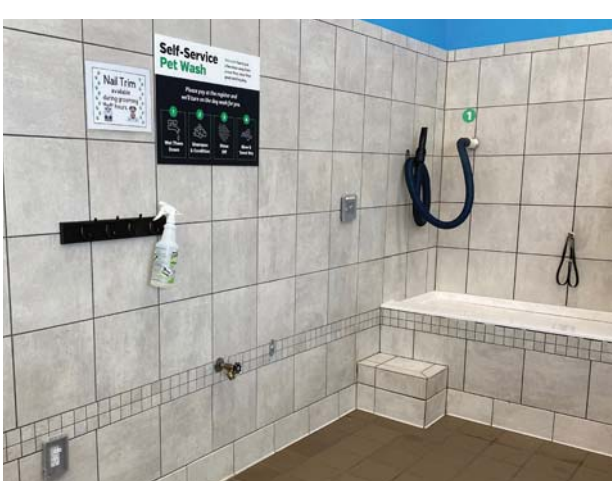

Photo 3. An example of an indoor wet or damp location (based on the AHJ interpretation).

One manufacturer describes a WR receptacle device as having nickel-plated contacts and mounting straps to prevent corrosion. These receptacles are also shipped with stainless steel mounting screws, and feature enhanced nylon and corrosion-resistant metal components to make them extra durable.

No one should have to face the dilemma of troubleshooting a receptacle and encountering the problem I described in the opening paragraph. Unfortunately, installations like this still exist because they were installed legally prior to the creation of WR receptacles.

Take care when you are troubleshooting these receptacles. Always turn off the electricity in case the receptacle has deteriorated and testing does not sense the presence of electricity. EC&M

Joseph Wages, Jr., is the digital education director at IAEI. Previously, he 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 No. 2 for the 2020 and 2023 Code cycles. He previously represented IAEI on NFPA's NEC Code-Making Panel No. 3 for the 2014 and 2017 NEC. He serves on the Underwriters Laboratories (UL) Electrical Council and on several UL Technical Standard Panels. He can be reached at jwages@iaei.org.

The Case of the Deadly Downed Power Line

An employee surveying utility pole placement is electrocuted after contacting a seemingly harmless downed power line.

By The Kentucky FACE Program

Note: This article does not represent final determinations regarding the nature of the incident, cause of the injury, or fault of employer, employee, or any party involved.

When a married man with a young daughter left for work one early autumn morning, his family, friends, and coworkers could not have foreseen the tragic events that would soon unfold. On that fateful day, the 31-year-old employee of an engineering firm was tasked with surveying utility pole placement in support of the development of engineering plans. During the course of his duties, the field technician, who had been with the company for two years and three months, discovered a downed power line. The victim attempted to move the power line but found it was tangled in a nearby tree. As he worked to unravel the power line, it somehow became energized and electrocuted him as he held the wire.

SETTING THE STAGE

The decedent's employer was an engineering firm founded in 2014 that employs 22 people. The company, which operates in multiple states across the U.S., specializes in surveying, analyzing, and mapping of utility poles.

According to a company representative, employees receive CPR training, first aid training, OSHA 10-hour training, online electrical safety training, and traffic safety training. The representative for the engineering firm also said it issues each employee a company safety manual but declined to provide specifics on the content of the manual.

THE SCENE

On Nov. 4, 2020, a two-person crew departed their out-of-state place of business en route to a large Kentucky metro area with the task of surveying power lines to develop future engineering plans. The job site was a residential area with homes located on each side of a two-lane highway (**Photo 1**).

Due to the placement of the utility poles and their proximity to the highway, the job required the duo to work in the front yards of private residences. Most of the overhead wires in this area run parallel with the roadway and cross over the highway at several points with smaller wires branching off to other parts of the area.

Photo courtesy of Google, Digital Image

Photo 1. Location where the incident occurred.

On this unseasonably warm November day — 68°F, 39% humidity, 8 mph winds, and no precipitation — the employees worked their way from utility pole to utility pole, collecting data such as pole height, distance between poles, and each pole's proximity to the highway. The data they collected would later be used to develop engineering plans for the installation of fiber-optic cable.

During the course of their tasks, the crew encountered a downed power line, which investigators determined was likely caused by a recent windstorm that had occurred in the area (**Photo 2** on page 16).

According to a company representative, the downed power line was entangled in a nearby tree that sat approximately 8 ft from the utility pole. The company representative stated that after the victim located the downed line, he worked to free it from the tree. Although the line was not initially energized, at some point in the process of untangling the wire, it became

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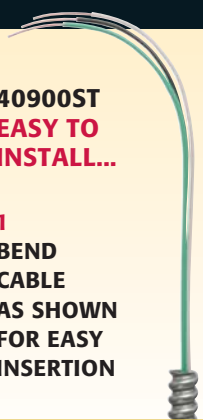

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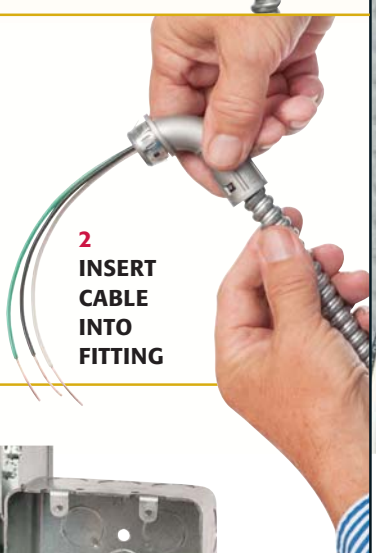

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MCI-A Steel & Aluminum	.440 to .550		.480 to .550	
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energized and delivered an electric shock to the victim, killing him instantly. As the victim maintained contact with the wire, his clothing caught fire, and his body was burned. The official cause of death was determined to be high-voltage electrocution (**Photo 3** on page 18).

CONTRIBUTING FACTORS

Kentucky FACE investigators identified the following unrecognized hazards as key contributing factors in this incident:

- Lack of hazard awareness.
- Insufficient procedures.
- Lack of training.

FACE RECOMMENDATIONS

In an effort to prevent a similar incident like this from occurring again, FACE offers three recommendations.

Recommendation 1: Employers should consider development of policies and procedures that specify the standard operating procedures for employees who encounter a downed power line.

According to the company, the victim had completed an online electric safety course, hosted by a third party upon being hired, two years and three months earlier. In this case, the victim had broad-spectrum training of general electrical safety, which was taken online. An example of a policy that may have prevented this particular fatality could simply read, "Downed power lines are dangerous; always assume a downed line is energized. If a downed line is located or observed, do not approach or touch the line. Leave the area immediately and contact a supervisor to report." The policy should identify the hazard, the steps that should be taken to minimize or avoid the hazard, and clearly identify the expectation of what is expected of the employee if the situation arises. In addition, OSHA provides "rules to live by" when dealing with a downed electrical line:

- Do not assume a downed power line is safe because it is on the ground or it is not sparking.
- Do not assume that any wire is a harmless telephone, television, or fiber-optic cable, and does not carry lethal current.
- Treat everything electrical as energized until tested and proven to be de-energized.

Photo courtesy of Kentucky FACE

Photo 2. Shown here is the utility pole that was being surveyed by the victim and his colleague. The pole pictured housed the wire that had broken loose during a windstorm and ultimately led to the victim's electrocution.

- Never go near a downed or fallen electric power line.
- Electricity can spread outward through the ground in a circular shape from the point of contact. As you move away from the center, large differences in voltages can be created.
- Never drive over downed power lines. Assume they are energized.
- If contact is made with an energized power line while you are in a vehicle, do not exit the vehicle unless it is on fire. If possible, call for help.
- If you must exit any equipment because of fire or other safety reasons, try to jump completely clear, making sure that you do not touch the equipment and the ground at the same time. Land with both feet together and shuffle away in small steps to minimize the path of electric current and avoid electric shock. Be careful to maintain your balance.

To help avoid similar events, employers should develop standard operating procedures that specify what actions employees are to take when a downed power line is encountered and restrict employees from engaging in activities for which they are not adequately trained to complete.

Recommendation 2: Employers should perform a job hazard analysis.

Prior to employees arriving on scene, the company had no knowledge of a downed power line in the area in which the employees were required to work. The lack of awareness presented the employees with an unexpected hazard that they were unprepared to address appropriately and safely. Implementing a job hazard analysis process can help

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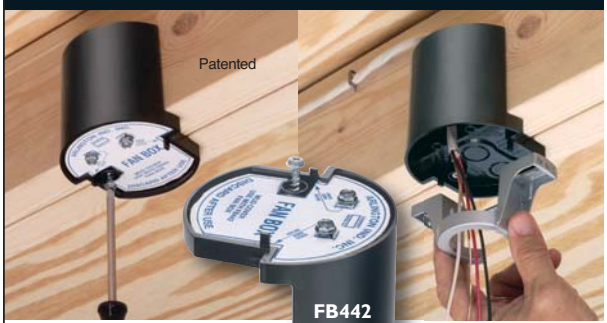

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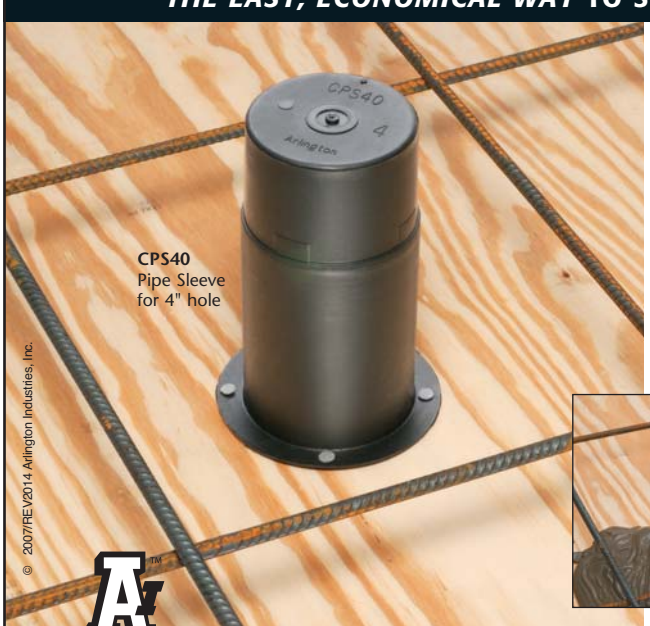

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Photo courtesy of Kentucky FACE

Photo 3. Location of where the victim was standing when he was electrocuted.

employers identify safety hazards that may be present and unique to a particular worksite prior to performing a job. OSHA defines a Job Hazard Analysis (JHA) as "a technique that focuses on job task as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment." A properly executed JHA of the worksite would have exposed known hazards and hazards that are likely or could be present in the future.

Furthermore, it is probable that a company employee whose primary function is to survey utility poles may observe or encounter a downed power line at some point throughout the course of his or her duties. A JHA would allow the company to analyze these risks, proactively develop a procedure for addressing the risk of a downed power line, ensure employees have the proper personal protective equipment, and allow for adequate training of employees prior to placing them in a risky environment. A JHA can be specific to a particular site, not just a task. Often, a new work site can expose a unique risk. Performing a JHA anytime employees are required to work in a new area or job site would likely have exposed the downed power line. After discovering the hazard, employers could have made the decision to eliminate the hazard by not allowing employees on the premises until the hazard was removed or allowed adequate time to develop a plan to complete the task in a safe manner.

A JHA may also reveal the need for additional policy and procedures. For example, calling the utility company prior to beginning work at a new site to check for reports of downed lines would be a logical procedure to implement, once the hazard had been identified in the JHA process. To ensure employee safety, employers should perform job hazard analysis on the task they require their employees to perform and prior to working at new locations that may have unknown hazards.

Recommendation 3: Employers should provide hazard awareness training to employees annually.

According to The National Fire Protection Association (NFPA), 1,651 workers died as a result of electrical injury between 2007 and 2016, which is nearly 3.5 deaths per week over a nine-year period. Electrocution often occurs rapidly and without warning, leaving the victim unable to act. Thus, proper hazard awareness training is critical for workers who could potentially be exposed to electric shock. Although the victim had received web-based electrical safety training through a third party upon being hired, electric shock hazard awareness training should occur on an annual basis. Hazard awareness training that is specific to the types of exposure the employee is likely to encounter should also be implemented. This training should include company-specific policies and procedures that have been developed and align with the expectations the company has for the employee's response to electrical hazards. Each employee subject to being exposed to the hazard should receive training; the training should include a form of validation that the employees understand and should reoccur on an annual basis to combat complacency.

A HARD LESSON

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in an injury or fatality. As evidenced by this tragedy, no one should ever make contact with a downed power line or electrical wire, no matter how harmless it appears. EC&M

This case report was developed by the Kentucky Fatality Assessment and Control Evaluation (FACE) Program. Kentucky FACE is a National Institute for Occupational Safety and Health (NIOSH)-funded occupational fatality surveillance program with the goal of preventing fatal work injuries by studying the worker, the work environment, and the role of management, engineering, and behavioral changes in preventing future injuries. Kentucky FACE is funded by grant 5U6O0H008483-16 from NIOSH. For more information, visit https://kiprc.uky.edu.

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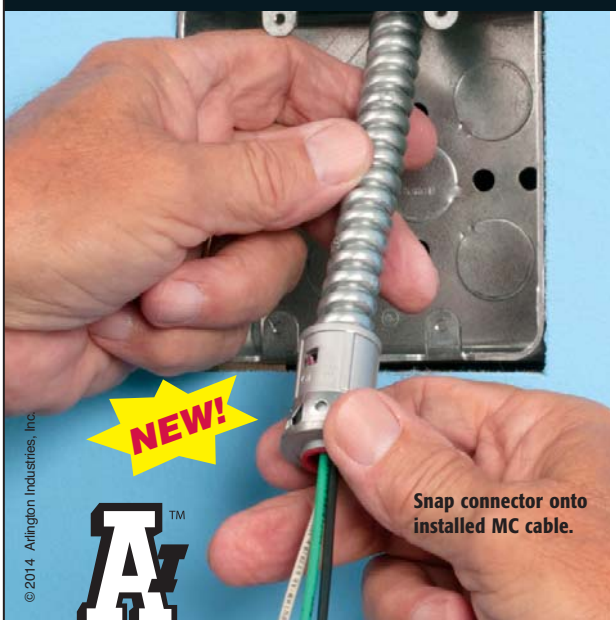

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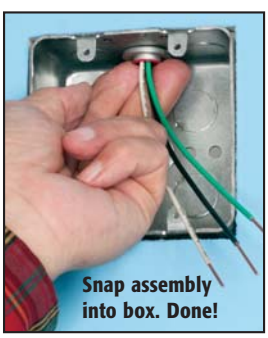

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8413	1-1/4"	1.000	1.460	.870	1.370	2-3, 2-4, 1-3, 1-4, 1/0-3, 1/0-4, 2/0-3, 2/0-4, 3/0-3
8414	1-1/2"	1.360	1.770	1.250	1.590	2/0-4, 3/0-3, 3/0-4, 4/0-3, 4/0-4, 250-3, 250-4
8415	2"	1.700	2.200	1.550	2.050	250-4, 300-4, 350-3, 350-4, 500-3
8416	2-1/2"	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
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By John Kostick, Master Electrician

FRIGHTENING FINDS

A close-up look at some seriously scary electrical blunders the installer before you left behind

The world is full of resourceful people — people whom we often admire for their ingenuity. Inventors, engineers, and architects who think outside the box can create innovations that blow our minds with their advanced technological knowledge. On the other end of the spectrum is the "do-it-yourselfer" who can fix a garden hose with a roll of duct tape, grow tomato plants out of old buckets, and hang a garbage can lid under a bird feeder to keep the squirrels out. Unfortunately, this same type of person often attempts DIY electrical work — whether it involves hanging a ceiling fan or rewiring an entire house.

As electricians, we sometimes find ourselves straddling both worlds. We are well-educated and licensed professionals who follow established codes and standards practices. Nevertheless, we often feed our families by correcting the mistakes of others who are either poorly trained or not trained at all. For some reason, there are still people out there who think an electrician's job is as simple as "black and white make a light." It's not until they see sparks, flames, or smell something burning that they finally call in the professionals.

Throughout my 40-plus years in the electrical industry, I have encountered all types of frightening finds. Some of these scary situations were created by the homeowners themselves; others were left by residential kitchen and bath contractors who cut corners and opted to perform the plumbing and electrical work without permits. It has always bothered me to see such failed attempts, knowing that a homeowner paid these contractors in good faith and believed the work was done professionally and to Code. What makes me cringe the most, however, is when I encounter shoddy work performed by licensed electrical contractors who take short cuts or try to perform work that requires a certain level of skills, tools, and equipment that is way out of their league.

I have hundreds of stories and thousands of pictures of some of the shocking scenarios I have encountered along my journey as an electrical professional. As you can imagine, it was difficult to narrow down my list for this article, so perhaps I can share more lessons learned with you in the future. For now, sit back, relax, and enjoy some of my most "Frightening Electrical Finds."

Now retired after 40 years in the industry, John Kostick is a licensed master electrician in New Jersey and Delaware. He is also a licensed electrical instructor in New Jersey, a certified fire instructor, and a volunteer firefighter. He can be reached at watchungelectric@aol.com. Also read his recent article, "A Pinch of Peril" at https://bit.ly/3o2dgVA.

THE HOUSE OF HORRORS

I remember the day like it was yesterday. The fire department I was a member of had responded to two calls in as many days to the same residence for "the smell of something electrical burning." The first call involved the meltdown of a power strip laying on the wooden floor of the master bedroom; the second call stemmed from a burning smell coming from the dishwasher. Having the fire department at her house two days in a row freaked the homeowner out so much that she was afraid to even sleep there. She immediately called me to ask if I'd come out, have a look at her wiring, and find out what was going on.

After meeting with the homeowner, she explained how she had arrived home around midnight to find her garage door opener didn't work when she pressed the button. When she entered the house, she smelled something burning in the bedroom and saw smoke. Next, she took me to the kitchen and explained that her dishwasher had suddenly stopped working as well — and that she also smelled burning in the kitchen.

I started my investigation by removing the panel cover and checking the breakers and the voltage on the phases. I soon discovered that the voltage on the phases was fluctuating as the homeowner went around the house, turning on light switches and such. It quickly became obvious that she had lost a neutral. To further complicate the issue, there was no earth or water pipe ground.

My initial diagnosis was that when she had come home and hit the button for the garage door opener, it didn't operate because the load caused the voltage to swing to the other phase, thus sending too much voltage to the power strip and causing it to fail and melt. The same thing happened with the dishwasher, but the motor cooked due to low voltage to the unit. Lost neutrals can cause much bigger problems than making your lights flicker!

After discussing my findings with the customer, she contacted her insurance company, which agreed to let me examine everything electrical in the house to determine if any further damage had occurred from the fluctuating voltages (including electronics, dimmers, and the HVAC system). I can't remember exactly what prompted me to remove the first device. Perhaps it was the exposed wiring in her changing room or the fact that she told me she had hired a "handyman" to complete various types of work in her home (including electrical), but there were never any permits or inspections required that she knew of. The minute I opened the first box, my journey down the rabbit hole began.

To be honest, I found so many things wrong that calling them "Code violations" doesn't even scratch the surface. Not only were many of the mistakes I found horrifying, but they were also outright examples of a lack of common sense — some people know just enough to be dangerous. Since I mentioned the changing room earlier, let's start our journey there.

An initial look at the switches and receptacle mounted to the bottom of the homeowner's changing room counter showed individual wires sticking out of the back of the boxes (**Photo 1**). Upon closer examination, I found the exposed wiring and splices (**Photo 2**). When I

Photo 1. If you look closely between the boxes, you can see the exposed conductors.

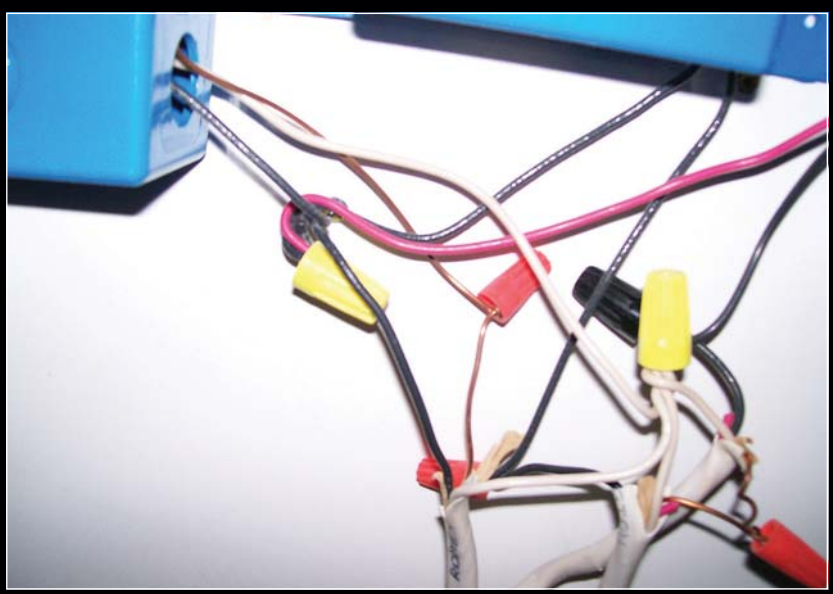

Photo 2. This is a closer look at the exposed splices.

Photo 3. A view of the NM cables that are pinched behind the countertop.

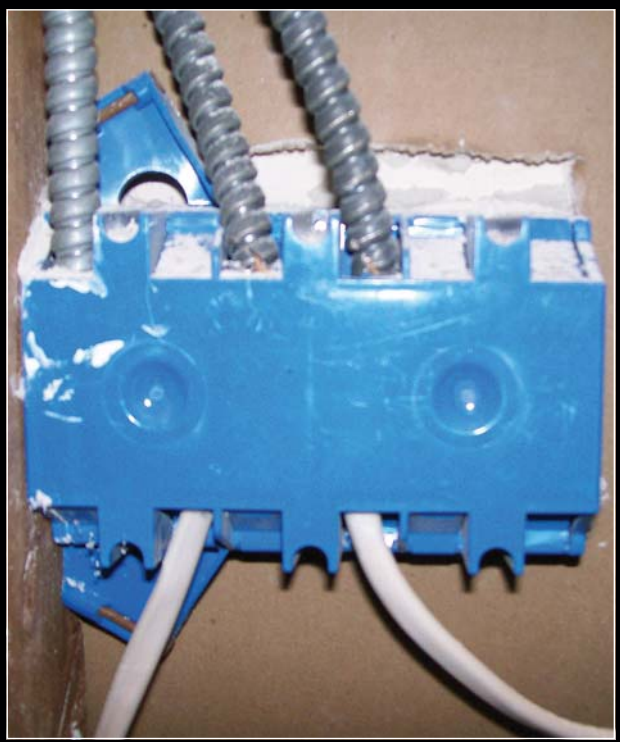

Photo 5. Exposing the back of the box revealed more problems.

Photo 4. This image exposes the mess lurking behind an innocent-looking cover.

Photo 6. This thermostat didn't sit flush against the wall, indicating some issue.

moved some of the items from the top of the counter, I discovered that the NM cables poked out of a hole in the wall above it and were sandwiched between the counter and the wall to which they were spliced openly below it (**Photo 3**).

Next, I checked the bathroom to see what surprises awaited me. An innocent-looking 2-gang assembly with a triple switch and a receptacle first caught my attention. When I pulled them out to check the splices (**Photo 4**), however, I realized it was actually a 3-gang plastic box

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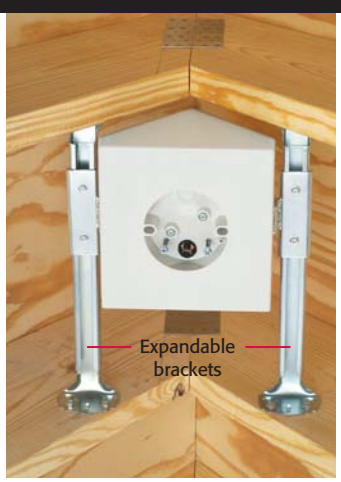

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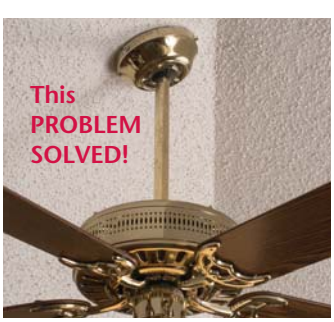

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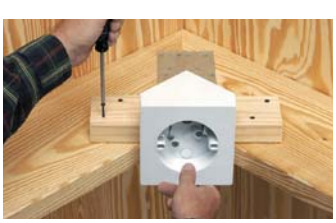

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Photo 7. Removing the devices revealed the hacked apart 1-gang box and the installer's method of wiring the thermostat.

Photo 10. Notice the NM cables wrapped around the box and stretched across the cabinet.

Photo 8. There is so much more room for splices when you don't use a box!

Photo 11. This installation is wrong on so many levels!

Photo 9. At least the installer used a box here! Nice job with the grounding as well.

with multiple cables entering it, including 2 BX cables (**Photo 5** on page 22). An oversized hole had been cut into the wallboard, and someone had laid tile in an attempt to cover the hole and the third gang of the box. But, hey, at least there was plenty of box!

Next, it was time to enter the bedroom, where I first noticed a line voltage thermostat for the electric baseboard heat). As you can see, it looked peculiar ((**Photo 6** on page 22). Here, I discovered the side of a 1-gang metal box had been removed, and the thermostat was being held in place by the wires and one wall anchor with a wallboard screw (**Photo 7**). This was an example of not having enough box!

By now, I realized that each device I removed was going to be as bad or worse than the last one. Focusing my attention on a 1-gang switch at the doorway, I removed the cover and saw the telltale wallboard screws anchoring the device — but anchored to what? I removed the screws and found an example of a new streamlined method of installing devices (**Photo 8**). Boxes? We don't need no stinking boxes!

FOR INSTALLATION OF OUTDOOR FIXTURES AND DEVICES

Made in USA

GARD-N-POST™

UL/CSA LISTED ENCLOSURES & SUPPORTS

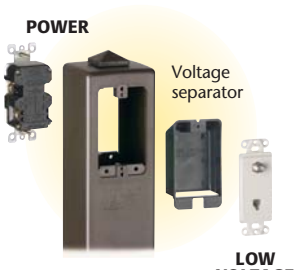
Listed Support for Fixtures and/or Devices Power & Low Voltage Openings

Listed Enclosure with EXTRA-DUTY Code Compliance

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

Arlington's **Gard-N-Post™ enclosures** and **supports** offer the attractive, safe, and easy way to install a light fixture and/or one or two devices outdoors!

- Non-metallic, heavy-duty UV rated plastic
- Damage resistant
- No chipping... 4 permanent colors
- GARD-N-POST... a variety of styles, 9" to 73" tall



Install power and low voltage outlets outside, in the same post

FOUR COLORS!

Circle 16 on Reader Service Card

Made in

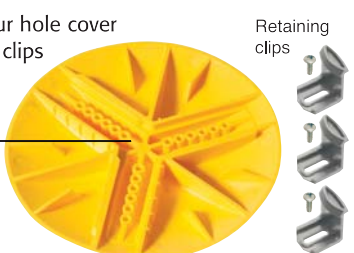
NON-METALLIC HOLE COVER KITS

RATED FOR 250 LBS *ENSURES COMPLIANCE WITH OSHA*

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

Arlington's non-metallic hole cover kits offer the *fastest way* to cover a hole – and ensure compliance with OSHA safety standards on a multi-story building site.

Available in two sizes, our hole cover kits come with retaining clips that adjust to fit a range of hole sizes.



- Reference scale for precise sizing to hole diameter
- Complies with OSHA Standard 1910.28 (b) (3) (i) (A)
- Rated for 250 lb load

Patent pending

***HC1742** fits 1-3/4" to 4-1/4" opening,*
***HC1762** a 1-3/4" to 6-1/4" hole*


HC1742 w/ clips set for 1-3/4" hole


HC1762 set for a 6" hole

Circle 17 on Reader Service Card

At yet another location, the installer almost got it right (**Photo 9** on page 24). Here, he or she installed a 4-inch metal box with a 2-gang raised adapter but failed miserably with the grounding. But again, at least there was a box!

It was now time to turn my attention to the kitchen sink. I know, I know… electricians don't do sinks, but why should the sink cabinet fail to surprise me (**Photo 10** and **11** on page 24)? Here, we have a 1-gang switch for the disposal unit that is partially recessed into the cabinet wall with the NM cables wrapped around it — and of course the receptacle providing power for the dishwasher via the yellow extension cord. Every undercabinet microwave oven needs a receptacle, right (**Photo 12**)?

Next came the countertop receptacles. Seeing none, I rolled up the little wooden doors where the backsplash would be and found some plug mold strips. My first thought was that it was highly unlikely they were GFCI protected (they weren't). When I snapped the cover off, I shook my head in disbelief. I've installed many of these strips, so I'm very aware of how little room there is for splices even with the larger entrance fittings. I've even seen where the solid copper wires were joined with barrel crimp connectors, of which I have never been a fan. Imagine how disgusted I was to discover that the strips were fed from the back, and the solid copper wires were joined using a telephone splice with no connectors or insulation! I have no idea how this didn't blow up (**Photo 13**).

Although I could keep going on and on about this house of horrors, I'll end with this last image (**Photo 14**). Pictured here is a bathroom receptacle. I can only assume that the wires were too short to move the box out of the corner, but that didn't stop this "creative" installer from putting the device in the wall. Why move a box when you can just cut the side of it open and extend the conductors to reach the device? But what about screwing the device into the box where it belongs so that it's supported? No worries — just screw the cover to the device and use the tile adhesive to hold it all in place. Add a little grout, and it looks perfect!

Photo 12. Apparently, the installer didn't have a box to cut in.

Photo 13. Imagine how difficult it must have been to perform this installation! It usually takes longer to do something the wrong way than it does to do it correctly.

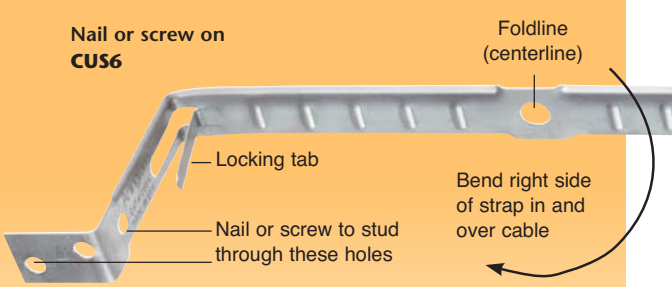
Photo 14. Some installation methods boggle the mind.

GALVANIZED STEEL

NEW

CABLE SUPPORT

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



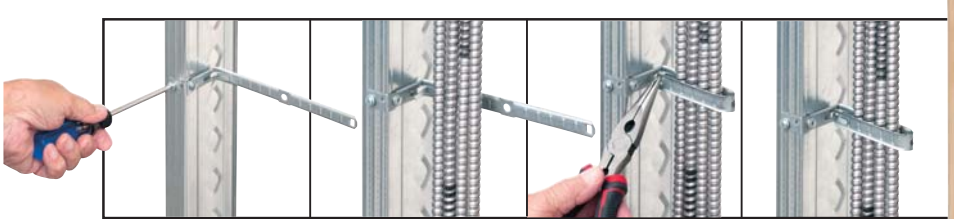
Holds up to four MC cables centered on a 2x4!

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)



c UL us

Arlington™

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

Made in USA

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

Circle 18 on Reader Service Card

PHOTOVOLTAIC

NEW

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.

- **For PV1000 and other cables** from .250 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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UL LISTED

Circle 19 on Reader Service Card

THE MISFIT MANUAL TRANSFER SWITCH

While inspecting some equipment for a customer, I came across this manual transfer switch (**Photo 15**). Chances are this was originally installed by a qualified electrician. As most of us know, some service technicians (who know just enough to be dangerous) make modifications simply to make things work. Although these are typically intended to be "temporary" fixes, it seems like there is never enough time or opportunity to do it correctly to begin with or to go back and complete a permanent installation.

Peering inside this switch, you can see that the installer must have only had a spool of red wire on the truck — and a roll of green tape as well. Look closer, and you'll see some water dripping from the original ground wire installed in the lug (**Photo 16**). It's interesting to note that the ground lug is deteriorating — likely, there is a less-than-adequate connection being made through the corrosion. If you look even more closely, you'll notice two red wires stuffed under the phase A and phase C on the load side. How nice that the installer took the time to place a zip tie on one of them to shape it in with one of the larger conductors.

Now comes the fun part. If you look at the wire from phase C, you can clearly see that when this equipment was installed, it got caught under the switch blade on phase A and short circuited (**Photo 17**). There's no way the installers could not have known that they crossed phases! The loud bang would have been the first indication, which is usually followed by a burnt electrical smell and puff of smoke. To walk away and leave things in this state is beyond comprehension. As I said earlier, other electricians or service technicians had to have noticed this over the years, but not one of them took the time to inform the customer of this unsafe condition or repair it.

Word to the wise: Always install equipment and conductors as if they are permanent because the chance to go back and do it right may never come.

Photo 15. Just a glance tells someone with rudimentary electrical experience that obvious issues exist here.

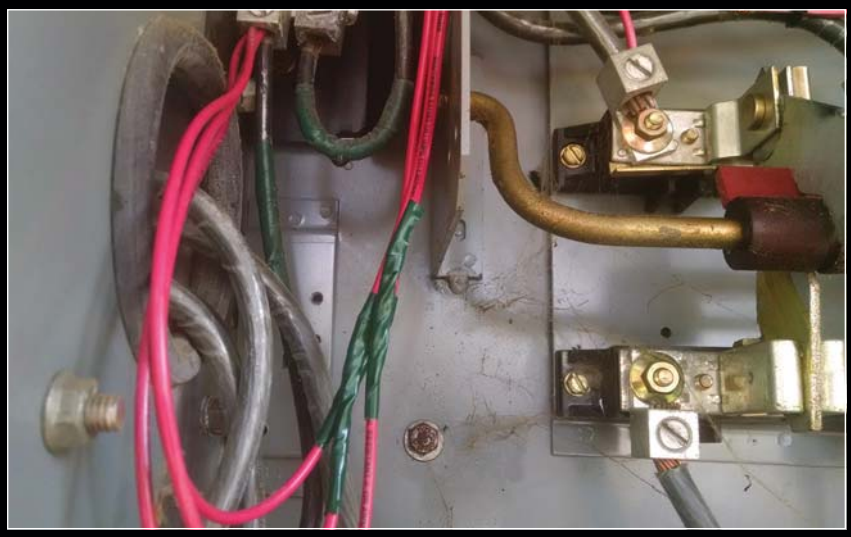

Photo 16. A closer look reveals grounding issues as well as water entering the enclosure.

Photo 17. Notice the damaged blade on the switch and the burned wire where it crossed phases.

SNAP²IT® CONNECTORS

EASIEST CABLE INSERTION • NO TOOLS • SECURE HOLD

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

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.

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	.590 to .920
505010AST	Duplex Snap in, 3/4" KO w insulated throat	(2) .590 to .920
4110ST	Snap in, 1/2" KO	.525 to .705
414110ST	Duplex Snap in, 1/2" KO	(2) .525 to .625
NEW! **4141107ST**	Duplex Snap in, 3/4" KO	(2) .525 to .705


4010AST
1/2" KO

Arlington® TM

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Patented.
Other patents pending.

Circle 20 on Reader Service Card

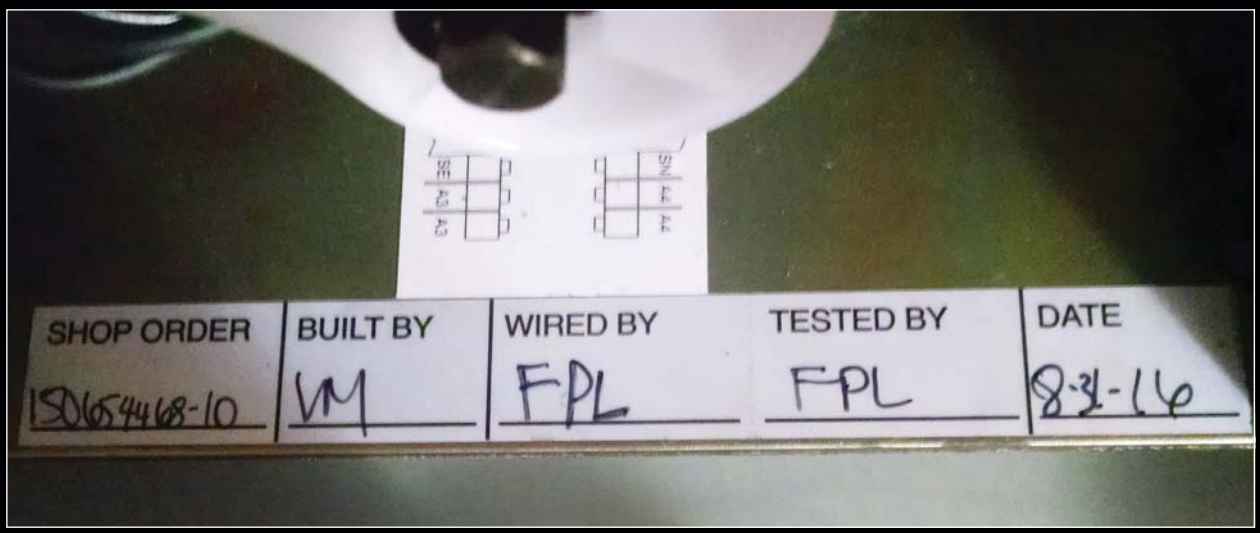

Photo 18. This label clearly identifies the technicians who worked on this device.

WHEN "TESTED" CAN'T BE "TRUSTED"

Almost every piece of material that electrical professionals use has been tested and listed for the purpose for which it was designed. We then use our skills and knowledge to install these components in a workman-like manner, double checking our work before we energize anything.

Professional inspectors examine our work to ensure these components are installed correctly, according to their design and used for their intended purpose. What helps govern this system is the fact that inspectors who are also electrical contractors may not perform work in the towns where they perform inspections, thus eliminating the chance of inspecting their own work.

On this particular job, I was installing a transfer switch. Inside the cabinet was a label with the build number and inspection details (**Photo 18**). In this case, the transfer switch happened to be wired by "FPL." However, it was also inspected by "FPL."

After mounting the switch on the wall and running my conduits to it, I was ready to terminate my wiring. As I was installing conductors in the top terminals, the factory-wired conductors literally fell out of the lugs that they were terminated under. First it was one set, then another, and finally the last pair.

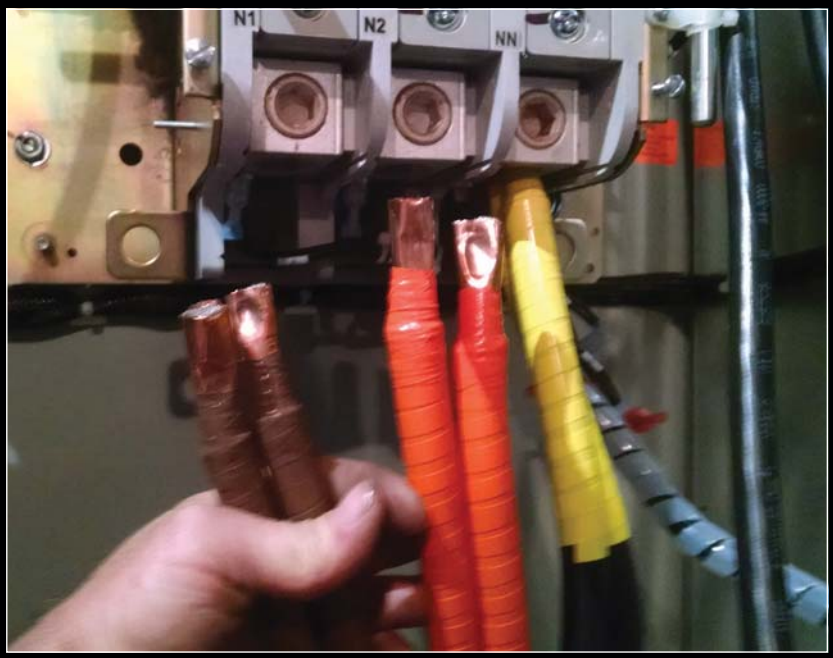

Photo 19. Imagine these conductors falling out of the lugs while energized and under a load!

As you can see in **Photo 19**, the lugs had not been loosened at all. At that moment, I cursed this person known as "FPL" because he or she had created a situation that would have killed me had I energized the switch. Secondly, if the conductors didn't fall out while I was working on them, they would have fallen out eventually under their own weight and possibly grounded out against the cabinet.

The moral of this story: Never assume that just because equipment is listed, assembled under supervised conditions, and tested before it leaves the plant that it can be trusted to be safe to install and energize. Always double check the work of others to protect yourself from a dangerous situation. In this case, it wasn't what another electrician did wrong; it was the technician in a manufacturing facility. EC&M

GRAY & BLACK NON-METALLIC • UV RATED

Made in USA

ENCLOSURE BOXES

PROTECT DEVICES, POWER BACKUPS and MORE!

Back plate
with electronics mounted
(not included)

All available with
or **without Back Plate**

Outdoor Rated
Meets NEMA 3R
with Hinge on TOP

SIDE hinge
for indoor use

Never Lose Another Cover
with a FACTORY-INSTALLED Cover!

Shipped with *factory-installed* hinged covers, Arlington's non-metallic enclosure boxes **meet NEMA 3R requirements for outdoor use** *when mounted with the hinge on top.*

Perfect for protecting and securing power backups, security devices and other valuable equipment indoors *or outside,* our heavy-duty, UV rated boxes come *with or without a back plate*. Get easy access to components, even after the enclosure box is installed.

Gray and black, in a variety of convenient sizes, including the **new 6" depth**.

'Lockable' with a knockout for a cam lock ***(EBL1** sold separately)* or a padlock latch.

Arlington®

GRAY Enclosure Boxes *Add suffix BL to order in Black

Cat #	UPC	Dimensions
EB0708	12672	7" x 8" x 3.5"
EB0708BP	23170	7" x 8" x 3.5" with Back Plate
EB1111	12670	11" x 11" x 3.5"
EB1111BP	23171	11" x 11" x 3.5" with Back Plate
EB1212	12671	12" x 12" x 4"
EB1212BP	23155	12" x 12" x 4" with Back Plate
EB12126	23172	12" x 12" x 6"
EB12126BP	23173	12" x 12" x 6" with Back Plate
EBL1	11400	Cam Lock

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Circle 22 on Reader Service Card

NEW CONCRETE

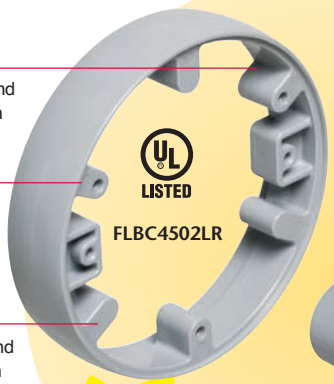
NEW FEATURES!

FLOOR BOX

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

SIDE A
Fits 6" round covers with a 3-1/2" screw hole pattern

SIDE B
Fits 6" round covers with a 3-3/8" screw hole pattern



NEW!
REVERSIBLE Leveling Ring

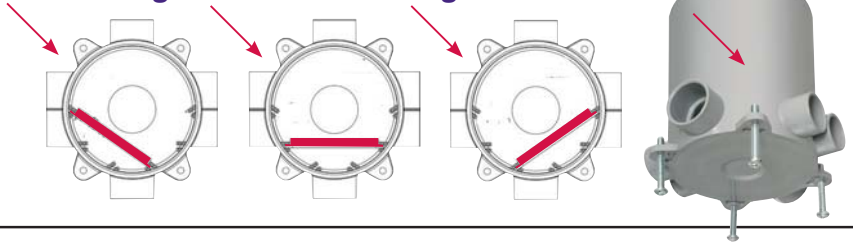
Arlington's FLOOR BOXES, COVER KITS, and accessories **FOR NEW CONCRETE** are the low cost, *convenient* way to install a receptacle *flush with a new floor*.

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.

Openings for optional screws
to raise box so concrete flows beneath

THREE Options for Low Voltage Divider Positioning



ARLINGTON COVER KITS for FLBC4502, FLBC4500 boxes

Brass or **Nickel-Plated Cover, FLIP LIDS**

Brass or **Nickel-Plated Cover, THREADED PLUGS**

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!*

FLBC4520BR Brown
FLBC4520W White
FLBC4520BL Black
FLBC4520CA Caramel
FLBC4520GY Gray

PLASTIC SINGLE FLIP COVERS IN 6 COLORS

FLBT6620NL

FLBT6620MB
TR receptacle

FLBT6620GMB, FLBT6620GNL
TR, decorator-style GFCI

FLBT6620UMB, FLBT6620UNL
TR receptacle, two USB ports

Brass or **Nickel-Plated Trapdoor, 3 DEVICE OPTIONS**

Patented. Other patents pending.

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ULTRA THIN FLANGES, METAL COVERS

RECESSED IN BOX® COVER KITS

FOR 4.5" CONCRETE BOXES

FLBC4580MB
brass-plated covers
stamped steel flange

FLBC4580NL
nickel-plated covers
stamped steel flange

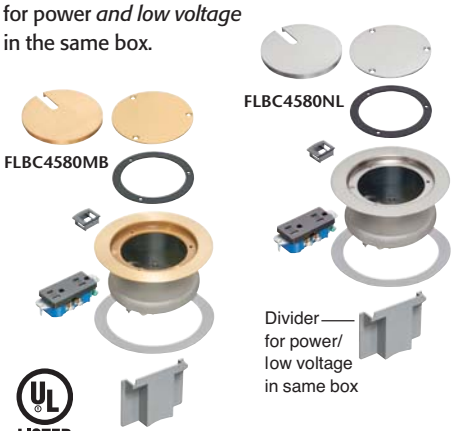
IN BOX® with Ultra-Thin Stamped Steel Flange

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.



UL LISTED 5B36

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Patent pending

Circle 24 on Reader Service Card

OSHA's **Top 10 Violations** of 2020

See which categories changed their positions from 2019 to 2020.

The U.S. Occupational Safety and Health Administration's (OSHA) Deputy Director, Directorate of Enforcement Programs Patrick Kapust recently unveiled its preliminary Top 10 list of the most cited violations for the fiscal year 2020. Moderated by *Safety+Health* magazine Associate Editor Kevin Druley, Kapust presented the preliminary data via an exclusive webinar organized by the National Safety Council's (NSC) *Safety+Health* magazine on Feb. 26, 2021.

Once again, Fall Protection – General Requirements maintained its No. 1 position, which is the tenth consecutive year it has held that spot, according to the NSC. Notable changes include Ladders (No. 5) making its way into the Top 5 most-cited violations; Lockout/Tagout (No. 6) falling two positions from No. 4 in 2019; and Respiratory Protection (No. 3) rising two spots from No. 5 in 2019.

In reviewing the data from 2020, it is important to note that the overall number of citations from the Top 10 list decreased from 2019 to 2020.

RECESSED FOR FLUSH-TO-THE-WALL MOUNTING OF FLAT SCREEN TVs

STEEL TV BOX™ KIT

COMBO BOXES FOR USE WITH METAL RACEWAYS

NEW!

Patented. Other patents pending.

NEW WORK
Mounting screws hold box securely on stud

Arlington's recessed STEEL combination power/low voltage **TV BOX**™ is the best way to mount a flat screen TV flush on a wall.

TV BOX provides power and/or low voltage in one or more of the openings. Plugs and connectors stay inside the box, without extending past the wall.

RETROFIT Mounting wing screws hold box in the wall

Designed for use in new or retrofit *commercial construction* where metal raceway is used, we have a STEEL TV BOX for almost any application!

- Steel box; non-metallic paintable white trim plate
- Easy to install, secure installation
- Optional covers for unused boxes

2 Gang
TVBS505

3 Gang
TVBS507

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NON-METALLIC

THE SCOOP™

ENTRANCE PLATES, HOODS, DEVICES

NEW
Entry Device w Brush opening

CED135
(with wall plate, order CED135WP)

Arlington's TVBU505 TV BOX

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

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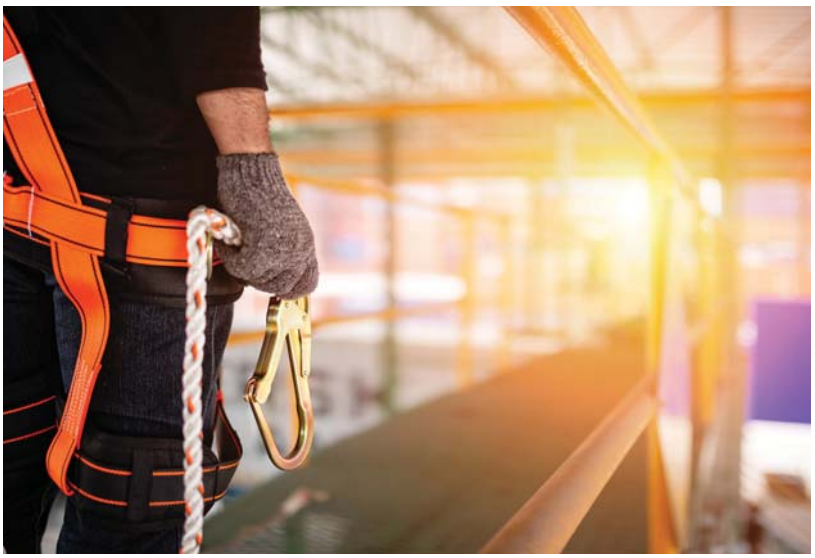
 Patented **Made in USA**

Circle 26 on Reader Service Card

No. 1: Fall Protection — General Requirements

For the tenth consecutive year, according to the NSC, **Fall Protection — General Requirements** has held its position as the most frequently cited violation. Associated with 1926.501, which sets requirements for employers to provide fall protection systems for their employees, this category did see a drop from 6,010 violations in 2019 to **5,424** citations in 2020. That count makes it the lowest total count of fall-related violations since 2014, according to past data.



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No. 2: Hazard Communication

Hazard Communication maintained its No. 2 position from 2019. However, this category saw 472 fewer citations in 2020 than it did in 2019 for a total of **3,199** violations. As of March 2012, its requirements, based on 1910.1200, have been updated to align with the UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS), Revision 3. The standards dictate that the hazards of all chemicals produced or imported are classified and that the information concerning them is communicated to employers and their employees.

No. 3: Respiratory Protection

Respiratory Protection moved up two positions to No. 3, with a total of **2,649** violations. This is 199 more violations than 2019 witnessed. Affecting many different industries, including General Industry (part 1910), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (part 1926), this category follows the rules laid out in 1910.134. Its primary goal is to prevent workers from atmospheric contamination of harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors.

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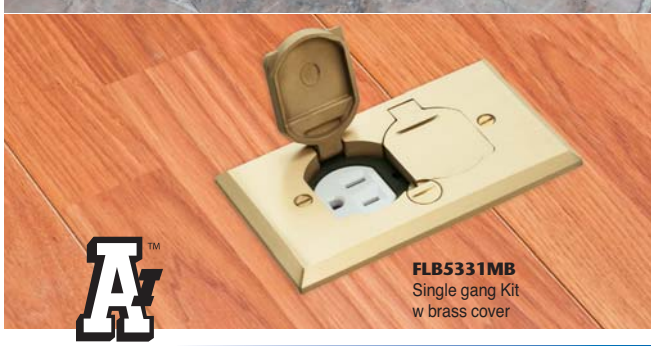
STEEL BOX WITH BRASS COVER

LISTED 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

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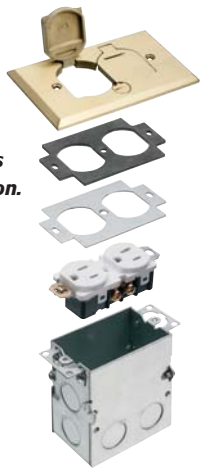
Arlington's **STEEL FLOOR BOX KITS** give installers a low cost, *convenient* way to install a receptacle *in a new or existing floor*.

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.

for NEW or EXISTING FLOORS



FLB5331MB
Single gang steel box
kit w brass cover

c UL us

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IN BOX® RECESSED COVER KITS

INSTALLS INSIDE 4.5" CONCRETE BOXES

NEW!

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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.*

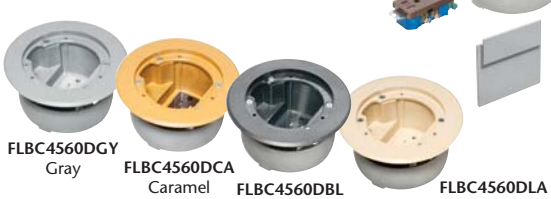
IN BOX covers install fast, *inside the can* reducing trip hazards caused by plugs sticking out of the box. They look great. And, you can have power and low voltage in the *same* box.

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

...and **plastic** in FIVE colors.



FLBC4560DGY
Gray

FLBC4560DCA
Caramel

FLBC4560DBL
Black

FLBC4560DLA
Light almond

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No. 4: Scaffolding

Scaffolding dropped from its No. 3 position in 2019 to No. 4 in 2020. The category saw a total of **2,538** violations compared to 2,813 citations in the previous year. The requirements of 1926.451 lay the groundwork for scaffolding-related safety measures; in most scenarios, each scaffold and scaffold component must be able to support, without failure, its own weight and at least four times the maximum intended load applied or transmitted to it. It is important to note that the standard does not apply to aerial lifts, the criteria for which are laid out exclusively in 1926.453.

No. 5: Ladders

This past year, **Ladders**, a category that is typically ranked in the lower half of this annual list based on past data, moved into the No. 5 spot from No. 6 in 2019. Despite moving up in ranking, however, the category saw 216 fewer citations in 2020 than in 2019, for a total of **2,129** violations. The Ladders category follows the requirements laid out in 1926.1053, which applies to all ladders, including job-made ones, at various types of job sites and locations.

No. 6: Lockout/Tagout

Lockout/Tagout dropped two rankings in 2020 to take the No. 6 position, making it one of the biggest changes to this year's rankings. It witnessed a total of **2,065** total violations compared to 2,606 in 2019 when it held the No. 4 spot. The 1910.147 standard covers the servicing and maintenance of machines and equipment in which the unexpected energization or start up of the machines or equipment, or releases of stored energy, could harm employees. Additionally, it establishes minimum performance requirements for the control of such hazardous energy.

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CABLE SPACER

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Quick, easy installation. *Just nail or screw The SPACER to a wood or metal stud!*

- Holds single or double row of power or low voltage cables:
  -One to eight 14/2
  -One to four 14/3, 12/2, 10/2
  -One or two 12/3
- Positions, fastens, routes power or datacom cable
- Complies with article 300.4(d) of NEC

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Screw-on CS14SC

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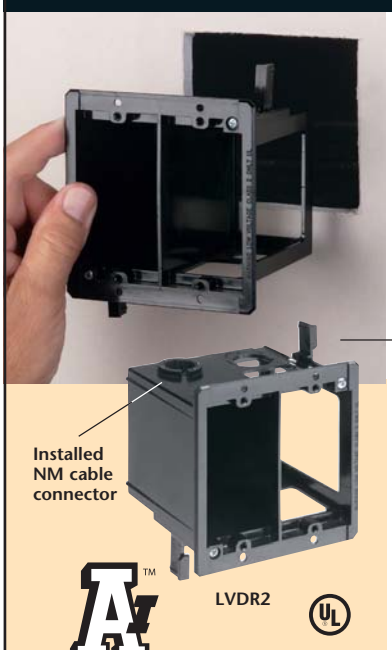
COMBO BOX

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)

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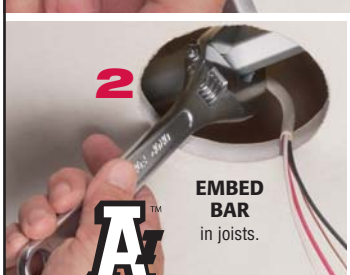
ADJUSTABLE BRACKET • EASY INSTALLATION IN EXISTING CEILING

FAN/FIXTURE BOX

HIGHER WEIGHT RATINGS



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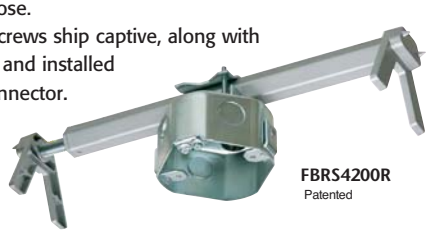
Arlington's extra heavy-duty, plated steel fan/fixture box with adjustable bracket has ***higher UL Weight Ratings***:
at 24" on-center: **70 lb Fan, 90 lb fixture**
at 16" on-center: **70 lb Fan, 150 lb fixture**

The 20.0 cu. inch FBRS4200R 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.



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

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No. 7: Powered Industrial Trucks

Maintaining the same spot from 2019, the **Powered Industrial Trucks** category ranks No. 7 with a total of **1,932** violations in 2020, which is 161 fewer citations than the previous year. Standard 1910.178 describes the safety requirements related to fire protection, design, maintenance, and use of fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks powered by electric motors or internal combustion engines.

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Courtesy of Western Area Power, Flickr

No. 8: Fall Protection — Training Requirements

Fall Protection — Training Requirements also held steady at the No. 8 position. While 2019 saw 1,773 total citations in this category, 2020 saw 152 less citations for a total of **1,621**. The requirements of this category are described in 1926.503, which states that employers shall provide a training program for each employee who might be exposed to fall hazards to enable each employee to recognize the hazards of falling and the procedures to be followed to minimize those hazards.

No. 9: Personal Protective and Lifesaving Equipment — Eye and Face Protection

Moving up one position from 2019 to No. 9, **Personal Protective and Lifesaving Equipment – Eye and Face Protection** had a total of **1,369** violations in 2020, only 42 less than the year before. This category is based on standard 1926.102, which requires that employers ensure each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.

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No. 10: Machine Guarding

Lastly, **Machine Guarding** moved down one spot in 2020 to No. 10. Standard 1910.212 requires that one or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area form hazards such as those created by point of operation, ingoing nip points, rotating parts, flying chips, and sparks. On a positive note, 2020 only saw **1,313** total citations in this category, down 430 from 2019.

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Arlington's aluminum *or plastic* **AnyBODY**™ ships as an LB, but converts *FAST* to a T, LL, LR or C by switching the cover plates and threaded flanges to create the style you need.

Easy and convenient, it saves you the hassle and cost of carrying five different conduit bodies.

- Competitively priced with LBs – ***NO EXTRA COST for the normally more expensive T*** – UL/CSA Listed
- **Plastic 1/2" to 4"** includes three flanges w/ glue-in pipe joint.
- **Aluminum 1/2" to 4"** includes threaded flanges for three openings. 1/2" to 2" are combination bodies: threaded for rigid, they also have a set-screw for use with EMT.

Aluminum T...C...LR...LL

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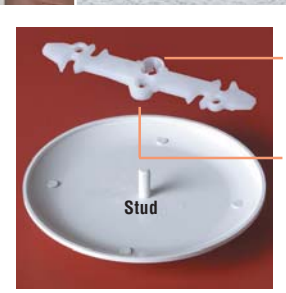
- Fits 3.5", 4" round or octagonal boxes

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 far enough to slip the bracket on.



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

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

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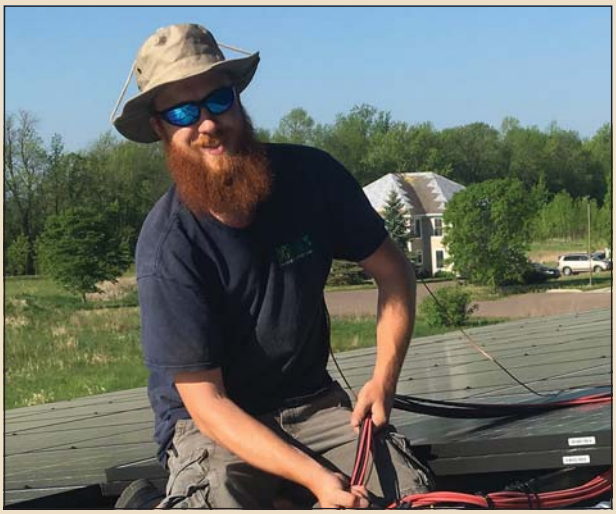

2021's 30 Under 30 *EC&M* Electrical All Stars

THROUGH HARD WORK, PERSEVERANCE, AND DEDICATION, THESE YOUNG ELECTRICAL PROFESSIONALS ARE MAKING THEIR MARK ON THE ELECTRICAL ENGINEERING AND CONSTRUCTION INDUSTRY.

By Amy Fischbach, Freelance Writer

To help power America during the pandemic, today's young electrical professionals are working behind the scenes to design and wire buildings and oversee new construction projects. To honor these up-and-coming leaders and essential workers, *EC&M* is proud to present its 2021 30 Under 30 All-Star honorees.

"I am honored to be selected to be part of *EC&M*'s 30 under 30 for 2021," says Clayton Wilkins, project manager for Koontz Electric. "My selected peers for 2021 are emerging leaders who will be paramount in the future success of our industry."

For 2021, *EC&M* honored electrical professionals in diverse roles — from engineering to electrical contracting to construction. The winners hail from cities nationwide and work for small businesses as well as some of the country's largest companies. Laura Vazquez, senior learning and development specialist at Power Design, says she is also proud to represent women in construction — especially in training and support roles.

"There is so much opportunity available in this industry. Being part of this list helps us to promote, and hopefully inspire, generations of future industry professionals," she says. "We're essential workers, and we're proud."

As a woman in a male-dominated industry, Karina Disarufino, scheduler and east region scheduling team lead for Henkels & McCoy, Inc., says she believes representation is vital for increasing diversity in the electrical industry.

"I am honored that members of my company would nominate me and hope to inspire women to look to jobs in the electrical industry as a viable, challenging, and rewarding career opportunity," she says.

The following profiles explore how these 30 young professionals got started in the industry, what a day in the life is like for them, and how they plan to reach their future goals.


Spig
SV1 ERO
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IES
Residential
Education Center
Class of 2019


COSTA


power design
LAURA VAZQUEZ


INC.

Zachary Allison says as a 25-year-old field supervisor, he knows how to effectively use technology and excels at communicating with the younger generation who is entering the electrical industry.

ZACHARY ALLISON

Job Title: Field Supervisor
Company: Weifield Group Contracting
Location: Brighton, Colo.
Age: 25; **Years on the Job:** 6
Interests: Spending time outdoors fishing, four wheeling, and hunting

Zachary Allison's father works in the civil side of construction, and he planned on following in his footsteps. When he realized it wasn't for him, the owner of an electrical company persuaded him that electrical was the only way to go.

He then attended four years of trade school at Independent Electrical Contractors-Rocky Mountain. In addition, he has completed training focused on motor controls, medium voltage, supervision, training others, and leadership.

"Completing four years of trade school really helped me to get to where I am today at Weifield," he says. "It taught me the ins and outs of electrical and also helped me to become the leader I am today."

He starts each day by being the first one on-site and ensuring his crews have the proper tools, materials, and layout for maximum productivity. After participating in a Stretch and Flex huddle, he supervises the workers to ensure everything is being installed correctly.

"My responsibilities have changed completely from the first years I started doing electrical work to now," he says. "I went from learning all the parts and pieces of the install to making sure everyone has the parts, pieces, and knowledge to deliver a quality product."

Recently, he managed a crew who installed the critical communication system for a 3.9-million-sq-ft Amazon distribution facility. He is currently working as a field supervisor on a design-build for Coors Tek based in Golden, Colo.

In the future, he hopes to eventually become a general manager or general superintendent and is excited and honored to be part of *EC&M*'s 30 Under 30.

"What sets me apart from others is my dedication and effort I give 110% of the time," he says. "I'm glad to see my hard work and dedication to the trade is paying off."

CAITLYN BIENIAK

Job Title: Apprentice Electrician
Company: Pieper Power
Location: Waukesha, Wis.
Age: 25; **Years on the Job:** 2.5
Interests: Hiking with her wife and dog, longboarding, and fixing cars. They have visited many states nationwide and enjoy finding new places to explore.

Caitlyn Bieniak's dad, mom, and grandfather are all electricians, sparking her interest in the trade.

"Coming from a long line of electricians, I always feel a sense of added pride in my work," she says.

Bieniak was born and raised in Waukesha County, Wis., and after enlisting as a diesel mechanic in the Marine Corps, she lived in California for four years before moving back to Wisconsin to start her apprenticeship.

So far, she has completed two-and-a-half years of her five-year apprenticeship program. As an apprentice, she has completed different labs and participated in simulations to be prepared for on-the-job situations. She also gained electrical experience while serving in the Marines, which molded her into a strong leader and instilled many positive traits in her — such as dependability, initiative, and drive.

"Working with electrical systems on vehicles in the Marines gave me important background knowledge that has proven useful in the field," she says.

As a second-year apprentice, she enjoys traveling to different job sites and learning new skills. At the same time, she is challenged by adapting to the pace of the job site.

"Some days, the pace is very quick, and there is a multitude of tasks to get done," she says. "Other days, you have to adapt to the pace of the other trades and work together to get everything completed in a timely manner."

She is currently working on a full remodel as well as an addition to a church built in the 1860s. In the future, she envisions working as a journeyman running jobs successfully for her company.

"I plan to finish my apprenticeship and constantly find ways to improve my knowledge in the field," she says.

As a woman veteran and electrical apprentice, Caitlyn Bieniak hopes to inspire others to continue working toward their dreams.

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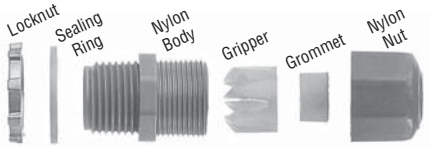
- Unique grommet and gripper deliver superior pullout resistance... and a liquid-tight, oil-tight seal when the nut is tightened



Connector Components LPCG50

- Sealing ring and locknut assure liquid-tight seal in knockouts
- Meets UL 35 lb pullout test

THREE COLORS

(GRAY) Catalog No.	Trade Size	Cord Range	Notes
LPCG503*	1/2	.100 - .360	* UL not applicable to wire dia. under .240
LPCG50*	1/2	.200 - .485	For BLACK connector add suffix BL; for WHITE add suffix W to catalog number.
LPCG507	1/2	.385 - .600	
LPCG753*	3/4	.100 - .360	
LPCG754	3/4	.200 - .485	
LPCG757	3/4	.385 - .750	

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Connector Components LPCG757SS

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CATALOG NUMBER S = Steel SS = Stainless	TRADE SIZE	CORD RANGE (DIA.)
LPCG503S*, LPCG503SS*	1/2"	.100 to .360
LPCG50S, LPCG50SS	1/2"	.200 to .485
LPCG507S, LPCG507SS	1/2"	.385 to .600
LPCG753S*, LPCG753SS*	3/4"	.100 to .360
LPCG754S, LPCG754SS	3/4"	.200 to .485
LPCG757S, LPCG757SS	3/4"	Grommet A .385 to .600 Grommet B .600 to .750

*UL listing not applicable for cords under .200" dia.

Wire strength will not meet UL 35 lb test requirements for fitting.

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JERRAD BRANTLEY

Job Title: Project Leader/Foreman
Company: Interstates Construction
Location: Abilene, Kan.
Age: 26; **Years on the Job:** 5
Interests: Spending time with his family and traveling

In high school, Jerrad Brantley helped build a pre-fab house from start to finish as part of his building trades class.

"I took interest in the electrical portion of the project. When I got into tech school, I found myself liking the industrial side the most, so I pursued that route," says Brantley, whose father served in the U.S. Army and who traveled around the country during his childhood.

For the last 12 years, he has lived in Kansas, where he completed a two-year program for electrical technology at Salina Tech. At Interstates, he says he has been able to work for and learn from talented people.

"Interstates invests so much time and resources to help keep improving myself and others around me," he says.

He started out in the trade as an apprentice but is now running his own jobs.

"I like being able to get out and work with my hands with people who share the same interest," he says.

For the last several years, he has enjoyed building relationships with different plants and owners in the feed milling industry and learning about new technology. For example, on a recent job for a feed mill, the team built the entire conduit system on virtual 3D scan and had 40,000 ft of conduit pre-fabbed off-site.

Jerrad Brantley takes the time to learn for himself and tries to help teach younger electricians.

"It worked out great," he says. "Technology plays a huge role for me and my crew."

He says he is honored to be selected for *EC&M*'s 30 Under 30.

"I can only imagine the amount of talent in the country of people under 30 in the electrical industry, so being chosen for the award means a lot," he says.

MIKE BRUNGARDT

Job Title: Design Engineer
Company: InPwr, Inc.
Location: Aurora, Colo.
Age: 25; **Years on the Job:** 4
Interests: In the summers, he summits each of Colorado's 58 14,000-ft peaks. In the winter, he huddles around the boil kettle making homebrew or cheering on the Colorado Avalanche hockey team.

As the grandson of a TV repairman and the son of a professional draftsman, the electrical industry came to Mike Brungardt in what he calls "a happy accident of colliding skills."

"Growing up, I had a circuit kit turning on lights and making sounds, so when I went to college with little idea of what I wanted to do, I picked the only area I knew a little bit about."

Raised in Aurora, Colo., he had a diverse spectrum of classes from circuit board design to green energy at Colorado State. The best education he received, however, was having his boots on the ground on-site for back-to-back disaster relief projects.

"Workers from all trades relied on each other under high pressure to complete the project," he says.

Now at InPwr, he is continuing to learn and expand his skill-sets outside of the office. For example, in the past year, he has become responsible for learning how to use surveying equipment to assist the field team with installing electrical underground.

"Seeing the ever-shifting nature of that work has influenced my design in areas I would have never considered before," he says.

At his job, there is nothing consistent about a day in his life, except for the inconsistency itself.

"Being in a small office in a small company, you are responsible for just about anything thrown at you. Although I have skills in AutoCAD, lighting design, and power design, it doesn't surprise me when I'm asked to spearhead something completely new," he says.

Case in point: He has not only learned surveying, but also created a standardized system of as-built drawings and managed other contractors for unique modeling. Recently, his company has won multiple design-build projects, and he expects to contribute to the drafting, power design, and lighting design. He considers himself a lifelong student.

"I am trying to learn and improve my craft every day," says Brungardt, who wants to thank his coaches, mentors, parents, and fiancée for their support in achieving success in his career.


Mike Brungardt enjoys working on design-build projects because they are challenging and ever-evolving.

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17 seconds
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*at $30.00/hour labor rate

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Catalog Number	Trade Size	Straight	90°
NMLT5	1/2"	✔	
NMLT905	1/2"		✔
NMLT7	3/4"	✔	
NMLT907	3/4"		✔
NMLT10	1"	✔	
NMLT9010	1"		✔

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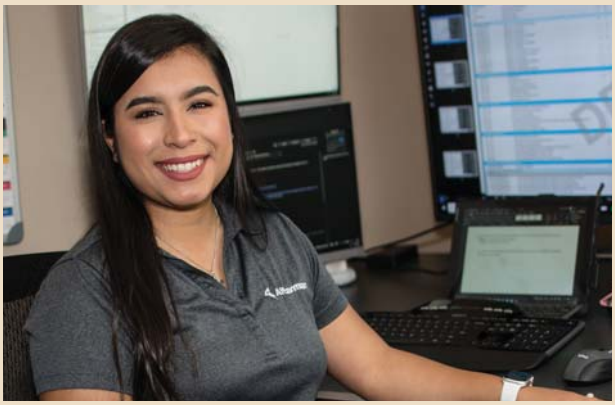

As a project manager, Melanie Cardenas will be able to run multiple jobs throughout her career, and each job comes with its own learning experiences and challenges.

MELANIE CARDENAS

Job Title: Project Manager
Company: Alterman, Inc.
Location: San Antonio
Age: 27; **Years on the Job:** 2
Interests: Loves to spend time with her husband, who is a cook, trying new foods, and baking

At the University of Texas-San Antonio, Melanie Cardenas took a construction management course, which steered her into a career in the construction industry.

During an internship at Alterman, she had the opportunity to dive into the construction world, which was very new to her at that time.

"Once I interned with Alterman, I realized my learning capabilities with an electrical contractor were immense, and it was a company that I wanted to grow and learn from," says Cardenas, who graduated with a bachelor's degree in construction management in 2018. "My internship allowed me to see the different aspects of the company, how they all work together, and how vital communication is between departments to collectively get the job done."

During the last two years at Alterman, she has taken initiative by enrolling in multiple electrical apprenticeship classes at the Joint Apprenticeship and Training Committee (JATC) to expand her electrical knowledge. As an assistant project manager, she worked under multiple project managers for two years, learning every leadership skill that she could.

Cardenas, who was recently promoted to a project manager position, says her daily work life varies, depending upon the day. She could be performing job-site walks, participating in meetings, or handling documentation.

Cardenas, who previously worked on a health care project, is now working alongside another project manager on some high-profile, mission-critical jobs. She hopes to one day be promoted to a senior project manager or a director.

"The only way to reach my goals is to continue to strive and do the best I can — and learn from my own experiences and potential mistakes," she says. "There is no excuse for not putting in hard work, so I plan on investing my time and future in this company."

EC&M ALL STARS 2021 UNDER 30

KEVIN CLEMENT

Job Title: Senior Project Manager
Company: Rosendin Electric, Inc.
Location: Arlington, Va.
Age: 28; **Years on the Job:** 7
Interests: Golfing, spending time with friends, watching hockey and football, and boating on the lake

Kevin Clement, who has several family members in the electrical industry, has always been interested in engineering and construction. Prior to working full-time, his interest in the electrical industry was validated by two internships with electrical contractors.

Born in Rochester, N.Y., he earned his bachelor's and master's degrees in architectural engineering from Pennsylvania State University. At Penn State, the architectural engineering program focused on team projects requiring members to solve problems. Now at Rosendin, he was selected to be a part of the Rosendin Leadership Academy to further grow his skill set.

"I believe what sets me apart from young professionals in the electrical trade is constantly listening to others," he says. "I also look at challenges and failures as opportunities to further develop personally as well as a team."

On a typical day, he starts out on the job site interacting with the field leadership team. Some of his other key responsibilities include negotiating contracts and change orders, working with the BIM/field team to organize the installation, and coordinating the electrical construction activities with the customer and field team.

"My responsibilities have changed from being more task-oriented to managing multiple people to successfully complete projects," he says. As a senior project manager, he enjoys working with customers to develop and improve the electrical design and prefabricate more components of the electrical work. Currently, he is finishing up a 430,000-sq-ft data center while starting two other data center projects.

In the future, he sees himself as a leader in the industry who is continuously pushing the boundaries of the electrical contracting industry.

"I plan to reach this goal by continuing to be a hard worker with a focus on building the people on our team while delivering value to our customers," he says.

On data center jobs, Kevin Clement is involved with managing the projects and working with the team to successfully deliver them.

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ONE-BOX mounts directly to a wood or steel stud for an extra-secure installation.

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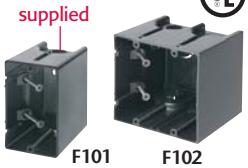
- Extra-large 22 cubic inch capacity (single gang)

NM cable connector supplied

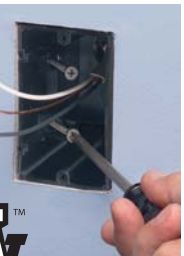


F101 *Single gang*
F102 *2-gang*

F101H *Single Horizontal*

Also** in 3-Gang, 4-Gang and **HORIZONTAL STYLES!

RETROFIT
Secure mounting to stud... *not the drywall*



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MEETS NEC

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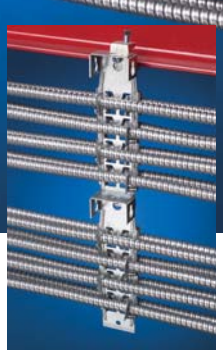

Hang Flex, MC or AC cables on a variety of surfaces in any direction

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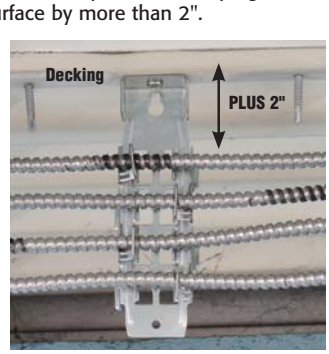
The outer surface of MC or AC metal jacketed cables installed *under* corrugated metal roof decking **must be 1-1/2" from underside of decking.**

Our SMC hangers *exceed* this requirement, keeping cable *away from* the deck surface by more than 2".



- Supports cables independently
- **Saves money** Use SMC Hangers in place of cable tray
- **Secures cable** Bend tabs over cable to lock it securely in place
- **Listed** to support, secure *up to eight* 14/2 to 10/4 cables as required by NEC 2020 (330.30)

SMC4 holds up to 4 cables. **SMC8** holds up to 8 cables. **SMC4F** mounts flat, holds up to 4 cables on one side.

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TIFFANY DENNING

Job Title: Estimator/Project Manager
Company: Nationwide Electrical Services, Inc.
Location: Goldsboro, N.C.
Age: 27; **Years on the Job:** 4
Interests: Riding down to Topsail Beach, going on bike rides, or taking long walks with her dog. She also enjoys working out/being active and taking hiking trips up in the mountains.

Tiffany Denning's family owns a commercial electrical business, where her uncle works as an electrician. Her father has also worked in the electrical industry for more than three decades. Born in Goldsboro, N.C., where she currently resides, Denning graduated from the University of North Carolina-Wilmington with her bachelor's degree in business management.

"My college experience prepped me for a career in project management by teaching me valuable time management skills and communication methods," she says.

Entering the electrical industry straight out of college, however, can be challenging. To succeed, she says it's important to keep an open mind and learn from the older generation.

"Not that many young professionals want to get involved with learning trade work. I feel like having a family background in the industry taught me how important the trades are and how solid the industry is," she says. "Always be on time, dependable, and work hard. These traits are so important, especially without having the electrical knowledge and experience when starting out."

Tiffany Denning says the future of the electrical industry and other trades continues from the growth her generation can bring.

For Denning, responsibilities change daily, but every day, she says there is something new going on — whether it's attending project meetings, checking site progress, or working at the office. Currently, she mostly focuses on estimating upcoming commercial projects, which include new school and fire alarm projects.

In the future, she sees herself as continuing on with large-scale projects and furthering her learning of the electrical trade.

"Currently four months pregnant with my first child, I am looking forward to teaching my little girl that she can be anything she wants to be, and her future career will not be limited by her age or gender," she says.

EC&M ALL STARS 2021 UNDER 30

KARINA DISARUFINO

Job Title: Scheduler and East Region Scheduling Team Lead
Company: Henkels & McCoy, Inc.
Location: Philadelphia
Age: 27; **Years on the Job:** 4
Interests: Hiking, traveling, and camping with her husband. She also enjoys archery, yoga, and cooking and hopes to one day pursue a yoga teacher certification.

As the daughter of a dentist and retired Navy senior chief, Karina Disarufino found her way into the electrical industry by happenstance. Born in San Diego, Disarufino was raised in Guam before moving to Southern Maryland for middle and high school. After earning her bachelor's degree in environmental studies with a minor in biology from Ursinus College, she worked for a biotech company in Philadelphia.

When she looked to switch jobs, she searched for a company that would invest in her professional development. After many applications and interviews, she accepted a position with Henkels & McCoy in their Growth Opportunities for Leadership & Development (GOLD) program, which has helped her develop analytical/critical thinking skills and expand her curiosity about the utility industry.

"These skills have allowed me to excel in the challenging, ever-changing field of electrical construction," she says.

She is now serving as a member of a large project team, working as a lead scheduler on a $500-million, multi-year project. While on-site, she interfaces with the project team to understand delays and schedule concerns. While at home, she uses collaborative platforms to stay up-to-date on project needs. She enjoys working with her project team and mentors.

"I am fortunate enough to work with people who are incredibly smart, innovative, passionate, and supportive," she says. "My team, along with my mentors, inspire me to be a better leader by encouraging clear communication, accountability, innovation, and confidence in my own decision making."

Over the next decade, she plans to continue to grow in the utility industry by challenging herself at work through mentorships and outside education opportunities.

"My goal is to become a leader in the industry that leads by example, sets high expectations, and creates an inclusive workspace that values critical thinking, teamwork, and problem-solving," she says.

Karina Disarufino is a co-chair for the Women in Construction group at Henkels & McCoy.

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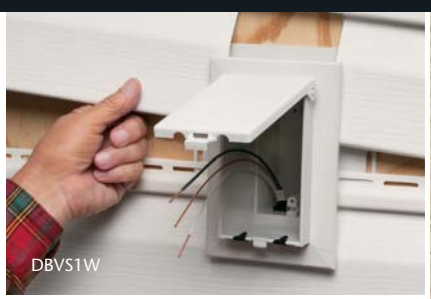
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Dominic Donofrio is helping his company to grow its Columbus, Ohio, office of operations, move to more privately funded projects in the medical and distribution markets, and expand its retail service network.

DOMINIC DONOFRIO

Job Title: Business Development Manager
Company: Enertech Electrical, Inc.
Location: Lowellville, Ohio
Age: 29; **Years on the Job:** 11
Interests: Spending time with his family, volunteering at church, hunting, and reading a good book

With a plumbing contractor for a grandfather and an electrical contractor for a father, Dominic Donofrio grew up in the trades. From sixth grade on, he worked in his father's warehouse. As he moved into high school and college, he spent his summers working on construction projects for Enertech.

"My parents encouraged us to work from a young age," he says. "As I was contributing my part to the family business, I learned more and more about the electrical trade."

In 2014, he graduated from the University of Akron with a bachelor's degree in business administration and construction management. He then joined Enertech full time and enrolled in the Independent Electrical Contractors apprenticeship program. In 2018, he graduated from the program as a journeyman electrician. Since that time, he has received electrical licenses in Ohio and West Virginia.

"My education paired with my trade school training has provided me with a good understanding of how the industry works," he says.

When he first graduated from trade school, he started running small projects, which turned into developing new clients for multimillion-dollar projects. Now that his job is focused on business development, he provides support in the day-to-day operations at Enertech and prospects clients.

"Doing client research and sales canvassing, as well as holding meetings with dozens of new clients every week, is challenging, but it is all worth it when we are able to secure a new client," he says.

In the future, he plans to work in a different management role at Enertech.

"As our company continues to grow, my responsibilities will change and grow with them," Donofrio says.

EC&M ALL STARS 2021 UNDER 30

EVAN EBANKS

Job Title: Superintendent
Company: Bates Electric
Location: Tampa, Fla.
Age: 27; **Years on the Job:** 8
Interests: Outdoor activities, including archery and camping

Evan Ebanks never envisioned himself going to college and working behind a desk in the corporate world. Instead, he was searching for a job where he could be outdoors.

"My dad has been in the trade since before I was born, and I have always been around the electrical trade," he says. "I like how you get to be hands-on and get to work your brain at the same time."

Ebanks, who grew up in the Tampa Bay area, completed a four-year vocational electrical apprenticeship program through Hillsborough Community College. He has also taken OSHA 10 and other training courses for lifts, trenchers, and excavators.

"In school, you learn a lot of codes, calculations, and more that you don't always see just being in the field," he says. "School also helped me to pass my journeyman test on the first try. I try to take any training courses I can that are offered to me so I can be as prepared as possible for any situation."

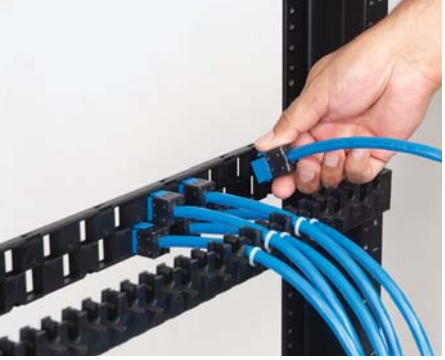
Right now, his company is working on a variety of projects from hotels to car dealerships to hospitals. Whenever his job is slow or at a stopping point, he looks to see how he can help on another project. As a superintendent, the most challenging part of his job is making the prints become a reality.

"A lot of times, things look really good on paper but don't work out so easily when bringing it to life," he says.

When it comes to the future, he is striving to move into a higher position, such as a project manager, and earn his master's electrician license.

"I'm going to keep soaking in all the experiences on the job that I can and taking all the training courses that I can," he says.

Bates Electric has meetings each month to discuss new tools, and Evan Ebanks says this investment in technology has helped to make his job much easier.



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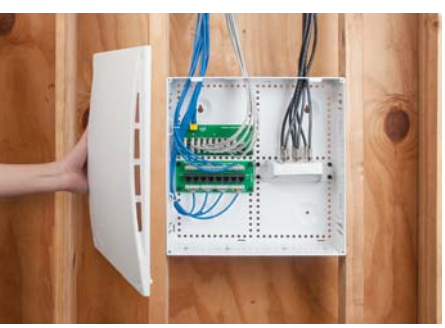

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Jacob Fetzner says he has gotten where he is today through hard work and dedication.

JACOB FETZNER

Job Title: Vice President of Residential Construction
Company: Titan Electrical Services of SWFL, LLC
Location: North Fort Myers, Fla.
Age: 25; **Years on the Job:** 7
Interests: Spending time with his wife and three children, dirt bike riding, woodworking, and playing video games

From a young age, Jacob Fetzner worked with his dad on electrical jobs in the field. He became quite familiar with stocking the truck, cleaning the warehouse, and how to clean up a job. When he was a senior in high school in Cape Coral, Fla., his father started his own company.

"I decided at that time it was a field I could excel in," he says. "I knew I already had a baseline of knowledge I could grow from."

After graduating from high school, he started working a full-time job for his parents' company, Titan Electrical Services, while also attending the electrical academy. He started in the field under other foremen, learning through the ranks. Upon completion of his apprenticeship program, he passed his state license exam on the first try.

"Many electricians don't have formal education — just on-the-job training," he says. "I wanted to learn the theory behind it, and by having that knowledge, I was able to understand many aspects of the field, which allowed me to move into leadership positions sooner."

He now manages 18 direct-report team members.

"My responsibilities have greatly increased with having a team under me to manage," he says. "I take great pride in making sure they are taken care of."

He is currently overseeing the operations of 36 custom-home projects.

"My favorite part of my job is seeing my projects go from paper to opening the door at the end of the project when the new owners are ready to move in," he says.

In the future, he endeavors to be a principal of Titan Electrical Services and help the company steadily grow and expand throughout the state of Florida.

"Much is to be learned, and as long as I continue to be teachable, the sky is the limit," he says.

EC&M ALL STARS 2021 UNDER 30

LANE FUNARI

Job Title: Project Manager
Company: The Superior Group
Location: Columbus, Ohio
Age: 26; **Years on the Job:** 4
Interests: Working out at the gym, reading books, kayaking, and hiking. He is also learning to speak Spanish and play the guitar — and enjoys traveling with his wife and doing home improvement projects.

As a graduate of The Ohio State University, Lane Funari blazed the way as the first in his family to graduate from a college or university. While majoring in construction management, he met a representative from The Superior Group, which sparked his interest in a career in the electrical industry.

Born and raised in a small suburb outside of Columbus, Ohio, Funari secured a part-time project engineer internship as a sophomore in college, and he worked full time each summer. Once he graduated in December 2019, he began his career in the commercial electrical construction industry.

As a project engineer, he performs daily job-site visits, manages submittals, RFPs, constraint logs, and material take-offs and procurement. In addition, he reviews labor projections and the budget, and manages the scope of work for subcontractors.

"When I started, I knew almost nothing about electrical construction. Since then, my responsibilities have changed a lot," he says. "I started with learning how to read drawings and specs, and now I'm given a lot of freedom and responsibility to help manage multimillion-dollar contracts."

While he says it's challenging to keep up on all the details on diverse projects — from data centers to higher education research facilities to correctional facilities — he loves all aspects of his job. He also enjoys testing out new technologies and finding ways to improve processes. For example, his company has expanded its engineering and virtual design construction groups to accommodate the needs of any project as well as explore new innovative prefabrication methods to best meet clients' needs.

"Technology is becoming more and more necessary throughout the construction industry," he says.

Funari recently was promoted to a project manager position, and he will be managing his own contracts for a private client data center.

"Construction is fast-paced and hectic at times, but I'm so happy this is where I landed," he says.


Lane Funari says his company supports his goals and provides him with the tools to be successful in his career in the electrical industry.

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UL 1640

UL 1640 applies to portable power distribution units (PDUs) which regulate and provide power to locations without adequate, existing distribution systems. To attain UL 1640 compliance in a construction site, a product must provide open neutral protection, along with standard GFCI protection.

UL 943

UL 943 provides specific requirements for ground-fault circuit-interrupters that adhere to the electrical installation codes of Canada, Mexico and the United States. As of May 5, 2021, UL 943 requires that products used in portable applications (in-line GFCI cordsets and Portable Distribution Units, for example) incorporate auto testing technology to further elevate worker and worksite safety.

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NICK GALLAGHER

Job Title: Project Manager
Company: Sunland Construction
Location: Austin, Texas
Age: 27; **Years on the Job:** 6
Interests: Spending time with family and friends, going to the lake, attending concerts, and woodworking

While earning his degree in construction science from Texas A&M University, Nick Gallagher worked multiple internships on wind farms and solar farms. Learning about the design, construction, and operation of wind turbines, solar tracking systems, the underground collection system, and substations inspired him to pursue a career in the renewable energy industry.

Gallagher, who was born and raised in Austin, Texas, also joined the Texas A&M Corps of Cadets, where he learned, practiced, and developed critical leadership skills.

"Professionally, on-the-job training with experienced superintendents and project managers provided an applied understanding of field operations," he says. "Managerial skills were obtained through formal leadership workshops, project management and scheduling courses, and installation training from product manufacturers."

The knowledge and leadership skills he learned in college are the foundation of his career, he says.

"Working in the field with craft workers, tradesmen, and superintendents provided real-world experience and taught me how to be a more effective construction manager," he says.

For example, he helped establish a new renewable energy division from the ground up, and he now contributes as a subject matter expert for wind, solar, and battery storage projects. His key responsibilities include client outreach, estimating, assistance with marketing, business, and financial planning.

"My favorite parts of my job include helping my peers learn about renewable energy projects and helping to establish this new division," he says.

In his current role, Nick Gallagher says each day is different and has its own set of challenges.

To communicate with his team, who are located from the Rockies to the East Coast, he uses Web-based collaboration tools and video conferencing.

"Technology is incredibly important to maintain communication and collaborate," he says.

Eventually, he sees himself as a higher-level leader in its renewable energy division. To reach this goal, he will help establish sustainable business practices, pursue viable new market opportunities, identify and overcome future challenges, and continuously hone skills for advancement.

EC&M ALL STARS 2021 UNDER 30

BRYCE HARTMAN

Job Title: Superintendent
Company: RES (Renewable Energy Systems)
Location: Citrus Heights, Calif.
Age: 26; **Years on the Job:** 7
Interests: Spending time with family and friends, playing golf, and taking on project cars or trucks

Bryce Hartman says he loves being a part of the industry and strives to keep bettering himself and those around him.

Bryce Hartman was exposed to the electrical industry from a very young age. His father is a third-generation journeyman lineman, who started working on greenfield substation construction in the early 1990s and now works on transmission lines and substations.

Hartman, who hails from Sacramento, Calif., started working in the industry two weeks after high school graduation. After taking industry-specific courses, he earned his certification in construction management from the University of California-Davis.

"I think my exposure to the industry starting at a young age has definitely given me the upper hand and matured my career very quickly," he says.

He attributes his training in construction/project management to helping him to become a more organized leader in the field.

"The knowledge I have on scheduling streamlines the work for the field and allows clarity for off-site management," says Hartman, who is working to obtain his PMP and CUSP Blue certifications.

Through the years, his work responsibilities have changed, but today, his job includes meetings with his foreman or the client, staging out materials for the crews, and performing quality control spot checks. His favorite part of his job as a substation superintendent is the critical thinking and problem-solving that go into creating a plan for his crew.

"Every job we build is different and poses new issues," he says.

Currently, he is working on a large solar field with multiple substations and 28 miles of transmission line.

"Five to 10 years from now, I see myself in an upper management role for operations helping to drive multiple crews to a safer, more efficient end result on all projects," he says. "I think young employees need to know a lesson my father taught me: If you're not learning something new every day, you are not working hard enough. I truly live by this quote, and think there are always smarter, faster, and — most importantly — safer ways of doing things."

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Jimmy Johnson says he would not be where he is today without his boss, George Tidden, who has trained and pushed him in his career.

JIMMY JOHNSON

Job Title: Instructor
Company: IES Residential
Location: Stafford, Texas
Age: 26; **Years on the Job:** 3
Interests: Walking his dog, longboarding, and brewing his own beer

Jimmy Johnson was inspired at a young age by his father, who worked as a heavy equipment operator for an electric company. His high school teacher, Mr. Schwartzman, also was a master electrician who had passion for the trade.

Johnson spent four years in the electrical program at Hartford Technical High School and then another four years taking night classes at Hartford Community College. During that time, he trained with several commercial and industrial electrical companies.

"The training I have received is the reason I had the opportunity to advance at such a young age," he says.

Johnson is currently teaching several electrical classes to students hailing from around the country.

"They are pushing me to learn the materials in all new ways," he says.

Over the years, he has helped train several hundred electricians, and he often starts his workday answering questions about the Code. He also walks jobs for quality or training purposes and teaches one of the nine weeks of employee training or continuing education/test prep classes.

As a master electrician, classroom instructor, supervisor, and field instructor, he says the most challenging part of his job is teaching electricians about rough-in and trim.

"There are always mistakes and unexpected complications, but it's interesting and challenging to keep everything running smoothly," he says.

His company is now offering online education classes four times a year for divisions located in Texas. Johnson is also working on putting electrical instructional videos online. He and his crew are also field testers for the Innovation Program, which is focused on finding new tools, methods, and processes.

"Today, technology is improving faster than ever before," he says. "Through putting information online and the Innovation Program, we are not just testing the latest tools, we are creating them."

Johnson plans to earn more master's licenses.

"I'll push the limits, and take the best opportunity in front of me with IES Residential," he says.

EC&M ALL STARS 2021 UNDER 30

BRENT KONKRIGHT

Job Title: Project Foreman
Company: Edgewood Electric, Inc.
Location: Edgewood, Ky.
Age: 21; **Years on the Job:** 4
Interests: Hunting, fishing, and spending time with his family

In high school, Brent Konkright was encouraged by his father to take an interest in the electrical trade. During his junior and senior years of high school, he enrolled in a vocational program at the Boone County Area Technology Center.

"While enrolled, I was offered a cooperative position with a local residential contractor and fell in love with the trade," Konkright says.

He now works with his younger brother, Ryan, who is in his first year of his apprenticeship at Edgewood Electric. Over the last four years, he has been enrolled in Edgewood University, the company's apprenticeship program. After graduating in May, he will pursue his electrical license in Kentucky.

In his current role, Konkright is responsible for working with electricians and other trades, coordinating deliveries with the general contractor, and ensuring his crews have the proper tools and materials.

"Every day poses different challenges — from weather to equipment deliveries being back ordered," he says. "I just try to stay positive and work with my project manager on remedying any and all issues that arise."

Edgewood Electric, which has a national footprint, is currently working on two refrigerated storage facilities in Dallas and Glendale, Ariz. He is also preparing to start a large project for Paul Hemmer Construction in Cincinnati.

Down the road, he looks forward to overseeing large industrial projects for Edgewood Electric. He would like to pursue a role in project management and assist with design on projects.

"I know that it will take time to achieve these goals, but with continued education, hard work, and studying under the management team at Edgewood Electric, I believe all my goals are attainable," he says. "I would like to thank my family, friends, and all of my coworkers who have helped me along the way."

At Edgewood Electric, Brent Konkright says he and the other project managers are always looking for ways to incorporate various labor-saving techniques to help their team members become more efficient.

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"…as for me and my house, we will serve the Lord." [Joshua 24:15]

Nichole Lutz says in the electrical industry, she has been training every day because there is always something new to learn.

NICHOLE LUTZ

Job Title: Technology Solutions Assistant Project Manager
Company: Encore Electric
Location: Lakewood, Colo.
Age: 27; **Years on the Job:** 2.5
Interests: Skiing, biking, and playing team sports; reading books; and hiking and adventuring with her pets

Born and raised in Houston, Nichole Lutz worked in the oil field for a year-and-a-half before switching to the electrical industry.

"My past experience helped me prepare for my current role in that it allowed me to develop my knowledge in applying different technologies to improve processes, troubleshooting, coordinating with multiple parties, interacting with diverse groups of people, adaption, quick learning, and other ways," says Lutz, a graduate of Louisiana State University with a degree in engineering. "My diverse career background has allowed me to be open-minded and to develop the skill of adaptation."

In her current role at Encore Electric, she participates in coordination meetings, reviews drawings, and keeps a close eye on the project budget. Since she first joined the company, her responsibilities have grown.

"When I first started, my main responsibility was to learn," she says. "Since I was new to the industry, this required a lot of research, going through drawings and other design documents, asking questions, and walking around the job site. From there, my responsibilities expanded to encompass management, training, quality control, and design-assist."

As the project manager of the Rocky Mountain Lions Eye Institute renovation project, Lutz is coordinating changes with subcontractors, participating in design, organizing the schedule, and managing/forecasting the budget. On this project, she says technology plays an important role.

"It is required to increase efficiency and maintain productivity," she says. "Through receiving feedback, our company is able to pre-emptively adapt to the needs of its clients and employees."

In the future, she sees herself in a position that she has the drive and passion for and is adding value.

"I plan to achieve this through trusting God in His plan for my life, accepting each challenge as an opportunity for growth, seeking mentorship and guidance from those with more experience than me, and pursuing growth in every area of my life."

EC&M ALL STARS 2021 UNDER 30

MATTHEW MANIACI

Job Title: Assistant Project Manager
Company: Fisk Electric
Location: Huntington Beach, Calif.
Age: 29; **Years on the Job:** 6
Interests: Hanging out with friends, playing board games, and spending time with his dog, Jameson

In college, Matthew Maniaci secured an electrical engineering internship early on in college.

"I verified the wiring on prefabricated substations, and I've been hooked ever since," says Maniaci, who recently moved from Chino Hills, Calif., to Huntington Beach to enjoy life by the ocean.

During his last year at California State University Long Beach, he worked as an intern at a construction company working on the Los Angeles Metro projects. Fisk Electric has three Los Angeles Metro projects, and he is working on a project near downtown LA's art district.

"I'm currently working on my fourth Los Angeles Metro project," he says. "With each project, I was able to take my experience from the previous one to do better on the next."

As an assistant project manager, he is charge of all the engineers for the electrical/systems subcontractor. His day starts at 7 a.m. and ends at 6 p.m., and he enjoys overcoming a new challenge every day.

Over the course of his career, he says he has been fortunate enough to work on some of the biggest construction projects in Los Angeles. Within the next five years, he sees himself as a project manager and plans to achieve this by mentoring with senior management.

"To succeed as a young employee in today's electrical industry, it's important to have a strong mentor to give you a strong foundation to build off of," he says.


With the amount of documentation required on modern-day projects, Matthew Maniaci says it's critical to invest in supporting technology. For example, Fisk Electric is implementing a new project management software.

Michael Miller is coordinating the installation of a 108-panel ground-mount solar system for Standard Energy Solutions.

MICHAEL MILLER

Job Title: Master Electrician and Construction Manager
Company: Standard Energy Solutions
Location: Columbia, Md.
Age: 29; **Years on the Job:** 12
Interests: Bow hunting, playing the guitar, and spending time with friends and family

Michael Miller, a licensed master electrician, fell into the electrical trade, which has blossomed into a fulfilling career for him. Over the last 12 years, he has invested in his life by being the best electrician and leader he can possibly be.

"I am a humble young man who is always trying to improve my knowledge along with those who work around me," he says. "I believe very strongly that you get out of something whatever you put into it."

After attending a four-year electrical program at Hartford Community College and acquiring his master's license, he started working as a master electrician for Standard Energy Solutions in May 2019. Since that time, he has attended Code change and arc flash seminars and attained his OSHA 30 certification.

To succeed in the electrical trade, he says it's important to have a go-getter mentality.

"There are plenty of people who show up, bend conduit, pull and terminate wire, and then go home," he says. "What separates someone from the pack is someone who asks why and is interested in being better and investing in themselves."

In his role, he is responsible for identifying any issues or concerns pertaining to upcoming projects, recruiting and interviewing potential job candidates, and performing job-site visits to review the quality of work. He also manages the crews for solar installations and helps maintain relationships with channel partners.

"My favorite part of the job is when everything on our install side is firing on all cylinders, and we are all working like a well-oiled machine," he says. "It's very satisfying, and it fills me with pride."

He says he sees himself continuing to grow as a person and an electrician.

"Since coming to the company I currently work for, I feel like I'm learning something new every day, which is awesome," he says.

EC&M ALL STARS 2021 UNDER 30

JOEL MUNSEY

Job Title: Electric Installer
Company: Connected Technology
Location: Roseville, Calif.
Age: 25; **Years on the Job:** 4
Interests: Spending time outdoors camping and backpacking in the mountains and along the coast

While taking electrical classes at his local junior college, a guest speaker from the Western Electrical Contractors Association (WECA) spread awareness about the electrical field and many the available opportunities.

"After learning that one could easily enter the field based on being an apprentice or trainee, it piqued my interest. From then on, I continued to pursue the trade," he says.

At Sierra College in Rocklin, Calif., he studied and practiced all the different trades, but he took a particular interest in the electrical and photovoltaic classes. After graduation, he began working with Zigg Electric in Granite Bay, Calif., where he learned much of the skills and practices that he uses today.

"I had plenty of one-on-one training," he says. "Steve, the owner, was literally full of information, and he wanted to teach me everything I needed to know for working in the industry."

At the same time, he took electrical training classes online with WECA, which taught him theory, the Code, and workmanship. He is still taking classes, but even after he becomes a journeyman this year, he wants to continue challenging himself and learning new skills and practices.

He started at Connected Technology as an apprentice in April 2020. Initially, he assisted lead techs with installations and delivering necessary parts. After a few months on the job, he was offered a position to become a lead technician.

"I am now the one calling the shots on how to proceed on installations and the best practices to keep integrity with our work," he says.

Every day varies due to the range of projects. The company specializes in residential projects on existing homes, but its main focus is EV chargers and home backup systems.

"As a lead technician, I enjoy being able to hook up and understand all the different types of installations and be able to train others in understanding them," he says.

Down the road, he sees himself with his own contractor's license or helping his current company succeed.

Joel Munsey says on every residential EV charger project, it's important to maintain integrity with each installation.

BRETT OLSON

Job Title: Assistant Project Manager
Company: EC Electric
Location: Portland, Ore.
Age: 25; **Years on the Job:** 2
Interests: Enjoying the beautiful Pacific Northwest hiking, floating the river, and snowboarding

Competing as part of his middle school's robotic team sparked Brett Olson's interest in electric power and tech systems. Born in Gresham, Ore., Olson majored in construction engineering management at Oregon State University. While attending college, he trained for the various tasks he would be performing as a project manager, including estimating, scheduling, planning, writing RFIs, budgeting, and examining financials. Now that he works for EC Electric, he says he has never lost the mindset of a student.

"Every day, I go to work with the expectation that I will learn something that will help me progress in my career — whether that be electrical install, management practices, or coordination of documents."

During a typical workday, he attends trade coordination meetings, prices change orders, modifies budgets, and solves issues as they arise on the project.

"Each day presents new challenges that need to be addressed and take an intuitive approach to solve," he says. "Because of this, the workweek never gets old, and I am able to learn in an interactive and dynamic manner."

He is currently working on Project Trident. Down the road, he sees himself as a project manager running his own projects.

"I plan on getting there by continuing to learn every day, surrounding myself with people who can teach me what is needed to know, and attending further education classes that will help prepare me for the future state of construction."

As the construction industry progresses, Brett Olson finds technology programs are becoming more integrated into the day-to-day progress of a project.

EC&M ALL STARS
2021 UNDER 30

JAMES PARKER IV

Job Title: Lead Fire Alarm Specialist
Company: Commercial Electrical Solutions
Location: West Wareham, Mass.
Age: 24; **Years on the Job:** 4
Interests: He and his dad enjoy building cars and driving them around. He has a 1987 IROC Z Camaro that he has done a lot of work on.

James Parker IV comes from a long line of journeyman electricians — his grandfather, father, and uncle are all in the trade. By working with his father and taking on a job at Commercial Electrical Solutions, he learned the ins and outs of electrical work.

"When I was little, my dad would bring me on little service calls, and I would just watch him figure stuff out," says Parker, who hopes to one day run a full construction job.

Now that he is working full time, he specializes in fire alarm wiring and systems. Some days, he works five or more small jobs. Other times, he spends his workday assisting the foreman with the fire alarm on a big project. For example, he installed all the fire alarm wires and devices at a Honda dealership so the foremen could concentrate on other tasks to keep up with the schedule.

"I am the fire alarm tech/get-stuff-done guy," notes Parker, who says he is good at retaining information.

In this role, he considers technology critical. "My boss is always asking me if there's a tool or anything that can help the job go quicker or easier," he says.

James Parker IV says in the electrical trade, you just need to have a good work ethic and the desire to learn.

KENNETH MICHEAL PYE

Job Title: Superintendent
Company: Amteck
Location: Charleston, S.C.
Age: 28; **Years on the Job:** 5
Interests: Spending as much time with his daughter as possible and hunting, fishing, and riding ATVs

Kenneth Micheal Pye's father was an electrician for 20 years before transferring into the low-voltage field for an additional 10 years. Upon high-school graduation, Pye started working for a small communications company directly for MUSC Healthcare.

The majority of his training has been in the field, working with phone systems, infrastructure cabling, network systems, access control, security camera systems, fiber-optic cabling, and managing multiple small projects. He has also earned many certifications with different manufacturers of copper and fiber products, access control, and security camera systems.

"My training has enabled me to view jobs differently than most and be able to work through difficulties and provide the most accurate solution," he says. "I am always pushing to learn new systems, software, install methods, and management techniques."

Every day is different, but oftentimes, he attends company and construction meetings and handles material management and purchasing. Over the course of his career, he went from running just one project to managing all service and small projects for his company. His company is working on a recabling project in health care buildings, and he is in charge of the access control and security upgrades.

Kenneth Micheal Pye says he has the ability to manage many different jobs with multiple teams while training new employees in various areas of the low-voltage field.

"My favorite part of my position is the ability to work with different leads on different job sites," says Pye, who sees himself in a senior project manager or branch operations management position in the future.

ARIYANA SADYKOV

Job Title: Safety Coordinator
Company: Sprig Electric
Location: Alameda, Calif.
Age: 27; **Years on the Job:** 1
Interests: Exploring and traveling, home décor, and cooking

Ariyana Sadykov grew up seeing her family members working in construction, and most are still in the trade. She was inspired to work in the electrical industry because she believes it is where the world is heading.

Ariyana Sadykov, who hopes to one day work as a safety director, strives to travel to at least 10 countries and be fluent in Russian and Japanese.

"I see electric cars on the road, and it still amazes me," says Sadykov, who was born in Los Angeles and raised in Las Vegas. "If someone was to tell me as a child that I would witness all of these innovations, I don't think I would have believed it."

Sadykov, who earned her bachelor's degree in occupational health and safety from Waldorf University, says walking different job sites and having the opportunity to use what she has learned helps her grow into a better safety professional.

"Working with the employees at the job site and building trust is something that was not taught but is required," she says. "Respecting people and loving what I do is the most essential part of the building of our safety culture."

As part of her job, she is responsible for inspecting all fall protection, rigging equipment, and hot suits before they are delivered to a job site. She also evaluates the equipment that has been returned, updates the safety inventory, and tracks where the equipment is located.

Because the company is experiencing a lot of jobs in which the employees must work on roofs, she FaceTimes with the workers to review the safety of their work processes.

"I see where they are tying off from, their anchor point, where they will be working, and what job task they will be doing," she says.

During her workday, she also files safety reports, handles incident claims with the insurance, and monitors, tracks, and logs employee certifications to ensure employees are qualified to perform tasks.

"The most challenging and favorite part is that every day is different," she says.

Ricky Smith, who is a fan of cordless tools, says technology in the electrical sector has helped him to tackle projects quicker and more accurately.

RICKY SMITH

Job Title: Lead Electrician
Company: Hill Electric
Location: Anderson, S.C.
Age: 27; **Years on the Job:** 7
Interests: Hanging out with his five-year-old son, who loves baseball, and going fishing

Back in 2013, the job Ricky Smith was working at was eliminated, and his friends encouraged him to apply for a position at Hill Electric. Smith, a high-school graduate with hands-on training, took their advice and called the company to explore opportunities.

Hill Electric, an industrial electrical contractor, gave Smith the chance to learn on the job as a helper. In five years, he worked his way up to an electrician. He says it's challenging to sit in a classroom and learn, and he obtained much of his knowledge by watching others on the job.

"The company is great at providing training and keeping us up to date on all the continuous learning opportunities," he says. "I have great bosses at Hill Electric who have helped me to grow my industrial electrical knowledge and encouraged my advancement."

He never considers his workdays stressful because he enjoys his job and the people. His favorite task is to run conduit.

"At times, when we have big projects with tight schedules, I am the lead point man," he says. "For me, the most challenging is control work. These are the types of areas I seek out help from my team leader."

The contractor specializes in process machinery, auxiliary equipment, and facility power systems for manufacturers in upstate South Carolina. For the last year, Smith has been assisting a long-standing customer that had a tornado hit its facility.

"We immediately jumped in to help, cleaning the site and then switching machines on busways," he says. "We are currently redoing all the data hubs and replacing the wiring."

As a 27-year-old electrician, he hopes to become a superintendent in five years at Hill Electric.

"I plan to do this by continuing to learn from my peers, many of whom have decades of experience at the company," he says.

SETH STEVENS

Job Title: Assistant Project Manager
Company: DC Energy Innovations
Location: Essex, Vt.
Age: 27; **Years on the Job:** 2
Interests: Playing disc golf, fishing, and going river swimming

When he was in high school, Seth Stevens remembers seeing electrical panels hanging on a back wall in his industrial electrical classroom. He was able to wire simple things like a lighting circuit, which made an impression on him.

"The hands-on experience when I was younger really made a difference for me," Stevens says.

After spending three years in high school doing residential and commercial wiring, he earned his associate's degree in electrical engineering from Vermont Tech. Stevens, who is on his fourth and final year to earn his journeyman's license, has been in the solar field for about a year-and-a-half now.

"I use what I have learned from going to class every day," he says. "There are a lot of things to think about when you are in the field. I am still an apprentice, so I lean on my foreman for guidance."

He says he enjoys what he is doing and has fun learning new things every day.

"When I first started in the company, I was more of a helper, but now I am more hands on with installing the solar equipment," he says.

Although currently a solar installer, he is transitioning to becoming a journeyman electrician. In his current role, he is working on a 46-panel, 19kW solar system. Beyond the installation, he is helping the engineering team with designing the placement of the mounting for the solar array.

In the future, he sees himself as being a key leader for the company and earning his master's license.

"I am always working to be better at what I do, and I plan to work hard and to keep improving and learning," he says.

Technology is always growing, and the electrical field needs more people, says Seth Stevens, who says the *EC&M* 30 Under 30 is a great way to show younger people how awesome it is to be an electrician.

TREY TAYLOR

Job Title: Commissioning Engineer
Company: Helix Electric
Location: Baltimore
Age: 25; **Years on the Job:** 3
Interests: Studying for his PMP test, refereeing, and traveling to different countries

As a college intern at Helix Electric, Trey Taylor had the opportunity to work on one of the largest projects in the company's history at the time. By walking out in the field with the superintendents and asking questions, he gained valuable knowledge about the ins and outs of the electrical trade.

"Coming in with little to no knowledge of the electrical industry, I can surely say that the mentors I've had with my time at Helix Electric have been extraordinary in my short success so far," says Taylor, who graduated with a bachelor's degree in applied physics from Indiana University. "You can learn all day about construction management in school or electrical engineering, but the only true value sessions you get is in the field working side by side with field superintendents, foremen, and others and starting to grasp the lingo and terms from them."

With a high-profile project and an accelerated schedule, his day-to-day activities and roles change by the hour. One of his favorite parts of his job was walking away from Fort Bliss Replacement Hospital in El Paso, Texas, knowing he gave his best effort into a very challenging job from a design aspect as well as construction.

"Knowing that I was able to build a state-of-the-art facility for the men and women of the United States Army is something I will always hold onto as my first project right out of college," he says.

To succeed in the electrical industry, one must be willing to put in long days and nights and learn from others in the industry, says Trey Taylor.

Looking ahead, he is open to adapting to a new city, different project, or team. He would also like to mentor others who come into the trade out of school with no background or experience.

"I will say for those who are nervous to jump into the electrical industry or have questions, they should try it out and jump into it," he says. "I believe it has been a great career choice and path, and I have made many connections along the way."

ALETHIA WALLEN

Job Title: Assistant Project Manager
Company: 5 Points Electrical
Location: Norcross, Ga.
Age: 29; **Years on the Job:** 6
Interests: Going to parks, reading books and manga, and working out at the gym

As a child, Alethia Wallen had a strong interest in heat, fire, and static shock; she also preferred remote-control vehicles over dolls.

"I always loved to take my father's tools and disassemble electronics around the house, much to my parents' dismay," she says. "As I got older, I turned to psychology, but my interest in the invisible particles that power society never disappeared."

When she was in between jobs, her cousin suggested that she give the electrical trade a try.

"I researched the company he worked for and the electrical trade as a whole, and I was really excited about the thought of a clear career path in which I can use my mental and physical abilities without being behind a desk or in sales," she says.

She started her journey in the electrical trade with Encore Electric in their prefabrication warehouse in Colorado and never looked back. Now at 5 Points Electrical, she has led commercial and residential projects as a field leader. She currently helps manage the Fulton County Government renovation project in the heart of Atlanta. Because all the construction work is done at night, she tries her best to be available — even if it is late in the evening.

"The success of the project is more important than a few minutes of sleep," she says.

Along with focusing on her day-to-day job, she is working to achieve project manager status, complete her engineering degree and the PMI certification, and obtain a master electrician license. She says she is honored to be selected as one of *EC&M*'s 30 Under 30 recipients.

"I can truly say that this is the best and most forward-thinking company I have been a part of, and I look forward to continuing my journey with it," she says.


Throughout the day, Alethia Wallen is pricing change orders, ensuring her projects are staying on schedule, reviewing drawings and specs, and communicating with general contractors about the progress of projects.

CLAYTON WILKINS

Job Title: Project Engineer
Company: Koontz Electric
Location: Morrilton, Ark.
Age: 26; **Years on the Job:** 6
Interests: Hunting, watching the Arkansas Razorbacks, spending time at the lake with family, and listening to music

Clayton Wilkins' brother, who worked as a construction manager and is now a manufacturer's representative, inspired him to work in the electrical industry. At age 18, he gained hands-on, on-the-job experience with Koontz Electric, which sets him apart from other young professionals in the trade.

"My first two summers as an intern, I worked as a field hand doing manual labor," he says. "Having boots on the ground will teach you things that can't be easily grasped or taught in a textbook."

In addition, he spent two summers in the office as a project manager's assistant, helping with bidding and estimating. Meanwhile, he worked toward his bachelor's degree in electrical engineering with a minor in math, marketing, and logistics from the University of Arkansas.

Once he began working full-time, he took on all the responsibilities involved with working as a project manager. He starts his 12-hour workday with a daily job hazard analysis and conference with the subcontractors on site. He then delegates tasks and reviews documents and drawings before wrapping up his day with a conference call, reviewing work completed and upcoming tasks.

"I enjoy working with the project owners, utility, general contractors, subcontractors, and Koontz personnel to quickly determine the best solution to a problem," he says.

He is serving as a project engineer for the Entergy West Monroe Reliability Improvement Project, and he says technology is critical for today's electrical firms.

"With increasing project complexity and multiple entities involved, technology is crucial for communication, scheduling, estimating, tracking project deliverables, cost analysis, and design," he says.

Clayton Wilkins has completed diverse safety training courses and certifications, which helps him to identify hazards on any given project.

In the future, he sees himself in an executive role with Koontz Electric, taking on more advanced projects. He plans to reach these goals by being a leader on the projects and assignments he is currently working on and building a relationship with industry peers.

EC&M ALL STARS 2021 UNDER 30

LAURA VAZQUEZ

Job Title: Senior Learning and Development Specialist
Company: Power Design
Location: St. Petersburg, Fla.
Age: 27; **Years on the Job:** 4
Interests: Playing guitar, camping, hiking with her fiancé, and playing video games

Born and raised in Miami, the electrical industry fell into Laura Vazquez's lap.

"I was green and didn't know much about it coming in, but as soon as I got in, I was amazed and wanted to know it all," she says. "My main goal was learning the industry well enough to be able to apply my expertise in education and technology and help our field teams perform more efficiently."

Laura Vazquez will continue to help her teams expand their skill sets as Power Design grows into a full-service, design-build MEP contractor and systems integrator.

Shortly after studying public relations and linguistics at the University of Florida, she began working in the training department at Power Design as a field trainer. After two years in that role, she was promoted to senior learning and development specialist and oversees the job site learning facilitators.

"Training is something I am very passionate about," she says. "If you take the time to listen to your audience and let them teach you, the way you teach them greatly improves. I continue to carry that mindset and stay curious about new technology to keep learning and grow my skill set."

Her workday starts with on-site training on a job site. For example, she could be training a new employee, helping a team with a specific application, or rolling out a new process. In the afternoons, she meets with her team and other departments to talk about recent trends, make plans for upcoming technology rollouts, and discuss training with project managers.

Currently, Power Design is piloting new processes and technologies to improve document, labor, and material management. She is working with the field training team and pilot groups to gather feedback prior to rolling these programs out to the entire company.

Leveraging technology in innovative ways is both the favorite and most challenging part of her role.

"I'm so grateful I work for a tech-driven company that champions technology and innovation as a core value," she says.

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Mastering the Art of Performing a Background Check

As hiring starts to pick back up, here's why every electrical employer must avoid cutting corners while rethinking old approaches to carrying out this seemingly straightforward task.

By Tom Zind, Freelance Writer

Although hiring may have slipped down the list of top priorities for electrical contractors coping with the ramifications of COVID-19 over the last year, it's almost certain to reassert itself as the pandemic subsides and work ramps back up. In fact, recent analysis from Associated Builders and Contractors (ABC) suggests the construction industry will need to hire approximately 430,000 more craft professionals this year (read "Construction Industry Faces Hiring Boom" [https://bit.ly/3eZWOks] for more details).

When and if that happens, contractors who have reduced headcount because of cancelled, scaled back, and postponed work could encounter fresh challenges reconstituting their workforces. And those needing to staff up will have to exercise a skill that may be a little rusty: the pre-employment background check.

Here's why this seemingly routine task may turn out to be more challenging than before. Reconnecting with laid off workers scattered over the last year by the pandemic might prove more difficult, many of whom may have since found other work or career paths. Therefore, fewer "known quantities" might be available. Then there's the persistent industry problem of finding people who want and/or are qualified to do construction-related work — one that could be magnified if a quick upturn in business forces companies en masse into a tight labor market.

Ultimately, any large-scale push to hire a lot of workers quickly from a smaller and thinner pool could test employers' ability to methodically vet applicants, and tempt them to take due-diligence shortcuts that could saddle them with workers who create workplace safety risks, productivity challenges, and costly turnover issues. At the same time, however, the industry's hardening labor market challenges, only compounded by the pandemic, might require companies to re-evaluate stringent qualification criteria that could hamper their ability to hire workers in a demand-exceeds-supply market. In other words, the process of checking applicant backgrounds might be starting to look less like a science and more like an art.

Here are a few timely considerations when it comes to thinking about applicant background checks:

Re-think those lines in the sand. Ruling out applicants with any kind of criminal record might not be operative in the real world of recruiting for some types of jobs today. Evolving views of fairness and bias in the criminal justice system, particularly as they relate to drug-related and other non-violent offenses, might dictate that employers show more tolerance for applicants with criminal records that surface in post-offer background checks.

"Think about what crimes you consider to be zero-tolerance; if you're too strict, you might find yourself in a place where it's very hard to find someone for some jobs," says Jared Rosenthal, CEO of Health Street, a New York-based company whose services include pre-employment background screening.

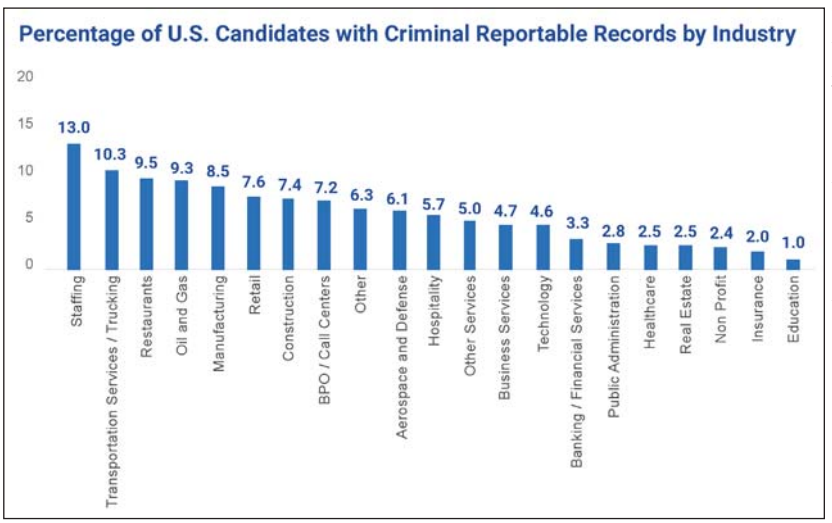


Fig. 1. Only six of 21 industry types had a higher reportable criminal record rate than construction in a recent survey from First Advantage.

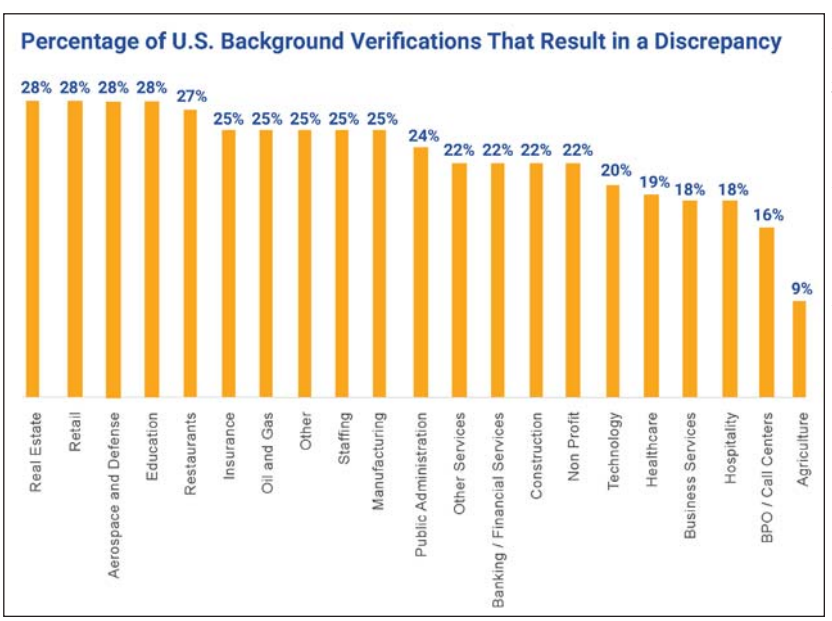


Fig. 2. According to a recent study from First Advantage, about 23% of applicants across 21 industries, on average, had verification issues on background checks, with construction logging about a 22% rate.

It's a dilemma that companies in the general construction space may be particularly likely to encounter. A study by First Advantage, an Atlanta-based workforce services company, shows that in 7.4% of background checks done for companies classified as "construction" in 2020, a reportable criminal record was found (**Fig. 1**). Only six of 21 industry types First Advantage serves had a higher "reportable record rate."

Drug usage is another evolving can of worms. New thinking about marijuana usage might be lessening employer concerns over convictions for simple possession. But at the same time, worries are growing over opioid usage, an issue of particular concern in construction. A recent Association General Contractors of America survey found 26% of contractors indicating it's more difficult to find applicants who can pass a drug test.

Resist the need for speed. Should hiring pressures mount amid rising competition for workers, companies could be tempted to rush background checks and hiring decisions. Smart hiring demands careful up-front consideration of candidate qualification criteria that will be incorporated into background checks, selection of partners capable of performing timely, but thorough checks and the patience to study and evaluate the results. Employers also must be armed with a thorough understanding of employment laws that might come into play if background checks reveal information that might disqualify candidates who've been offered conditional employment. Acting quickly to sew up top candidates could become more important, but it shouldn't come at the expense of fully knowing and evaluating a candidate's qualifications.

Stay alert to qualification discrepancies. Contractors employing skilled trade workers must know applicants have the skills, training, and experience to do the work competently and safely. Incorporating credential checks and detailed employment history into background checks for these workers is essential, and employers must examine results to be certain hires are who they say they are.

Checking educational criteria, licensing, and training could become more critical as the last year's pandemic may have disrupted employment, experience, schooling, and certifications for some applicants. Employers might have to be alert to workers eager to getting back to work as the pandemic recedes being less than forthright on qualifications. Education and employment verification discrepancies show up routinely in background checks, First Advantage data shows (**Fig. 2** on page 71). On average, about 23% of applicants across 21 industries had verification issues on background checks, with construction logging about a 22% rate.

Keep it professional. Doing background checks by the book and avoiding the temptation to do quick and dirty applicant Internet/social media searches, for instance, will be critical if a hiring frenzy begins. "You basically shouldn't Google the person," Rosenthal says. "You may find things that employment law says you can't consider during the hiring process. Background check companies like us will often find things the company shouldn't see, like records of arrests that don't result in a conviction or information that conflicts with the employment provisions of the Americans With Disabilities Act. We'll filter out that type of information." EC&M

Tom Zind is a freelance writer based in Lees Summit, Mo. He can be reached at tomzind@att.net.

Safety Equipment and Workwear

Lift-front hood

A lift-front hood has been added to the company's Ultralight series of arc-flash personal protective equipment (PPE). Highlights include a larger viewing area through a clear gray color shield that must be latched to keep operators safe within hazardous areas but can be lifted to easily facilitate compatibility with the company's hood ventilation system to ensure air circulation, provide cooling, and reduce the risk of dehydration. A headlight strap with an optional LED light provides illumination for working in poorly lit environments.

Cementex

Cut- and abrasion-resistant gloves

SmartCut BKCR2403 gloves are designed for users on jobs that require cut and abrasion resistance, along with long-wearing grip, dexterity, and flexibility. Lightweight, the 18-gauge high-performance polyethylene (HPPE) and glass-fiber shell offer ANSI cut resistance level 2 protection. The product features composite yarn that includes a blend of high-strength filament fibers for cut resistance, upwound with nylon and spandex for movement. A black, flat polyurethane palm coating offers abrasion protection and enhanced grip on dry surfaces.

Brass Knuckle

Leather and cut-resistant gloves

The company recently added leather gloves and cut-resistant touchscreen gloves designed to keep users connected with technology while remaining safe. The leather gloves feature professional-grade goatskin leather; knuckle and finger protection with PVC guards; mesh backing for breathability; ergonomic shape; EVA foam padding for extra comfort; leather thumb reinforcement for protection; and hook and loop closure on the cuff strap for a snug fit. The touchscreen gloves come in both ANSI A2 cut resistance and ANSI/ISEA 105-2016 cut level A4 varieties. Both CE-certified touchscreen models feature nitrile dip technology for enhanced grip; thumb reinforcement; seamless knit cuff; and the ability to be machine washed. Additionally, the Cut 2 gloves are rated for EN 388: 2015 4342 B, while the Cut 4 gloves are rated for EN 388: 201 4442 D.

Klein Tools

Safety vest

This high-visibility performance safety vest features 15 reinforced pockets, a clear ID holder, and a zippered rear tablet pocket. Additionally, it includes a padded collar designed for comfort and a reinforced pass-through for fall protection. Offered in both yellow and orange varieties, the garments are Type R Class 2-rated. They are also available in CSA/ANSI versions.

Milwaukee Tool

Remote boom

A remote boom control option has been added to the company's 1644, 1732, and 1075 models. This feature enables operators to control the boom from outside the cab and place material at height, achieving precision placement further onto a building, along with providing improved visibility during load placement. It can also potentially eliminate the need for two people. On telehandlers equipped with the remote boom feature, users can wirelessly operate engine startup, boom raise/lower, boom extend/retract, fork tilt up/down, and auxiliary hydraulics. When operating the remote boom control from the fork-mounted work platform, a platform docking station is required, which provides a stable surface to magnetically mount the remote-control box.
JLG Industries

Strut and threaded rod shear

The SHR strut and threaded rod shear is designed to cut strut that is burr-free and ready for installation. In 3 sec, the portable, hydraulic shear slices through Unistrut, Powerstrut, Superstrut, back-to-back strut, and threaded rod by a blade that is held securely in place by two knobs. Features include a precision-machined, ductile iron frame; 30-ton hydraulic cylinder; easy set up; quick-coupler that connects to any 10,000-psi power source (not included); a large top-mounted handle for easy transportation; marker notch to monitor cut lengths using a standard tape measure; adjustable backstop for rapid, repetitive shearing; and a quick-release lever for side-to-side movement. Additionally, the SHR provides toolless blade-set changes with front workpiece support that rotates out of the way.
Wilton

Industrial Ethernet tester

The LinkIQ-IE cable+network industrial Ethernet tester is designed to troubleshoot network cabling. Featuring a touchscreen interface, the tester offers a single-test approach that automatically provides the appropriate measurements based on what is at the other end of the cable. For an open cable, it shows the length and pairing. If the cable is terminated with the supplied remote, the test result shows the maximum data rate the cable can support (up to 10 Gbps). If connected to a switch port, LinkIQ-IE shows the name of the switch plus the port name, speed, and duplex. If PoE is advertised, it will display the power and class (up to 90W or Class 8) and then load the switch to verify the power can be delivered.
Fluke Networks

Conduit support systems

Calbrite BriteRail and FlatRail sanitary stainless steel conduit support systems meet HACCP and ASME food safety standards and USDA Pathogen Reduction rules. Features include polished 304 stainless steel, 180-grit "brite" finish for increased corrosion resistance and structural strength, few component parts, and a long-lasting design. Both models help improve conditions in hygienic environments by eliminating exposed threads and reducing areas where water can pool and harbor bacteria during the washdown process. In addition, the custom dome- or flat-shaped design of the strut decreases the risk of bacteria forming or debris buildup. The BriteRail version is certified for NSF/ANSI 169 standards.
Atkore

Outdoor smart plug

Designed for applications such as landscape and string lighting and some motors and pumps, the company has added an outdoor smart plug to its Caséta smart lighting control system. The IP65-rated plug features a solid-core construction to protect the device's inner electronics against dust and rain. In addition, the product offers wireless control via the free company app, voice command, or the Pico remote control; compatibility with Amazon Alexa, Apple HomeKit, Google Assistant, and Ring video doorbells and cameras; built-in smart timer; and Smart Bridge, which delivers reliable control without slowing a home's Wi-Fi.
Lutron

Rotary hammer

Using CORE18V PROFACTOR batteries, the SDS-max Hitman rotary hammer is designed to deliver performance comparable to corded counterparts. The GBH18V $1^{9}/_{16}$-in. model offers 5.2 ft-lb of impact energy (EPTA), while the GBH18V-45C 1⅞-in. model delivers 9.3 ft-lb of EPTA. Both feature rotary hammer and hammer-only modes with Vario-Lock positioning to rotate and lock the chisel. In addition, they offer soft start and controlled RPM and BPM for easy-to-control drilling and chiseling applications, with an on-tool interface for tool performance, feedback, and control. Other features include kickback control technology to reduce the risk of sudden tool reactions in bit bind-up situations and an anti-vibration system with a longer air cushion in the hammer tube and dampeners in the handle to help reduce vibration.
Bosch Power Tools

The Differences Between Grounding and Bonding — Part 5 of 12

To safely conduct any fault current likely to be imposed, electrical equipment must have bonding. This is often where the fun begins.

By Mike Holt, NEC Consultant

This article is the fifth in a 12-part series on the differences between grounding and bonding.

Let us start our discussion by focusing on the bonding requirements for services.

The metal parts of raceways and/or enclosures containing service conductors must be bonded together [Sec. 250.92(A)]. Use bonding jumpers around reducing washers and ringed knockouts for service raceways (**Fig. 1**). You can use standard locknuts to make mechanical connections to raceways, but you cannot use them as the bonding means [Sec. 250.92(B)].

Ensure service bonding by one of these methods [Sec. 250.92(B)]:

(1) Bond metal parts to the service neutral conductor. A main bonding jumper is required to bond the service disconnect enclosure to the service neutral conductor [Sec. 250.24(B) and Sec. 250.28]. At the service disconnect enclosure, the service neutral conductor provides the effective ground-fault current path to the power supply [Sec. 250.24(C)]; therefore, you don't have to install a supply-side bonding jumper in PVC conduit containing service-entrance conductors [Sec. 250.142(A)(1) and Sec. 352.60, Exception No. 2].

(2) Terminate metal raceways to threaded couplings or listed threaded hubs.

(3) Terminate metal raceways to threadless fittings.

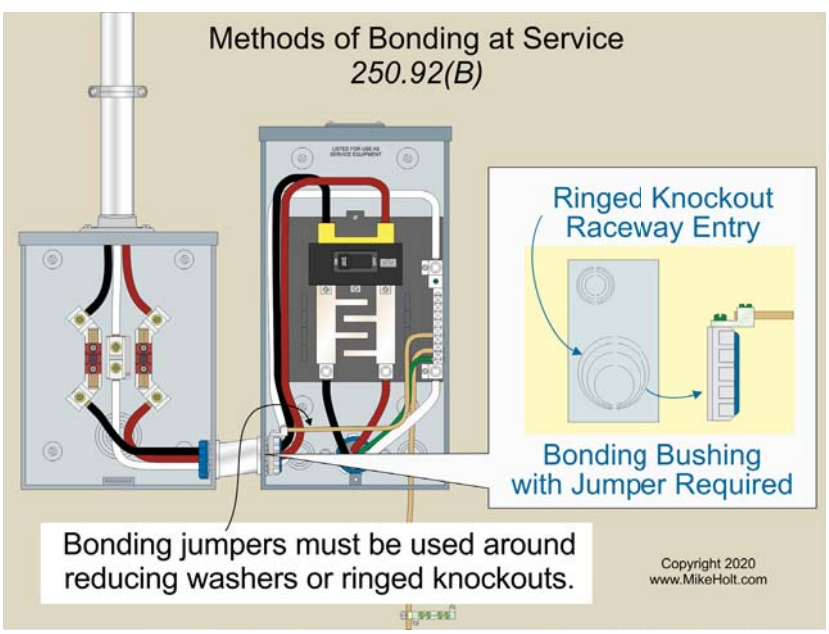


Fig. 1. Follow these requirements to properly bond equipment at a service location.

(4) Use listed devices, such as bonding-type locknuts, bushings, wedges, or bushings with bonding jumpers to the service neutral conductor. A listed bonding wedge or bushing with a bonding jumper to the service neutral conductor is required when a metal raceway containing service conductors terminates to a ringed knockout.

A supply-side bonding jumper of the wire type used for this purpose must be sized per Table 250.102(C)(1), based on the size/area of the service phase conductors within the raceway [Sec. 250.102(C)]. A bonding-type locknut, bonding wedge, or bonding bushing with a bonding jumper can be used for a metal raceway that terminates to an enclosure without a ringed knockout.

A bonding locknut differs from a standard locknut in that it contains a bonding screw with a sharp point that drives into the metal enclosure to ensure a solid connection. Bonding one end of a service raceway to the service neutral provides the necessary low-impedance fault current path to the source.

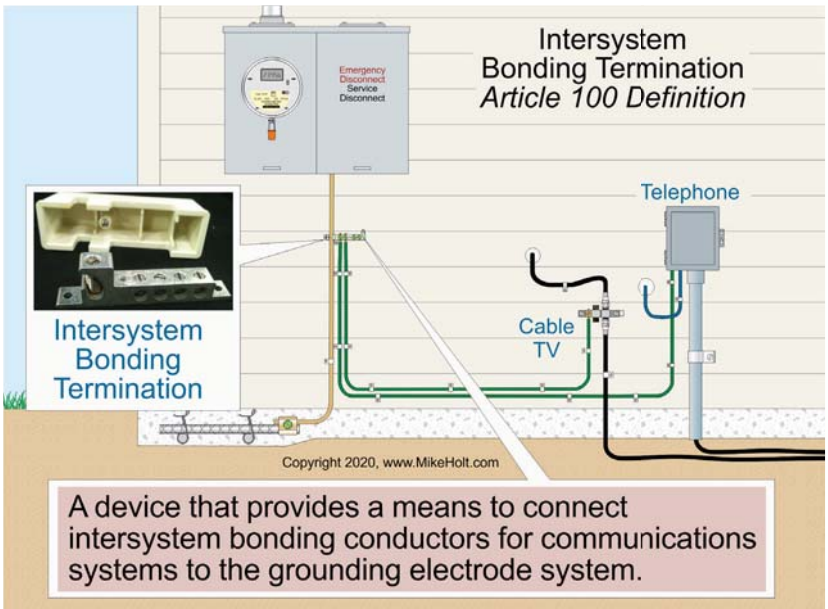


Fig. 2. An intersystem bonding termination device must meet all the requirements in Sec. 250.94(A).

BONDING COMMUNICATIONS SYSTEMS

A bonding termination device must be provided for communication systems [Art. 805], radio and TV equipment [Art. 810], CATV [Art. 820] and similar systems [Sec. 250.94]. You bond these different systems together to minimize voltage differences between them.

An intersystem bonding termination device must meet all the following requirements [Sec. 250.94(A)]:

(1) Be accessible.

(2) Have a capacity for at least three intersystem bonding conductors.

(3) Be installed so it does not interfere with the opening of any enclosure.

(4) Be securely mounted and electrically connected to the service disconnect, meter enclosure, or grounding electrode conductor (GEC).

(5) Be securely mounted and electrically connected to the building's disconnect or GEC.

(6) Be listed as grounding and bonding equipment.

Exception: An intersystem bonding termination device is not required where communications systems are not likely to be used.

An "Intersystem Bonding Termination" is a device that provides a means to connect communications systems' (twisted wire, antennas, and coaxial cable) bonding conductors to the building grounding electrode system [Art. 100] (**Fig. 2**).

BONDING METAL PARTS

Metal parts intended to serve as the equipment grounding conductors (EGCs) must be bonded together to ensure they can safely conduct any fault current likely to be imposed on them [Sec. 110.10, Sec. 250.4(A)(5), Sec. 250.96(A), and Table 250.122 Note].

Nonconductive coatings (such as paint) must be removed to ensure an effective ground-fault current path, or the termination fittings must be designed so removal is unnecessary [Sec. 250.12].

BONDING 277V AND 480V CIRCUITS

Metal raceways or cables containing 277V or 480V circuits terminating at ringed knockouts must be bonded to the metal enclosure with a bonding jumper sized per Sec. 250.122 [Sec. 250.102(D)].

Where oversized, concentric, or eccentric knockouts are not encountered, or where a box or enclosure with concentric or eccentric knockouts is listed to provide a reliable bonding connection, a bonding jumper is not required. But you must use one of the methods listed in the Exception to Sec. 250.97. For example, use two locknuts on rigid metal conduit or intermediate metal conduit — one inside and one outside of boxes and cabinets.

Equipment bonding jumpers must terminate by any of the eight means listed in Sec. 250.8 [Sec. 250.102(B)]. These include listed pressure connectors, terminal bars, and exothermic welding.

SUPPLY-SIDE BONDING JUMPER SIZING

Supply-side bonding jumpers must be sized per Table 250.102(C)(1), based on the size/area of the phase conductor within the raceway or cable [Sec. 250.102(C)(1)].

If the phase supply conductors are paralleled in two or more raceways or cables, then size the supply-side bonding jumper for each per Table 250.102(C)(1), based on the size/area of the phase conductors in each raceway or cable [Sec. 250.102(C)(2)].

A single supply-side bonding jumper installed for bonding two or more raceways or cables must be sized per Table 250.102(C)(1), Note 3, based on the equivalent area of the supply-side phase conductors [Sec. 250.102(C)(2)].

Let's take a look at an example to help clarify these requirements.

Question: What size supply-side bonding jumper is required for three metal raceways, each of which contain 400kcmil service conductors?

Answer: As per Sec. 250.102(C)(2) and Table 250.102(C)(1), you need a 1/0 AWG supply-side bonding jumper for each raceway. A single supply-side bonding jumper is permitted for multiple raceways based on the equivalent area of the supply-side phase conductors.

LOAD-SIDE BONDING JUMPER SIZING

Size bonding jumpers on the load side of feeder and branch-circuit overcurrent devices per Sec. 250.122 [Sec. 250.102(D)].

Let's examine another example to help clarify these requirements.

Question: What size equipment bonding jumper is required for each metal raceway where the circuit conductors are protected by a 1,200A overcurrent protective device (OCPD)?

Answer: If you use a single bonding jumper to bond two or more metal raceways, size it per Sec. 250.122, based on the rating of the largest circuit OCPD. In this case, a quick check of Table 250.122 shows us that a 3/0 AWG equipment bonding jumper is required (**Fig. 3**).

BONDING PIPING SYSTEMS AND EXPOSED STRUCTURAL METAL

Electrically continuous metal water piping must be bonded to one of the following [Sec. 250.104(A)(1)]:

(1) Service-disconnect enclosure.

(2) Service neutral conductor.

(3) GEC, if of sufficient size.

(4) One of the grounding electrodes of the grounding electrode system if the GEC or bonding jumper to the electrode is of sufficient size.

The metal piping system bonding jumper must be copper if within 18 in. of the surface of earth [Sec. 250.64(A)] and adequately protected if exposed to physical damage [Sec. 250.64(B)].

A ferrous metal raceway containing a GEC must be made electrically continuous by bonding each end of the raceway to the GEC [Sec. 250.64(E)]. The points of attachment must be accessible.

Size metal water piping system bonding jumpers per Table 250.102(C)(1), based on the size/area of the service phase conductors. These are not required to be larger than 3/0 copper or 250kcmil aluminum or copper-clad aluminum, except as permitted in Sec. 250.104(A)(2) and (A)(3).

Bonding is not required for isolated sections of metal water piping connected to a nonmetallic water piping system. In fact, these isolated sections of metal piping should not be bonded because they could become a shock hazard under certain conditions.

When an electrically continuous metal water piping system in an individual occupancy is metallically isolated from other occupancies in a building, the metal water piping system for that occupancy can be bonded to the equipment grounding terminal of the occupancy's switchgear, switchboard, or panelboard. Size the bonding jumper based on the rating of the circuit OCPD per Sec. 250.102(D) [Sec. 250.104(A)(2)].

The metal water piping system of a building supplied by a feeder must be bonded to one of the following:

(1) The equipment grounding terminal of the building's disconnect enclosure.

(2) The feeder equipment grounding conductor.

(3) One of the building's grounding electrodes of the grounding electrode system if the grounding electrode or bonding jumper to the electrode is of sufficient size.

Size the bonding jumper per Sec. 250.102(D), but it's not required to be larger than the largest feeder phase or branch-circuit conductor supplying the building.

Other metal-piping systems in or attached to a building must be bonded [Sec. 250.104(B)]. The piping is considered bonded when it is connected to an appliance that is connected to the circuit equipment grounding conductor.

Informational Note 1: Bonding all metal piping and metal air ducts will provide additional safety.

Informational Note 2: Further information can be found in NFPA 54, *The National Fuel Gas Code*, and NFPA 780, *Standard for the Installation of Lightning Protection Systems*.

Exposed structural metal that is interconnected to form a metal building frame must be bonded to one of the following [Sec. 250.104(C)]:

(1) The service-disconnect enclosure.

(2) The neutral at the service disconnect.

(3) The building's disconnect enclosure for those supplied by a feeder.

(4) The GEC where of sufficient size.

(5) One of the grounding electrodes of the grounding electrode system if the GEC or bonding jumper to the electrode is of sufficient size.

Author's comment: This requirement does not apply to metal framing members (such as metal studs) or the metal skin of a building.

Metal water piping systems and structural metal interconnected to form a building frame must be bonded to the transformer secondary winding per Sec. 250.104(D)(1) through (D)(3). For example, exposed structural metal used this way in the area served by a transformer must be bonded to the secondary neutral conductor where the GEC is connected at the transformer [Sec. 250.104(D)(2)].

Exception No. 1: Bonding to the transformer is not required if the metal structural frame serves as the grounding electrode [Sec. 250.52(A)(2)] for the transformer.

DON'T BE THE ONE AT FAULT

With all the details involved, an omission or oversight is likely when bonding for fault current. That could result in tragic consequences.

Try the following verification method. On an installation drawing, mark all the points where a bonding jumper should provide a fault path back to the source. Then walk down the installation with that drawing and markup what is missing. 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.

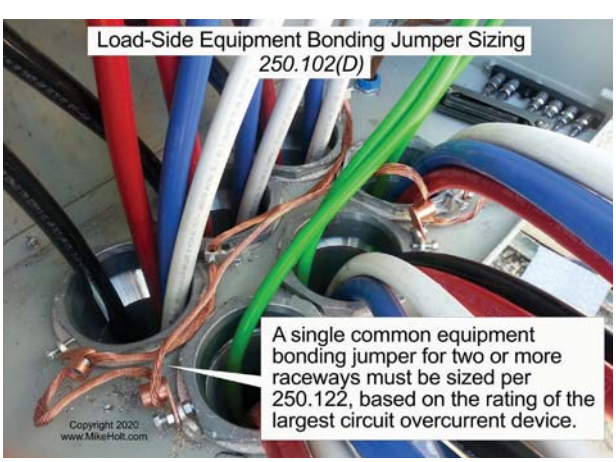
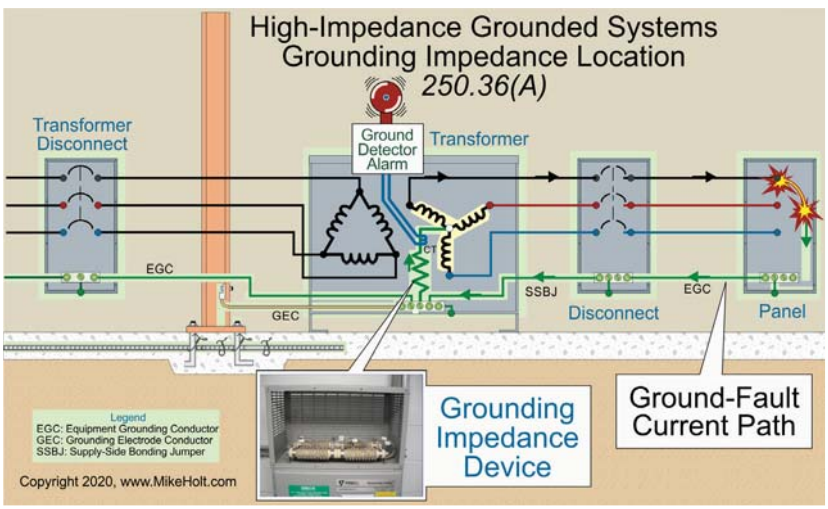


Fig. 3. Size the equipment bonding jumper based on the rating of the largest circuit overcurrent device.

Stumped by the Code?

By Mike Holt, NEC Consultant



High-impedance grounded systems have a resistor installed between the neutral point of the separately derived system and the equipment grounding conductor.

Based on the 2020 NEC. Underlined text indicates a Code change.

Q. What does the Code define as a dormitory unit?

A. Dormitory Unit. A building, or a space in a building, in which group sleeping accommodations are provided for more than 16 persons who are not members of the same family in one room, or a series of closely associated rooms, under joint occupancy and single management, with or without meals, but without individual cooking facilities [Art. 100 Definitions].

Q. What NEC conditions allow for the installation of high-impedance grounded systems?

A. To limit ground-fault current to a low value, a high-impedance grounded system is permitted to be installed on three-phase systems of 480V up to 1,000V where all the following conditions are met [Sec. 250.36]:

(1) Conditions of maintenance and supervision ensure that only qualified persons service the installation.

(2) Ground detectors are installed on the system.

(3) Only line-to-line loads are served.

Informational Note: According to Annex O of NFPA 70E, Standard for Electrical Safety in the Workplace, high-impedance grounding is an effective tool to reduce arc flash hazards.

Author's Comments:

- High-resistance grounding will insert an impedance in the ground return path and will typically limit the fault current to 10A or less, leaving insufficient fault energy and thereby reducing the arc flash hazard level. High-resistance grounding will not affect arc flash energy for line-to-line faults [Annex O NFPA 70E].
- High-impedance grounded systems are generally referred to as "High-Resistance Grounded Systems" in the industry. These systems are generally used where sudden interruption of power will create increased hazards and where a reduction of incident energy is needed for worker safety.

(A) Grounding Impedance Location. A grounding impedance is typically a resistor installed between the neutral point of the separately derived system and the grounding electrode conductor (**Figure**).

Q. What is the Code rule for the connection of a portable generator to a grounding electrode?

A. Section 250.34 Generators — Portable and Vehicle- or Trailer-Mounted

(A) Portable Generators. A portable generator is not required to be connected to a grounding electrode (grounded) if both [Sec. 250.34(A)]:

(1) The generator only supplies equipment and/or receptacles mounted on the generator.

(2) The normally noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame.

Q. What is the Code rule for the connection of a vehicle- or trailer-mounted generator to a grounding electrode?

A. Section 250.34(B) Vehicle- and Trailer-Mounted Generators. Vehicle- and trailer-mounted generators are not required to be connected to a grounding electrode (grounded) if:

(1) The generator frame is bonded to the vehicle or trailer frame.

(2) The generator only supplies equipment or receptacles mounted on the vehicle, trailer, or generator.

(3) The normally noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame. EC&M

Illustrated Catastrophes

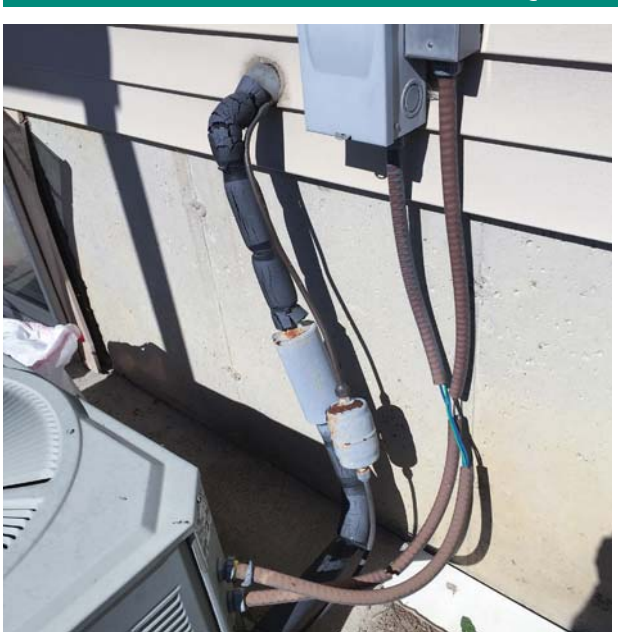
By Russ LeBlanc, NEC Consultant

All references are based on the 2020 edition of the NEC.

WHEW! THAT WAS A CLOSE CALL

A mere ½ in. closer, and this screw could have done some serious damage to the EMT and conductors inside. This is a great example of why Sec. 300.4(E) requires raceways, cables, and boxes to be installed and supported to provide no less than 1½ in. of separation between the lowest surface of the metal-corrugated sheet roof decking and the top of the raceway cable or box. Screws such as the one in the picture are often used to hold down insulating materials when repairs are made to rubber membrane roofs. The workers making the roofing repairs have no way of knowing if the screw they are installing will be catching the high part or low part of the metal corrugated roof, so they use very long screws in order to guarantee that the screws will grab something. If raceways or cables are installed too close to the metal roof decking, they can be damaged by these long screws. I have gotten many service calls to make repairs to cables and raceways damaged during these types of roofing repairs. Securing cables and raceways directly to the metal roof deck was a very common practice until the Code finally prohibited it in 2002.

A NOT-SO-LIQUIDTIGHT INSTALLATION



I will certainly give this installer credit for installing the Class 2 control wires in a raceway separate from the power wires feeding this air-conditioning equipment. Section 725.136 generally requires Class 2 and Class 3 circuits to be kept separated from power conductors and provides several methods to achieve this separation. However, the choice to install liquidtight flexible nonmetallic conduit (LFNC) in this outdoor, sun-drenched area may need to be reviewed. Section 300.6(C)(1) requires nonmetallic raceways exposed to direct sunlight to be listed or identified as being sunlight resistant. Section 356.10(3) does permit LFNC to be installed in outdoor locations if the LFNC is listed and marked for this purpose. According to the product standards, LFNC suitable for installation outdoors is marked "outdoor." The LFNC in this photo has been so damaged by the sunlight that I could not read any of the markings on it. In fact, the LFNC was so dry and brittle that it had cracked and completely separated. Perhaps this LFNC was not suitable for this outdoor location. Sunlight combined with extreme cold in the winter and extreme heat in the summer has taken a severe toll on this raceway, and it needs to be replaced.

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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 2020 NEC.

Hint: Which way is up?

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

Using the 2020 NEC, correctly identify the Code violation(s) in this month's photo (in 200 words or less) and you could win an Arlington Industries SL1B18 SLIDER BAR kit, which includes the SLIDER BAR and single-gang nonmetallic box with installation screws and slider clip. E-mail your response, including your name and address, to russ@russleblanc.net, and he will randomly select three winners (excluding manufacturers and prior winners) from the correct submissions. Submissions without an address are not eligible to win.

MAY WINNERS

Our two winners this month were Jeff McKinley, owner/proprietor of Electri-Cal Co. in Riverside, Calif., and Michael Wireman, an *EC&M* reader from Richland, Wash. They were both able to correctly cite Code violations in this photo.

I spotted this vintage installation while shopping for antiques in an old barn, which was converted into an antique shop. The NM cable entering the bottom of this 4-in. square box came up a little short, but the installer connected it anyway. Section 300.12 requires cable sheaths to be continuous between boxes, cabinets, fittings, outlets, or other enclosures. A close look at that same NM cable reveals that the cable does not contain an equipment grounding conductor. Do you think the metal box is grounded and bonded as required by Sec. 314.4? I was not able to remove the cover to make this determination, but I am still curious to know. The missing knockout seals on the side of the box are a classic violation of Sec. 110.12(A), which requires unused openings to be closed in a manner that provides protection substantially equivalent to the walls of the enclosure. The use of uninsulated cable staples was a very common practice and is not prohibited by Code.

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