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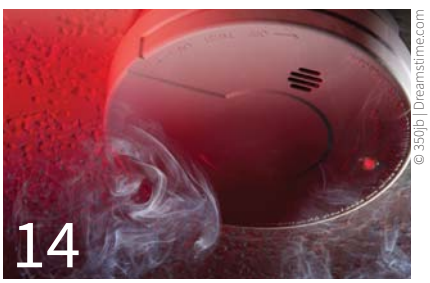

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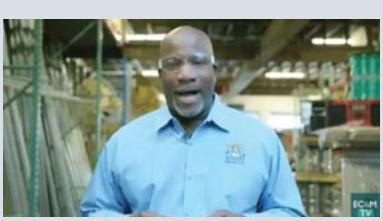

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Video ▶ In Episode 10, Electrical Trainer Harold De Loach reviews definitions found in Art. 100 of the National Electrical Code.

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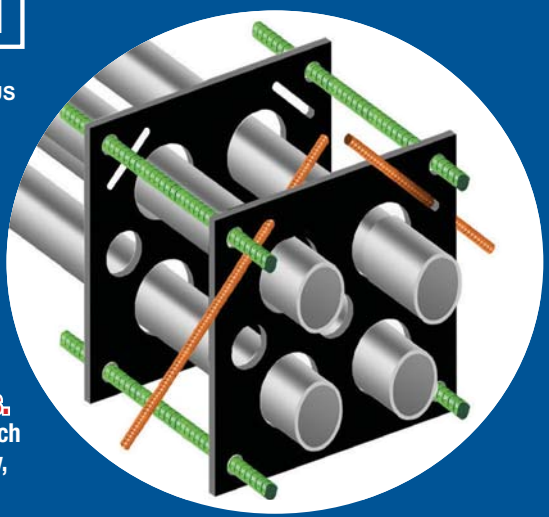

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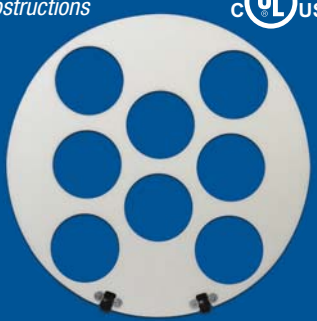

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Ongoing Worker Shortage Woes

By Ellen Parson, Editor-in-Chief

When it comes to worker shortage woes, everyone in the electrical industry feels the pain, at least to some degree — whether you're a small mom-and-pop shop, a mid-size electrical contracting firm, or a multi-million-dollar consulting engineering firm. The problem is obviously not a new one. As long as I've been covering the construction market for the past 25-plus years as a journalist, employers have struggled to recruit and retain electrical professionals from entry level to senior management. When you actually dig into the numbers, it can really make your head spin. Take the last few days as an example. I recently noticed two press releases that crossed my desk two days apart from the same organization (Associated Builders and Contractors) that expressed much different outlooks.

On March 8, the headline read, "Construction Job Openings Plummet by a Shocking 240,000 in January." That stat definitely caught the attention of ABC Chief Economist Anirban Basu. "While the total number of job openings economy-wide stood at a lofty 10.8 million at the end of January, meaning that there are still nearly two job openings for every unemployed American, the number of construction job openings plummeted from 488,000 in December to 248,000 just one month later, according to the JOLTS (U.S. Bureau of Labor Statistics' Job Openings and Labor Turnover Survey) report," he said in the press release. "In other words, almost one-half of all construction job openings disappeared in a single month." Then, on March 10, "Construction Adds 24,000 Jobs in February" read the next headline from ABC. Given the February jobs report data, Basu suggested this data point was likely an aberration. "Both residential and nonresidential contractors added jobs in February, which is consistent with ABC's Construction Confidence Index, indicating that many contractors continue to seek additional staffing," he said, noting that while industry momentum persists, the jobs report suggests the Federal Reserve still has considerably more work to do to slow the economy. "Construction industry momentum may falter at some point in the future as project financing becomes increasingly expensive. That said, some contractors will continue to have significant workflow even in the instance of an economy-wide recession."

In this issue, we have several articles that address different aspects of the skilled worker shortage. First, the article (on page 18) by Garrett Wilson, president of Fieldbin, sheds light on different outreach strategies and technological advances that are helping electrical contracting companies and engineering firms reach the next generation of electrical workers. While companies can certainly try to entice workers out of retirement (as one approach), he maintains the bigger issue confronting the industry is how can the profession get younger — and do so as fast as possible to meet current market demand and sustain it into the future.

Harold De Loach, a master electrician and electrical trainer/instructor for more than 30 years, has been on a mission to combat the ongoing worker shortage for years now — educating the younger generation on the benefits of entering and working in the electrical trade as well as motivating them to persevere and succeed in the real world. The founder of The Academy of Industrial Arts in Philadelphia and longtime contributor to *EC&M* magazine through his popular column in our monthly eTrain newsletter, De Loach is making a difference in the lives of electrical apprentices. In his article, "Tips for Passing an Electrical License Exam," starting on page 30, De Loach offers best practices that have consistently produced positive results with his students.

In today's market, *any* job opening is tough to fill. With an obvious shortage of electrical professionals for the foreseeable future, read the article on page 38 to find out why some positions prove to be tougher than others to staff. In "People Skills," Freelance Writer Tim Kridel puts all of the employment data into perspective, identifies top challenges faced by electrical contracting companies and design firms alike, and examines innovative ways to reach passive candidates and boost recruiting efforts.

These articles gave me a much greater perspective on the underlying factors that affect the ability of electrical firms to successfully staff their work forces. Unlike years ago — when I entered the job market in the mid-1990s, for example — most young people seeking employment were primarily motivated by compensation, career advancement opportunities, or simply the ability to secure and keep a job. Today — for better and for worse — the scales have shifted. And many of today's next generation of workers (electrical and otherwise) value a whole new set of nontraditional incentives that might persuade them to choose one employer over another. The companies that figure out how to appeal to them first will inevitably gain a serious competitive advantage.

Ellen Parson

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Don't Have a Blast

Seven ways to reduce arc flash incident energy

By David Rewitzer, Hood Patterson & Dewar

Arc flash reduction methods must be considered before working on energized electrical equipment for personnel safety. The idea behind energy reduction is to place energized electrical equipment in a state where less arc energy is available when an arcing fault occurs. These techniques range from the obvious (de-energize!) to more complex and costly engineering solutions.

Section 240.87 of the 2011 NEC, initially titled "Noninstantaneous Trip," was added to address breakers without an instantaneous tripping function to trip breakers with no intentional delay. In the 2014 NEC, the title changed to "Arc Energy Reduction" with the intent to improve worker safety by reducing the arc flash incident energy (AFIE) on a circuit breaker that can be adjusted at 1,200A or higher.

Section 240.87 of the 2020 NEC lists seven methods to reduce arc flash energy — whether in initial design/construction or on a retrofit project. Each of the seven methods comes with pros and cons. Let's take a look.

METHOD 1 — ZONE SELECTIVE INTERLOCKING (ZSI)

ZSI establishes a higher level of sophistication by reducing intentional short-time and ground-fault delays to shorten the fault-clearing time using communications between upstream and downstream breakers. In an existing selectively coordinated system, this communication scheme permits faults to be isolated and cleared by the nearest upstream device without an intentional time delay.

Pro: Allows selective coordination for faults outside of the zone and quick response for faults inside the zone (no intentional time delay).

Con: Requires hard wiring between each device, which can get complicated and tedious to install and test, making cost a factor.

METHOD 2 — DIFFERENTIAL RELAYING

This method requires the use of programmable relays to detect and compare multiple currents to clear faults. The basic protection concept is that the current flowing into the protective zone equals the current flowing out of the protection zone. Traditionally, differential relaying is used for medium-voltage applications. This method is typically designed and installed as a custom product.

Pro: Site and application-specific.

Con: Requires installation of relays and large current transformers (CTs) with increased space requirements, adding cost.

Data centers practice maintenance testing and require at least one of the arc flash mitigation methods.

METHOD 3 — ENERGY-REDUCING MAINTENANCE SWITCH (ERMS) WITH LOCAL STATUS INDICATOR

Manufacturers offer this option as an integral feature of circuit breakers that provide for installing a remote switch and indicator light. An ERMS switch is the second set of protection settings on a trip unit, typically with a lower instantaneous setting, designed to trip a breaker without any intentional delay during an arcing fault event. For example, let's say protection settings A are used in normal operations and selectively coordinated with upstream and downstream equipment. Along with this coordinated system, there is a high AFIE. The maintenance switch is activated when performing maintenance on downstream equipment, switching to protection settings B, which alters settings to lower the AFIE. Once maintenance has been completed, the ERMS will be switched back to normal mode with protection settings A now activated (along with the higher AFIE).

This is a simple design in theory with one possible drawback: In some instances, the maintenance switch does not get switched back, leaving protection settings B still activated. This allows settings overlap or mis-coordination between that device and downstream equipment, hence the reason for the local status indicator light. This oversight can have negative consequences depending on the load it is serving and could result in nuisance tripping.

Note: Manufacturers differ in their philosophy regarding protection settings B. For example, some manufacturers' protection settings B automatically set the instantaneous settings too low, while others allow B settings to be programmed,

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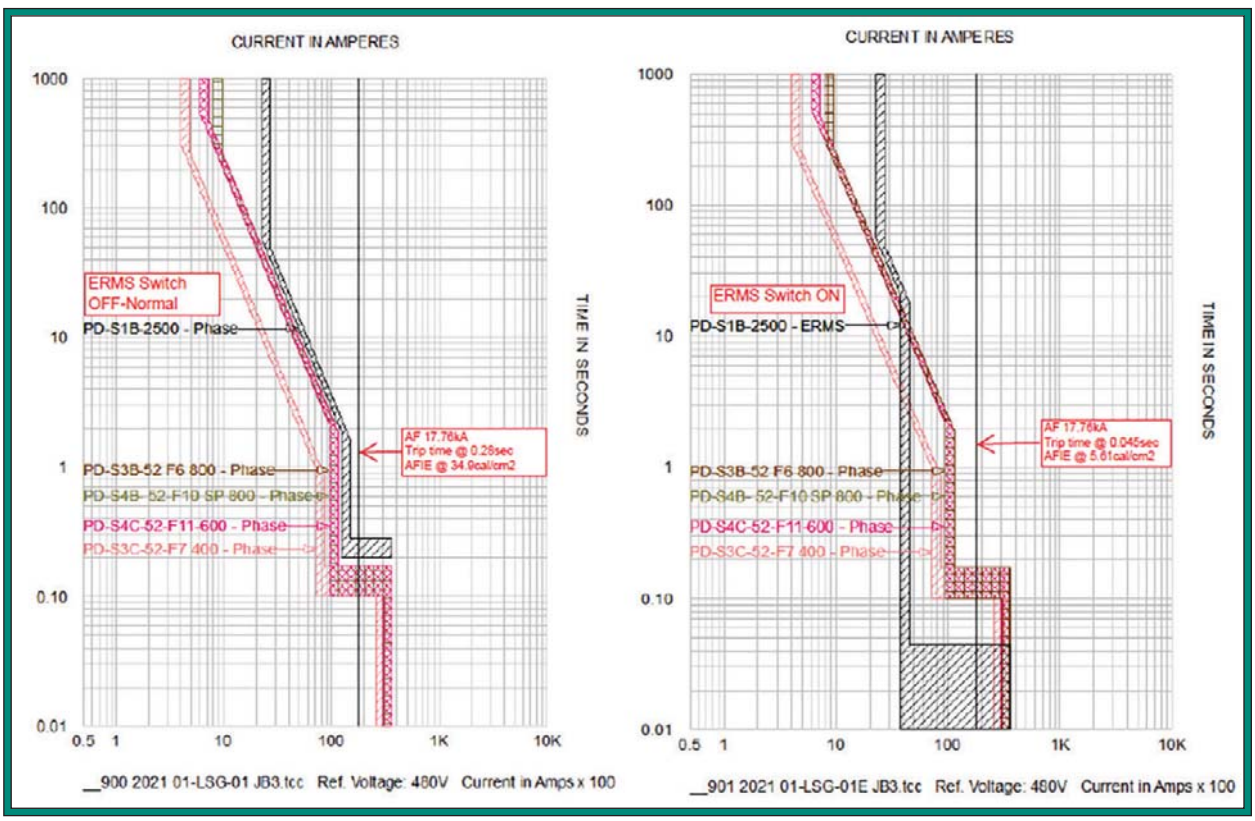

In this specialized field, the engineers performing the study rely on coordination software to develop protection settings.

offering more flexibility for the engineer performing the study. He or she must understand these differing philosophies and owner requirements.

Pro: A mid-range priced solution. The indicator light for ERMS activation makes this option relatively easy to use.

Con: Human error. The switch can be left in the maintenance mode position, allowing for mis-coordination and nuisance tripping. Some manufacturers do not have flexibility in programming.

METHOD 4 — ENERGY-REDUCING ACTIVE ARC-FLASH MITIGATION SYSTEM

This is one of several special systems that automatically limit the energy released during an arc-fault event by one or more detection means (see **Figure** above). The following lesser-known concepts are based on NFPA 70E, *Standard for Electrical Safety in the Workplace*, Annex O:

• One concept reduces the arc duration by creating a low-impedance current path for the arcing fault, allowing the upstream breaker time to clear the fault. Essentially, this method forces a bolted fault on the circuit, which transfers electrical energy to a new path, causing the upstream breaker to operate with no intentional delay.

• Another concept is to use an arc-flash relay with two components: light sensors to detect the light produced by the arc-flash event and a current sensor (typically a CT) to detect the sudden rise in overcurrent. These two components, when detected simultaneously, send a trip signal to the protective device to operate without intentional delay.

• Another solution is an energy-reducing line-side isolation barrier enclosing the line-side conductors. This option protects workers from both shock and arc-flash events on the line side of the protection device.

• Arc-resistant equipment can also be used to divert arc energy away from personnel.

Pro: Design can be specific to the end-user or specific application.

Con: Can get pricey from concept to design, installation, and testing.

METHOD 5 — INSTANTANEOUS TRIP SETTING WITH TEMPORARY ADJUSTMENT NOT PERMITTED

When this method was originally added, the industry treated it like a temporary maintenance switch, meaning the instantaneous setting would be lowered to reduce the AFIE to an acceptable level during maintenance work. However, problems arose as workers made random adjustments to the protective settings without an engineer performing a study, calculating the actual arcing fault, and advising which settings adjustments to make.

This resulted in settings that did not lower the AFIE and falsely left workers thinking they were protected. Also, since there was no indicator light (as in Method 3), settings were often not adjusted back, or a random setting was reapplied because the worker didn't remember the original settings. These human errors left the electrical system uncoordinated and could make the existing arc-flash label inaccurate, leading to


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additional unsafe work conditions. As a safeguard, a clarification added in 2020 NEC states: *Temporary adjustment of the instantaneous trip setting to achieve arc energy reduction shall not be permitted.*

The actual intent of this method is to have a studies engineer calculate the arcing-fault current and permanently set the protective settings to trip on this arcing current. The obvious problem with this method is that the settings might be so low that the coordination downstream is an issue and possible nuisance tripping occurs.

Pro: Inexpensive solution, which can be achieved with existing protection settings.

Con: Possible downstream coordination issues and nuisance tripping.

METHOD 6 — INSTANTANEOUS OVERRIDE

An instantaneous override is a fixed, built-in factory trip setting protecting against fault currents above a breaker's withstand capability. This setting is usually set higher than the standard instantaneous setting, and it usually protects against faults — but not always. This method should be used only when designing and installing new breakers and where the owner can have a voice in the design process. If the override function trips the breaker, coordination issues and nuisance tripping might occur.

Pro: Inexpensive option, as there are no additional costs for new equipment.

Con: Possible coordination issues; might not be an option on existing equipment.

METHOD 7 — APPROVED EQUIVALENT MEANS

This method was included to allow for any future technology. As technology continues to evolve, any equivalent method to the six listed above can be evaluated and approved by the Authority Having Jurisdiction (AHJ). This approval is usually obtained through prior discussion between the studies engineer and the AHJ.

Which is the best method? The methods discussed above are provided if, and only if, there is a greater danger of not de-energizing. Section 110.4(A) summarizes the intent of NFPA 70E: *Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards or increased risk.* Of course, the best method is to de-energize the equipment.

CONCLUSION

What could be more dangerous than an electrocution or arc flash incident that burns or kills a worker? If there is an arc flash event in a facility and a worker is injured, the burden is on the owner to justify why they did not de-energize, and the consequences can include hefty fines and expensive lawsuits. Therefore, the priority must shift to de-energization. Owners and site operators need to find ways to shut down and perform work safely. Like personal protective equipment, these mitigation methods should be the last line of defense, not the first. EC&M

David Rewitzer, PE, CEM, is a power systems studies engineer at Hood Patterson & Dewar. He specializes in electrical safety for medium voltage and low voltage facility power distribution systems in data centers, large campuses, health-care institutions, and commercial/industrial facilities. He can be reached at jpeerbolte@netaworld.org.

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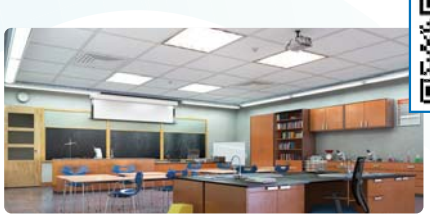

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Smoke Alarm and Carbon Monoxide Detector Location Requirements

Understanding the basic requirements outlined in the International Residential Code and NFPA 72

By Joseph Alexander, City of Suwanee, Ga.

During residential inspections, my biggest challenge is getting electricians and contractors to accept that the "old" way of installing smoke alarms and carbon monoxide (CO) detectors is no longer adequate. This is definitely what I consider a cross-code (or cross-over code) issue. Not only do electricians and builders not know the proper installation requirements for these safety devices, but most inspectors also don't know as well. I find this troubling, as the reference to the primary code for smoke alarms and CO detectors (NFPA 72, *National Fire Alarm and Signaling Code*) has been referenced in the International Residential Code (IRC) since it was first published in 2000.

Most electricians are familiar with the basic location requirements for these devices. For example, place a smoke alarm in each sleeping room, in areas outside bedrooms, and on each floor of the dwelling, including basements and cellars. They also know smoke alarms shall receive their primary power from the building wiring (with battery back-up) and shall be interconnected in such a manner that the actuation of one alarm will activate all the alarms. But many electricians would struggle to cite additional requirements beyond this basic list.

Let's take a closer look at the smoke alarm and CO detector requirements outlined in the most current editions of the IRC and NFPA 72.

PLACEMENT OF DEVICES

• At least one smoke alarm on each level of a dwelling unit, including

basements and habitable attics. [IRC Sec. 314.3(3) and NFPA 72 Sec. 29.5.1.1]

- In each sleeping room [IRC Sec. 314.3(1) and NFPA 72, Sec. 29.5.1.1]
- Outside of each sleeping room, within 21 ft of the door to a bedroom measured along the path of travel [IRC Sec. 314.3(2) and NFPA 72, Sec. 29.5.1.1]

Not only do electricians and builders not know the proper installation requirements for these safety devices, but most inspectors also don't know as well.

- At least 3 ft horizontally outside the door of a bathroom containing a bathtub or shower [IRC Sec. 314.3.1(4) and NFPA 72, Sec. 29.8.3.4]
- Smoke alarms installed in kitchens shall comply with exclusion zones per IRC Sec. 314.3.1 and/or the 10-ft radial exclusion zone detailed in NFPA 72, Sec. 29.8.3.4.
- Additional smoke alarms are required when an interior floor area (excluding garage spaces) exceeds 1,000 sq ft. All points on a ceiling shall have a smoke alarm within a distance of 30 ft (travel distance) or shall have an equivalent of one smoke alarm per 500 sq ft. [NFPA 72, Sec. 29.5.1.3.1 and Sec. 29.5.1.3]
- No less than 36 in. from the supply of a forced-air HVAC system. [NFPA 72, Sec. 29.8.3.4(7)]
- Not within 36 in. horizontally from the tip of the blades of a ceiling fan. [NFPA 72, Sec. 29.8.3.4(8)]
- On the ceiling adjacent to basement stairs going up. [NFPA 72, Sec. 29.8.3.4(10)]
- On the highest portion of the ceiling or the sloped portion of a tray (coffered) ceiling within 12 in. vertically down from the highest point. [NFPA 72, Sec. 29.8.3.4(11)]
- The location and spacing of smoke alarms shall be based on the anticipated smoke flows due to the plume and ceiling jet produced by the anticipated fire. [NFPA Sec. 17.7.3.1.1]
- For new construction, CO detectors shall be installed in dwelling units containing fuel-fired appliances. If the dwelling has an attached garage with an opening that connects with the dwelling unit, it must have a CO detector. Note: Some states have amendments regarding CO detectors.

ADDITIONAL REQUIREMENTS

- Smoke alarms shall receive their primary power from the building wiring, with battery back-up. [IRC Sec. 314.6 and NFPA 72, Sec. 29.6.2 (rechargeable batteries) and 29.6.6 (nonrechargeable)]
- When more than one smoke alarm is required they shall be interconnected [IRC Sec. 314.4 and NFPA 72, Sec. 29.8.2.1]. Listed wireless units are allowed. [IRC Sec. 314.4 and NFPA 72, Sec. 29.7.7]
- Where alterations, repairs, or additions requiring a permit occur, the individual dwelling unit shall be equipped with smoke alarms located as required for new dwellings. [IRC Sec. 314.2.2]

As there are many requirements in NFPA 72, this is a synopsis of the very basic requirements. Further requirements exist in the standard for ceilings with beams or joists, sloped or peaked ceilings, and areas exposed to high heat. It's also important to note the requirements for smoke alarms and carbon monoxide alarms change with each new release of these standards. It is incumbent upon electricians, builders, and inspectors to keep up with these changes — and to accept that NFPA 72 is the real driver as to requirements and placement of smoke alarms/carbon monoxide detectors. EC&M

Joseph Alexander, C.B.O., C.F.M, M.C.P., is the chief building official for the City of Suwanee, Ga. He can be reached at JAlexander@suwanee.com.

Atkore™ Celebrates Winner of its $100,000 **Truck of Your Dreams Sweepstakes**

The sweepstakes, won by an Ohio-based electrical contractor, helped underscore Atkore's commitment to Building Better Together with electrical contractors

No matter what type of job they're on, all electrical contractors share one thing in common: They need a truck with not only the reliability to handle adverse terrain but also the versatility to serve as a mobile office, command post, tool hauler, and even storm shelter.

Knowing how critical it is to get just the right vehicle, Atkore, a leading global provider of electrical, safety and infrastructure solutions, created the Win the Truck of Your Dreams Sweepstakes to continue delivering on its Building Better Together promise to electrical trade professionals worldwide.

After receiving an overwhelming volume of sweepstakes entries, Atkore selected winning electrical contractor Brian Supplee in a 3rd-party, random drawing. The company held an all-staff celebration for him in February at its Harvey, Illinois headquarters, where Bill Waltz, Atkore President and Chief Executive Officer, presented the grand prize to Supplee, a Project Manager at Ohio-based U.S. Utility Contractor Co., Inc. Before entering the sweepstakes, Supplee relied on Atkore to supply PVC conduit, rigid galvanized steel conduit, and strut products for construction projects.

"Win the Truck of Your Dreams celebrates our electrical contractor customers and underscores Atkore's commitment to Building Better Together with them," said Waltz. "Building Better Together is not just a tagline—it's part of our DNA. It means delivering a full suite of products and solutions from nearly 30 brands to electrical trade professionals whenever and wherever they need them around the world."

"When you work with Atkore, you have a passionate team behind you, along with the high quality and reputation of long-established brands," Waltz noted. These include nearly 100-year-old brands like AFC Cable Systems and Unistrut to Allied Tube & Conduit, Cope Cable Tray, FRE Composites, US Tray, Heritage Plastics, and United Poly Systems, as well as many other highly respected brands recognized throughout the industry.

Entering the contest provided Supplee with greater insight into the additional ways he can use Atkore products and services to support U.S. Utility's projects moving forward. "As an instructor and contractor, it's important for us to have efficiency," Supplee said. "The tools and training available from Atkore really provide us with that. It's a lot easier to have a one-stop shop, and one thing I've learned from this experience is that Atkore is a total solutions provider."

"We want to thank our electrical contractor partners for everything they do for society," Waltz said. "This sweepstakes was an important way to build on our program of monthly giveaways and express our gratitude in a way that is most meaningful to contractors."

With approximately 47 manufacturing facilities worldwide, Atkore offers an unmatched breadth of electrical products and solutions. The goal is to ensure that electricity safely and efficiently runs through all types of facilities and infrastructure projects worldwide. Whether for roads, bridges, data centers, warehouses, hospitals, manufacturing plants, or high-rise buildings, Atkore supplies products and services that meet electrical contractors' unique needs.

"Our mission statement is to be the customer's first choice, and that's all about what we can do to make the contractor's life easier," Waltz said. "That's innovation. That's labor-saving solutions. That's digital tools. That's having mobile showrooms come to job sites for hands-on demonstrations. That's delivering a full suite of products wherever and whenever contractors want it. It's also about listening to their feedback and ideas we can then use to make their lives better."

Product lines include everything from PVC, HDPE, steel, fiberglass and specialty conduit to armored cable, cable management systems, fasteners, safety and security products and framing systems. Atkore's array of support resources include online training via Atkore University and a full suite of webinars, the Atkore Virtual Solutions Center with its 3D application environment, mobile showrooms

that bring product demos and training directly to worksites, and the Atkore BIM Toolbar plugin for Revit. With all that, Atkore is proud to provide electrical trade professionals with a world-class level of flexibility, training and convenience.

U.S. Utility Contractors Co, Inc., which has been in business since 1989, is a perfect example of the type of electrical contractor Atkore supports every day on a wide range of projects. U.S. Utility works on transmission distribution as well as AT&T communications, traffic signals and highway lighting. Most of its projects are turnkey.

“The thing I like best about being a contractor is taking a project from start to finish,” Supplee said. “After completing it, I like being able to drive by years later and see what we did with a sense of accomplishment.”

He cited U.S. Utility’s work on the Veterans’ Glass City Skyway Bridge over the Maumee River on I-280 in Toledo, completed in 2007, as a particular highlight. “I started that project when I was 26,” Supplee recalled. “It was a four-year project and there were a lot of challenges—from being down in the water, putting in the ground rods, running conduit up for the ground conductors, all the way to being at the very top of the bridge to install the lightning rod and the FAA beacons. I’ve been over that bridge so many times, walked it so many times, I can tell you where everything is. That was the most memorable job for me. It was a statement piece in Toledo.”

Atkore’s role with contractors is to be there with them every step of the way as jobs like that move from conception to completion. “We are committed to

making your life as an electrical contractor as easy as possible,” Waltz said. To that end, Atkore continues to focus on new product and service innovations—and on further expanding its product portfolio to meet electrical contractors’ emerging needs. For additional product insights, visit Atkore’s New Products Portal at **atkore.com/new-products-portal**

Winning a new truck customized to meet every worksite need and stocked with Atkore products is the stuff electrical contractor dreams are made of—and Atkore is proud to make those dreams a reality.

About Atkore Inc.

Atkore is forging a future where our employees, customers, suppliers, shareholders and communities are building better together—a future focused on serving the customer and powering and protecting the world. With a network of manufacturing and distribution facilities worldwide, Atkore is a leading provider of electrical, safety and infrastructure solutions.

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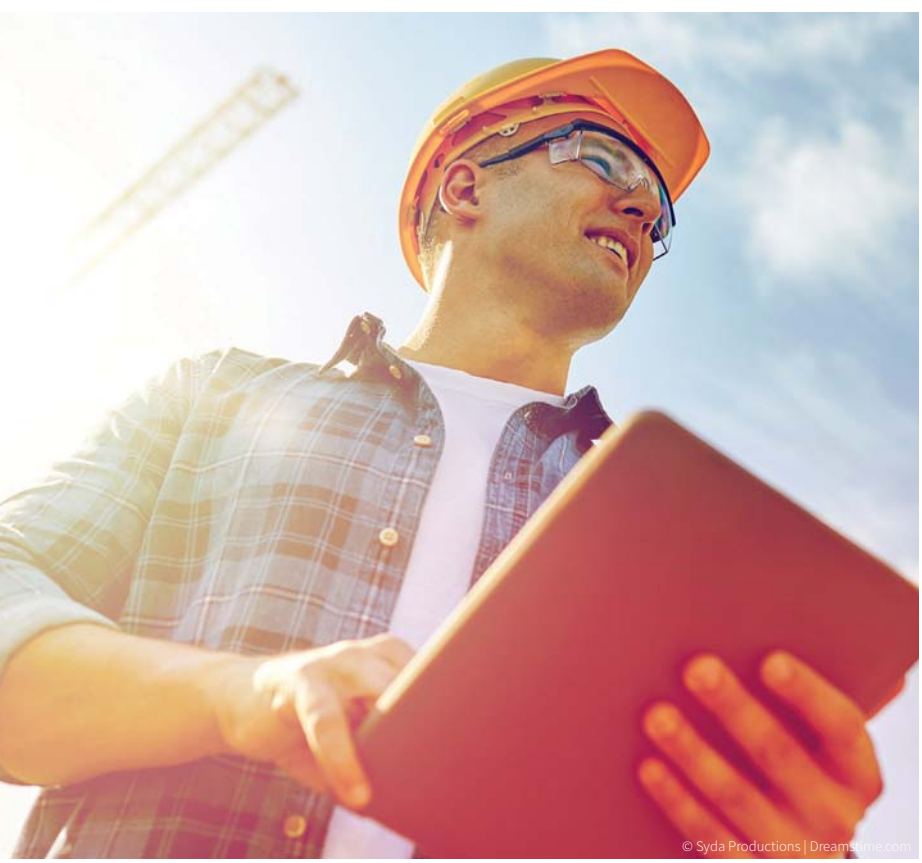
How Electrical Contractors Can Attract Top Talent

Consider these outreach strategies and technological advances for reaching the next generation of electrical workers.

By Garrett Wilson, FieldBin



Electricians are facing a perfect storm. Demand for electricians is at an all-time high, spurred in large part by rising electrical consumption, an aging infrastructure, extreme weather conditions that require an immediate response, and rising demand for installation of a broad range of energy-saving devices within the residential and light commercial sphere, in addition to other in-demand installations, such as solar panels and electric vehicle (EV) charging stations.

Unfortunately, this record-setting demand is far outstripping the nation's supply of electricians. At present, there are about 750,000 electrician jobs nationwide. Employment of electricians is expected to grow about 9% from 2020 to 2030, according to forecasts by the U.S. Bureau of Labor Statistics, with nearly 85,000 openings for electricians projected each year, on average, over the decade.

Despite those estimates, the one-two punch of an increasing number of experienced electricians leaving the industry and a lack of interest among younger workers in entering the profession have combined to create an unprecedented shortage of electricians.

PANDEMIC-FUELED RETIREMENT

The exodus of electricians from the profession began in earnest on the heels of the 2008 recession, from which the construction industry — by far the largest employer of electricians — has yet to completely recover. Then COVID-19 hit, accelerating the retirement rate of baby boomers among electricians.

A 2021 analysis by the St. Louis Fed indicates that the pandemic pushed more than three million baby boomers into early retirement. While some of these older workers faced layoffs, electricians in their 50s and 60s were much more likely to walk away from the job.

All of this means that any anticipated growth among electricians over the next decade will largely be devoted to replacing jobs lost due to baby boomer retirements. But given unprecedented demand, can those jobs realistically be replaced when fewer young people are interested in becoming electricians?

ATTRACTING YOUNG TALENT

Like it or not, millennials and Gen Zers are much more likely to enroll in a four-year or two-year college than to attend trade school with the mindset of pursuing a career in the field service professions. Recent surveys show that 40% of millennials and Gen Zers are more

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likely to earn a bachelor's degree than to pursue a career in skilled labor. Only 17% of high school and college students say they want to work in construction, while nearly 77% indicate they want to work in technology.

These young adults also show a marked preference for the various perks that working in what used to be called a "white collar" environment provides. These include everything from career development opportunities, student loan repayments, and flexible work schedules to Fitbits, gym memberships, and offsite social events.

Given this, what (if anything) can electrical contractors do to counter these prevailing trends? While companies can certainly try to entice individual workers out of retirement, the bigger issue confronting the industry as a whole is how can the profession get younger — and do so as fast as possible to meet current market demand and sustain it into the future.

The answer may be for electrical contractors to take a page out of the playbook that has proven to be so successful for colleges and countless brands targeting young adults and begin marketing effectively to students while they are still in high school. Rather than waiting for young people to stumble into considering a career as an electrician on their own, the industry needs to take proactive steps to generate awareness of the kind of work electricians do, the tools they use (which increasingly depend on technology), the challenges they solve, and the benefits the profession provides teens and young adults.

OUTREACH STRATEGIES

To that end, many companies are now participating in high school career days and partnering with local high schools (and, in some cases, elementary schools) to make electrical training programs available as a STEM elective — both of which have provided opportunities to showcase the profession and recruit the next generation of electricians. Exposing students to the work electricians do at an early age creates an opportunity for young people to see if they enjoy electrical work while learning a few things in the process.

In addition to direct outreach, some companies are now using social media — a tool numerous surveys have shown young people use as much as nine hours daily. Placing very brief but informative videos on apps such as TikTok, the most downloaded app in the world with almost 60% of its users between the ages of 16 and 24, can serve to generate interest in the profession and recruit new workers, while simultaneously marketing a company to potential customers.

While companies can certainly try to entice individual workers out of retirement, the bigger issue confronting the industry as a whole is how can the profession get younger — and do so as fast as possible to meet current market

Getting in front of prospective workers, however, is only part of the problem. Regardless of whether electricians are talking directly to students or posting social media videos, they need to use messaging that will connect with their young audience. For students considering career choices, that translates into promoting the benefits the profession offers, including steady, challenging work; ample overtime opportunities; highly competitive salaries; and job satisfaction.

CONSIDER THE COST

The rapidly escalating price of higher education also suggests using messaging that focuses on the attractive scholarships and apprenticeships offered by many trade and vocational schools. According to BestColleges and the National Center for Education Statistics, the average trade school education costs about $33,000. For context, that is roughly equivalent to the average total costs for a year of college at a four-year school in 2021 ($35,551), including tuition and fees, on-campus room and board, books, supplies, and other expenses. Over the course of four years, that comes to $142,000, or roughly 40% of an average family's income.

It is further worth noting that college degrees don't represent the ticket to success they once did. High school seniors and their parents are often shocked to learn that less than half of college graduates under the age of 25 are working at a job that requires a college degree. Moreover, with an increasing number of people graduating from college, most jobs that once required a bachelor's degree now demand a master's degree for entry-level positions.

That's not to say students shouldn't consider college. It simply means they should investigate all career options. And for those who are good problem solvers, enjoy flexibility and working independently, and like working with technology, a career as an electrician represents a very viable option.

THE ROLE OF TECHNOLOGY IN ATTRACTING TALENT

The use of technology by electricians seems to be one of the primary factors responsible for drawing young people into the profession. Unless they are exposed to the work peformed by electricians, younger adults seldom realize the kinds of technology routinely used by electricians today. This includes:

- Robotics, which increasingly are being deployed by electricians in places with potential electrical hazards;
- Drones, which are being used to capture images in hard-to-reach locales and as part of the monitoring process;
- Wearable devices equipped with sensors designed to alert electricians if

they are too close to high-voltage electricity or other potential hazards;

• Augmented reality devices, such as smart helmets, which enable electricians to know exact locations of electrical cables, ductwork, and other building systems without repeatedly consulting blueprints; and

• Smartphone and tablet apps to mange work assignments, perform electrical calculations, view product specifications, check code requirements, and view installation guidelines.

Beyond these tools, electricians are routinely dealing with technology such as BIM modeling (which generates and manages digital representations of physical infrastructures).

REMOTE POSSIBILITIES

While generating awareness of how these various technologies has become an integral part of the electrician's toolbox ultimately can attract more young people to the profession, electrical contractors still must deal with a near-term in which demand far outstrips their ability to provide needed services. To cope with this shortage of electricians, electrical contractors are focusing on working smart, rather than simply working hard. Equipping electricians with mobile devices or tablets so that they can visually explain potential problems and how they plan to address those issues, for example, speeds up the time spent on a particular job.

Similarly, many businesses have turned to electronic communications to send messages to customers and employees, schedule appointments, deliver invoices, and receive payments. Some electrical contractors are even employing video conferencing to consult with customers before dispatching an electrician to the scene. Some companies are also outsourcing tasks that take up too much of their electricians' time. Hiring staffing agencies, meanwhile, can help to shift the burden of finding skilled electricians off of the company and onto the recruitment pros who typically have a roster of potential workers whom they can contact for a specific job.

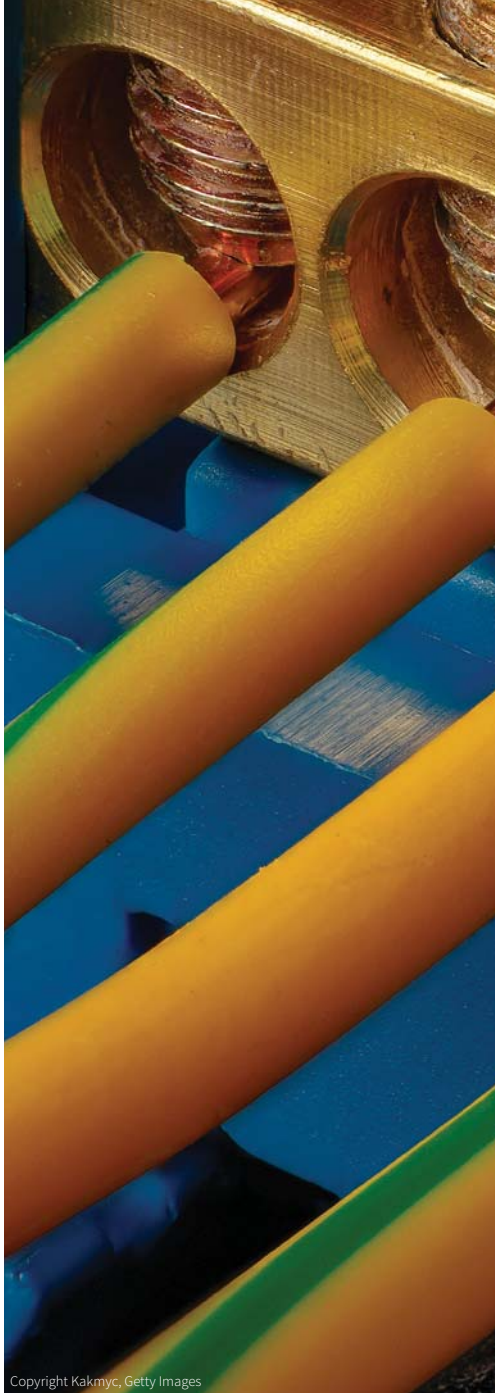
Bottom line: The profession is rapidly changing, but by taking advantage of existing technology and innovations on the horizon, electricians can position themselves and their companies to better meet current demand and draw the kinds of workers who represent the future of the industry. EC&M

Garrett Wilson is the president and co-founder of FieldBin. He has been a serial entrepreneur and expert at building and branding startups for more than 20 years. His experience includes multiple high-growth startups, SaaS products, M&A, fundraising, and agencies that leveraged his deep knowledge in both B2B and consumer markets. For more information, visit https://www.fieldbin.com/

By Randy Barnett, NTT Training

How To Make Proper Grounding and Bonding Connections

Best practices for applying the eight methods outlined in Sec. 250.8 of the NEC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Despite plenty of *EC&M* resources on grounding and bonding, including theory and specific rules on the topic, the simple question we continually get from electrical professionals in the field is: "So how do I have to ground and bond?" The National Electrical Code (NEC) lists eight specific methods to make grounding and bonding connections in Sec. 250.8. Failure to install these connections properly can result in shock, fire, or, most certainly, power quality problems. Let's take a look at each one in more detail.

METHOD 1 — PRESSURE CONNECTORS

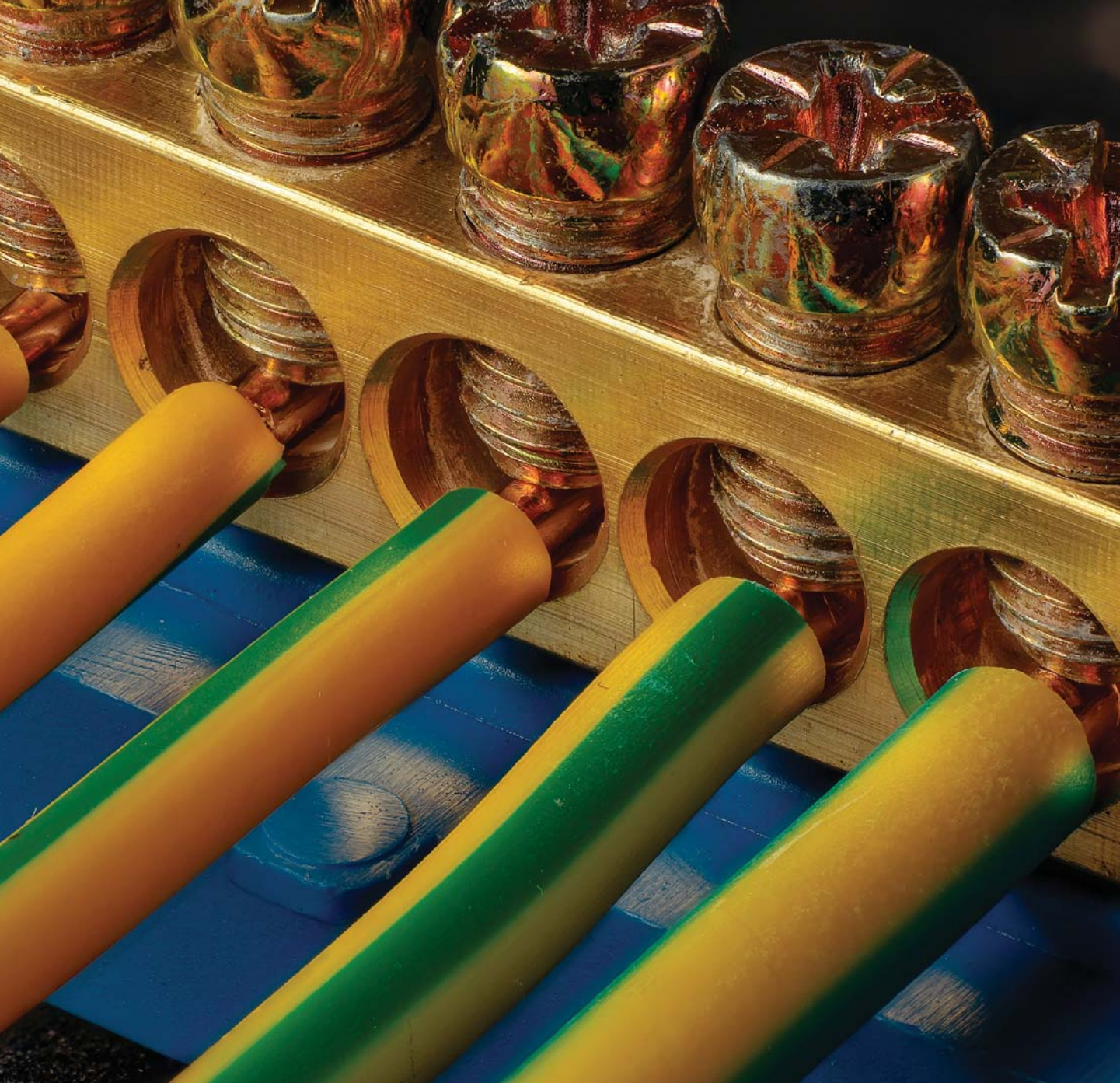
Listed pressure connectors are the first item appearing in this list. Many of these connectors are commonly used for making bonding connections. For example, twist-on wire connectors (e.g., Wire Nuts™), often used to splice equipment grounding conductors (EGCs) fall into this category (see **Photo 1** on page 24).

Listed pressure connectors are evaluated according to one of three UL 486 standards, such as UL486C *Splicing Wire Connectors*. Also included in this category are commonly used tool-crimped connectors, insulation-piercing or displacement connectors, spring-action connectors, tool-applied crimp connectors, and mechanical set-screw connectors.

With twist-on connectors, the tapered and coiled metal insert inside of an insulated plastic cap twists the conductors together as the worker turns the plastic cap. Certain industrial facilities do not allow the use of these twist-on connectors. Instead, they rely on tool-applied crimp connections or other mechanical connectors.

Always adhere to the instructions in the listing and labeling of the connectors. Each manufacturer identifies a combination of wire sizes and the number of wires that can be used for each size connector. This information is often provided on the container for the connectors. Color coding of connectors helps to select the correct size connector for the application. Additionally, manufacturers may have information as to whether pre-twisting of conductors is necessary (though many electrical workers will often do this using lineman pliers).

Most manufacturers recommend against pre-twisting. These twist-on connectors are listed for both stranded or solid conductors or a combination of each. When connecting stranded conductors with solid conductors, the stranded conductor should be placed



slightly above the solid conductor, allowing the twisting motion to wrap the stranded conductor around the solid conductor. The general manufacturer recommendation is to continue to twist the connector until two wraps of the conductor are made around each other. Also, pay attention to the manufacturer's strip lengths for conductors when removing insulation. No bare conductor should protrude from the open end of the connector, and no insulation is to be twisted underneath the coiled spring. Remember, manufacturer instructions are the result of extensive testing and design. As such, recognized testing laboratories evaluate these products based on the manufacturer's application information. Failure to follow these instructions can not only be a violation of NEC Sec.110.3(B) but can also jeopardize the integrity of the grounding and bonding system. Considering the purposes and importance of proper grounding and bonding adherence to manufacturer instructions goes without question.

Questions continually arise regarding the use of the "green" colored twist-on connectors. Green twist-on connectors are not specifically listed for just bonding connections. Any suitably sized color connector can be used for splicing bonding conductors. These green-colored twist-on wire connectors with a hole in the top for insertions of a bonding jumper are not suitable for use for ungrounded or grounded conductors.

Tool-crimped connections provide excellent mechanical and electrical connection integrity. Once again, they must be applied according to manufacturers' instructions as part of their listing. These connectors may be bare metal or have a plastic covering. The covering is not for insulation purposes, but for identification only as to AWG size for conductors to be inserted in the connector. Most only allow one conductor inserted into a barrel end. They are available for splicing conductors (butt splices) or terminations (ringed or forked). Once again, proper

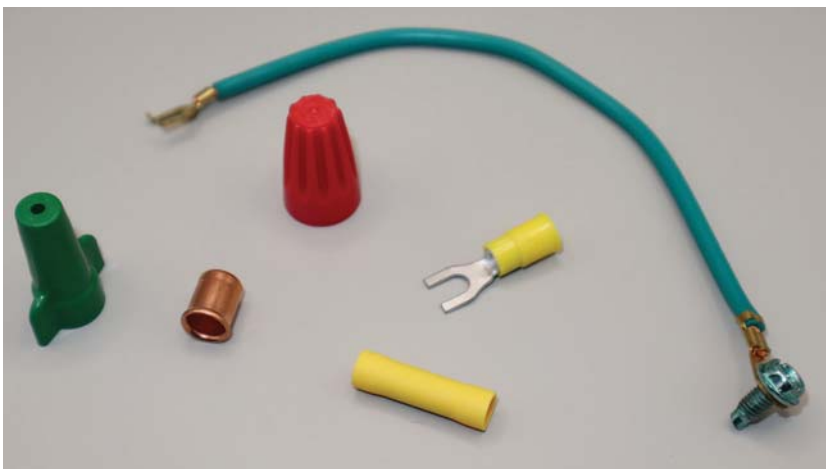


Photo 1. Listed pressure connectors are often used for bonding connections. Typical connectors are twist-on type connectors and tool-crimped connectors. At left is a green twist-on connector with a hole in the top to allow pushing through of a solid equipment grounding conductor to bond to the wiring device. The green bonding jumper at the top is prefabricated with listed tool-crimp connectors at each end. The red twist-on connector can be used for grounding and bonding applications. The tool-applied crimps (bottom center) are listed for stranded conductors only.

strip length is essential. The insulation should sit up against the open end of the barrel, and the bare conductor should slightly protrude or be visible at the opposite end of the barrel. Proper crimp tools (some listed) must be used to make the crimp over the correct area of the barrel with the correct pressure applied. Crimp-on connectors are listed for stranded conductors only — not solid conductors.

These tool-applied crimp connectors provide a secure splice or termination and will not vibrate or come loose over time. For terminations, the screw or lug used to attach the connector to the terminal must be torqued and properly maintained to ensure connection integrity over time. They are available for various AWG-size conductors and are typically color-coded by the manufacturer.

METHOD 2 — TERMINAL BARS

Terminal bars are often provided by equipment manufacturers to allow the connection of multiple conductors at one convenient location. Panelboards are an example where an equipment grounding bus bar is provided in the enclosure and is bonded to the enclosure. Once again, pay particular attention to instructions for installation. Unless otherwise noted in the instructions, only one conductor per terminal is allowed, and torque requirements apply (**Photo 2**).

METHOD 3 — PRESSURE CONNECTORS LISTED AS GROUNDING AND BONDING

This option encompasses several distinct types of connectors. These are specifically listed for grounding and bonding applications and cannot be used in other applications unless specified. When observing the label(such as UL) the words "grounding and bonding" appear adjacent to the label. Ground clamps are identified for specified size ground rod and conductor sizes. This category also includes irreversible crimp connectors that are installed with hydraulic crimping tools (**Photos 3a, b,** and **c** on page 26).

METHOD 4 — EXOTHERMIC WELDING

Exothermic welding is a chemical process that fuses conductor material to form a molecular bond. This process is permanent, and the weld is not subject to corrosion. Exothermic welding is often used for the connection of stranded copper conductors to rebar. The general rule is grounding electrode conductors must be continuous in length. However, exothermic is one method permitted to splice grounding electrode conductors.

METHOD 5 — MACHINE SCREW-TYPE FASTENERS

Machine screw-type fasteners that engage not less than two threads — or that are secured with a nut — are permitted. If a 10-32 machine screw is used in a $\frac{1}{16}^{th}$-in.-thick enclosure, then two of the screw threads will be engaged in the metal enclosure. Testing has shown this to be sufficient engagement for grounding and bonding purposes. If two threads cannot be engaged, then a nut can be placed on the machine screw for securement.

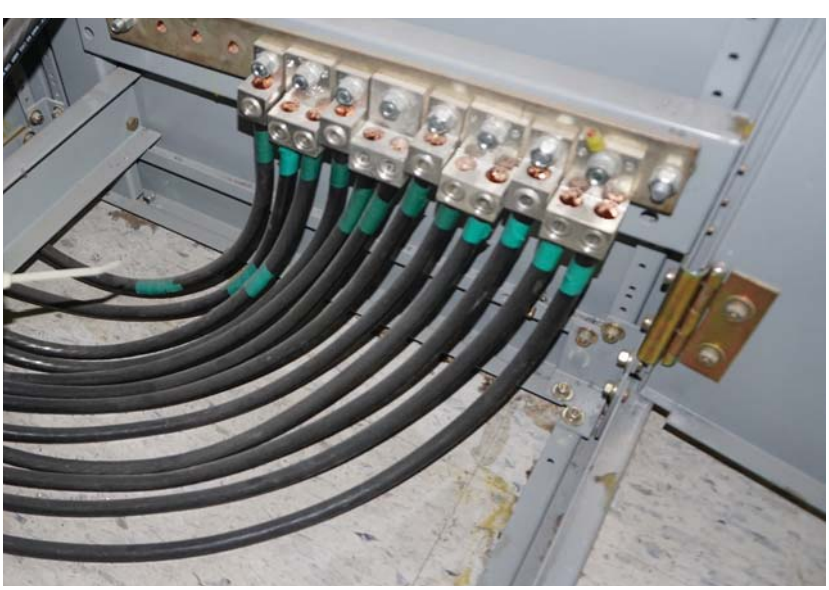


Photo 2. Terminal bars are often provided by equipment manufacturers to allow the connection of multiple conductors at one convenient location. Torque requirements apply to both the bolted connection of the lug to the terminal bar and the wire termination itself.

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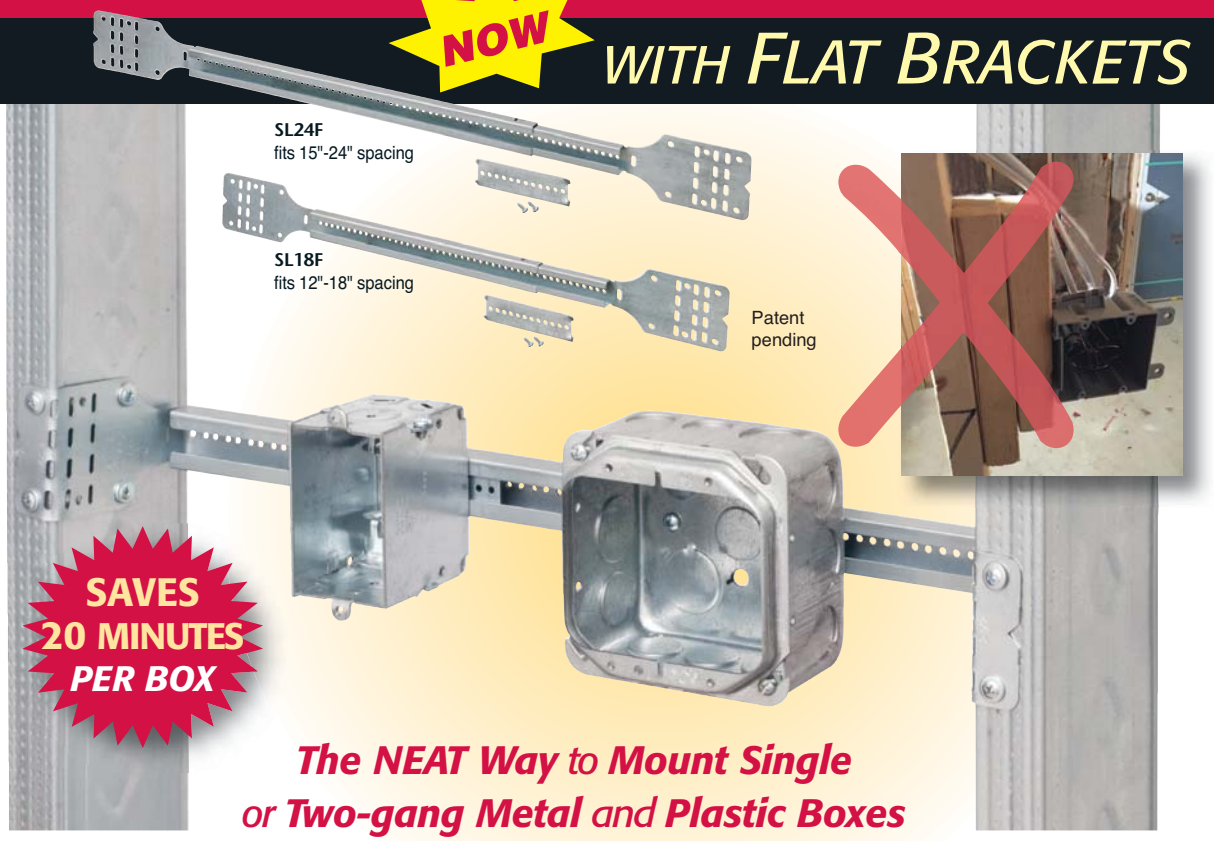

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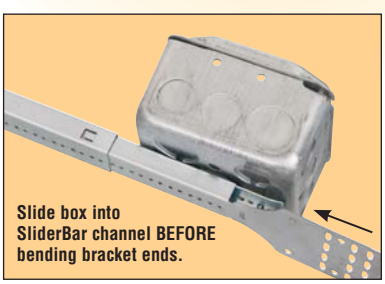
Slide box into SliderBar channel BEFORE bending bracket ends.


Bend SliderBar bracket ends 90°. Bend ends again along guides to desired wall board thickness.

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SL18F FLAT SLIDERBAR KIT Adjusts to fit between studs, 12" to 18" o.c.

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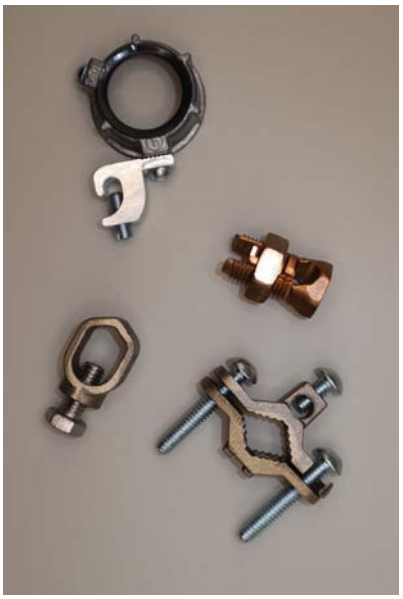

Photo 3a. Pressure connectors listed as grounding and bonding are evaluated under UL 487 for grounding and bonding applications only and may not be used for power conductor connections. From top clockwise: Grounding bushing, split-bolt (also evaluated for other applications), ground clamp, cable-to-ground rod clamp (acorn clamp).

Photo 3b. NEC Sec. 250.94 requires bonding for communication systems. One of the two options is the use of an Intersystem Bonding Termination (IBT) device. This IBT bonds communication wiring (green conductor) to the grounding electrode conductor at the service exterior to the service enclosure.

Photo 3c. An irreversible crimp connector has been applied by compression to these stranded grounding conductors.

MACHINE 6 — THREAD-FORMING MACHINE SCREWS

Thread-forming machine screws that engage not less than two threads in the enclosure are also permitted by Sec. 250.8. Thread-forming screws displace material as they are screwed into a pilot hole. All the displaced material flows around the screw's threads, providing a secure connection that resists loosening over time. Sheet metal and drywall screws are not permitted for grounding and bonding. Connections that use only solder are also not permitted because excessive heat in a ground fault could cause solder connections to loosen or melt.

METHOD 7 — CONNECTIONS THAT ARE PART OF A LISTED ASSEMBLY

Manufacturers build control cabinets in compliance with specific standards. Panel makers will identify termination points for grounding and bonding

Five Common Errors Found in Grounding and Bonding Systems

Improper installation and maintenance of grounding and bonding systems can result in shock, fire, and power quality issues. Common errors include:

1. Not applying proper torque to connections. Applying too much torque may result in a high-resistance connection.

2. Use of improper connector. For example, using a tool-applied crimp connector listed for stranded conductors with a solid conductor.

3. Failure to follow NEC requirements for locations to ground and bond.

4. Use of improper table for sizing grounding and bonding conductors. These are the correct tables:

- Table 250.66 is for sizing the Grounding Electrode Conductor for Alternating-Current Systems
- Table 250.102(C)(1) for sizing the Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating-Current Systems
- Table 250.122 for the Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

5. Failure to maintain grounding and bonding connections per NFPA 70B *Standard for Electrical Equipment Maintenance*. Compliance with this standard is now required.

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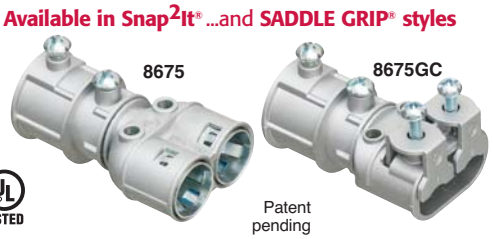

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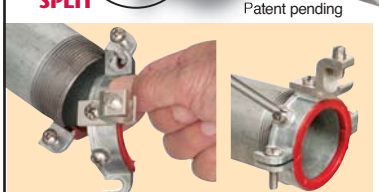
BUSHINGS

For THREADED and UNTHREADED RIGID



1. Loosen side screws. Allow bushing to pivot around installed cables
2. Tighten set screw to seat bushing on conduit

Arlington's 550 series zinc diecast split grounding bushings deliver convenience and time-savings. They're split to allow the addition of a bushing AFTER conductors are installed in threaded or unthreaded Rigid/IMC conduit.

- Ships Assembled – *Multiple sizes*
- Compatible with EMT, 2-1/2" to 4" trade sizes, and EMT threaded fittings

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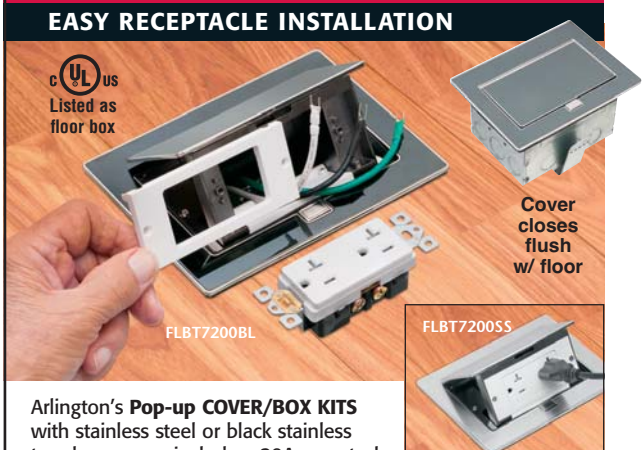
STAINLESS STEEL • POP UP COVER

FLOOR BOX KITS

EASY RECEPTACLE INSTALLATION



Arlington's **Pop-up COVER/BOX KITS** with stainless steel or black stainless trapdoor covers include a 20A receptacle – OR you can install one of your own. It's *easy.* The receptacle installs from the front. There's no need to dismantle the hinge.

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- Fits surfaces up to 1-1/2" thick
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- Uses standard rectangular receptacle, and GFCI, and GFCI/combination receptacles

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connections. Quite often, a bonding jumper will be installed with listed pressure connectors at each end to bond the door to the enclosure (**Photo 4**).

METHOD 8 — OTHER LISTED MEANS

Other listed means may be considered a catch-all phrase. However, the UL *Guide Information for Electrical Equipment the White Book* defines these "other listed means" options. For example, ground clips used on metal boxes are listed for use on square or octagonal boxes and for solid conductors only. Other examples include grounding and bonding locknuts, grounding and bonding hubs, ground mesh used in swimming pool construction, and grounding wedge lugs (**Photo 5**).

HOW TO VERIFY GROUNDING AND BONDING CONNECTIONS

The NEC does not specify electrical resistance values for bonding. According to the NEC, bonding must "establish electrical continuity and conductivity." Section 250.53(A)(2) provides an exception for supplemental grounding electrode requirements: "If a single rod, pipe, or plate grounding electrode has a resistance to earth of 25 ohms or less, the supplemental electrode shall not be required."

However, ANSI/NETA ATS-2021 *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems* provides requirements. Connections require "investigation if point-to-point resistance values that exceed 0.5 ohm." Other standards may require a maximum resistance into the earth of 5 ohms or less. Improper grounding and bonding per NEC requirements, IEEE standards and other documents are often the cause of power quality issues in distribution systems (see **Sidebar**, "Five Common Errors Found in Grounding and Bonding Systems," on page 26).

FOLLOW THE RULES!

In summary, NEC Sec. 250.8 requires one of eight methods to make grounding and bonding connections. Different listed connectors are available to splice and terminate grounding and bonding conductors. Electrical workers must properly apply each of these components per manufacturers' instructions. Knowing what connectors are available, selecting the proper connection method, having the correct tool for the job, and properly applying the connection device are critical to prevent both shock and fire hazards — and allow for proper operation of the distribution system. EC&M

Photo 4. Here's an example of "connections that are part of a listed assembly." Panel makers will often identify termination points for the location of grounding and bonding connections. Notice the listed tool-crimped connector with the yellow plastic covering to identify AWG size for the connector. Additionally, the grounding symbol indicates the proper location for this bonding connection.

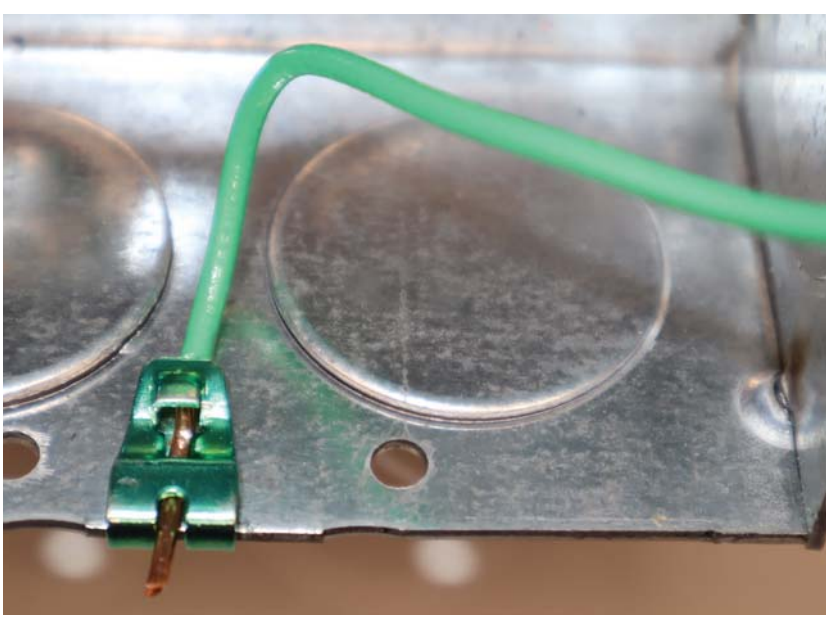

Photo 5. "Other Listed Means" include items such as ground clips used on metal boxes. They are listed for use on other than round boxes and for solid conductors only. The conductor is threaded through the clip, a screwdriver is used to push the clamp and conductor onto the edge of the box, and then the excess conductor is clipped off.

Randy Barnett is the electrical codes program manager for NTT Training. He can be reached at electricrb@yahoo.com.

SAVES TIME • LOOKS GREAT!

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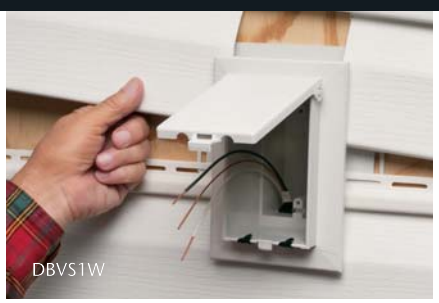

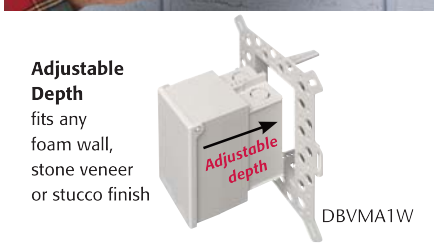

No extra parts to buy or handle mean you save big on labor and materials!

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

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

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

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Tips for Passing an Electrical License Exam

The first step is to get your mind right.

By Harold De Loach, Academy of Industrial Arts

For many electricians, journeymen, and engineers, taking a licensing examination is one of the most important and challenging goals to achieve in their career journey. Once you accomplish this goal, you can create a more efficient and transparent path to success. In addition, your customers will have more confidence in you and your work. Being a credentialed tradesperson is the highest form of professionalism in the trades — it shows you're serious. This test is not just a test; it's a game changer. Being a licensed master electrician can change your life, your income level, and the legacy you'll leave behind.

As a master electrician, trainer, and instructor for more than 30 years, here are some tips that have produced consistently positive results with my students.

CREATE A STUDY PLAN, AND STICK TO IT.

Exams can be nerve-racking — they challenge our confidence and expose technical deficiencies. This exam will force you to face the areas in this craft where you do not excel. That's okay, but use this to your advantage by hitting any potential problem areas head on.

First, create a consistent study plan you'll stick with. Don't be greedy with your daily routine, piling up appointments and promises to others on your study days. Learn to say no to customers who add on additional items at the last minute, typically when it's time to go. Just reschedule a return visit, and do it another time — no matter how hard it is. Practice being more conservative with your time when you must study, avoiding anything that will interfere with your routine. Once you break your study pattern, it's extremely hard to regain the rhythm.

Some electricians thrive on a "last-minute cramming" lifestyle, but this is certainly not the best way to ensure success. Most of us aren't natural test takers, so remember not to fall into this trap.

Set realistic goals for your study routine. Don't study when you're fatigued — you'll learn and retain information best with

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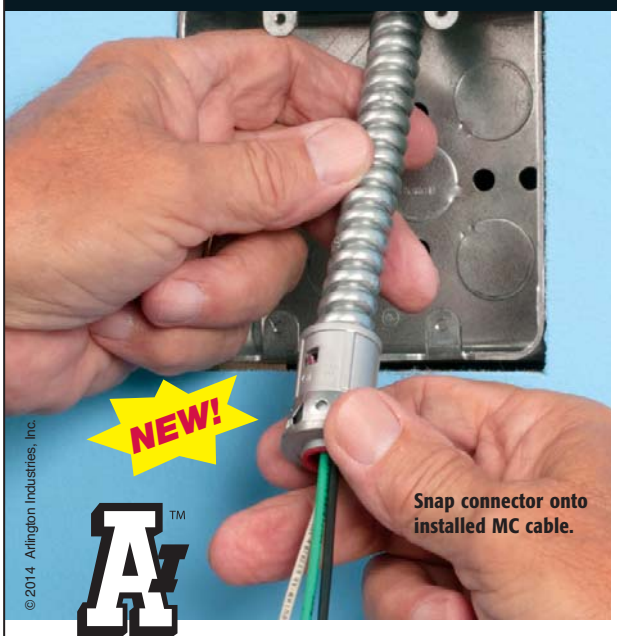
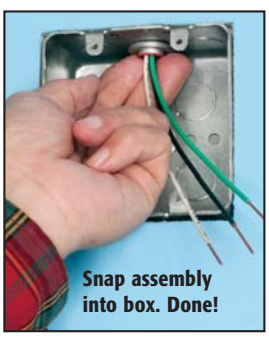


Arlington's new one-piece **RETROFIT SNAP2IT®** fittings are *easy to use in an OLD WORK installation*, and handle the widest variety of cables! They're ideal for adding additional circuits to a load center. And you get the same labor-savings in a retrofit installation!

Easy snap-in installation - NO TOOLS. Install connector into the knockout in an ***existing* box**, pulling cable/conduit through the knockout. Slip the fitting onto the cable, then snap the assembly into the box. That's it... a secure installation with *no pullout*.



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Widest total cable ranges 14/2 to 10/3
Widest variety of cables AC, MC, HCF, MC continuous corrugated aluminum cable, MCI-A cables (steel and aluminum), AC90, ACG90 and FLEX

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- Easy to install one or two-piece styles for any siding type
- NM cable connector included
- UV rated for long outdoor use
- Textured, paintable finish

ONE piece 8141F Fixture Box	VS	TWO piece 8081F Electrical Box
No extra cover to lose or store		Separate cover and box
For light fixtures		For light fixtures, standard receptacles
Costs less than 8081F		

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Location/Chapter	Title/Table/Figure	Purpose
Article 90	Figure 90.3: Code Arrangement	NEC chapter navigation.
Article 110	Table 110.26(A)(1): Working Spaces	Equipment clearances based on voltage.
Article 110	Table 110.28(A)(1): Enclosure Selection	Enclosure selection based on environment.
Article 210	Table 210.21(B)(3): Receptacle Ratings for Various Size Circuits	Helps you to determine branch circuit conductor and breaker size to receptacles.
Article 220	Figure 220.1: Branch-Circuit, Feeder, and Service Load Calculations	Helps you navigate the entire article. Save time by utilizing this handy map for the whole article.
Article 220	Table 220.12: General Lighting Loads by Occupancy	Helps you to calculate lighting loads by building square footage based on the type of occupancy
Article 220	Table 220.42: Lighting Load Demand Factors	Lighting load demand factor table for service calculations. Follow instructions in Annex D.
Article 220	Table 220.54: Demand Factors for Household Electric Clothes Dryers	Demand factor table for electric clothes dryers in dwelling units. Be careful; you might have to use the "minimum" dryer VA rating in 220.54 — not what they give you in the question.
Article 230	Figure 230.1: Services	Helps you navigate through the entire Article.
Article 240	Table 240.6(A): Standard Ampere Ratings for Fuses and Inverse Time Circuit Breakers	List of all the standard circuit breakers and fuse sizes. This table is very helpful when answering motor questions from Article 430.
Article 250	Figure 250.1: Grounding and Bonding	Helps you navigate through the entire Article.
Article 250	Table 260.66: Grounding Electrode Conductor for Alternating-Current Systems	This table will help size the grounding electrode conductor for the ground rod and the cold-water ground
Article 250	Table 250.122: Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment	This handy table helps you select a grounding conductor based on the size of the breaker feeding the circuit. This will help you to be less dependent on the boss or the electrical inspector.
Article 300	Table 300.5: Minimum Cover Requirements, 0 to 1,000 Volts, Nominal, Burial in (Inches)	Minimum burial depths for electrical circuits based on the voltage and location. This handy table will make you less dependent on the boss.
Article 310	Table 310.15(B)(2)(A): Ambient Temperature Correction Factors Based on 30°C (86°F)	Correction factor table based on conductors from 310.15(B)(16). Use this table when "correcting" based on the temperature around the conductor.
Article 310	Table 310.15(B)(3)(a): Adjustment Factors for More Than Three Current-Carrying Conductors	Adjustment factor table based on number conductors in a raceway from 310.15(B)(16). Use this table when "adjusting" conductors to "derate."
Article 310	Table 310.15(B)(16): Allowable Ampacities of Insulated Conductors Rated Up To and Including 2,000 Volts, 60°C Through 90°C (140°F Through 194°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)	The most important table in the NEC. Use this table to select your conductors based on ampacity, temperature, and insulation type. This is how you find your wire size for feeders, branch circuits, electrical equipment, and panelboards.

Highlight this important list of Articles and Figures, and see if you can bring this Table to the exam with you for reference.

a fresh mind. Sort out your obligations, arranging them by priority, and then set up a timetable for when you're going to study. Organize what content or subject areas you plan to study when, giving some subjects more time than others (depending on your areas of deficiency). You must feel comfortable during your study period. Most people learn better when they isolate themselves, but do whatever works best for you. Watch YouTube videos. Read *EC&M* articles. But most importantly, remain focused.

Make sure your notes are neatly organized and that you have enough space to spread your textbooks, charts, and notes out. Work in a brightly lit area, use highlighters/sticky notes, and sit in a comfortable chair. Get rid of distractions — avoid computer games and family members during study sessions. Explain to them why you need at least a few hours per day to study at home, and stick to this regimen. In addition,

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Designed for devices, Arlington's *economical* single and two-gang **Vapor Boxes** offer easy nail-on installation in new construction.

These cost-saving boxes don't include gaskets, but when caulked around the NM cable during installation, they **meet the requirements of NEMA OS-4.** And help meet International Energy Conservation Codes (IECC), and other codes *where required.*

- Nails ship captive. Plugs and NM cable connectors supplied.

2-hour Fire Rating

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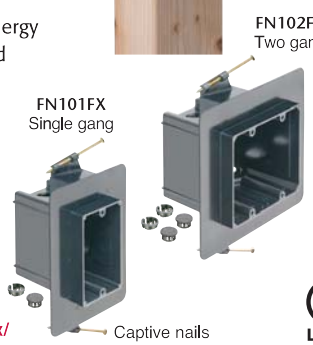

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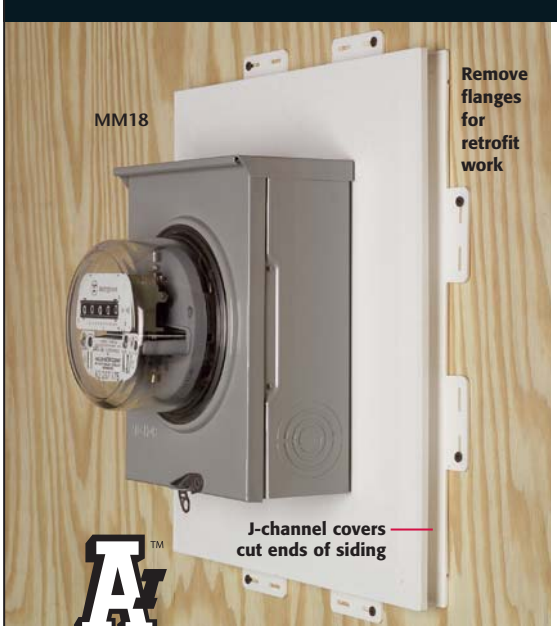

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Arlington's one-piece, non-metallic Mounting Bases provide a smooth, flat mounting surface for most electric meters, *including the largest sizes* – as well as a variety of other products such as timers, disconnects, inlet boxes and more.

UV rated, paintable plastic for long outdoor life.

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

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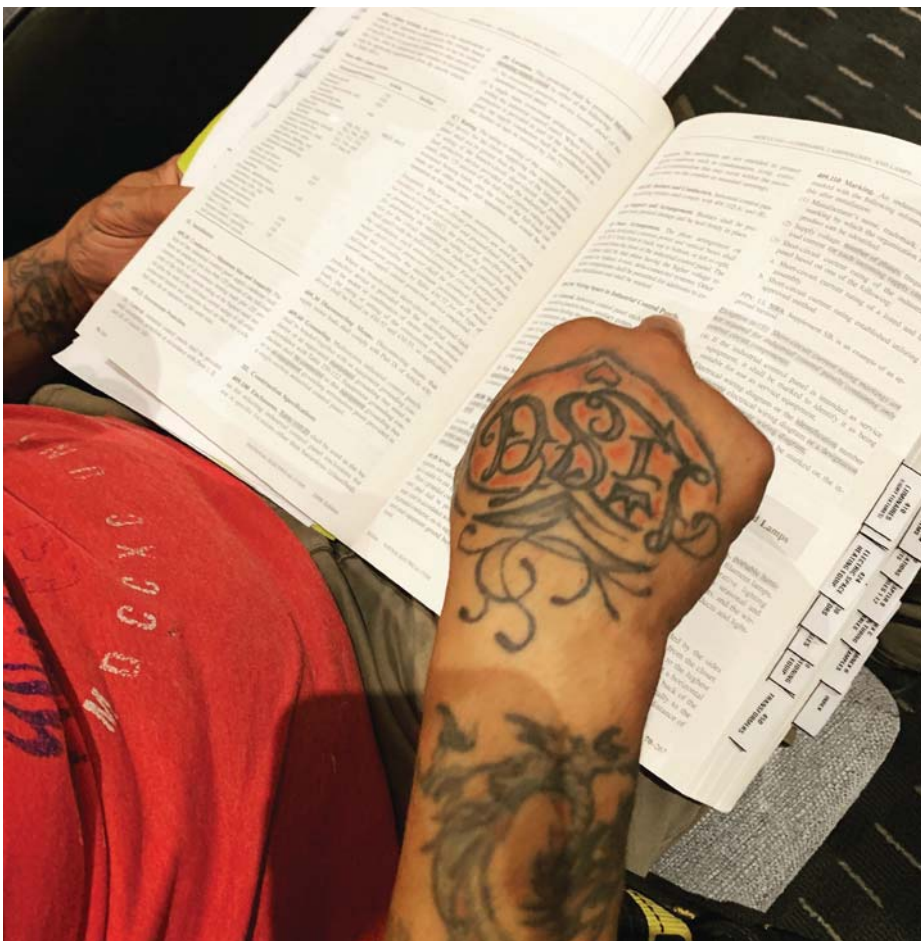
MM7 5" X 7"	MM18 15-7/8" X 17-5/8"
MM10 7" X 10"	MM23 17-5/8" X 23"



Most electrical exams are "open book," so find out in advance what you're allowed to bring into the testing center, such as the *NEC Handbook*.

always travel with study material, ensuring you'll make good use out of "all" of your downtime. This little secret will put you on the path to becoming a lifelong learner. Do whatever it takes to intensify your focus on success, such as installing a vision board on the wall in front of you. Keep your motivation high. Don't let anything or anyone stress you out during this period.

Most electrical exams are "open book," so find out what you're allowed to bring into the testing center.

Check the testing center's website for information on the specific exam you're taking. If you're taking a state examination, find information on the exam layout, subject matter, and content. Check with anyone you know who may have taken the exam recently or in the past.

Most state exams or major cities have exams that are five hours long. New York has a practical hands-on portion of the exam. Make sure you're mentally and physically prepared for that type of test.

Most electrical exams are "open book," so find out what you're allowed to bring into the testing center. Some test sites allow additional handbooks like the "Ugly's" electrical helper book, the English dictionary, and the *NEC Handbook*. Use every advantage you

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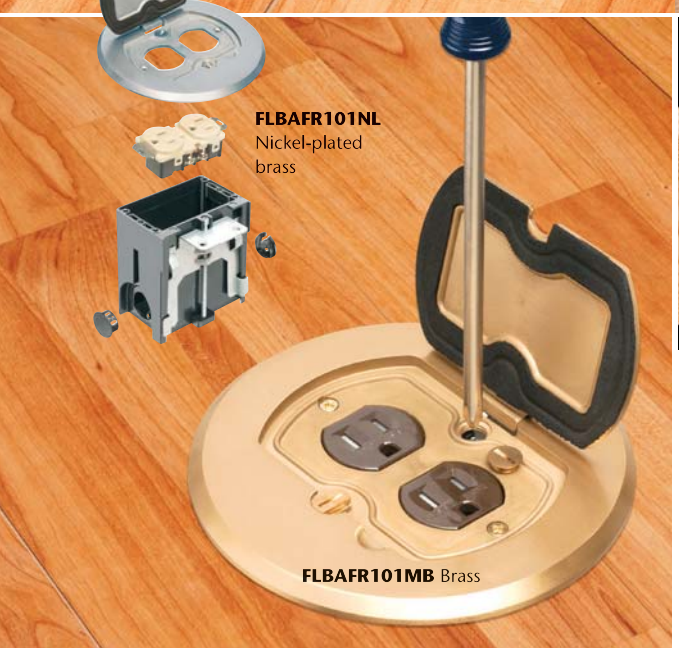

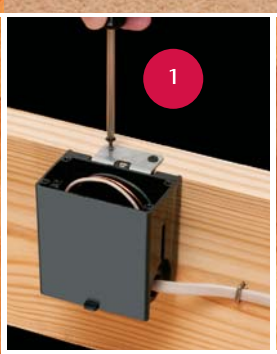

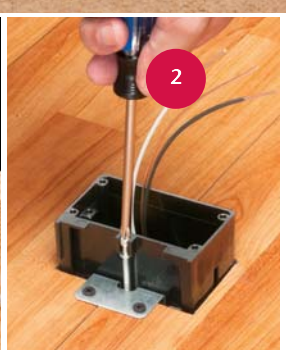

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They're the low cost, *easy way* to install a duplex receptacle flush with the floor.

- **Gasketed covers with ONE or TWO FLIP LIDS** prevent water intrusion and protect the box when not in use
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Author Harold De Loach, a master electrician and electrical trainer/instructor, has more than 30 years of experience in the field and teaching passionate people to enter the electrical trade. Pictured here are some of his students at The Academy of Industry Arts in Philadelphia.

can. You can even call the testing center and ask questions ahead of time.

IT'S TEST DAY

Get some rest the days leading up to the test. Don't arrive at the test center stressed, tired, or not feeling your best due to a late night of partying. Remember Murphy's Law — anything that can go wrong will go wrong on test day. So be prepared to do some serious time management planning in advance of the actual test day. Visit or plan a route to the testing center. Leave home early so that you don't have to speed. Arrive on time. The test center proctor may not be empathetic to your reason for being late. Have everything you need to complete the sign-in procedures at the testing center, such as a valid form of "non-expired" government-issued photo ID with your signature.

Be confident, and have your plan ready when you hit the start button.

HOW TO TAKE THE EXAM

The test creator strategically arranges the questions (randomly) in a way that is designed to create stress, anxiety, and confusion. You may be given difficult questions right at the beginning of the exam, but don't let this throw you off.

Here's the number one rule to follow: Skip questions. Don't take the exam in the order in which it is given to you. Most testing software platforms will give you the option to "skip" a question and go to the next one. For the first few hours of the exam, answer questions that require the least amount of time. Focus on the "low-hanging fruit" first if you will — going from the least difficult to the most difficult.

Exam questions can be organized by the number of steps it takes to answer the question. Some may take only one; others could take up to five steps. For example, service calculations, some motors questions, and anything that requires a table typically require three to five steps to get an answer. Avoid these questions early in your exam; the goal is always to save time in the beginning. Doing this will leave you with enough time allocated to answer the more time-consuming questions at the end. This will also leave you time to review all of your answers before you hit "finish."

Also remember that all questions aren't created or weighted equally. The exams in my area, for example, have a "General Knowledge" section and a "Plans Reading" section that feature very time-consuming questions. Save those for the end.

PARTING TIPS

When preparing for any kind of electrical licensing exam, remember these golden rules:

- Re-arrange the questions in an order that makes you feel more comfortable, even if you have to skip the first 10 to 20 questions. Answer the easy ones first.
- Work on math and motor problems last. This will save you time.
- Associate Chapters with Articles. For more tips on how to do this, read my previous article ("The NEC for Newbies in a Nutshell" at https://bit.ly/3T828Ws), and watch the accompanying webinar.
- Highlight the important Tables and Figures noted in the **Table** on page 34. If possible, bring a copy of this Table to the exam.

Here's the number one rule to follow: Skip questions. Don't take the exam in the order in which it is given to you. Most testing software platforms will give you the option to "skip" a question and go to the next one. For the first few hours of the exam, answer questions that require the least amount of time.

In summary, to pass an exam like this, "getting your mind" right from the start is one of the most important strategies you can use to your advantage. You must not only understand the flow of the test but also the nuances and language of the exam. Paying specific attention to all of these aspects of test taking will inevitably improve your score in the end as well as your chances for continued success in your lifelong journey of electrical learning. EC&M

Harold De Loach, a master electrician and electrical trainer/instructor, is the founder of The Academy of Industrial Arts in Philadelphia. He can be reached at info@taia-school.com.

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WITH and WITHOUT INSULATED THROAT

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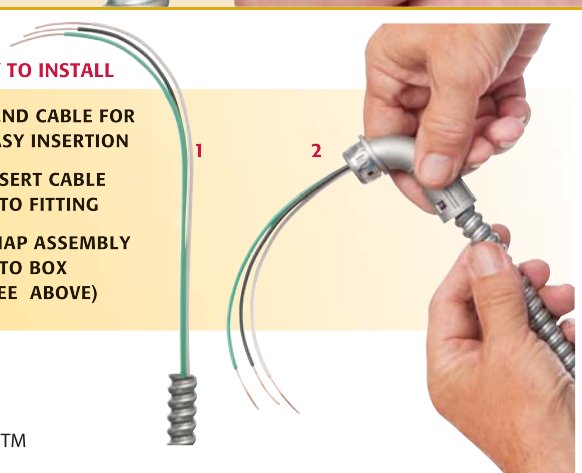
- Handles widest range & variety of cables: 14/2 to 10/2 AC, MC, HCF, MC continuous corrugated aluminum cable, MCI-A cables (steel and aluminum), AC90 and ACG90
- Fast, super-secure installation...No pullout
- Easy to remove from box...reusable

90° SNAP2IT® CABLE RANGES

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

EASY TO INSTALL

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



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People Skills

With an estimated annual shortage of 80,000 electrical professionals into the next decade, any job opening is tough to fill. But some are proving to be tougher than others.

Courtesy of Faith Technologies Incorporated

Faith Technologies Incorporated, a Menasha, Wis.-based electrical contracting and engineering firm that is listed on both *EC&M*'s Top 50 Electrical Contractors and Top 40 Electrical Design Firms lists for 2022, is actively reaching out to "passive" candidates to boost recruiting efforts.

By Tim Kridel, Freelance Writer

Every year through 2031, the electrical industry will have an average of 80,000 job openings, according to the U.S. Department of Labor. That's roughly 11% of all positions. Those numbers mean that for the foreseeable future, any job opening will be tough to fill. But some will be tougher than others.

Each year, *EC&M* surveys the largest electrical contractors and electrical design firms about a variety of topics, including "most difficult positions to fill." In the September 2022 Top 50 Electrical Contractors survey, "electrician" was deemed the toughest, followed by "journeyman," as shown in **Fig. 1** on page 40. And in the June 2022 Top 40 Electrical Design Firms survey, "project engineer" ranked first, followed by "supervising engineer," as shown in **Fig. 2** on page 40.

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

System components get the job done quickly and easily.

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

The **Slide-On Trough** holds and protects cable. To add length, install more sections that join together with **Coupling**.

Angles and **Tees** make turning corners a breeze.

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

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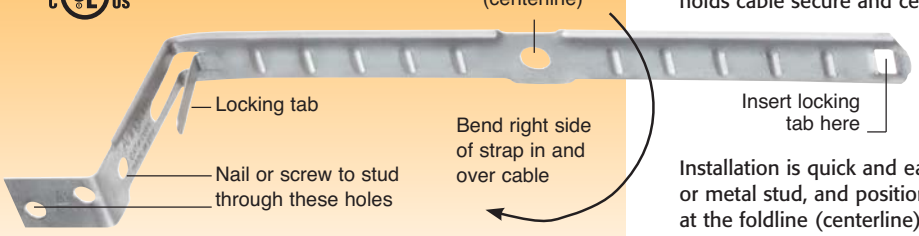
ECONOMICAL...HOLDS UP TO FOUR MC CABLES • EASY TO INSTALL



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- Complies with 2020 NEC, article 300.4(D)

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

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"We currently have five mid-senior-level electrical engineering positions open for hire," says Patrick Burnside, senior recruiter at Long Beach, Calif.-based P2S. "We saw a substantial increase that started in the third quarter of 2021 and was consistent through the third quarter of 2022. During that span, we had as many as 15 electrical engineering postings at any given time."

There's also an ironic conundrum: Engineers are in such short supply that they can practically name their price, but many don't put themselves in a position to exert that power.

"Engineers at these levels are working," Burnside says. "They don't typically apply to open positions posted on job sites or company websites unless they have a compelling reason. That can be job flexibility, salary, work environment, or several other issues. I believe they get caught up in day-to-day tasks and may be too busy or exhausted to think about a change. A large part of my job is to reach out to these passive candidates and start the conversation of 'what if?'"

Menasha, Wis.-based Faith Technologies Incorporated (FTI), an electrical contracting and engineering firm that is listed on both *EC&M*'s Top 50 Electrical Contractors and Top 40 Electrical Design Firms lists for 2022, is doing similar outreach.

"Post COVID, it has been an interesting couple of years," says Jami Garrity, director of talent acquisition. "We did have a surplus of individuals applying, and now we're on the opposite side where we are actively reaching out to what we call 'passive' candidates and saying: 'Here's why FTI is better than the individuals that you're working for now. We're a growing company. We have a record amount of backlog for 2023.' We have individuals that actually come back because they recognize that our safety is top-notch."

Specializing in highly complex projects also can limit a firm's pool of potential candidates.

"Our projects consist of larger and more complex designs," Burnside says. "Finding candidates with the knowledge and experience of these projects proves more difficult to source. Ideally, our mid to senior engineers should be licensed in the state they practice.

"Depending on workload, we hire entry-level design engineers (zero to two years) to senior-level project managers (minimum seven to 10 years). We look for mid- to senior-level candidates with experience in larger, more complex projects, including health-care facilities, upper and lower educational facilities, technology and laboratory facilities, and larger federal projects, such as airports and seaports."

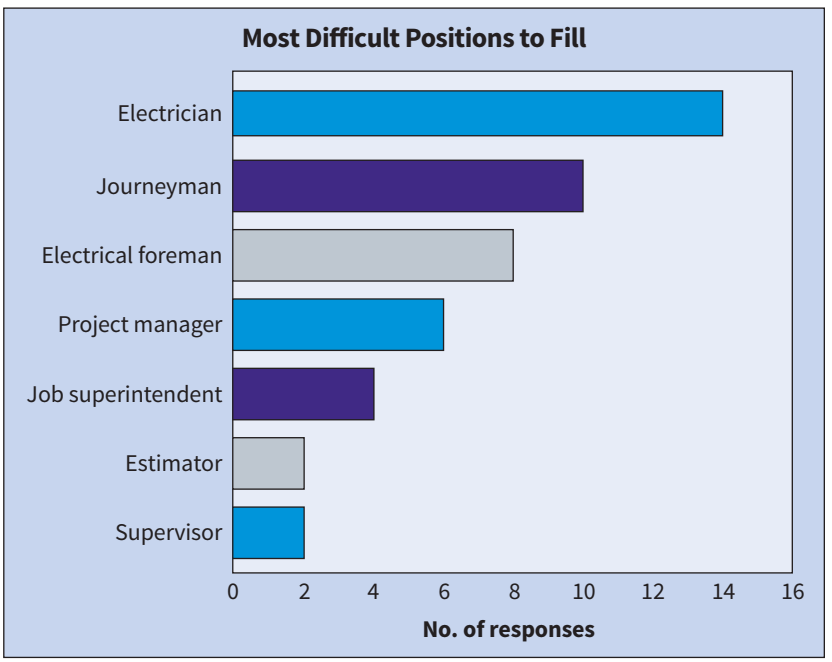

Fig. 1. "Electrical foreman," which had retained the top spot for the last several years as the "most difficult position to fill" among Top 50 Electrical Contractor respondents, was replaced in 2022 by "electrician" followed by "journeyman."

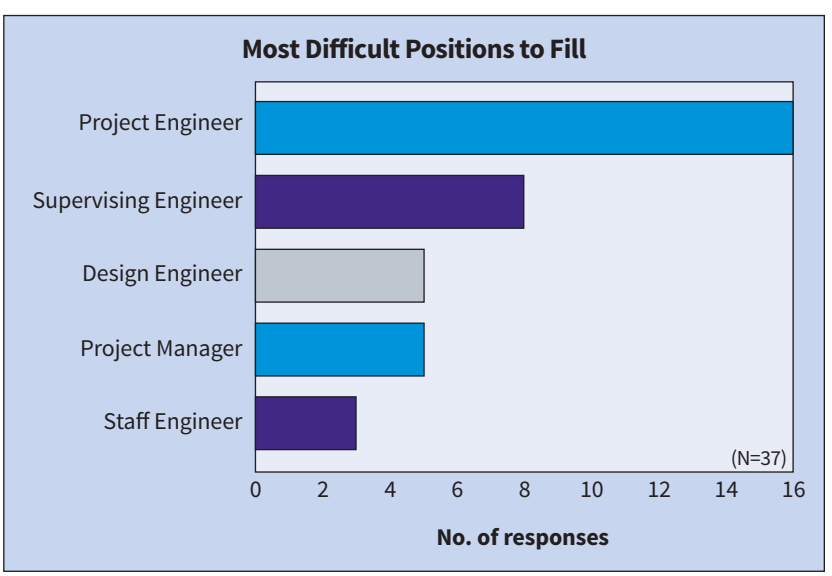

Fig. 2. Again in 2022, "project engineer" topped the list of "most difficult jobs to fill" for Top 40 Electrical Design Firms.

LEADERS NEEDED

Finding experienced people who also are willing and able to take on

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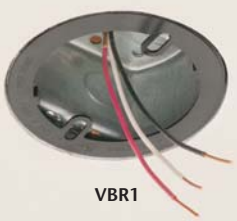

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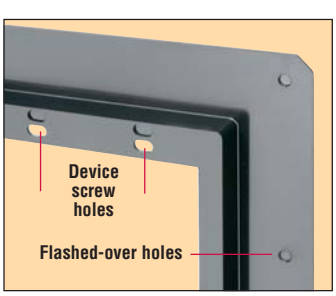

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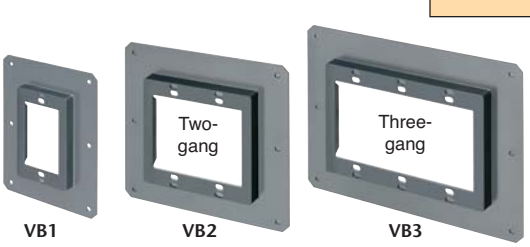

VB1 VB2 VB3

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Courtesy of Faith Technologies Incorporated

Faith Technologies Incorporated, which employs both electrical contracting and engineering workers, focuses on the company's commitment to top-notch safety as a recruiting tool.

leadership and mentorship roles is another challenge across the board.

"We definitely see the journeyman role being the most challenging position to fill," Garrity says. "Fortunately, we have a lot of opportunities to come in as what we call a 'ground-up growth hire.' We'll bring individuals in with zero electrical experience and have them go through a variety of courses, including our fully paid apprenticeship program where they're going to get those skills to be able to take the journeyman test. A lot of the time is spent on site where they're working alongside different crews and being able to learn from individuals who have been in the trade for quite some time."

San Jose, Calif.-based Rosendin Electric faces a similar struggle.

"The less experienced and those entering the trade are becoming more available," says Troy Vandine, workforce development trainer at Rosendin's Charlotte, N.C. office. "It's the field leadership to be able to direct those less experienced people that we are really struggling to find."

Rosendin is No. 4 in *EC&M*'s 2022 Top 50 Electrical Contractors listing and a national player, so it can leverage that scale to move leadership to where it's needed — at least temporarily.

"Guys that are working with Rosendin around the country are able to come in and help provide some of the leadership," says Bobby Emery, the firm's workforce development coordinator for central Tennessee.

Another challenge is finding employees who have experiences — as in plural.

"A lot of the journeymen coming to work for us have always worked for contractors that kept them more task-oriented instead of well-rounded as far as their training," Emery says. "We're struggling with that. You'll have a guy who comes in that's really good on conduit or wall rough-in, but he doesn't know how to hook up a transformer or make terminations."

A wide range of experiences can help journeymen take on more of a leadership role.

"When you're out in the field, journeymen wiremen are leaders in themselves," Emery says. "They're able to take direction from their foreman and direct two or three workers that are working with them."

SHARING IS CARING

A well-rounded journeyman also can be a great mentor, but unfortunately, that's not always the case. Therein lies another ironic problem for employers: Although everyone in the electrical industry bemoans the chronic shortage of people, some still fear being out of a job.

"In our region, a lot of journeymen — I would say close to 40% — feel if they pass that knowledge down, it may limit their ability to keep their job or to have a job in the future," Emery says.

His colleague Vandine adds: "With me and Bobby, when we got into the trade, there was somebody that took us under their wing, showed us the ropes, took the time to tell us when we were wrong, and praised us when we were right. That seems like a lost art."

Some firms are addressing the labor shortage by creating their own apprenticeship programs. Obviously, that strategy requires veteran employees willing to share their expertise.

"Because we have our in-house apprenticeship program, we also have in-house training," says FTI's Garrity. "They're called 'technical trainers.' We have quite a few of them across the board because they are the individuals who are truly passionate about the trades and want to pass that knowledge along.

"We have individuals on staff that are so good with the Code that all they do is teach the Code to individuals who maybe are struggling. They can have one-on-one sessions with those individuals. They can do online training or in-person training."

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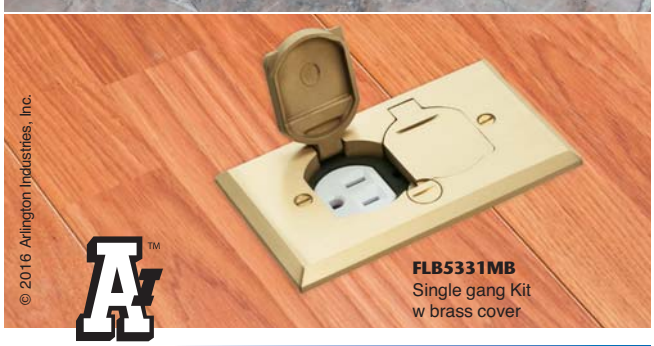

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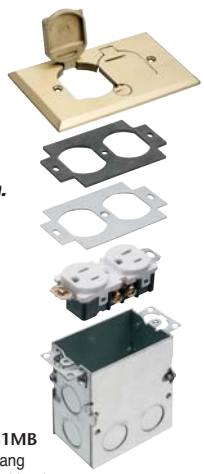

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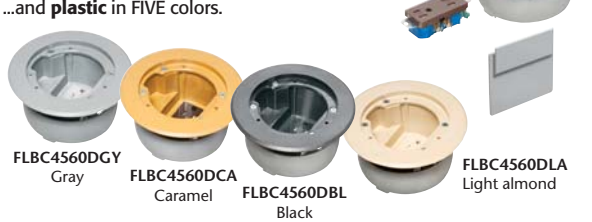

Product info aifittings.com/landing/inbox-cover-kits/

Anecdotal evidence suggests that younger employees who have begun moving up the ranks are more inclined to share what they've learned with those just starting out.

"I sat in a foremen meeting several weeks ago, and these young foremen were up there saying, 'Our most precious resource in our company is our apprentices,'" says Al Paxton, chief people officer at Lakewood, Colo.-based Encore Electric. "When I heard that I was like: 'Oh my gosh! We're probably in a pretty good place right now as long as we can continue to promote that way of thinking from our leaders.'"

Those kinds of people skills can go a long way toward keeping newcomers at a company — or even in the profession.

"If you have some adjustments to make or you have something you need them to work on, you pull them to the side so they don't feel that they're singled out," says Rosendin's Vandine. "But you praise in public."

Simply stopping to talk with employees can help boost morale and retention, especially in large firms.

"We had a gentleman working here in the prefab shop," Emery says. "I was walking through one morning, and I stopped and talked to him for 5 minutes. Just asked him how his day was going and how his family was doing and told him he was doing a great job. Then I walked on to the office.

"At the end of the day, he looked me up and said: 'I've been doing this for several years and never had anybody take time to thank me for the job that I was doing. I just want you to know that I appreciate it.'"

HOW TO KEEP WHO YOU HAVE

Ample career options also can be key for attracting and retaining talent. In the case of people who are new to the profession, that strategy requires mentors to educate them about all the opportunities they're unaware of.

"We have an excellent tenure with our employees," says P2S's Burnside. "One of the reasons is we offer a pathway for career advancement to all new hires. We do this by pairing all new hires with a mentor. That mentor will work with the new hire to help map out their desired career path with us. Of course, we encourage and support our employees to seek employment accreditation, such as licensing and certifications."

It's equally important to show experienced employees that they have plenty of options, too.

"Foreman and superintendents all want to know what their career path looks like," Paxton says. "It's a leadership responsibility to help both people see that it's not just a linear path. There's a lot of ways that the dots could connect."

Most apprentices also are starting out in life.

"Dollars will sway a young person, especially a young person that's got a family," Paxton says.

Higher pay also can be attractive if it means they can provide for their family without putting in 60- or 70-hour weeks.

"Who's the most vulnerable employee?" Paxton says. "One of our senior executives said, 'Is it the lowest paid person in the company?' I think it's probably the hourly employee that has the highest responsibility load: a mortgage, kids. They're not really making all that much money, and the economy is crazy. I think that makes people more vulnerable, and they'll be easily swayed by a dollar or two."

In theory, the bigger an electrical contractor is, the more money it has to snap up talent. But the reality is different, especially when it comes to people who have completed their apprenticeship programs and are now ready to test.

Some career paths are a tougher sell.

"There's a stigma with service I'm still trying to figure out," Paxton says. "There are guys who just want to get out there and build stuff. Service is good work; it pays really well, and you're kind of your own boss.

"We pay a premium for service techs because they've got to give us that great customer experience. They interface directly with our customers. It's more challenging to get those people in the door because we have pretty high expectations."

SHOW ME THE MONEY

In theory, the bigger an electrical contractor is, the more money it has to snap up talent. But the reality is different, especially when it comes to people who have completed their apprenticeship programs and are now ready to test. That's because solid new hires can have a much bigger impact on a company with 50 electricians than a firm with 1,000.

"Smaller firms will throw a big premium at a really good, ready-to-test apprentice," Paxton says. "The people that they want to cherry-pick — that's where it gets super competitive."

People with a lot of familial responsibilities also often want to know that their employer is capable of taking care of them when a sector or the entire economy starts to slow. This concern can give an edge to contractor and design firms that work in a variety of sectors — from traditional ones to emerging ones such as renewables and EVs.

"If we have a recession, maybe that electrician can learn something new and put up a solar panel instead of [working in] the traditional industrial space," says FTI's Garrity. "We have a lot of different manufacturing environments if someone doesn't want to work out in the field anymore or in office settings. We've got virtual design programs, estimating programs, and operational leads that are needed." EC&M

Tim Kridel is an independent analyst and freelance writer. He can be reached at tim@timkridel.com.

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5010AST	Snap in, 1/2" KO w insulated throat	.580 to .780
505010AST	Duplex Snap in, 3/4" KO w insulated throat	(2) .590 to .820
4110ST	Snap in, 1/2" KO	.525 to .705
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Overvoltage Protection

Don't rely on a single type of surge protection device; implement a strategy based on tiered protection.

By Mike Holt, NEC Consultant

With the 2020 revision of the NEC, Art. 242 replaced two individual Articles that appeared in earlier editions of the Code — Art. 280 [Surge Arrestors] and Art. 285 [Transient Voltage Surge Suppressors (TVSSs)]. Implementing a good strategy for overvoltage protection encompasses the material contained in both of those prior Articles.

Part I of Art. 242 provides the general, installation, and connection requirements for overvoltage protection and overvoltage protective devices (i.e., surge protective devices or SPDs). Part II covers SPDs rated 1,000V or less that are permanently installed on premises wiring systems. Part III covers surge arresters permanently installed on premises wiring systems over 1,000V nominal.

IT WILL BRING YOU TO TIERS

Distribution step-down transformers do not filter out transients. They reduce transients by the same proportion they step down the line voltage. For example, a 480V/120V delta/wye transformer has a 4 to 1 turns ratio, which means a 1,800V spike coming into that transformer will translate to a 450V spike on the other side of it.

It helps to think of power distribution voltage levels as a series of layers that get smaller as you go from the source to the point of use. We start with the higher voltages and further break down voltage levels into what we call a tiered protection strategy.

SPDs are designed to reduce transient voltages present on premises power distribution wiring and load-side equipment. These transient voltages can originate from sources ranging from lightning to laser printers. Voltage spikes and transients that are caused by the switching of utility power lines, power factor correction capacitors, or lightning can reach thousands of volts and amperes. Voltage spikes and transients that are caused by utilization equipment such as photocopiers, laser printers, and other highly reactive loads can be in the hundreds of volts.

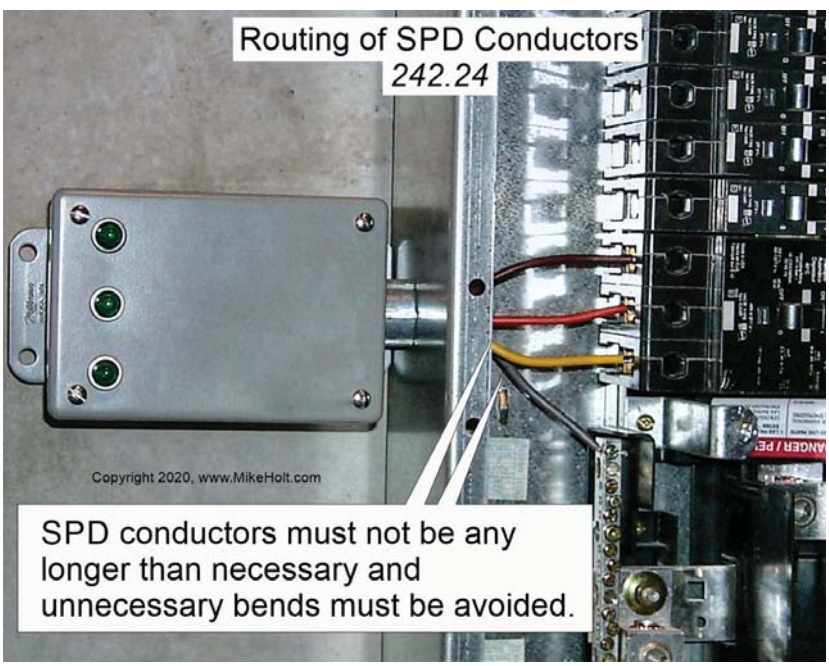

Fig. 1. Shorter conductors and minimal bends improve SPD performance by helping to reduce conductor impedance during high-frequency transient events.

Transients produced by utilization equipment are the typical culprits when you have frequent failures of electronic equipment such as computers, telecommunications equipment, security systems, and electronic appliances.

An SPD limits transient voltages by diverting or limiting surge current and preventing the continued flow of current while remaining capable of repeating these functions [Art. 100].

A key concept in the application of these devices is they limit transient voltages rather than eliminate them. How much a particular device limits transient voltages depends on which level of power distribution and environment it is designed for.

A given SPD device can limit voltage only within a certain range. That's why a tiered system is necessary. The first SPD device downstream of the disturbance handles the voltage down to something on par with that level of voltage distribution. This continues for as many levels as needed until you're at the branch circuit SPD, which can't possibly handle the original transient but can easily handle what the other SPDs have passed to it.

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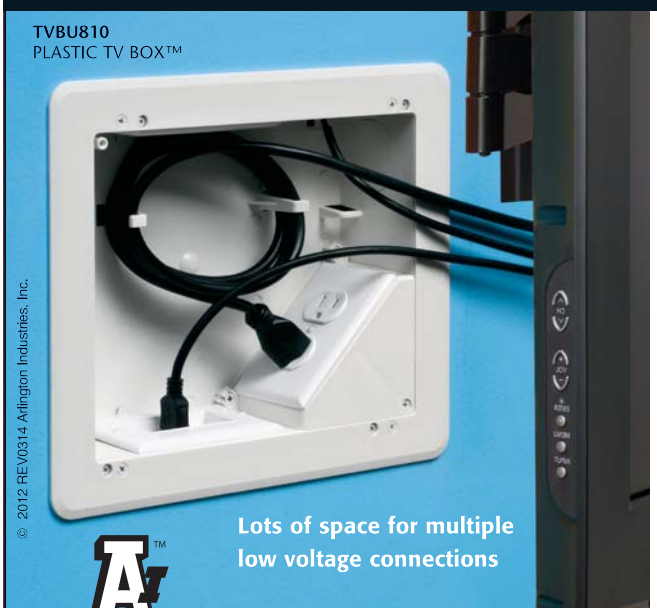

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PROHIBITED USES

You cannot use an SPD [Sec. 242.6]:

(1) In circuits that exceed 1,000V.

(2) In ungrounded systems, impedance grounded systems, or corner-grounded delta systems unless listed specifically for use on these systems.

(3) If the voltage rating of the SPD is less than the maximum continuous phase-to-ground voltage available at the point of connection.

SPD REQUIREMENTS

SPDs must be listed [Sec. 242.8]. UL 1449, *Standard for SPDs*, says these units are intended to limit the maximum extent of transient voltage surges on power lines to specified values. They are not intended to function as lightning arresters.

SPDs are susceptible to failure at high fault currents. SPDs must be marked with their short-circuit current rating. You cannot install an SPD where the available fault current exceeds its rating [Sec. 242.10].

Where you use SPDs, ensure each phase conductor of the SPD-protected circuit is connected [Sec. 242.20]. If the SPD comes as a 3-phase system in a box, simply connect the phase wires of the SPD to the electrical system's phase wires. Otherwise, you will probably be connecting an individual SPD between any two conductors (whether ungrounded or grounded). A grounded conductor and the equipment grounding conductor can be interconnected only by the normal operation of the SPD during a surge [Sec. 242.30].

Line and grounding conductors must be at least 14 AWG (12 AWG if aluminum) [Sec. 242.28]. Connect only one conductor to a terminal, unless the terminal is identified for multiple conductors [Sec. 110.14(A)]. Don't make the leads any longer than necessary, and avoid bends that are sharp or unnecessary [Sec. 242.24] (**Fig. 1** on page 46). Shorter conductors and minimal bends improve SPD performance by helping to reduce conductor impedance during high-frequency transient events.

TYPES 1, 2, 3, AND 4

SPD types are numbered from the service (Type 1), feeder (Type 2), branch circuits (Type 3) to components integrated into the equipment (Type 4). As the energy level decreases, the Type number increases. For that reason, using each Type in a tiered strategy is the only way to effectively protect infrastructure and loads from transients.

Here is a more detailed explanation of the tiers.

Type 1 SPDs normally go on the supply side of the service disconnect [Sec. 242.12(A)(1)]. However, you can install them on the load side of the service disconnect per the requirements of Sec. 242.14 [Sec. 242.12(A)(2)] (**Fig. 2**). For example, you might want to use a Type 1 SPD on a particular feeder that supplies a large motor.

Type 2 SPDs must be connected to the load side of the service disconnect [Sec. 242.14(A)] rather than the supply side. You can connect them anywhere on the load side of the feeder overcurrent protective device [Sec. 242.14(B)] and you can connect them anywhere on the premises wiring of a separately derived system [Sec. 242.14(C)].

Type 3 SPDs must be connected somewhere on the load side of branch circuit protection [Sec. 242.16], and their application stops at the equipment served.

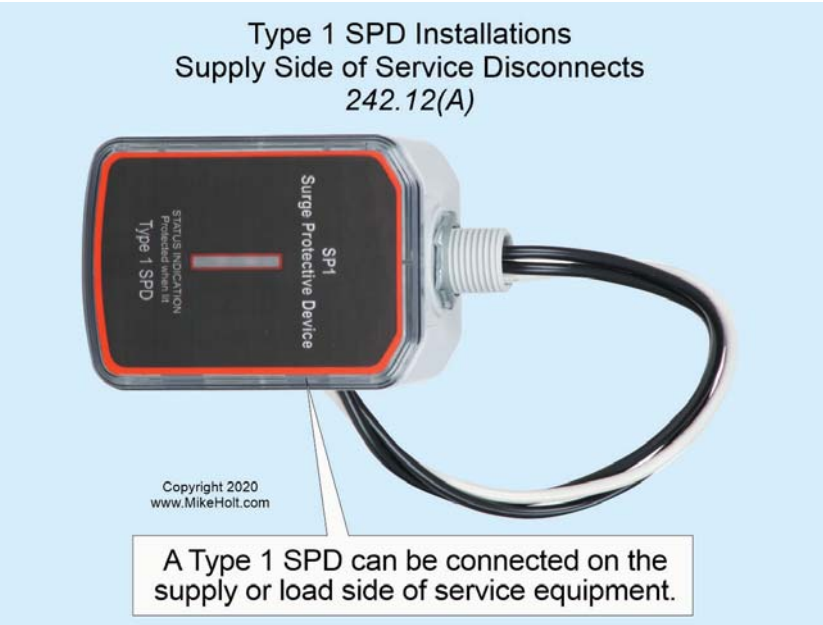

Fig. 2. You might want to use a Type 1 SPD on a particular feeder that supplies a large motor.

Type 4 SPDs are installed in the equipment served and can be installed only by the equipment manufacturer [Sec. 242.18]. A common scheme is metal oxide varistors (MOVs) connected between each power input line and ground. You may see these, for example, inside a case power supply. They shunt the remaining overvoltage out of the power line. However, they are easily destroyed if the incoming voltage exceeds their rating. Proper application of Types 1, 2, and 3 upstream of the MOV-protected equipment is essential.

EFFECTIVE PROTECTION

Your transient protection system needs to consist of layers of transient shields, each one at a lower energy level as you peel back another layer of the transient protection onion. The idea is to keep knocking down the voltage level of the transient.

Correctly select the SPDs that will most economically and effectively protect your branch circuits and their loads. EC&M

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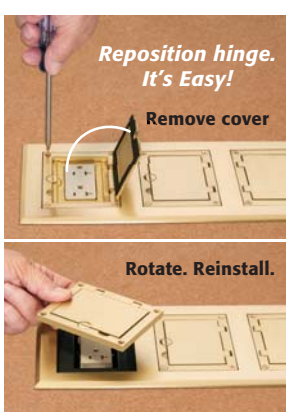
Lock two boxes together for a two-gang box. Add another for three-gang!

Covers open in Both Directions



PLASTIC Listed Cover/frame kits
NOW IN PLASTIC, FIVE Colors!

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

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

Cover installs with hinge on either side.

UL LISTED

Made in USA

Plastic Cover/frame Kit

Single gang
FLBC8510BR Brown
FLBC8510BL Black
FLBC8510GY Gray
FLBC8510CA Caramel
FLBC8510LA Lt Almond

Two-gang
FLBC8520BR Brown
FLBC8520BL Black
FLBC8520GY Gray
FLBC8520CA Caramel
FLBC8520LA Lt Almond

Three-gang
FLBC8530BR Brown
FLBC8530BL Black
FLBC8530GY Gray
FLBC8530CA Caramel
FLBC8530LA Lt Almond

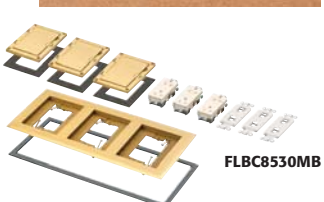
FLBC8510BR

Arlington®

Metal Cover/frame Kit

Brass finish
Single gang **FLBC8510MB**
Two-gang **FLBC8520MB**
Three-gang **FLBC8530MB**

Nickel finish
Single gang **FLBC8510NL**
Two-gang **FLBC8520NL**
Three-gang **FLBC8530NL**



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

Patented

Product Info aifittings.com/landing/gangable-box-kits/

NEW CONCRETE

NEW FEATURES!

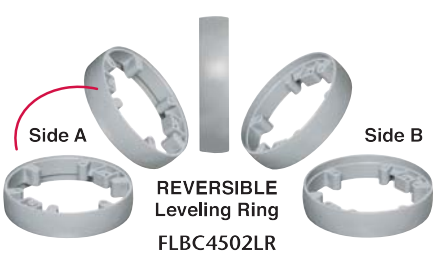
FLOOR BOX

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

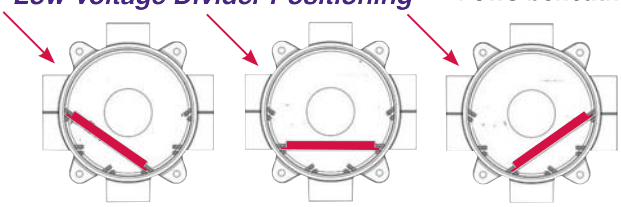
Arlington's FLOOR BOXES, COVER KITS, and accessories **FOR NEW CONCRETE** are the low cost, *convenient* way to install a receptacle *flush with a new floor.*

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

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



THREE Options for Low Voltage Divider Positioning



Openings for optional screws to raise box so concrete flows beneath

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**

PRODUCT INFO aifittings.com/landing/flbc4502/

Patented. Other patents pending.

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

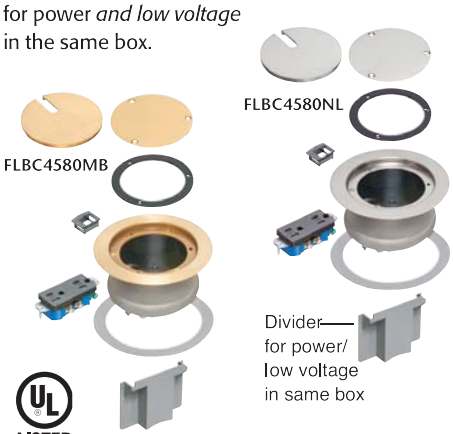
IN BOX® with Ultra-Thin Stamped Steel Flange

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

Arlington™

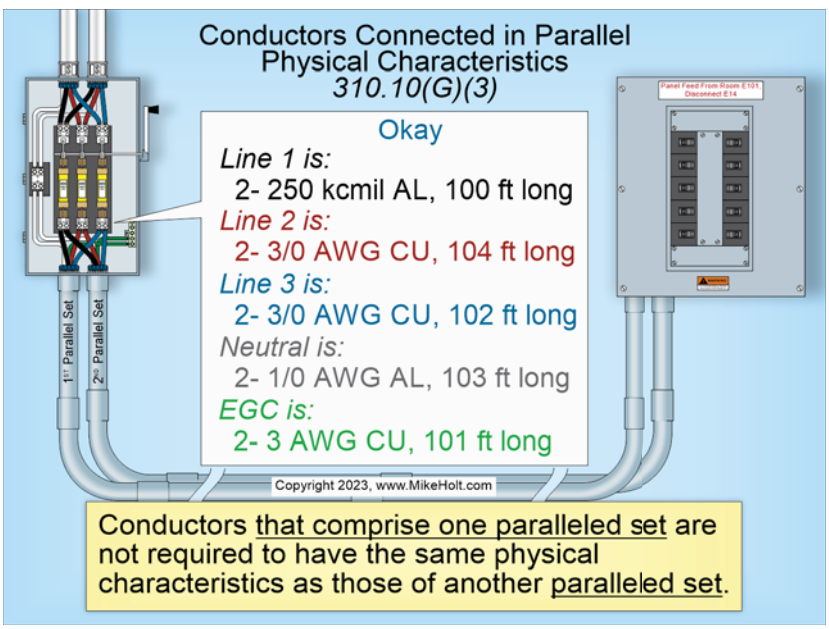
www.aifittings.com • Scranton, PA 18517 • **800/233-4717**

PRODUCT INFO aifittings.com/landing/flbc4580

Patent pending

Stumped by the Code?

By Mike Holt, NEC Consultant



Conductors that comprise one paralleled set are not required to have the same physical characteristics as another paralleled set.

All questions and answers are based on the 2020 NEC.

Q. What are the rules related to paralleling of conductors?

A. The requirement associated with the paralleling of conductors can be found in Sec. 310.10 [Uses Permitted].

(G) Conductors Connected in Parallel.

(1) 1/0 AWG and Larger. Phase, neutral, and equipment grounding conductors are permitted to be connected in parallel (electrically joined at both ends). When paralleling phase and neutral conductors, they must be sized 1/0 AWG and larger.

Author's Comment: When conductors are installed in parallel (electrically joined at both ends), the current flow will be evenly distributed between the individual parallel conductors.

(2) Conductor and Installation Characteristics. All parallel phase conductors, neutral conductors, equipment grounding conductors, and supply-side bonding jumpers must comply with the following:

(1) Be the same length.

(2) Be the same conductor material (copper, aluminum, or copper-clad aluminum).

(3) Be the same size in circular mil area (minimum 1/0 AWG).

(4) Have the same type of insulation.

(5) Terminate in the same manner (set screw versus compression fitting).

Author's Comment: Raceways or cables containing parallel conductors for Phase A, Phase B, Phase C, neutral, and the equipment grounding conductor must have the phase, neutral, and equipment grounding conductors (or supply-side bonding jumpers) in each raceway [Sec. 300.3(B)(1)]. Conductors that comprise one paralleled set are not required to have the same physical characteristics as another paralleled set (see **Figure**).

(5) Equipment Grounding Conductors. Equipment grounding conductors must be sized per Sec. 250.122(F), but they are not required to be 1/0 AWG and larger.

(6) Bonding Jumpers. Supply-side bonding jumpers must be sized per Sec. 250.102(C) and load-side bonding jumpers must be sized per Sec. 250.102(D), but they are not required to be 1/0 AWG and larger.

Q. What are the NEC requirements related to cabinets, cutout boxes, and meter socket enclosures in wet locations?

A. Section 312.2.

Weatherproof. Cabinets for panelboards, cutout boxes for disconnects, and meter cans installed in damp or wet locations must be weatherproof.

According to Art. 100, "Weatherproof" means constructed or protected so exposure to the weather will not interfere with successful operation [Art. 100].

Above Live Parts. Raceways entering above the level of live parts (such as busbars and overcurrent devices) of cabinets, cutout boxes, and meter cans in wet locations must use a sealing locknut, Myers hub, or connector listed for wet locations.

Author's comment: In accordance with "UL Guide Information DWTT," sealing locknuts are permitted on the outside or inside of the enclosure for RMC, IMC, or inside the enclosure for connectors if marked for this use on the fitting carton. EC&M

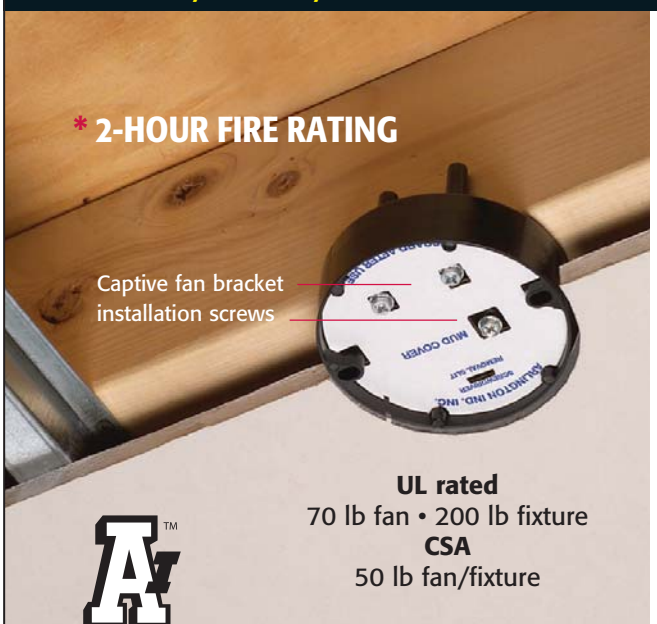
These materials are provided to us by Mike Holt Enterprises in Leesburg, Fla. To view Code training materials offered by this company, visit www.mikeholt.com/code.

SECURE, JOIST-MOUNT INSTALLATION

Made in USA

FAN/FIXTURE PAN BOX

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



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

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

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

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

Patented

ADJUSTABLE • NON-METALLIC

Made in USA

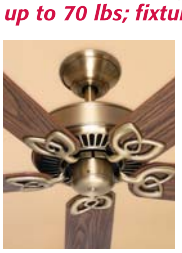
IN/OUT™ BOX for Fans & Fixtures

EASY TO INSTALL... IN NEW CONSTRUCTION

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

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

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



Product info aifittings.com/landing/fba426

1 Cutaway: Box set back in double drywall

2 After ceiling's installed, (if necessary) use the depth adjustment screw to position box flush with ceiling.

Patented

Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

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

ACCESS DENIED

Gaining access to the wiring in the recessed box on the left side of this raceway run will be a real chore because a flexible raceway was not used. That rusted electrical metallic tubing (EMT) raceway will need to be disassembled to remove the cover. When I first spotted this installation, I thought the EMT was a liquid-tight flexible metal conduit (LFMC). Upon closer inspection, I realized it was EMT. Making surface extensions from a cover is permitted by the Code, but this installer did not do it correctly. Section 314.22 requires surface extensions to be made by securing an extension ring over the box, but the exception permits surface extensions to be made from the cover of a box — if the cover is unlikely to fall off or be removed assuming its means of securement becomes loose. It also requires flexible wiring methods to be used when making an extension from a cover. The length of the flexible wiring method must be such that it permits the removal of the cover and provides access to the interior of the box. Grounding and bonding continuity must be independent of the connection between the cover and the box.

LORD OF THE KNOCKOUT RINGS

Stuffing several equipment grounding conductors (EGCs) into a lug designed for only one conductor is the first problem I want to point out here. Section 110.14(A) requires terminals for more than one conductor to be identified for that use. The next problem here is the lack of bonding bushings installed on the connectors for the metal raceways where they enter this metal enclosure. We don't want fault current traveling through those knockout rings on circuits above 250V to ground. Where oversized concentric or eccentric knockouts are encountered when installing circuits of over 250V to ground, Sec. 250.97 requires electrical continuity between the metal raceway and metal enclosure to be ensured by bonding and grounding methods specified for services in Sec. 250.92(B)(2), (3) or (4). Bonding bushings with bonding jumpers should be used for bonding these raceways containing 480V circuit conductors. If no knockout rings were encountered — or if the enclosure was listed for reliable bonding above 250V to ground — then following the bonding techniques specified in Sec. 250.92(B) would not be required. In this case, typical threadless connectors could be used or cable connectors with one locknut inside the cabinet (as was done, albeit incorrectly here), or other listed fittings could be used.

ONE-PIECE. SAVES TIME – LOOKS GREAT!

Made in USA

RECESSED IN BOX®

LOW PROFILE, EXTRA DUTY COVER • *TWO STYLES for 1-1/2" and Foam Wall Systems*

One-piece **IN BOX®**, the recessed electrical box for exterior use, eliminates installing an electrical box and bubble cover assembly, so *you save big* on labor and materials.

IN BOX installs in the wall – so less shows outside. Fewer parts to handle. Time savings. *A great-looking job with Arlington's IN BOX!*

- Non-metallic, 22.0 cu. in. box with EXTRA-DUTY weatherproof-in-use clear or white cover
- Accepts single-gang devices; no gaskets required

Fits ANY foam board *on 2-3/4" to 5" wall or* ***custom stucco finishes*** *1/4" to 2-1/2" thick.*

DBVMA1W
white cover

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

For ***1-1/2" wall systems,*** *including foam. Eliminates separate flashing.*

DBVME1W
white cover

Patented/Additional patents pending

Arlington®

800/233-4717 • www.aifittings.com

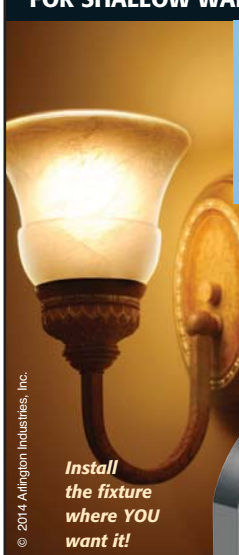
Product Info aifittings.com/landing/db-series

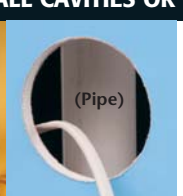
LOW PROFILE • 4" DIAMETER

Made in USA

SCONCE BOX

FOR SHALLOW WALL CAVITIES OR OBSTRUCTIONS





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

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

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

FSC405R
Sconce Box

Patented

Arlington®

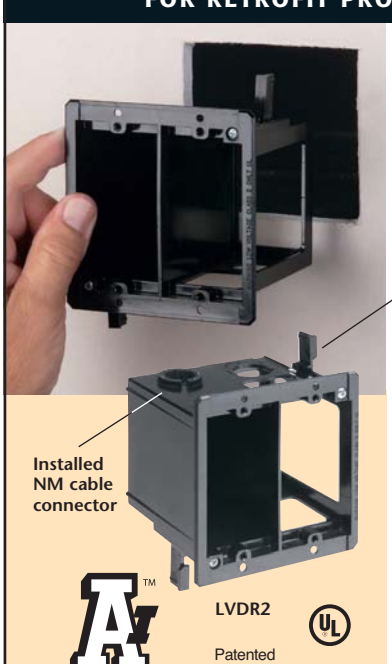
800/233-4717 • www.aifittings.com

Product info aifittings.com/landing/sconce-box

POWER & LOW VOLTAGE

COMBO BOX

FOR RETROFIT PROJECTS



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

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

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

LVDR2

Patented

Product info aifittings.com/landing/combo-boxes

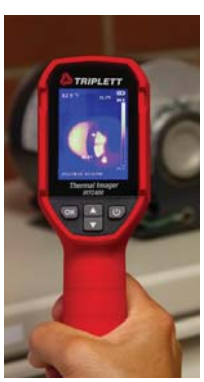
Arlington®

800/233-4717 • www.aifittings.com

PVC-Coated Conduit

With bright, standard bold color options, the corrosion-resistant PVC-coated conduit is designed to provide users with color options for coated conduit projects. With conduit available in six new standard colors (red, orange, yellow, blue, white, and green), system designers can assign conduit colors based on specific installation requirements. The PVC-coated color galvanized rigid steel conduit has earned ETL verification while also meeting UL 6 safety standards. According to the company, the ETL verification and UL 6 safety listing validate the adhesion of the conduit's PVC coating and ensures long-term system protection in the harshest environments, including bridges, tunnels, wastewater treatment, petrochemical, and mining.
Atkore

Thermal Camera



The IRTC400 thermal imaging camera is ideal for finding leaks and hot spots in electrical, HVAC, automotive, and facility applications. The thermal imager has a 120 × 90 pixel (10,800) thermal detector with ≤60mk thermal sensitivity (NETD) that displays both center spot and high/low temperature tracking. The imager's sensors allow it to detect mechanical breakdowns, water leaks and moisture buildup, heat loss, and more. The 2.4-in. focus-free, color TFT display shows imagery in 320 × 240 resolution with multiple color display palettes. The imager has a temperature range of -4°F to 752°F, a built-in LED worklight, and user programmable audible and visual high/low temperature alarms, making the imager customizable and ready for use in any environment.
Triplett Test Equipment

EV Charger

ChargePost is a compact, battery-based charging system that enables ultra-fast electric vehicle (EV) charging on existing power connections without the need to extend existing grids. The system is equipped with an all-in-one design that integrates the battery, power electronics, cooling system, and charger in a compact package requiring only 21.5 sq ft of ground space. Each ChargePost is equipped with two charging points for fast EV charging, giving drivers more than 60 mi of range in just a few minutes (up to 300kW DC power with one charging point and 150kW with two charging points in use at the same time) and up to two optional 75-in. digital displays on its exterior surfaces.
ADS-TEC Energy

Multipurpose Scaffold

The multi-purpose pro scaffold is designed for professionals working at height. The commercial-grade rolling scaffold features the company's QuickLink technology, allowing for multiple scaffolds to easily link together for job sites that need added platform space for more people. The NSRS-72MP steel rolling 6-ft scaffold has a 1,250-lb load capacity (distributed evenly). The locking casters swivel for convenient 360° mobility. The design protects the locking pins to prevent accidental unlocking or release. Deck pins secure plywood to the scaffold frame. Platform height is adjustable in 2-in. increments for unique working heights and uneven surfaces such as a stairwell. Sections stack easily when casters are removed (2 section maximum).
Werner

DC-DC Converters

The TDU 1 series of 1W un-regulated DC-DC converters with 1,500VDC isolation is available in a miniature DIP-8 package. The TDU 1 series consists of nine models offering 5/12/24 V_{in} (±10% input range) and single un-regulated outputs of 5/12/15 V_{out}. The converter is packaged in the industry standard DIP-8 footprint (0.4 × 0.5 in). The TDU 1 is designed to offer a compact low-cost alternative to regulated converters with no concession for quality and lifetime, including: an operating temperature range of -40°C to 85°C without derating; high-efficiency operation up to 83%; continuous short circuit protection; and an MTBF of 5 million hr (MIL-HDBK-217F). The compact dimensions of these converters make them an ideal solution for space-critical applications in communication equipment, instrumentation, and industrial electronics.
TRACO POWER

Wire Stripper

The stainless steel curved wire stripper (WSS-1020) cuts and strips the most commonly used stranded- and single-conductor wires. The product is made from high-carbon stainless steel that is heat treated to improve durability. According to the company, the blades can cut and strip solid wires from 10 AWG to 20 AWG and stranded wires from 12 AWG to 22 AWG. The WSS-1020 has curved, ergonomically designed handles and a coil spring at the joint to help reduce hand fatigue. In addition, the tool's jaws feature six stripping holes, two looping holes, and cutting holes for 8-32 and 10-32 threaded screws. Finally, the product features knurled jaw ends for superior gripping.
Jonard Tools

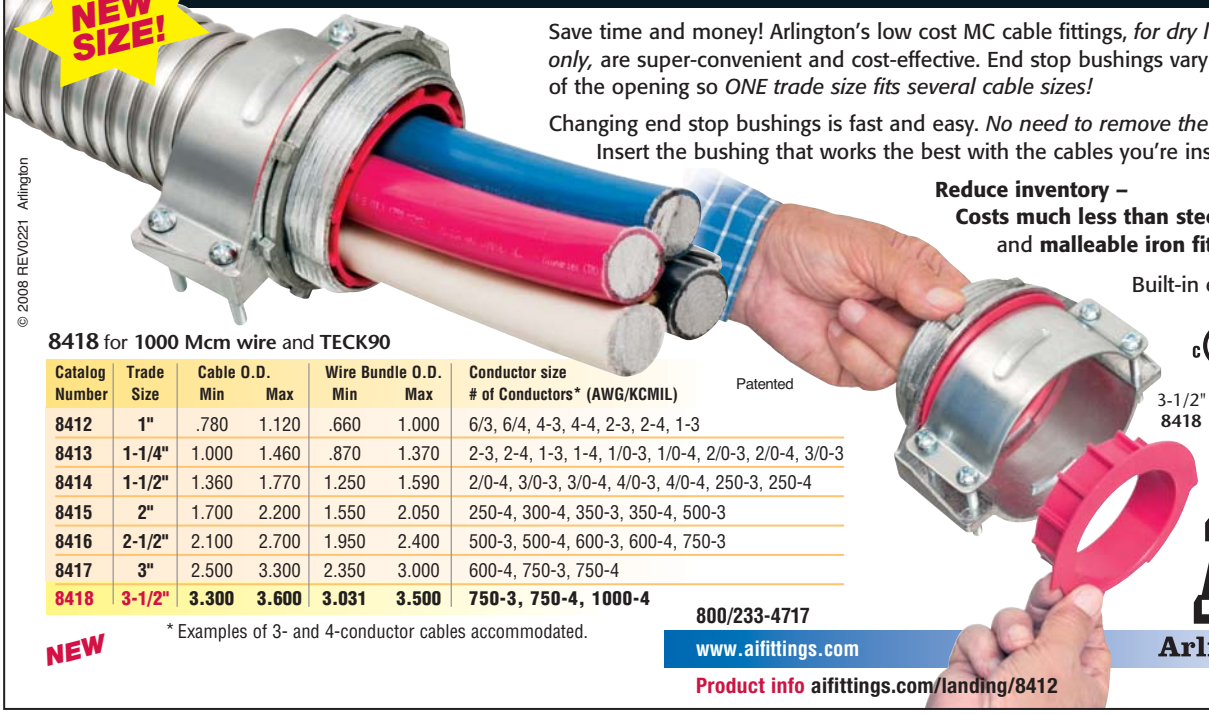
LOW COST • ZINC

Made in USA

MC CABLE FITTINGS

NEW SIZE! 3-1/2"

THAT FIT SEVERAL CABLE SIZES



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

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

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

Built-in end stop

c UL us

Patented

3-1/2" **8418**

8418 for **1000 Mcm wire** and **TECK90**

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

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

NEW

800/233-4717

www.aifittings.com

Arlington®

Product info aifittings.com/landing/8412

NON-METALLIC • VENTED FOR EASIER STACKABILITY

Made in USA

CONCRETE PIPE SLEEVE

THE EASY, ECONOMICAL WAY TO SLEEVE THROUGH CONCRETE POURS!

CPS40
Pipe Sleeve
for 4" hole

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

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

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

CPS40

Nail sleeve to form.

After concrete sets, cut sleeve flush with surface.

Insert conduit into sleeve.

Arlington®

800/233-4717 • www.aifittings.com

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

PRODUCT NEWS

Wiring Devices

According to the company, the Decora Edge line of wiring devices is a faster, easier, and safer way to install electrical devices for the home. Decora Edge simplifies installation by enabling users to simply push stripped 14-gauge or 12-gauge electrical building wire into a termination port and close a lever that clicks into place, terminating the connection. The product features a patent-pending color-coded lever termination where the stripped end of a wire is inserted into the device, and a simple integral lever clamps the wire into place without the use of screws. This design has a snap feature with an audible click, so installers can be confident with every termination.

Leviton

Industrial UPS

The DIN rail industrial UPS is designed to deliver reliable power and battery backup to industrial environments. The product can withstand the demanding conditions of warehouses, plants, and automated manufacturing/fabrication facilities. A rugged, compact housing enables this DIN rail mountable UPS to integrate seamlessly and securely into electrical enclosures. With both AC and DC options available, this DIN rail UPS can be deployed in any non-traditional IT environment. It is available in four models, including 500VA/300W and 850VA/510W AC power variants and 240W and 480W DC power variants.

Eaton

Linear High-Bay Luminaire

The high-bay premium series offers high energy efficiency with PMMA optical glare-control lens. Available in 5,000K with a high 80+ CRI, it provides 150 lm/W. The series is available in four wattages of 92W, 135W, 185W, and 270W delivering 13,800 lm, 20,250 lm, 27,750 lm, and 40,500 lm, respectively. The product is also available with the company's Bluetooth mesh advanced controls and accepts external sensors with capabilities ranging from simple occupancy sensing to group mesh control. The Series includes 120V-277V operation with 0V-10V dimming and is designed to work with customized controls for daylight harvesting to meet specific energy codes. Luminaires are equipped with 6kV ANSI surge protection.

EarthTronics

2023 ELECTRICAL SALES FORECASTS

Powered by Electrical Marketing

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For questions on *Electrical Marketing*'s new market data, contact Jim Lucy, *Electrical Marketing*'s Editor-in-Chief, at jlucy@endeavorb2b.com.

Metering & Monitoring Equipment

Smart Sensor

The Ability smart sensor turns rotating equipment (including drives, motors, and applications such as pumps) into smart, wireless connected assets. This solution is designed to detect potential asset disturbances and planned maintenance before the reliability, productivity, and safety of machinery are impacted. The smart sensor fits to the asset's surfaces, collecting and transmitting data via smartphone or gateway to a secure cloud service. Advanced algorithms analyze the data to provide real-time insights into the condition and performance of monitored assets. The asset to be monitored is chosen during commissioning. All components of a powertrain can be monitored via one portal, either individually or as part of the complete powertrain.

ABB

Power Quality Meter

Nexus 1450 cyber secure power quality meter's version 5.0001 firmware now includes distributed fault recording using the meter's internal IEC 61850 protocol server. The system works by triggering a waveform capture on up to 16 m when a breaker operation occurs on the primary meter. Additional new features include direct access to internal COMTRADE waveform files using a RESTful API. These new features join the Nexus 1450 meter's other capabilities, including 0.06% accuracy in energy metrology for critical metering applications.

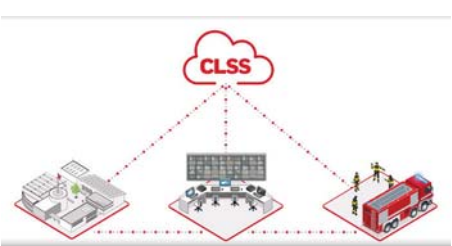
Electro Industries/GaugeTech

Data Acquisition Server

VerifEye EMHXD is an intelligent, flexible data acquisition server (DAS) that collects energy data from meters and environmental sensors through flexible inputs and Modbus RTU/TCP protocols. Designed to connect to IP-based applications, the EMHXD allows users to connect thousands of energy points, benchmark energy usage, and reduce energy costs. The EMXHD collects data from connected (wired or wireless) devices based on user-selected intervals. Compatible with virtually all front-end software and reporting tools, users can easily access the data through any web browser.

Leviton

Fire Alarm System



NOTIFIER INSPIRE fire alarm system with self-test detectors is designed to help create a safer building environment by increasing facility managers' awareness of system needs, while equipping service providers with digital self-testing tools that streamline maintenance and support regulatory compliance/system uptime. NOTIFIER INSPIRE is an all-in-one fire system that delivers protection, scalability, efficient monitoring, as well as flexible and timely reporting. It helps enhance fire technician efficiency as it is designed to scale based on the building's needs, minimizes the need for equipment changes, and provides secure connectivity.

Honeywell

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What's Wrong Here?

By Russ LeBlanc, NEC Consultant

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

Hint: Follow the leader.

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

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

JANUARY WINNERS

Our winners this month were: Wayne Eckert, an *EC&M* reader from Clewiston, Fla.; Jason Andrews in Coquille, Ore.; and Juan García, a contest participant from Panorama City, Calif. Each was able to correctly cite some Code violations spotted in this photo.

For starters, the box cover was not designed to be installed to flip open to the left. It should have been installed with the cover flipping up. This type of cover is only weatherproof when closed. So, in this particular case, it's not even the correct type of cover. For 15A or 20A, 125V or 250V receptacles installed in wet locations, Sec. 406.9(B)(1) requires enclosures to be weatherproof whether or not an attachment plug cap is plugged into the receptacle. Receptacles in wet locations must be listed and identified as weather-resistant (WR). If that GFCI receptacle gets damaged by water, the GFCI protection may fail to operate properly and leave users at an increased risk of shock. An extra-duty outlet box hood or some other weatherproof assembly could be used here.

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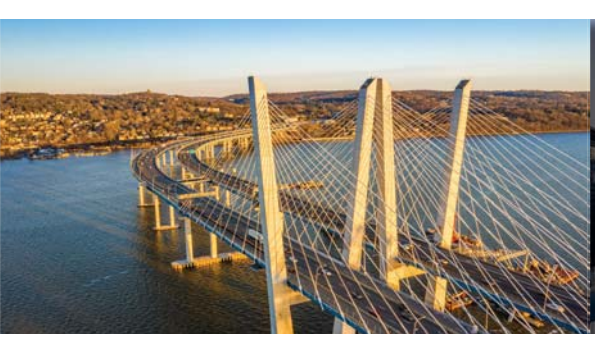

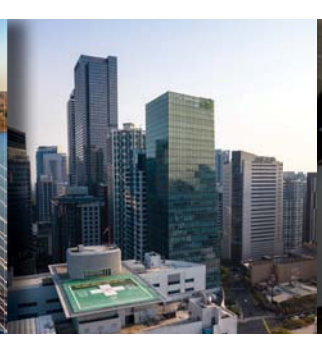

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