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THE MAGAZINE OF ELECTRICAL DESIGN,
CONSTRUCTION AND MAINTENANCE

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# 2022 CONSTRUCTION OUTLOOK

*With the economy improving and concerns over COVID-19 waning, the electrical construction industry should be on track for a solid year — if it can navigate higher prices, supply chain issues, and worker shortages.*



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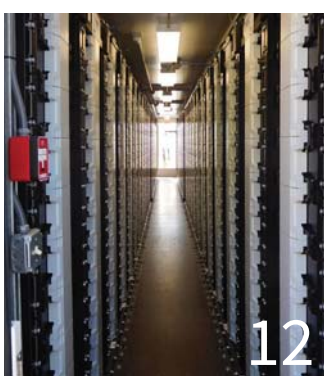




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Photo courtesy Trimble Buildings

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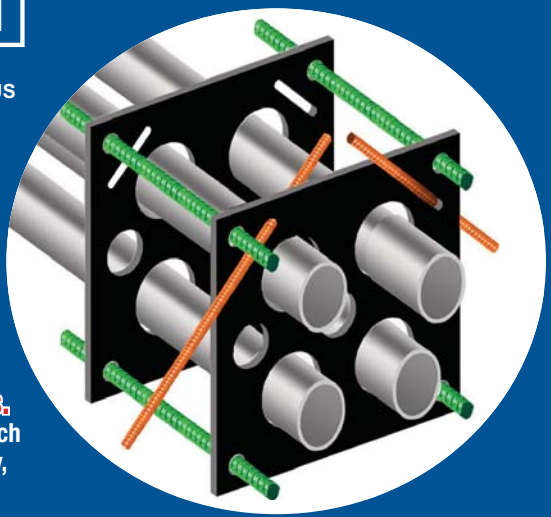
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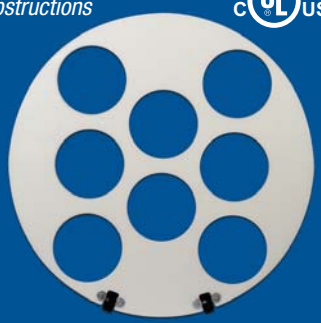
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# Poised for Prosperity

By Ellen Parson, Editor-in-Chief



At the end of every December, we close the book on another trip around the sun and turn the page to a new chapter, looking to the New Year with hopes of more positive times ahead. That picture obviously looks different to different people — maybe it's love, health, happiness, adventure, growth, good fortune, peace, stability, or whatever term you'd like to insert. At *EC&M*, this time of year is also filled with reflection and contemplation. By combing through all of the industry resources out there, including the latest industry reports, economic indicators, and market data, our editorial team strives to summarize the latest predictions for the electrical industry in our annual construction forecast, assembling everything in one easy-to-digest package.

Written by Jim Lucy, editor-in-chief of *Electrical Wholesaling* magazine (who has 40 years of experience covering the electrical industry), this month's cover story, "The 2022 Construction Forecast," takes the guesswork out of complicated forecasting by providing readers with a snapshot of the hottest trends to watch for going forward. How will 2022 compare to 2021? "Thankfully, we have a better handle on COVID-19 today than we did 12 months ago. The global economy is also on a more solid footing than it was in 4Q 2020, and the overall expectations of many economists for U.S. GDP growth are in the 4% to 5% range," Lucy writes. "Job sites are open, and face-to-face meetings with co-workers, suppliers, and customers are becoming more common. The recently passed Infrastructure Bill is also expected to provide some real financial benefits for the electrical construction industry. All in all, the 2022 construction forecast adds up to what should be a decent year for electrical contractors, facility maintenance workers, and other electrical professionals." There is one caveat, however — that is, if they can navigate the higher material prices, supply chain issues, and worker shortages that continue to cause serious challenges.

With the passage of the Infrastructure Investment and Jobs Act (IIJA) in November, $1.2 trillion of new funding will be earmarked, $550 billion of which will be spent in the next five years on sectors like transportation, broadband, electric vehicle charging stations, and utilities. According to new reports released by the American Council of Engineering Companies (ACEC) Research Institute in early December (https://bit.ly/3s2wBtQ), the data show the engineering and design services industry has rebounded from project postponements due to COVID, though firms identify a tight labor market and lack of qualified workers as continued barriers to growth across public and private markets. Additional findings from the organization's sentiment report, which tracked perceptions of engineering leaders across the country (conducted before passage of the IIJA), found that compared to three months earlier, respondents noted positive sentiment for transportation sectors, including roads and bridges (+30 points), transit (+20), and airports (+23). Looking ahead 12 months, the net rating of positive sentiment among respondents was even higher for roads and bridges (+69), transit (+60), and airports (+54).

"This is a great time to work in the engineering and design industry, as we tackle some of the biggest challenges facing America. The deep bench that is our engineering community has the expertise to provide sustainable projects in the built environment that are safer and more resilient — projects that will benefit society for generations to come. Our industry has a lot to be proud of," said Robin Greenleaf, ACEC board chair.

Whether you come from the electrical contractor, electrical engineer, or plant facility side of the house, turn to the cover story on page 20 for comprehensive analysis (based on forecasts from leading organizations such as Dodge Data & Analytics, the American Institute of Architects, and Associated Builders and Contractors) to help you identify the most promising market areas in 2022 for your business that are poised for prosperity.

Ellen Parson



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# Fires Caused by Poor Connections

## Anyone involved in fire safety issues should have a basic understanding of this phenomenon.

By Vyto Babrauskas, Ph.D., Fire Science and Technology Inc.

My previous article, "Smoking Out the Main Causes of Electrical Fires," featured in the November 2021 issue, explores why poor connections are the No. 1 cause of electrical fires in the United States. This is consistent with statistics from Ontario, Canada. Thus, it is important for electrical inspectors, fire investigators, and other personnel involved in fire safety issues to have a basic understanding of the phenomenon. Some of the common connection types available today include:

- Twist-on connectors (often referred to by the trade name WireNut).
- Screw connections.
- Spade or D-lug connectors.

While soldered or welded connections exist in some applications, most connection types depend on mechanical force for their integrity. This, in turn, requires sufficient force and good surface conditions at the interface. All metals exposed to air oxidize, but excessive oxidation can result in failure, as can dirt or other foreign substances.

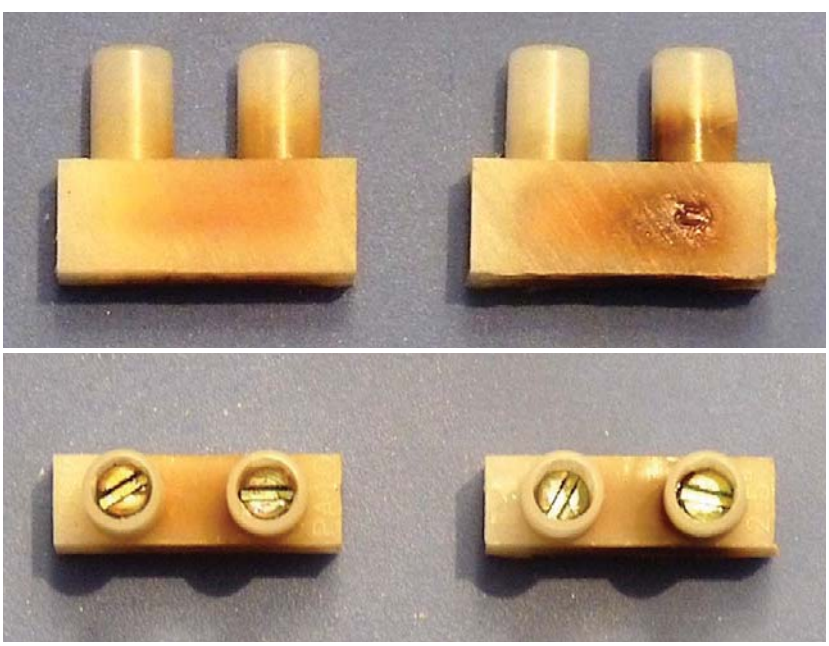


Photo courtesy of Vyto Babrauskas

**Photo 1.** Two screw connectors in incipient failure. The barrels cannot accommodate a screwdriver blade wider than 3.5 mm; thus, the screws may not be adequately tightened upon installation.

### ALUMINUM WIRING PROBLEM

Old-timers will remember the aluminum wiring problem from the mid-1970s, which occurred in the United States and Canada. The problem was not with the wiring itself but with the connections.

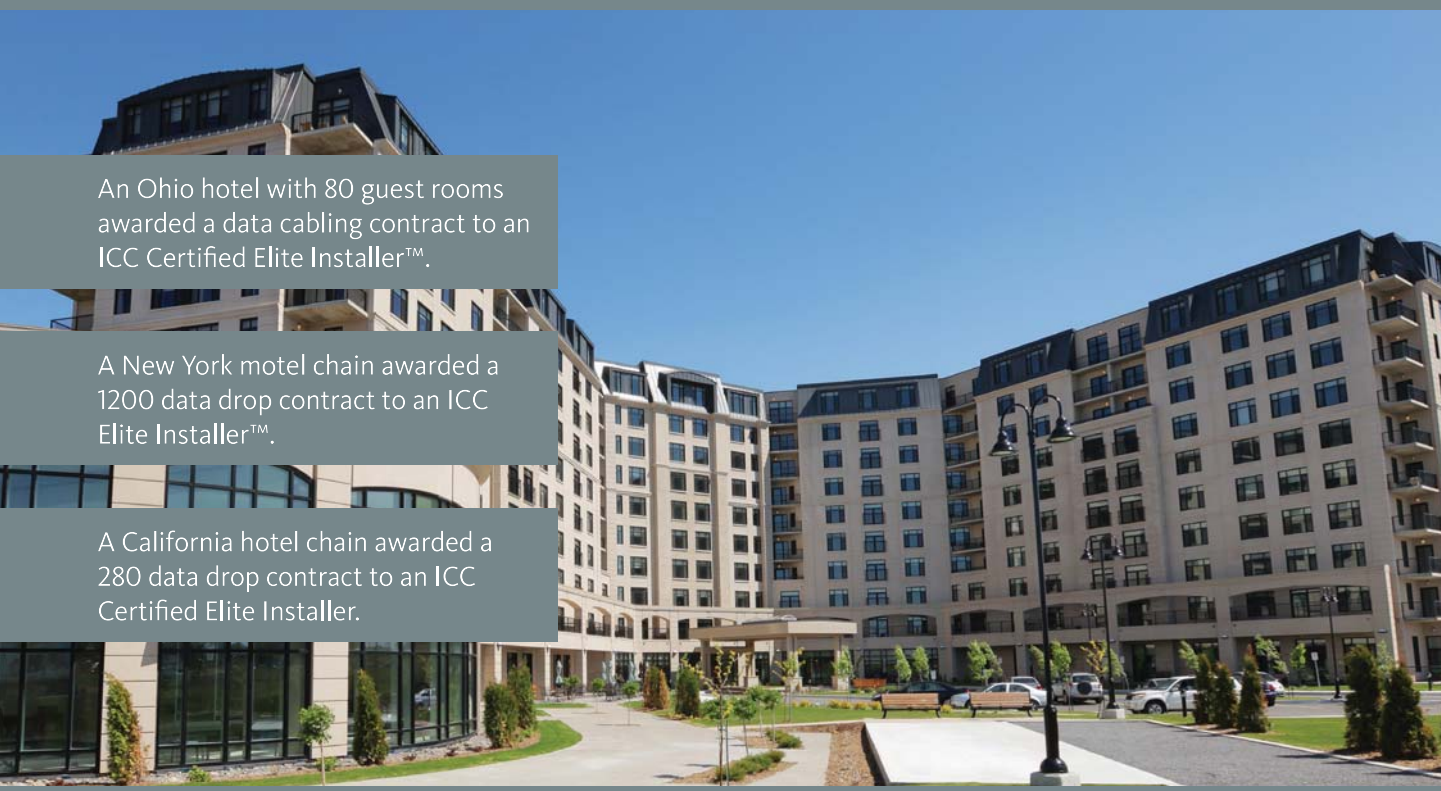
Aluminum branch circuit wiring was introduced in that era as a cost-cutting measure. However, adequate engineering had not been done on the interface points at the connections in outlets, switches, and other devices. As it turned out, these connections were not properly engineered to cope with thermal cycling.

In most residential and light-commercial applications, there are few sustained loads; most loads are "on" only part of the time, resulting in thermal cycling of the circuit, including the connections. The problem was that the aluminum wires used had too high a yield strength and too poor a creep behavior. This meant that, with reasonable force applied, the wire failed to conform to mating parts well enough during initial installation, while later cycling progressively relaxed the force and progressively decreased the area available for conducting electricity through the interface. Note that this was a problem only for 12 AWG and 10 AWG branch-circuit connections. Aluminum feeders, service entrance cables, and other high-ampacity circuits can safely use aluminum wiring because the connections there are not subject to the same problems.

### COPPER AND BRASS

Today, the bulk of fires due to poor connections involve copper or brass as the main metals, with smaller amounts of plated steel also being encountered. Thus, most commonly, we are not dealing with poor design engineering but with poor workmanship when failures occur. While

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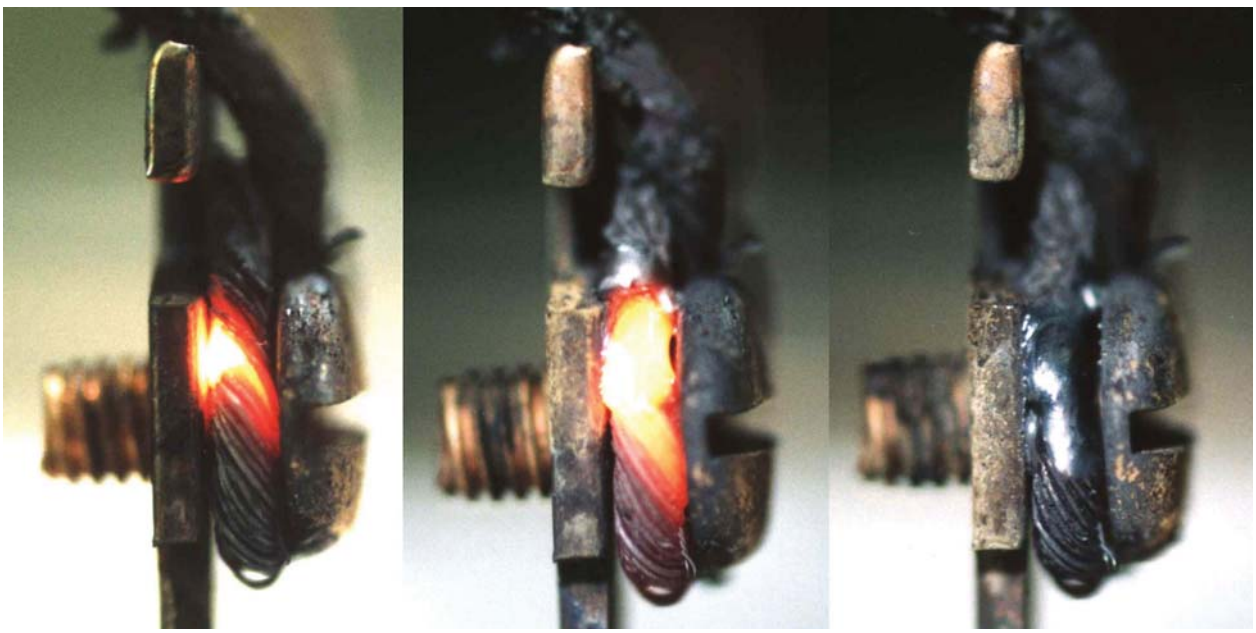


Photo courtesy of Yasuaki Hagimoto

**Photo 2.** This shows overheating and glowing at a screw connection carrying 10A at 100VAC.

poor workmanship can come in a variety of types, the most common fault is inadequate tightening. In a smaller fraction of the fires, environmental contamination can be the causative factor (e.g., salt-water splashing or salty air contamination).

## EXAMPLES OF POOR CONNECTIONS

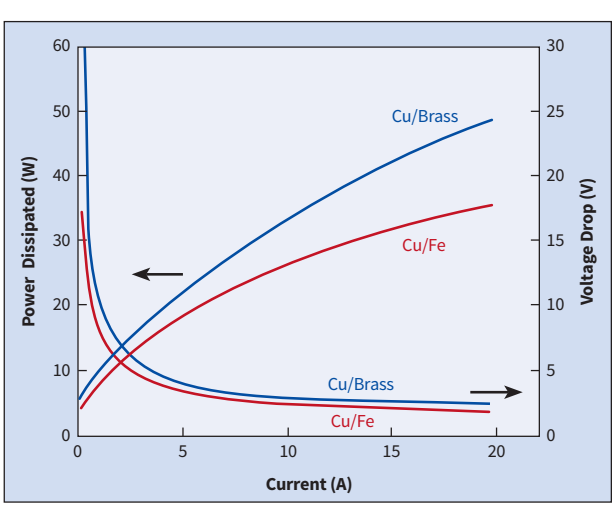
Most poor connections are due to sloppy workmanship. For example, an electrician in a hurry fails to properly torque a connection. Nevertheless, **Photo 1** (on page 8) shows an example where bad design (not bad workmanship) led to overheating of some lamp connectors. These connectors were used for some low-voltage wiring with a load of 12.5A. This load is substantial, yet the design of the connectors required the electrician to use a miniature screwdriver, which cannot reasonably be expected to supply adequate torque to the recessed setscrew.

More common are failures of screw connections at duplex receptacles. **Photo 2** shows a laboratory experiment exhibiting a progressive sequence of failure at such a connection. Poor connections often — but not necessarily — appear to be glowing, which can involve temperatures in excess of 2,192°F (1,200°C). Note that while copper itself melts at 1,981°F (1,083°C), its oxides can be heated to higher temperatures.

It's important to appreciate that glowing may not be steady but may rather have an intermittent character. It is also important to understand that while reaching such high temperatures is of serious concern, not all glowing connections lead to a fire. Instead, a significant fraction will simply open up and no longer function. This is why finding "dead" outlets in a building should be a major concern to inspectors. The likely reason why an outlet died is that there was a bad connection that, after a certain amount of time, opened up. Left undisturbed, the connection is likely to stay dead. However, the concern is that the same individual who installed this receptacle wired other outlets in the same manner, and one of those could very well lead to fire rather than an open circuit.

Delving into the details, engineers might want to know the electrical characteristics of a poor connection. Although these can vary widely, some example test results are shown in the **Figure** below. The results show a power drop in the range of 5W to 50W, with a voltage drop of 3V to 25V. If the actual results are 12W and 7V, this does not constitute a significant voltage drop or a large power draw. Thus, the condition might not readily be detected in the functioning of the circuit unless it had a persistently intermittent character.

What advice can be given to investigators potentially encountering a fire starting from a poor connection? First,




Power dissipation and voltage drop across glowing connections of two types.

do not expect to find arc beads. Visible arcing artifacts can often be found after such an event, but there is no requirement for such artifacts to be created in all cases. Some investigators and forensic engineers are too narrowly focused and believe arc beads are the one-and-only evidence of an electrical failure. This practice needs to be strongly discouraged. Statistically, an arc bead is much more likely to be a victim of fire than its cause. Conversely, electrical fires can start without any arc beads being present.

In many cases, a bad connection can be recognized by looking at the local burn patterns. In the case of receptacles, for example, if the device is damaged due to an ongoing room fire, then when you remove it from the wall and look at the side of the device, you should see a burn damage gradient that is severe at the front and progressively milder further back. Conversely, if the receptacle was overheating due to a bad connection, there is likely to be a "bull's eye" pattern visible centered over the suspect area (**Photo 3**).

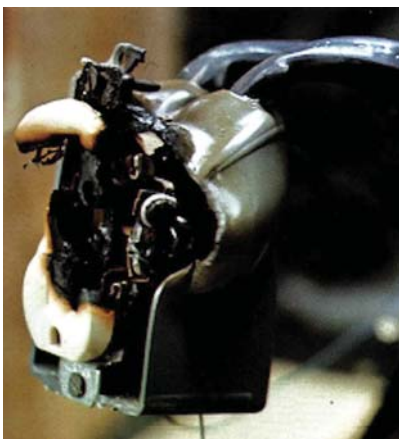


Photo courtesy of YNIST

**Photo 3.** Note the bull's eye damage pattern on the receptacle on the left, which is caused by overheating connection.

Another technique that's important in the investigation of artifacts is metallurgical analysis. High temperatures lead to grain growth in metals. Here, a comparative analysis is typically the best strategy. All artifacts in the vicinity of fire are likely to have been exposed to high temperatures, but temperatures can be expected to be hotter and longer at a bad connection than at a connection that had only undergone fire heating. Furthermore, in any receptacle, it is highly unlikely that all screw connections would have been overheating. Thus, if the connections are recovered, cross-sectioned, and analyzed, excessive grain growth may potentially be identified, allowing a particular connection to be suspected. EC&M

*Dr. Vyto Babrauskas is a forensic science specialist working in the areas of fire and explosion safety. He recently published the handbook, "Electrical Fires and Explosions," in April 2021. He can be reached at vytob@doctorfire.com.*




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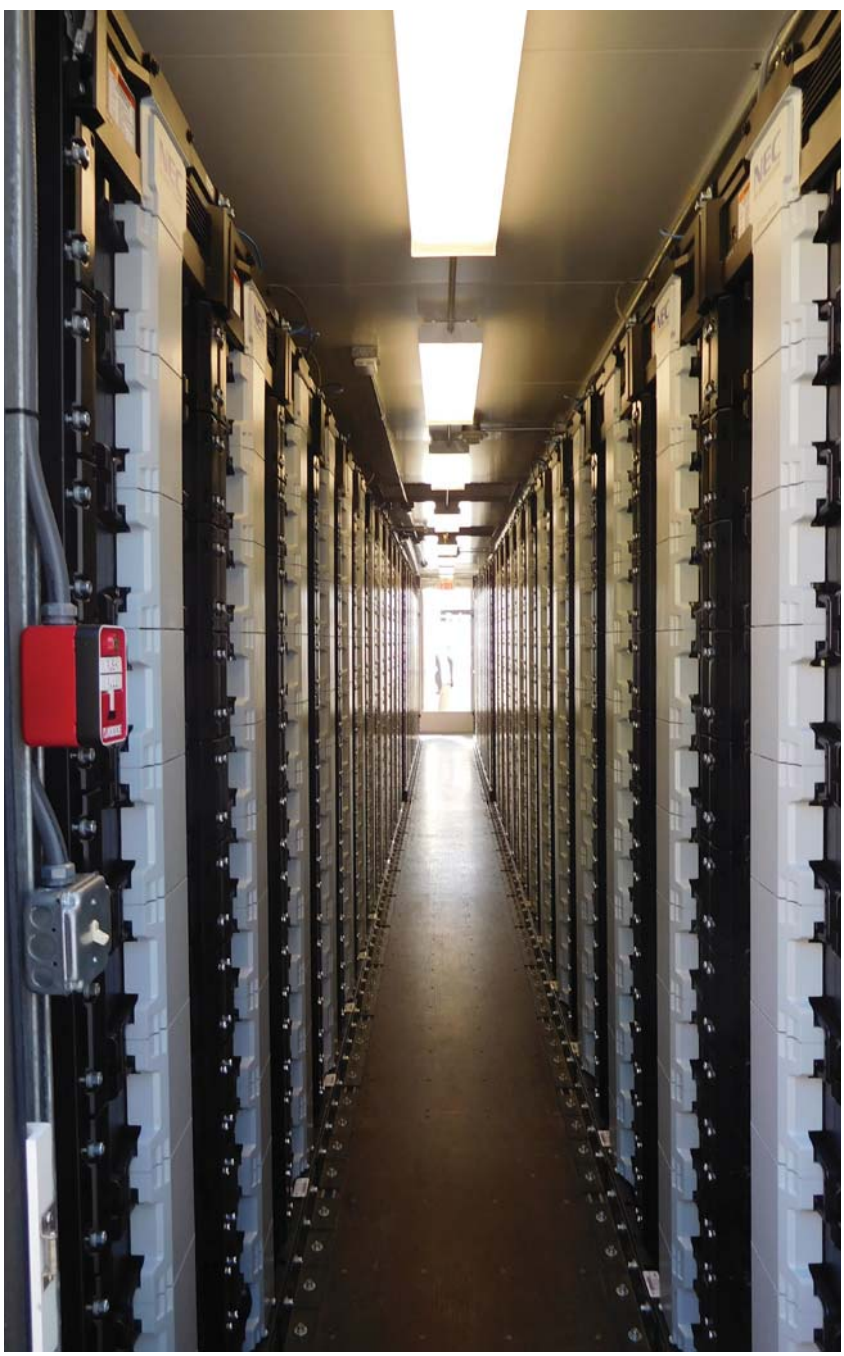
# Energy Storage System Update

## Let's take a look at these systems regarding fire codes and building codes.

By Jim Rogers, Bay State Inspectional Agency

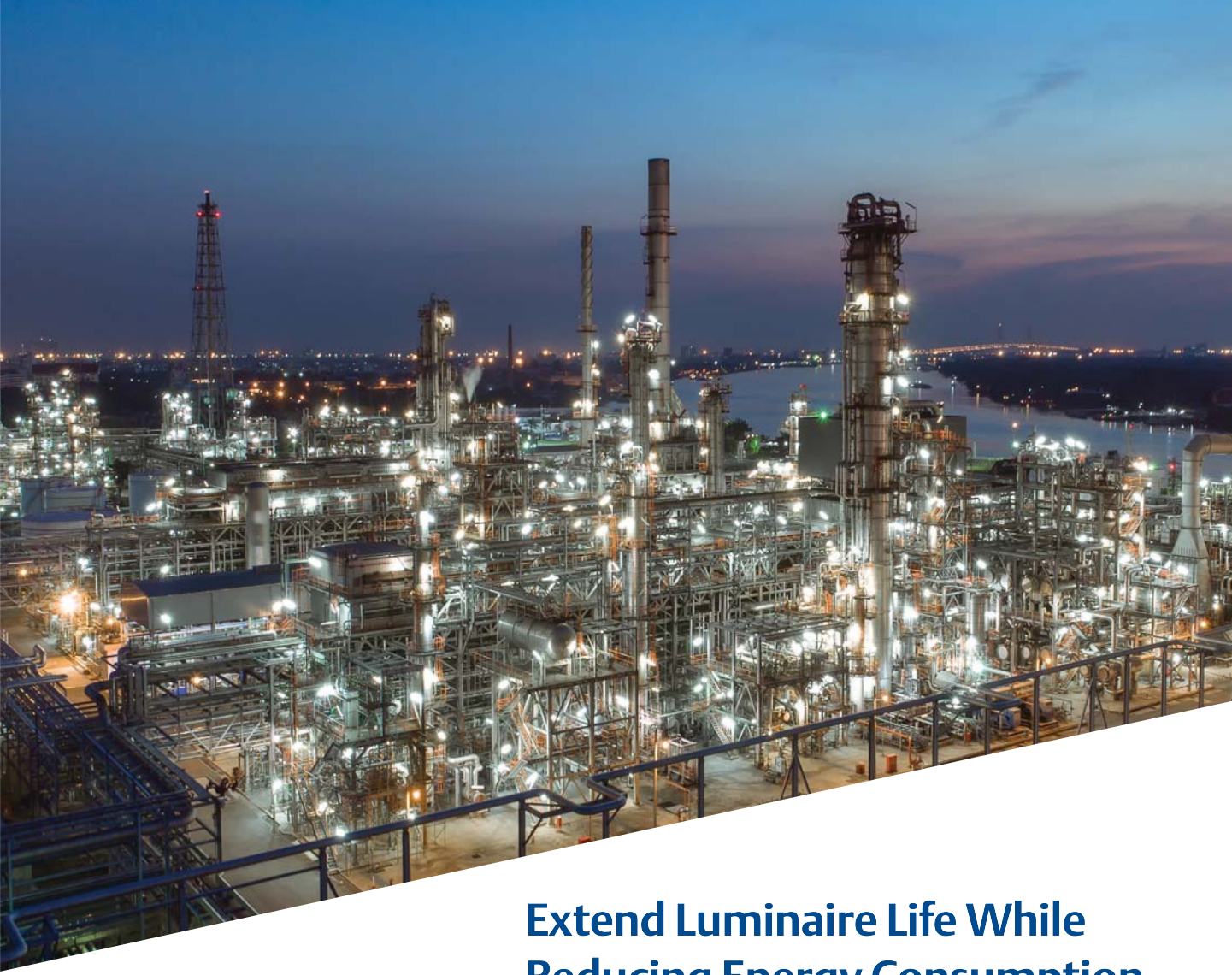
In the October 2020 issue of *EC&M*, we discussed the requirements for energy storage systems (ESSs) as covered by the 2020 edition of the NEC. It's time to take another look at these systems regarding fire codes and building codes.

To address concerns expressed by fire services that have to respond to buildings in emergency situations (both fire-related and non-fire related), NFPA 1, *Fire Code*, and the 2021 International Fire Code (IFC) contain requirements relative to the installation of ESSs, especially in residential occupancies. In response to this, NFPA established a technical committee to develop a new standard for the installation of these systems. Note that these requirements are in addition to those found in NFPA 70, the *National Electrical Code*, and they are not intended to override or replace them.



### ORIGIN AND DEVELOPMENT

The ESS project that led to this first edition of NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, was approved by the NFPA Standards Council in April 2016, after which a call for members was posted. The original request was submitted by an individual on behalf of the California Energy Storage Alliance to address gaps in regulation identified in workshops held by the U.S. Department of Energy and the Fire Protection Research Foundation. In August of that same year, the Standards Council appointed the first NFPA Technical Committee on ESSs. The initial draft was developed over the course of three meetings by the Technical Committee, and it was released to the public in 2017. Over the past two years, the Technical Committee has met several



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times to review feedback from the public and make improvements to the standard.

Some of the requirements this new standard covers are as follows:

(1) Plans and specifications associated with an ESS and its intended installation submitted to the AHJ for approval.

(2) Location and layout diagram of the room or area in which the ESS is to be installed.

(3) Details on hourly fire-resistant-rated assemblies provided or relied upon in relation to the ESS.

(4) The quantities and types of ESS units.

(5) Manufacturer's specifications, ratings, and listings of ESS.

(6) Description of energy storage management systems and their operation.

(7) Location and content of required signage.

(8) Details on fire suppression, smoke or fire detection, gas detection, thermal management, ventilation, exhaust, and deflagration venting systems, if provided.

(9) Support arrangement associated with the installation, including any required seismic support.

This new standard covers ESS installations in indoor and outdoor locations and provides even more installation restrictions when installing an ESS in or at a dwelling occupancy. Indoor locations include non-dedicated-use buildings or (put another way) general-use buildings that have an ESS installed within them. There are requirements for separation from adjacent ESS assemblies and a limit of 50kWh per group assembly. Dedicated-use buildings are those that are intended for use only for containing ESS assemblies for grid-tied operations. Information is provided for what else is required, which includes items such as site access providing a means for personnel to egress from the area and limiting such personnel to those necessary to operate the installation. This adjacent use is limited to 10% of the building area.

There is a general prohibition to the installation of other than portable ESS units in sleeping rooms or living areas of dwelling units. Chapter 15 contains some more specific requirements for ESS installations associated with one- or two-family dwellings or townhouse units.

The first requirement aligns with the requirements found in the NEC, and that is the listing of the assembly in accordance with UL 9540. This listing requirement is limited to ESS equipment with a rating of 1kWh or greater in maximum stored energy. ESSs listed and labeled solely for utility or commercial use shall not be used for residential applications.

ESSs shall be installed in accordance with the manufacturer's instructions and their listing. One thing that is different from a standard electrical installation in one of the residential applications is a requirement for a commissioning procedure, which requires the following steps:

(1) Verify that the system is installed in accordance with the approved plans and manufacturer's instructions and is operating properly.

(2) Supply a copy of the manufacturer's installation, operation, and maintenance instructions included with the listed system.

(3) Provide training on the proper operation and maintenance of the system to the system owner.

(4) Provide a label on the installed system that contains contact information for the qualified maintenance and service providers.

In addition, it is required to separate individual ESS units a minimum of 3 ft apart unless documented fire testing is provided that would allow for a lesser distance. This information would be provided by the manufacturer.

As far as where these units can be located in a dwelling unit setting, they are limited to the following locations:

(1) In attached garages separated from the dwelling unit living area and sleeping units in accordance with the local building code.

(2) In detached garages and detached accessory structures.

(3) Outdoors on exterior walls or on the ground located a minimum of 3 ft (914 mm) from doors and windows.

(4) In enclosed utility closets and storage or utility spaces.

If the room or space where the ESS is to be installed is not finished, the walls and ceiling of the room or space shall be protected with not less than ⅝-in. Type X gypsum board.

An ESS shall not be installed in the living area of dwelling units or in sleeping units other than within utility closets and storage or utility spaces.

The limitation of energy ratings for these installations is as follows:

Inspector Intel articles are provided by the International Association of Electrical Inspectors (IAEI), www.iaei.org, a membership-driven, non-profit association headquartered in Richardson, Texas, that promotes electrical safety throughout the industry by providing education, certification of inspectors, advocacy, partnerships, and expert leadership in electrical codes and standards.

If the room or space where the ESS is to be installed is not finished, the walls and ceiling of the room or space shall be protected with not less than ⅝-in. Type X gypsum board.

• Individual ESS units shall have a maximum stored energy of 20kWh.

• The aggregate rating amount within a dwelling, garage, or accessory structure shall not exceed:

(1) 40kWh within utility closets and storage or utility spaces.

(2) 80kWh in attached or detached garages and detached accessory structures.

(3) 80kWh on exterior walls.

(4) 80kWh in outdoor installations.

The last item we'll cover is the fire detection that is required by NFPA 855, which is as follows:

Interconnected smoke alarms shall be installed throughout the dwelling, including in rooms, attached garages, and areas in which ESSs are installed in compliance with the local building code.

Where ESSs are installed in an attached garage or an area in which smoke alarms cannot be installed in accordance with their listing, an interconnected listed heat alarm shall be installed and connected to the smoke alarm system required by the local building code.

As with any new standard, it will take time for jurisdictions to formally adopt it into a regulatory requirement.

## SUMMING IT UP

Much of this information is what NFPA 855 requires, and this article is intended to provide awareness of this new standard. Both enforcers and installers need to be aware of this standard. As with any new standard, it will take time for jurisdictions to formally adopt it into a regulatory requirement. It is recommended that installers check with the jurisdictions where they are working to see if the adoption process is either underway or complete. Those interested in this standard are encouraged to get involved in the NFPA process because this standard is subject to public review and comment just like all NFPA standards. EC&M

*Jim Rogers is the owner/operator of Bay State Inspectional Agency, Vineyard Haven, Mass. He is an active instructor for IAEI, the wiring inspector for the town of Oak Bluffs, and the chair of NEC Code-Making Panel (CMP) 4. He has previously taught for the International Brotherhood of Electrical Workers (IBEW). He can be reached at bsia@vineyard.net.*



# A Walk in the Job-Site Wilderness

## Good intentions don't always lead to ideal results when it comes to using prefabrication on construction projects.

By Dr. Perry Daneshgari and Sydney Parvin, MCA, Inc.

Without upfront planning, continuous communication throughout the project, and a feedback loop from the field to the shop after project completion, electrical contractors may fall prey to one or more of these common pitfalls.

### INCORRECT DIMENSIONS

Specify dimensions when requesting prefab to avoid the potential need for manipulation on site. As shown in **Photo 1**, this crew had to re-orchestrate conduit runs and cut into concrete blocks to fit bends that were made at the shop.

### OVERPRODUCTION

Quantify items needed as much as possible and avoid early mass production where changes are anticipated. A review of the drawings and count of items at the beginning of a job will eliminate the potential risk of major overproduction and the need for return or repurpose of prefabricated items. A phased approach to production and communication of design changes can also keep any overproduction risk to a minimum.

### BAD ASSUMPTIONS

Include the prefab shop in plans on how the job will be built. Communicating details like whether the pipe will be roughed in overhead versus in the wall can reduce the chances of the shop making incorrect assumptions and supplying incompatible items. On a recently completed project, the prefab shop built boxes to go in the ceiling, and once they arrived on site the crew then had to take them apart and remake them for the walls. Another approach that can minimize the impact of incorrect assumptions or differences between BIM and the reality of the job site (**Photo 2** on page 18) is to build a sample in the shop, test it on the site, and, once successfully installed, build the rest.



**Photo 1.** These bends had incorrect lengths and required manipulation on the job site.

### OMITTING A PLAN FOR LOGISTICS

Once you have identified prefab opportunities on your project, nailed down the specifics, and are ready to get started, it can be easy to overlook details for packaging, delivery, and handling on the job site.

Without thinking through the logistics, you may end up running into a few of the following issues:

- Damaged or unusable material
- Duplicated effort in packaging and waste removal (one in the shop, and again on the job site)
- Extra storage of material on site (weeks or months before it is needed, with risk of damage)
- Difficulty moving material on site

An example of difficulties in moving materials around a job site is shown in **Photo 3** on page 18. The conduit stubs, although they saved

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installation time, posed some handling challenges.

Entry between floors wasn't wide enough, so they had to be removed from the cart, brought in, and placed back on the rack. Then, they were rolled to the necessary location. Due to how they were stacked, the crew also struggled to remove one item at a time from the rack.

## MOVING FORWARD

New ways of performing work can undoubtedly come with challenges and growing pains. Rather than sweeping issues under the rug — or going back to traditional familiar methods of installation — it is critical to capture feedback when issues or difficulties occur so that the organization can learn and improve their operations in the shop on the next job. EC&M

*Dr. Perry Daneshgari is president and CEO of MCA, Inc., Grand Blanc, Mich. He can be reached at perry@mca.net. Sydney Parvin is an associate data analyst and technical assistant to the VP of Operations at MCA, Inc., Grand Blanc, Mich. She can be reached at sparvin@mca.net.*




**Photo 2.** These excess devices from prefab were built before design changes were issued.



**Photo 3.** These tangled conduit stubs created challenges on site despite saving time during installation.

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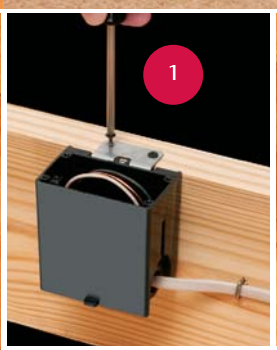
# FLOOR BOX KITS

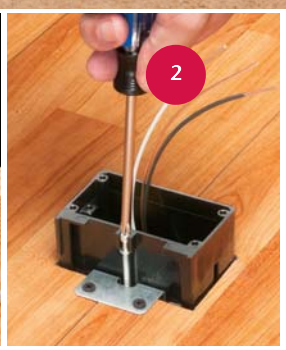
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# 2022 Construction Forecast

With the U.S. economy improving and concerns over COVID-19 waning, the electrical construction industry should be on track for a solid year — if it can navigate higher prices, supply chain issues, and worker shortages.

**By Jim Lucy,** Editor-in-Chief, *Electrical Wholesaling*

What a difference a year makes. At this time last year, the economy was still climbing out of a huge hole from the pandemic. Vaccines for COVID-19 had not yet hit the market, and cases were spiking. Mask restrictions were everywhere, and access to job sites was uncertain in many areas of the country. We were also all spending way too many hours on Zoom meetings.

Thankfully, we have a better handle on COVID-19 today than we did 12 months ago. The global economy is also on a more solid footing than it was in 4Q 2020, and the overall expectations of many economists for U.S. GDP growth are in the 4% to 5% range. Job sites are open and face-to-face meetings with co-workers, suppliers, and customers are becoming more common. The recently passed Infrastructure Bill is also expected to provide some real financial benefits for the electrical construction industry.

The 2022 construction forecast all adds up to what should be a decent year for electrical contractors, facility maintenance workers, and other electrical professionals. Some niches within the construction market will provide more



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business than others, and some regions of the United States will be loaded with work, while others will be quieter. This article will help you identify the most promising market areas in 2022 for your business.

## NATIONAL VIEW

On a national basis, several of the best-known construction economists expect steady, if not spectacular, growth for next year. Two of our favorite annual construction forecasts are published by Richard Branch, chief economist for Dodge Data & Analytics, and Kermit Baker, chief economist for the American Institute of Architects (AIA).

At the 2022 Dodge Construction Outlook, Branch said he expects total construction to increase 6% in 2022 to $946 billion after a 12% increase in 2021 (**Table 1** on page 22). He cautioned webinar attendees at the annual forecast conference that although the construction market will grow next year, product pricing, material shortages, and worker shortages will be some of the biggest issues. Branch is looking for the biggest increases in spending on construction starts in the following areas:

- Commercial: 12% to $143 billion
- Warehouses: 13% to $52.8 billion
- Offices: 10% to $49.7 billion
- Retail: 14% to $15.5 billion
- Hotels: 24% to $8.8 billion

He said in a recent press statement that although U.S. economic growth has resumed after a slowdown in 3Q 2021 because of the resurgence of the Delta variant of the coronavirus, "the construction sector's grip on growth remains tenuous."

"Long term, construction starts should improve, fed by an increase of nonresidential building projects in the planning pipeline and the recent passage of the Infrastructure Bill," he said in the release. "Both will provide meaningful support and growth to construction in the year to come. This expectation, however, must be tempered by the significant challenges facing the industry: high prices, shortages of key materials, and the continued scarcity of skilled labor. While healing from the pandemic continues, there's still a long road back to full recovery."

AIA's Baker is optimistic about the construction industry's fortunes in 2022. He says AIA architects are seeing more demand for retrofit work. "Even prior to the pandemic, architecture firms were reporting that almost half of their billings, on average, resulted from renovations, rehabilitations, retrofits, additions, and historic preservation projects on the existing building stock," he said in a post about AIA's Consensus Construction Forecast. "This was before concerns developed



Photo courtesy of Ford Motor Co.

At two new EV battery plants, Ford and SK Innovation plan to invest $11.4 billion and create a total of 11,000 new jobs in Stanton, Tenn., and Glendale, Ky. Production of the new electric vehicles and advanced lithium-ion batteries will begin in 2025.

regarding how buildings could be made safer for employees and customers with heightened health concerns.

"After declining about 2% last year, the AIA Consensus Construction Forecast Panel in its mid-year update is projecting that spending on nonresidential buildings will decline an additional 3.9% in 2021 — an upgrade from the 5.7% decline forecast at the beginning of the year — and that 2022 will see a 4.6% increase in spending. The strongest performers this year are expected to be health care facilities (1.4%), and a few others should see only modest declines — retail (1.3%); religious (0.9%); and education (2.1%). However, in 2022 virtually all the nonresidential building sectors are expected to see healthy growth, paced by lodging, as well as amusement and recreation, both of which saw steep declines during the pandemic."

**Dodge 2022 Construction Outlook Forecast ($ Billions)**

| Category | 2021 | YOY % change | 2022 | YOY % change |
|---|---|---|---|---|
| Total Construction | $893 | 12 | $946 | 6 |
| Institutional | $136 | 5 | $145 | 6 |
| Commercial | $128 | 15 | $143 | 12 |
| Educational | $62 | 0 | $67.5 | 9 |
| Warehouse | $46.7 | 36 | $52.8 | 13 |
| Office | $45.3 | 4 | $49.7 | 10 |
| Health Care | $30.1 | 8 | $32.9 | 9 |
| Manufacturing | $22.7 | 46 | $22.6 | 0 |
| Retail | $13.6 | 10 | $15.5 | 14 |
| Hotels | $7.1 | -18 | $8.8 | 24 |
| Data Center | $7.6 | 17 | $7.7 | 2 |
| ***Source:*** *Dodge Data & Analytics* | | | | |

**Table 1.** Dodge Construction & Analytics believes total construction spending will rise 6% to $946 billion. Commercial construction, the largest individual category measured in sales dollars in this year's forecast, is expected to increase 12% to $143 billion in construction spending.

## NEXT YEAR'S CHALLENGES

Following are some of the obstacles electrical construction professionals will have to navigate in the coming year in order to stay competitive.

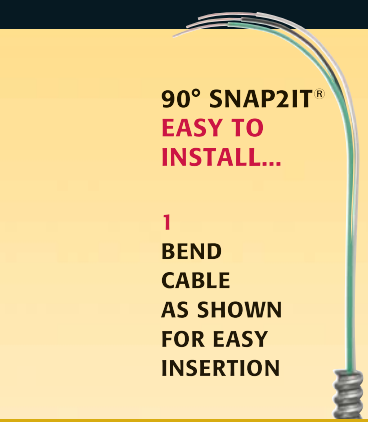
**Skyrocketing product prices.** Double-digit year-over-year (YOY) price increases for electrical products are common this year, according to *Electrical Marketing's* Electrical Price Index, which analyzes monthly and year-over-year price increases for more than 20 electrical products (**Table 2** on page 24). The largest increases are in pole-line hardware (43.1%); power wire & cable (37.1%); boxes (37%); ballasts (36%); and building wire & cable (31.3%).

**Supply chain issues.** If you could look into the containers loaded on the dozens of cargo ships outside the Los Angeles-Long Branch port complex now waiting for a chance to unload, you would see mountains of electrical products. Many of these products are LED lamps, lighting control equipment, and other semiconductor-based projects manufactured in China or other Pacific Rim nations. The scarcity of many of these products has

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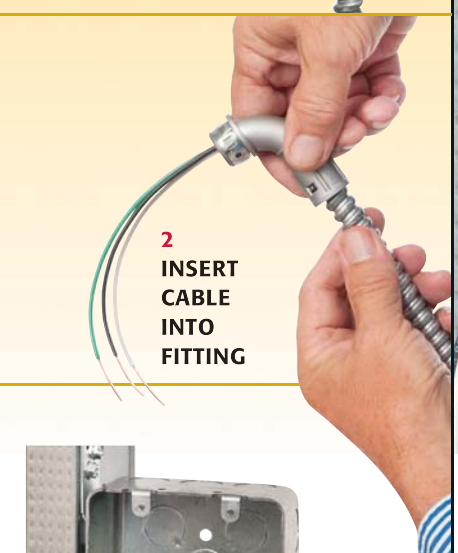
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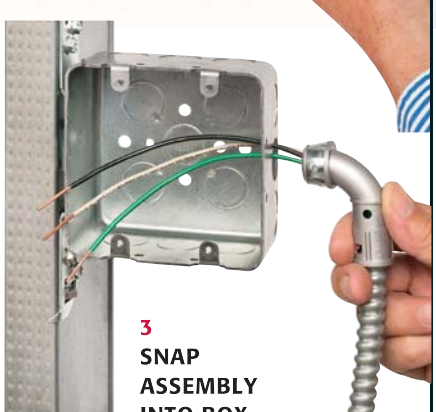


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|---|---|---|---|---|
| | Dia. Range | Cable Range | Dia. Range | Cable Range |
| **MC/HCF/AC** Steel & Aluminum | .380 to .600 | 14/2, and 12/2 with & w/o ground. 14/3, 14/4 12/3, 12/4 10/2 | .490 to .600 | 14/3, 12/2, and 12/3 with & w/o ground. 14/4 12/4 10/2 |
| **MCI-A** Steel & Aluminum | .440 to .550 | | .480 to .550 | |
| **AC90, ACG90** | .450 to .550 | | .480 to .550 | |
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| Electrical Marketing's Electrical Price Index | | | | | |
|---|---|---|---|---|---|
| **Products** | **Oct. 2021** | **Sept. 2021** | **% Change Month** | **Oct. 2020** | **% Change Year** |
| **Total Index** | | | | | |
| Total Index | 179.6 | 180.9 | -0.7 | 156.2 | 15 |
| **Wire & Cable** | | | | | |
| Building Wire & Cable | 248.1 | 245.7 | 1 | 189.0 | 31.3 |
| Power Wire & Cable | 302.3 | 302.3 | 0 | 220.6 | 37.1 |
| **Lighting** | | | | | |
| Lamps | 175.4 | 173.0 | 1.4 | 161.7 | 8.4 |
| Industrial Fixtures | 156.4 | 155.1 | 0.8 | 144.5 | 8.3 |
| Ballasts | 208.2 | 199.6 | 4.3 | 153.0 | 36.1 |
| Residential Lighting | 166.3 | 161.7 | 2.8 | 149.8 | 11 |
| **Switchgear, Panelboards & Transformers** | | | | | |
| Panelboards & Switches | 181.3 | 189.1 | -4.1 | 173.7 | 4.4 |
| Switchgear | 189 | 197.5 | -4.3 | 171.9 | 9.9 |
| Transformers | 151.4 | 149.9 | 1 | 139.3 | 8.7 |
| **Conduit & Boxes** | | | | | |
| Metal Conduit | 217.5 | 216.2 | 0.6 | 188.6 | 15.3 |
| Nonmetallic Conduit | 220.8 | 235.9 | -6.4 | 172.7 | 27.9 |
| Boxes | 251.1 | 251.8 | -0.3 | 183.3 | 37 |
| **Overcurrent Protection** | | | | | |
| Circuit Breakers | 189.8 | 195.4 | -2.9 | 181.1 | 4.8 |
| Fuses | 175.3 | 175.9 | -0.3 | 162.2 | 8.1 |
| **Wiring Devices, Connectors, Fittings, & Fasteners** | | | | | |
| Fasteners | 180.3 | 176.7 | 2 | 164.1 | 9.9 |
| Wiring Devices & Connectors | 148.2 | 148.0 | 0.1 | 136.9 | 8.2 |
| Conduit Fittings | 220.7 | 241.4 | -8.6 | 170.5 | 29.4 |
| **Electric Heat, Air Conditioning & Fans** | | | | | |
| Electric Heating Equipment | 159.5 | 158.3 | 0.8 | 147.0 | 8.5 |
| Fans & Blowers | 183.2 | 183.1 | 0 | 168.2 | 8.9 |
| Air Conditioners | 167.4 | 166.4 | 0.6 | 156.8 | 6.8 |
| **Tools & Test Equipment** | | | | | |
| Hand & Power Tools | 152.7 | 149.7 | 2 | 144.1 | 6 |
| Electric Measuring & Integrated Instruments | 128.4 | 128.4 | 0 | 128.0 | 0.3 |
| **Other** | | | | | |
| Industrial Controls | 173.7 | 174.1 | -0.2 | 165.4 | 5 |
| Pole Line Hardware | 247.6 | 244.4 | 1.3 | 173.1 | 43.1 |
| Generators | 166.1 | 162.6 | 2.2 | 154.2 | 7.7 |
| Telephones | 225.3 | 223.6 | 0.8 | 180.0 | 25.2 |
| Appliances | 123.7 | 123.7 | 0.1 | 115.1 | 7.5 |

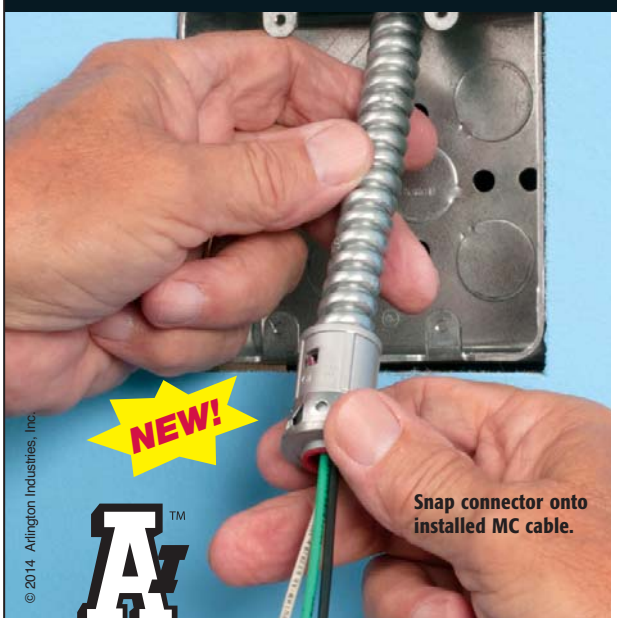
***Source:*** *Electrical Marketing's monthly Electrical Price Index (EPI) is compiled by IHS Markit and is available as part of a subscription to Electrical Marketing newsletter (www.electricalmarketing.com)for just $99 per year. To subscribe, visit https://endeavor.dragonforms.com/loading.do?omedasite=PEN6149_JEland*

**Table 2.** Double-digit year-over-year price increases for electrical products are common this year, according to *Electrical Marketing*'s Electrical Price Index. The largest increases are in pole-line hardware (43.1%); power wire & cable (37.1%); boxes (37%); ballasts (36%); and building wire & cable (31.3%).

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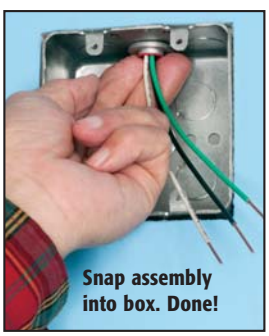
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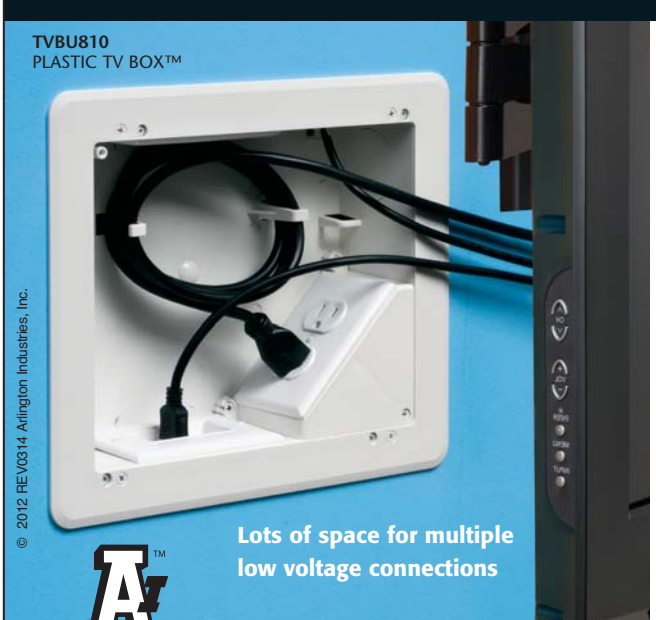
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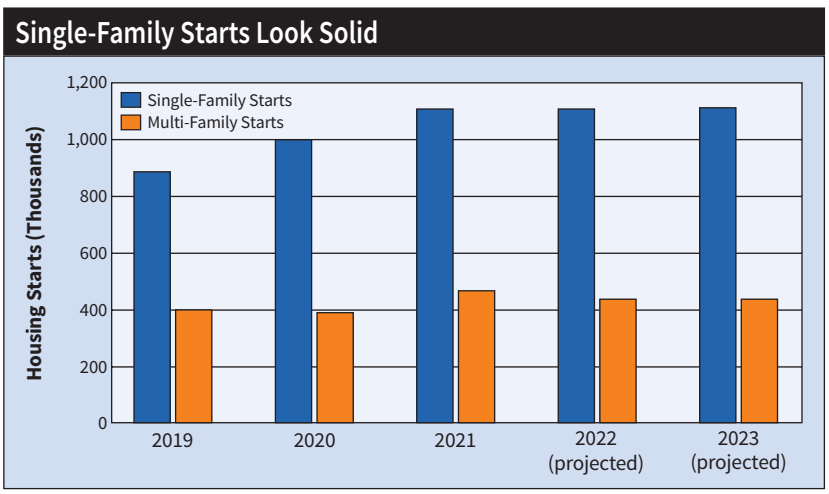



**Table 3.** The National Association of Home Builders (NAHB) expects single-family starts to maintain their current annual pace of more than 1 million starts next year with a 16% increase over 2021. NAHB expects multi-family starts to slide 6% to 444,000.

driven the historic price increases for all sorts of electrical products and has sent shockwaves up and down the supply chain. Unfortunately, they don't seem likely to calm down in the short term.

Let's explore the construction market segments that should provide the most opportunities in 2022.

## BUSY TIME FOR HOME BUILDERS

While the business fortunes for home builders always vary on a market-by-market basis, the U.S. residential construction market should have another good year, according to industry experts, with single-family homes (the largest individual segment of the entire construction market) providing more opportunities than apartments, condos, and other multi-family construction projects. At press-time, the single-family construction market was positioned to end the year as the strongest niche of them all. When measured on a new construction basis, the year-over-year growth rate of new single-family construction was up 30.4% through September to $412.7 billion. The fact that single-family construction accounted for 26.2% of all construction dollars spent during this period gives you a pretty good idea of why the housing market is such a critical element of the entire U.S. economy.

It looks like the market drivers are in place for home builders to have another very good year in 2022. Combined with historically low mortgage rates, demographic trends point to a healthy parade of millennials and other new homebuyers entering the market for their first home. The National Association of Home Builders (NAHB) expects the single-family housing market to have another year of double-digit growth in 2022 (**Table 3**). It's forecasting 1.1 million housing starts in 2022, a 15.8% increase. You can expect home building activity to continue on its historical trend of being ultra-concentrated in the states with the highest population growth, which are in the Sunbelt. Through September 2021, 10 states accounted for an estimated 62% of all single-family building permits — Texas, Florida, North Carolina, California, Georgia, Arizona, South Carolina, Tennessee, Colorado, and Utah.

Drill down into the data, and you will also find that a relative handful of Metropolitan Statistical Areas (MSAs) account for a giant share of all housing activity. For example, the 50 MSAs in **Table 4** (on page 28) currently account for 31% of all building permits year-to-date (YTD). Some perennial housing all-stars made the Top 10 — Houston; Dallas; Phoenix; Atlanta; Austin, Texas; Tampa, Fla.; Charlotte, N.C.; Orlando, Fla.; Jacksonville, Fla.; and Nashville, Tenn.

Two NAHB executives say that, despite these market drivers mentioned earlier, the residential market won't reach its potential if it doesn't overcome several challenges. "The rising count of homes permitted but that have not yet started construction is a stark reminder to policymakers to fix the supply chain so that builders can access a steady source of lumber and other building materials to keep projects moving forward," said NAHB Chairman Chuck Fowke in a press release.

"Single-family permit data has been roughly flat on a seasonally adjusted basis since June due to higher development and construction costs," added NAHB Chief Economist Robert Dietz. "Demand remains solid but housing affordability is likely to decline in 2022 with rising interest rates."

## COMMERCIAL MARKET OPPORTUNITIES

Here's a snapshot of what the experts believe is in store for the commercial market in 2022.

**Mega-warehouses.** Dodge Data & Analytics expects another record-breaking year for construction activity in the warehouse niche, with $52.8 billion in warehouse construction starts (a 13% gain). This activity has more than doubled since just 2018. Since that time, Amazon has spent $9.7 billion blanketing the United States with its monstrous fulfillment centers. Two Amazon warehouses that broke ground earlier this year in Massachusetts and New York give you an idea of just how big these buildings are. The $466-million Amazon North Andover Fulfillment Center in North Andover, Mass., is 3.77 million square feet, and the $410-million Amazon warehouse/distribution center in Rochester, N.Y., is 2.6 million square feet. Check out **Table 5** (on page 30) to see other large commercial facilities being built or on the drawing boards.

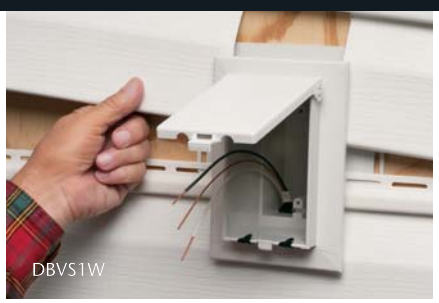
**Data centers.** It looks like data centers and warehouses will be two of the busiest niches in the construction market for yet another year. Dodge Data & Analytics doesn't expect data centers to top the record $10.5 billion in business we saw in 2018, but the $7.7 billion in construction activity it's forecasting for 2022 (up 2% from 2021) will include quite a few projects worth at least $400 million in total construction spending. The biggest of them all, according to Dodge data, is

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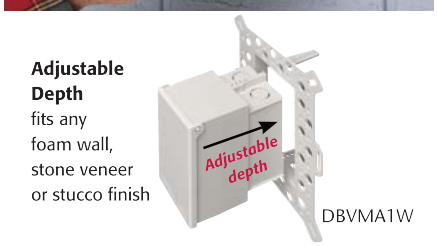
















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- Single and two-gang, vertical and horizontal, for a variety of new and old work applications
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## Top 50 Metropolitan Statistical Areas (MSAs) for Single-Family Building Permits Year-to-Date

| Rank | MSA | 1-Unit Building Permits — Sept. 21 | # Change YOY | % Change YOY | 5-Units+ Building Permits — Sept. 21 | # Change YOY | % Change YOY |
|---|---|---|---|---|---|---|---|
| 1 | Houston-The Woodlands-Sugar Land, TX | 40,255 | 4,946 | 14 | 11,368 | -4,443 | -28 |
| 2 | Dallas-Fort Worth-Arlington, TX | 39,161 | 7,530 | 24 | 20,489 | 9,084 | 80 |
| 3 | Phoenix-Mesa-Chandler, AZ | 27,534 | 4,968 | 22 | 10,315 | 204 | 2 |
| 4 | Atlanta-Sandy Springs-Alpharetta, GA | 24,928 | 4,915 | 25 | 3,958 | 1,205 | 44 |
| 5 | Austin-Round Rock-Georgetown, TX | 19,250 | 3,923 | 26 | 19,515 | 4,570 | 31 |
| 6 | Tampa-St. Petersburg-Clearwater, FL | 15,444 | 3,761 | 32 | 4,317 | 1,215 | 39 |
| 7 | Charlotte-Concord-Gastonia, NC-SC | 14,767 | 1,509 | 11 | 6,929 | 2,797 | 68 |
| 8 | Orlando-Kissimmee-Sanford, FL | 13,466 | 2,099 | 18 | 10,211 | 3,027 | 42 |
| 9 | Jacksonville, FL | 12,725 | 3,383 | 36 | 4,836 | 3,103 | 179 |
| 10 | Nashville-Davidson-Murfreesboro-Franklin, TN | 12,625 | 2,196 | 21 | 10,113 | 1,989 | 24 |
| 11 | Raleigh-Cary, NC | 11,196 | 1,831 | 20 | 5,273 | 2,355 | 81 |
| 12 | San Antonio-New Braunfels, TX | 11,161 | 3,639 | 48 | 6,490 | 1,979 | 44 |
| 13 | Washington-Arlington-Alexandria, DC-VA-MD-WV | 10,642 | 709 | 7 | 10,249 | 2,991 | 41 |
| 14 | Denver-Aurora-Lakewood, CO | 9,911 | 1,971 | 25 | 10,613 | 5,653 | 114 |
| 15 | New York-Newark-Jersey City, NY-NJ-PA | 9,794 | 1,873 | 24 | 28,673 | -664 | -2 |
| 16 | North Port-Sarasota-Bradenton, FL | 9,481 | 3,414 | 56 | 2,407 | 1,717 | 249 |
| 17 | Las Vegas-Henderson-Paradise, NV | 9,083 | 1,814 | 25 | 2,494 | 552 | 28 |
| 18 | Riverside-San Bernardino-Ontario, CA | 8,941 | -89 | -1 | 1,465 | 637 | 77 |
| 19 | Minneapolis-St. Paul-Bloomington, MN-WI | 8,724 | 1,772 | 25 | 9,989 | 2,331 | 30 |
| 20 | Cape Coral-Fort Myers, FL | 8,317 | 3,556 | 75 | 1,353 | -1,890 | -58 |
| 21 | Los Angeles-Long Beach-Anaheim, CA | 8,272 | 1,539 | 23 | 14,204 | 3,354 | 31 |
| 22 | Chicago-Naperville-Elgin, IL-IN-WI | 7,711 | 1,970 | 34 | 5,248 | 751 | 17 |
| 23 | Indianapolis-Carmel-Anderson, IN | 7,508 | 1,703 | 29 | 1,480 | -738 | -33 |
| 24 | Myrtle Beach-Conway-North Myrtle Beach, SC-NC | 7,429 | 2,337 | 46 | 474 | 338 | 249 |
| 25 | Lakeland-Winter Haven, FL | 7,194 | 2,290 | 47 | 1,640 | 400 | 32 |
| 26 | Sacramento-Roseville-Folsom, CA | 7,072 | 1,925 | 37 | 1,934 | -901 | -32 |
| 27 | Greenville-Anderson, SC | 6,994 | 2,375 | 51 | 680 | -350 | -34 |
| 28 | Seattle-Tacoma-Bellevue, WA | 6,978 | 360 | 5 | 13,709 | 4,135 | 43 |
| 29 | Portland-Vancouver-Hillsboro, OR-WA | 6,678 | 964 | 17 | 5,201 | 821 | 19 |
| 30 | Miami-Fort Lauderdale-Pompano Beach, FL | 6,664 | 1,204 | 22 | 11,940 | 548 | 5 |
| 31 | Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | 6,574 | 953 | 17 | 10,442 | 7,022 | 205 |
| 32 | Boise City, ID | 6,482 | 614 | 10 | 2,348 | 1,416 | 152 |
| 33 | Oklahoma City, OK | 6,038 | 979 | 19 | 171 | -80 | -32 |
| 34 | Provo-Orem, UT | 5,981 | 953 | 19 | 2,964 | 2,525 | 575 |
| 35 | Columbus, OH | 5,250 | 1,462 | 39 | 3,304 | -829 | -20 |
| 36 | Kansas City, MO-KS | 5,230 | 870 | 20 | 2,792 | -776 | -22 |
| 37 | Charleston-North Charleston, SC | 4,681 | 396 | 9 | 1,783 | -407 | -19 |
| 38 | Richmond, VA | 4,650 | 984 | 27 | 1,748 | -8 | 0 |
| 39 | Columbia, SC | 4,609 | 1,149 | 33 | 432 | 389 | 905 |
| 40 | Detroit-Warren-Dearborn, MI | 4,463 | 804 | 22 | 1,947 | 1,097 | 129 |
| 41 | Fayetteville-Springdale-Rogers, AR-MO | 4,441 | 1,011 | 29 | 988 | -12 | -1 |
| 42 | St. Louis, MO-IL | 4,375 | 110 | 3 | 1,817 | 471 | 35 |
| 43 | Ocala, FL | 4,320 | 1,654 | 62 | 72 | 45 | 167 |
| 44 | Salt Lake City, UT | 4,317 | 513 | 13 | 4,144 | 303 | 8 |
| 45 | Cincinnati, OH-KY-IN | 4,275 | 295 | 7 | 1,832 | 562 | 44 |
| 46 | Port St. Lucie, FL | 4,255 | 1,343 | 46 | 1,074 | 955 | 803 |
| 47 | Colorado Springs, CO | 4,062 | 395 | 11 | 2,380 | 1,581 | 198 |
| 48 | Tucson, AZ | 4,028 | 905 | 29 | 630 | 157 | 33 |
| 49 | Deltona-Daytona Beach-Ormond Beach, FL | 3,914 | 1,546 | 65 | 83 | -392 | -83 |
| 50 | Boston-Cambridge-Newton, MA-NH | 3,822 | 466 | 14 | 8,029 | 1,822 | 29 |

***Source:*** *Building permits through Sept. 2021 from U.S. Census Bureau*

**Table 4.** Texas dominated *EC&M's* list of the 50 Metropolitan Statistical Areas (MSAs) with the most single-family building permits through September 2021, with three MSAs in the Top 5 — Houston (40,255); Dallas (39,161); and Austin (19,125).

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## Large Construction Projects Now Underway or on the Drawing Boards

| Contract Value ($ Millions) | Project | City | State | Project Type | Status | Source |
|---|---|---|---|---|---|---|
| 8,500 | Venture Global LNG export facility | Plaquemines Parish | LA | Oil & gas | Broke ground Oct. 21 | www.construction.com |
| 7,000 | Hall Park mixed-use mega-project | Frisco | TX | Mixed-use | Fall 2023 start | Dallas Morning News |
| 6,000 | First phase of Taiwan Semiconductor plant | Phoenix | AZ | Industrial | Broke ground Oct. 21 | www.construction.com |
| 5,600 | Mayo Clinic - Multi-year expansion project | Rochester | MN | Hospital | Plans announced | Becker's Hospital Review |
| 3,750 | University of California - Davis Health - 16-story hospital and 5-story pavilion | Sacramento | CA | Hospital | Plans announced | Becker's Hospital Review |
| 2,000 | Massachusetts General Brigham - Multiple projects in Massachusetts and New Hampshire | Boston | MA | Hospital | Plans announced | Becker's Hospital Review |
| 2,000 | Facebook expansion of existing campus | Prineville | OR | Data center | Plans announced | www.bisnow.com |
| 1,740 | Harborview Medical Center renovation | Seattle | WA | Hospital | Plans announced | Becker's Hospital Review |
| 1,600 | Harbor-UCLA Medical Center - 346-bed tower & outpatient building | West Carson | CA | Hospital | Plans announced | Becker's Hospital Review |
| 1,500 | Children's Healthcare of Atlanta | Atlanta | GA | Hospital | Plans announced | Becker's Hospital Review |
| 1,500 | Diamond Green Diesel refinery | Port Arthur | TX | Oil & gas | Underway | www.construction.com |
| 1,300 | Methanex Methanol Plant | Geismar | LA | Industrial | Broke ground Oct. 21 | www.construction.com |
| 1,200 | Ohio State University's Wexner Inpatient Hospital Tower | Columbus | OH | Hospital | Broke ground Feb. 21 | www.construction.com |
| 1,200 | Terminal Warehouse conversion in Chelsea neighborhood | New York | NY | Multi-family | Underway | www.construction.com |
| 1,200 | 1.1-GW Sanborn Solar Facility | Mojave | CA | Renewables-Solar | Underway | www.construction.com |
| 1,000 | Second & third phase of California Northstate University medical center | Sacramento | CA | Hospital | Broke ground in September | www.construction.com |
| 1,000 | Brooklyn Hospital Center | Brooklyn | NY | Hospital | Plans announced | Becker's Hospital Review |
| 1,000 | Research & Development District office project | San Diego | CA | Office | Underway | www.construction.com |
| 1,000 | University of California - Irvine | Irvine | CA | Hospital | Plans announced | Becker's Hospital Review |
| 1,000 | Collin Creek redevelopment | Plano | TX | Mixed-use | Planning stage | collincreekplano.com |
| 1,000 | Inova Health Systems campus | Alexandria | VA | Hospital | Plans announced | Becker's Hospital Review |
| 1,000 | Ginger data centers | West Des Moines | IA | Data center | Plans announced | datacenterdynamics.com |
| 920 | Michigan Medicine's University Hospital new facility | Ann Arbor | MI | Hospital | Underway | www/mlive.com |
| 915 | Gateway South transmission project | Medicine Bow | WY | Utility | Underway | www.construction.com |
| 896.6 | LAX Airport Metro Connector | Los Angeles | CA | Airport | Underway | www.enr.com |
| 850 | Nucor steel mill | Brandenburg | KY | Industrial | Broke ground Jan. 21 | www.construction.com |
| 840 | Veteran Affairs (VA) Hospital | Louisville | KY | Hospital | Approved | www.wdrb.com |
| 825 | 450MW Desert Quartzite Solar Facility | Blythe | CA | Renewables - Solar | Broke ground Jan. 21 | www.construction.com |
| 800 | Facebook Eastmark Parkway data center | Mesa | AZ | Data center | Broke ground in August | www.construction.com |
| 800 | 1.5-million-sq-ft fulfillment center | Lancaster | TX | Warehouse | Announced plans in November | www.businesswire.com |
| 785 | ApiJect Systems' Gigafactory | Durham | NC | Factory | Broke ground Feb. 21 | www.construction.com |
| 670 | Pittsburgh International Airport modernization | Pittsburgh | PA | Airport | Broke ground in September | www.construction.com |
| 658 | Irvine Campus Medical Complex | Irvine | CA | Hospital | Broke ground in September | www.construction.com |
| 625 | Atkina Solar Power Project | Wharton County | TX | Renewables-Solar | Underway | www.construction.com |
| 616 | Flamingo Crossing Apartments | Winter Garden | FL | Multi-family | Broke ground in August | www.construction.com |

**Table 5.** The construction of large hospitals valued at $1 billion or more and data centers in the $400-million to $500-million range look most likely to lead all project types in 2022.

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- **Fast, secure snap-on installation**
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  ***From cable*** Loosen screw on top. Remove connector from cable.
  ***From box*** Slip screwdriver under notch in Snap-Tite® ring. Twist. Remove connector.

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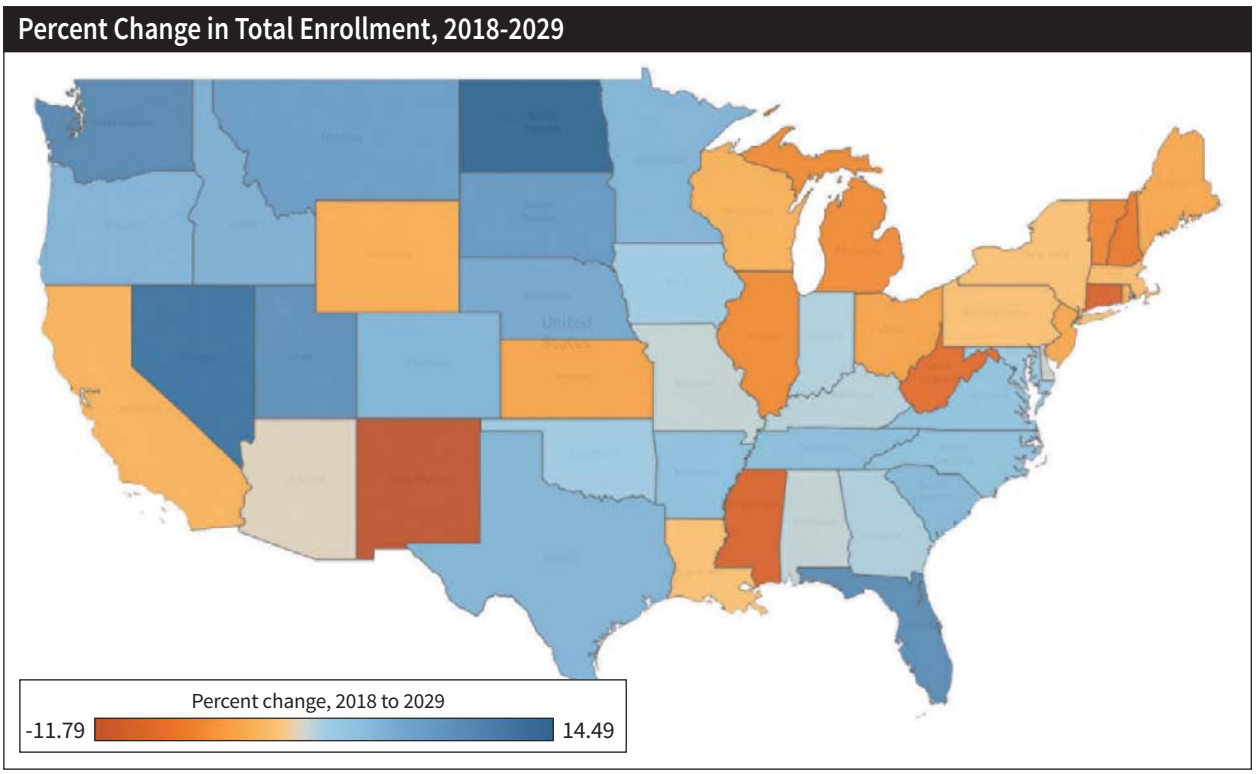



**Fig. 1.** This map shows which states will gain or lose the most K-12 student enrollment through 2029, according to projections from the National Center for Education Statistics. It's not surprising that many states in the Sunbelt are expected to have the largest enrollment increases over the next eight years.

the $800-million Facebook Data Center Campus that broke ground in Mesa, Ariz., in August 2021. Other sizeable data centers now underway include the $400-million Sterling 144MW EdgeCore Data Center in Sterling, Va., and two $400-million Facebook data centers in Altoona, Iowa, and Springfield, Neb.

## HOSPITALS TO HAMMER HEALTH-CARE MARKET

Dodge expects a strong 9% increase to $32.9 billion for hospital construction, after logging an 8% increase in 2021. *EC&M*'s editors spotted several mega-projects valued at $1 billion or more. The largest hospital now being built is the $1.2-billion Wexner Hospital Tower on the Ohio State University campus. Not to be outdone by a Big 10 Conference football rival, the University of Michigan's $900-million Michigan Medicine Tower broke ground in May 2021.

Down the road, the Mayo Clinic is planning a $6-billion expansion of its main campus in Rochester, Minn. Some other impressively sized projects are on the drawing boards, according to *Becker's Hospital Review,* including the $3.75-billion University of California-Davis hospital in Sacramento, Calif.; the $2 billion that Massachusetts General Brigham will be spending on multiple facilities in and around Boston; Seattle's $1.74-billion renovation of the Harborview Medical Center; and the $1.6-billion Harbor-UCLA Medical Center in West Carson, Calif.

## K-12 CONSTRUCTION: WHERE IT'S HOT AND WHERE IT'S NOT

Construction on public K-12 schools, one of the larger individual construction categories, is dependent on enrollment growth, age of existing facilities, and the local climate for the bond issues that typically fund a big percentage of the construction costs. Since these construction projects are often loaded with the latest in energy-efficient lighting, security, voice-data-video (VDV), and climate control systems, the bid process is often ultra-competitive.

According to projections from the National Center for Education Statistics, increases in public school enrollment through 2029 will be most common in the Sunbelt and Western states (**Fig. 1**). According to Dodge Data & Analytics, one of the larger public school projects that broke ground in 2021 was the $344-million Lowell High School in Lowell, Mass. A post at www.bostonrealestatetimes.com said the project includes 388,262 square feet of renovated space and 234,515 square feet of new construction.

## HOT LOCAL MARKETS

The 25 Metropolitan Statistical Areas (MSAs) shown on the map (**Fig. 2** on page 34) should outpace other MSAs in terms of electrical construction potential, according to *Electrical Wholesaling* estimates developed from analysis of growth in population, employment, building permits, and unemployment rates. Most of these markets are in the Sunbelt or Intermountain states. For the second year in a row, Austin is at the top of the list. Other metros that ranked at the top of the list using these criteria include: Sarasota, Fla.; Dallas; Jacksonville, Fla.;

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| LTMC507 | .550" - .730" | goes into 1/2" KO |
| LTMC75 | .725" - .890" | goes into 3/4" KO |

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

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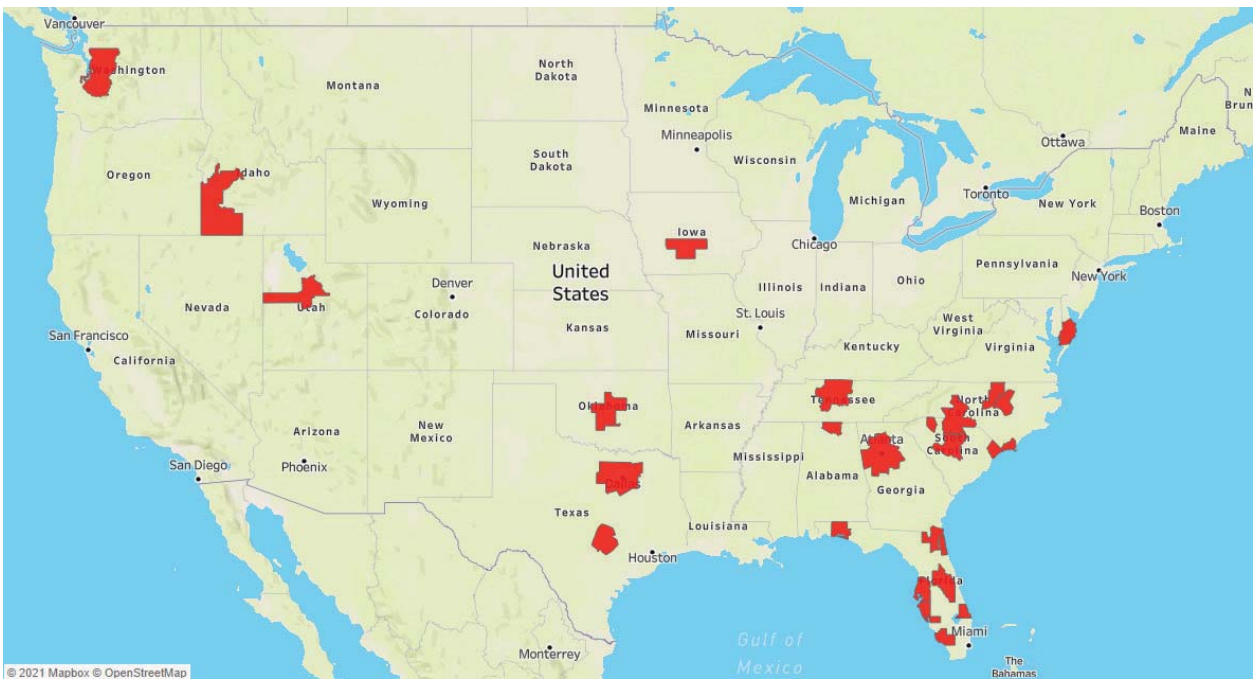



**Fig. 2.** The 25 MSAs shown on the map should outpace other MSAs in terms of electrical construction potential, according to *Electrical Wholesaling* magazine estimates developed from analysis of growth in population, employment, building permits, and unemployment rates. Most of these markets are in the Sunbelt or Intermountain states.

Raleigh, N.C.; Nashville, Tenn.; Charlotte, N.C.; and Tampa, Fla.

A contributing factor to the health of any local construction market is contractor employment. Electrical contractor employment is only available at the national level by the U.S. Bureau of Labor Statistics (BLS), and BLS data for electrician employment at the local level is only available annually. However, a good rule of thumb is that electrical contractors historically employ 13% of all construction



Photo Courtesy of Hall Group

The $7-billion Hall Park mixed-use mega-project is expected to break ground in 2023 in Frisco, Texas.

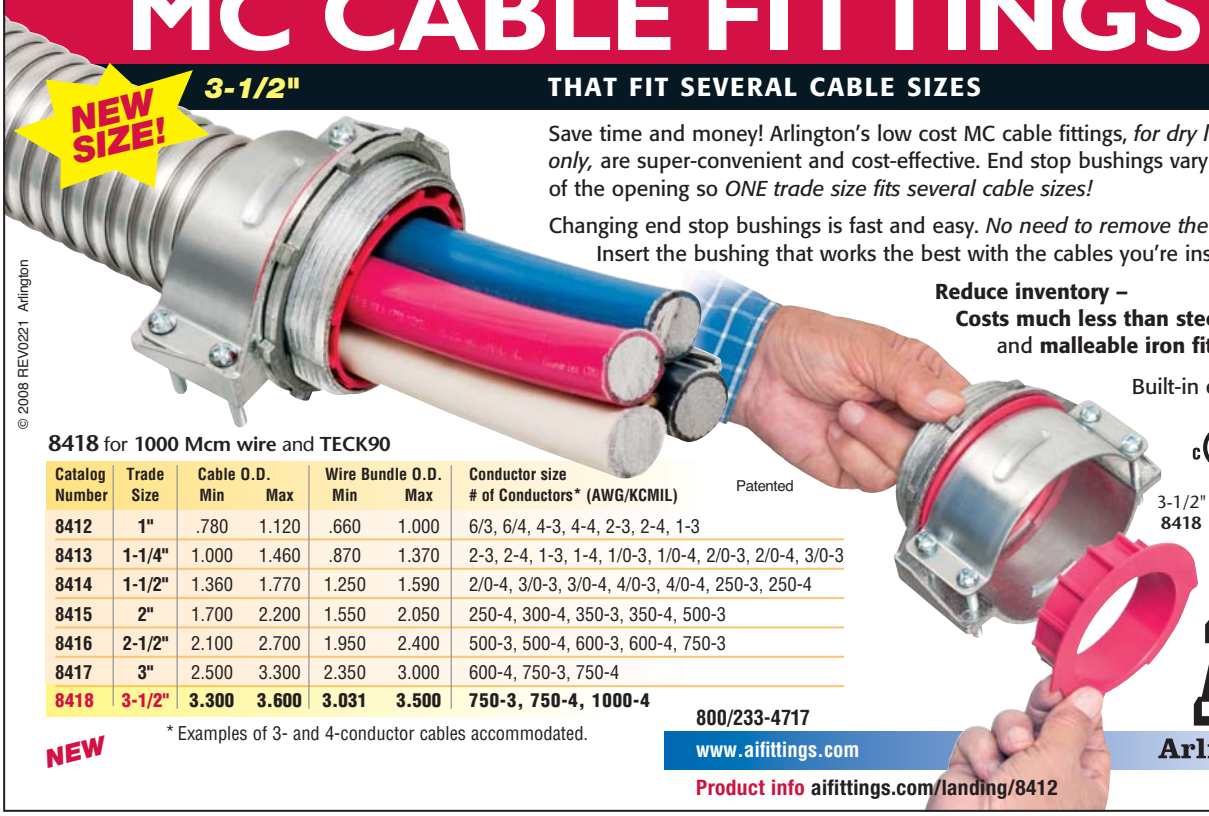
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Changing end stop bushings is fast and easy. *No need to remove the strap.* Insert the bushing that works the best with the cables you're installing.

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**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** |

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

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Product info aifittings.com/landing/8412

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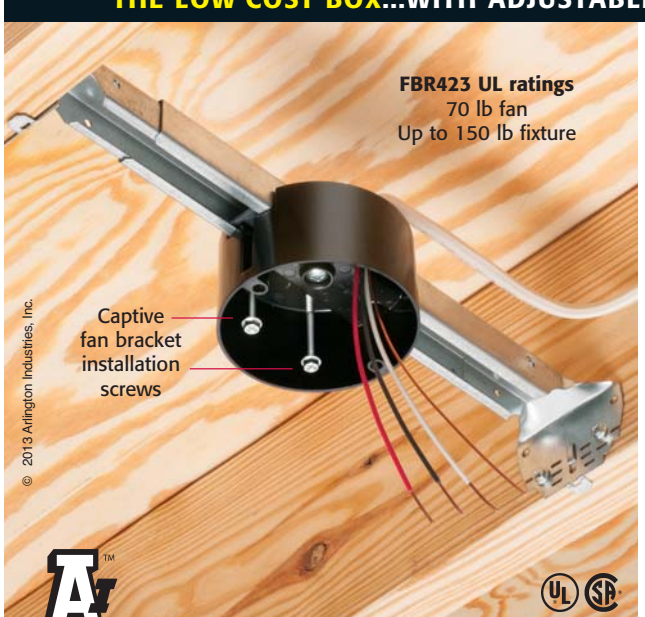
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FLUSH-WITH-THE-CEILING INSTALLATIONS

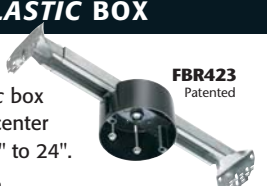
Made in USA

# NEW FAN/FIXTURE BOX

## THE LOW COST BOX...WITH ADJUSTABLE STEEL BRACKET AND *PLASTIC* BOX




Arlington's low cost, economical *steel* fan/fixture bracket with *plastic* box delivers super-secure, versatile on-center mounting between joists spaced 16" to 24".




- Easy mounting in new construction... fan bracket installation screws ship captive
- Bracket ends adjust for flush installation on ceilings up to 1-1/4" thick. They're pre-set for a 1/2" ceiling. Bend along score line for other ceiling depths.



- 23.0 cu. in. plastic box is positionable anywhere along bracket
- UL/CSA Listed

*** 2-HOUR FIRE RATING**







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

Product info aifittings.com/catalog/fan-fixture-boxes/steeladjustable-bracket-with-plastic-box/FBR423

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## 50 Fast-Growing Markets for Electrical Contractor Employment

| Metropolitan Statistical Area (MSA) | Estimated Electrical Contractor Employment | YOY # Change | YOY % Change |
|---|---|---|---|
| Boston-Cambridge-Nashua, MA-NH | 16,844 | 1,365 | 8.8 |
| Seattle-Tacoma-Bellevue, WA | 17,728 | 1,222 | 7.4 |
| Sacramento-Roseville-Arden-Arcade, CA | 10,387 | 1,179 | 12.8 |
| San Diego-Carlsbad, CA | 11,462 | 914 | 8.7 |
| Pittsburgh, PA | 8,675 | 906 | 11.7 |
| Indianapolis-Carmel-Anderson, IN | 8,134 | 776 | 10.5 |
| St. Louis, MO-IL | 9,464 | 758 | 8.7 |
| Minneapolis-St. Paul-Bloomington, MN-WI | 12,363 | 732 | 6.3 |
| Chicago-Naperville-Elgin, IL-IN-WI | 23,504 | 719 | 3.2 |
| Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | 15,825 | 589 | 3.9 |
| Orlando-Kissimmee-Sanford, FL | 11,154 | 563 | 5.3 |
| Portland-Vancouver-Hillsboro, OR-ID | 10,283 | 537 | 5.5 |
| Denver-Aurora-Lakewood, CO | 14,521 | 490 | 3.5 |
| Raleigh, NC | 5,880 | 477 | 8.8 |
| Northern Virginia, VA | 10,807 | 472 | 4.6 |
| Riverside-San Bernardino-Ontario, CA | 14,075 | 455 | 3.3 |
| Albuquerque, NM | 3,618 | 451 | 14.2 |
| Cleveland-Elyria, OH | 5,399 | 442 | 8.9 |
| Jacksonville, FL | 6,366 | 433 | 7.3 |
| Beaumont-Port Arthur, TX | 2,505 | 429 | 20.7 |
| Phoenix-Mesa-Scottsdale, AZ | 17,801 | 403 | 2.3 |
| Salt Lake City, UT | 6,990 | 394 | 6.0 |
| Cape Coral-Fort Myers, FL | 4,632 | 390 | 9.2 |
| Dallas-Fort Worth-Arlington, TX | 28,500 | 390 | 1.4 |
| Baton Rouge, LA | 5,391 | 390 | 7.8 |
| Midland, TX | 3,757 | 390 | 11.6 |
| Tampa-St. Petersburg-Clearwater, FL | 11,314 | 373 | 3.4 |
| Charlotte-Concord-Gastonia, NC-SC | 9,221 | 351 | 4.0 |
| Kansas City, MO-KS | 7,297 | 347 | 5.0 |
| Fort Lauderdale-Pompano Beach-Deerfield Beach, FL, FL | 6,665 | 338 | 5.3 |
| Tulsa, OK | 3,501 | 334 | 10.5 |
| Providence-Warwick, RI-MA | 3,614 | 329 | 10.0 |
| Rochester, NY | 3,185 | 325 | 11.4 |
| Atlanta-Sandy Springs-Roswell, GA | 16,909 | 321 | 1.9 |
| Boise City, ID | 4,125 | 321 | 8.4 |
| Lebanon, PA | 7,388 | 316 | 4.5 |
| Oakland-Hayward-Berkeley, CA | 9,568 | 308 | 3.3 |
| Columbus, OH | 6,192 | 295 | 5.0 |
| San Francisco-Oakland-Hayward, CA | 16,176 | 277 | 1.7 |
| Fort Worth-Arlington, TX, | 9,546 | 277 | 3.0 |
| Buffalo-Cheektowaga-Niagara Falls, NY | 3,081 | 260 | 9.2 |
| Detroit-Warren-Dearborn, MI | 10,643 | 251 | 2.4 |
| Los Angeles-Long Beach-Anaheim, CA | 32,314 | 234 | 0.7 |
| Springfield, MA-CT | 1,811 | 225 | 14.2 |
| Austin-Round Rock, TX | 9,204 | 225 | 2.5 |
| Toledo, OH | 2,063 | 208 | 11.2 |
| Bridgeport-Stamford-Norwalk, CT | 1,881 | 199 | 11.9 |
| Augusta-Richmond County, GA-SC | 2,721 | 199 | 7.9 |
| Virginia Beach-Norfolk-Newport News, VA-NC | 5,300 | 186 | 3.6 |
| Ogden-Clearfield, UT | 3,033 | 186 | 6.5 |

***Source:*** *U.S. Bureau of Labor Statistics data for construction employment and Electrical Wholesaling magazine estimates for electrical contractor employment based on historical trends.*

**Table 6.** Three local market areas have seen YOY increases through Sept. 2021 in electrical contractor employment of at least 1,000 employees: Boston (1,365); Seattle (1,222); and Sacramento, Calif. (1,179), according to *Electrical Marketing* estimates.

PHOTOVOLTAIC

# NEW CABLE CONNECTORS

## CONNECTS, PROTECTS MULTIPLE PV1000 CABLES



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

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




© 2017 Arlington Industries Inc.

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

UL LISTED

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

Product info aimedia.co/media/catalog-pages/D-4.pdf

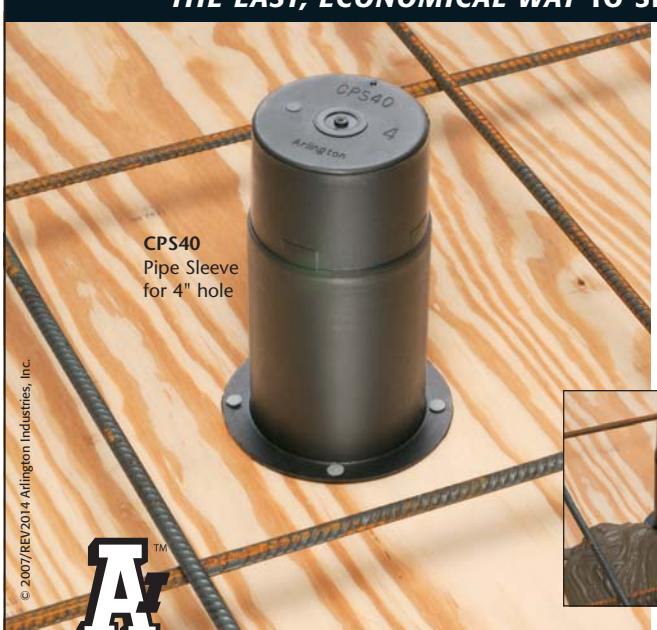
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NON-METALLIC • VENTED FOR EASIER STACKABILITY

Made in USA

# CONCRETE PIPE SLEEVE

## *THE EASY, ECONOMICAL WAY* TO SLEEVE THROUGH CONCRETE POURS!




**CPS40**
Pipe Sleeve
for 4" hole

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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.



CPS40

- 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"



Nail or screw sleeve to form.



After concrete sets. Cut sleeve off flush with surface.



Insert conduit into sleeve.

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

Product info aifittings.com/catalog/miscellaneous/concrete-pipe-sleeves

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workers. Using this calculation, according to *Electrical Marketing* estimates, three local market areas have seen YOY increases through September 2021 of at least 1,000 employees: Boston (1,365); Seattle (1,222); and Sacramento, Calif. (1,179), as shown in **Table 6** on page 36.

Another way to measure the construction climate in large metros is with the construction spending data developed by Dodge Data and Analytics (**Table 7**). According to Dodge's September 2021 year-to-date data, the San Diego and Pittsburgh markets logged the biggest year-over-year increases in

**Construction Spending in Largest Metropolitan Statistical Areas (MSAs)**

| Metropolitan Statistical Area | State | Nonresidential Construction ($ millions) | % Change YOY | Residential Construction ($ millions) | % Change YOY | Total Building ($ millions) | % Change YOY |
|---|---|---|---|---|---|---|---|
| San Diego-Carlsbad-San Marcos | CA | 4,021.8 | 113 | 1,884.3 | 21 | 5,906.1 | 92 |
| Pittsburgh | PA | 1,519.3 | 142 | 1,056.6 | 38 | 2,575.9 | 85 |
| Miami-Ft. Lauderdale-Miami Beach | FL | 3,531.2 | 21 | 6,146.7 | 49 | 9,677.9 | 38 |
| Columbus | OH | 2,467.8 | 39 | 2,347.6 | 30 | 4,815.3 | 34 |
| Kansas City | MO-KS | 2,507.4 | 42 | 2,620.1 | 25 | 5,127.5 | 33 |
| Raleigh-Cary | NC | 700.3 | 7 | 3,813.8 | 37 | 4,514.0 | 31 |
| Denver-Aurora | CO | 1,922.5 | 17 | 4,985.7 | 35 | 6,908.3 | 30 |
| Oklahoma City | OK | 953.9 | 58 | 1,723.9 | 18 | 2,677.9 | 30 |
| Philadelphia-Camden-Wilmington | PA-NJ-DE | 3,376.1 | -3 | 3,784.0 | 77 | 7,160.2 | 28 |
| New Orleans | LA | 525.5 | 28 | 1,002.0 | 27 | 1,527.5 | 27 |
| Boston-Cambridge-Quincy | MA-NH | 6,895.6 | 18 | 3,929.4 | 24 | 10,825.1 | 20 |
| Orlando | FL | 1,846.6 | 11 | 6,014.0 | 22 | 7,860.6 | 19 |
| Baltimore-Columbia-Towson | MD | 1,722.1 | 0 | 2,150.0 | 39 | 3,872.1 | 19 |
| New York-Northern New Jersey-Long Island | NY-NJ-PA | 14,971.2 | 14 | 14,632.1 | 22 | 29,603.4 | 18 |
| Tampa St. Petersburg-Clearwater | FL | 1,645.3 | -6 | 5,525.0 | 26 | 7,170.3 | 17 |
| Indianapolis-Carmel-Anderson | IN | 1,822.7 | -16 | 3,268.0 | 51 | 5,090.7 | 17 |
| Dallas-Ft. Worth-Arlington | TX | 8,069.2 | 7 | 13,228.8 | 22 | 21,298.1 | 16 |
| Minneapolis-St. Paul-Bloomington | MN | 1,765.1 | -12 | 4,732.0 | 32 | 6,497.1 | 16 |
| San Jose-Sunnyvale-Santa Clara | CA | 1,702.4 | 25 | 990.9 | -1 | 2,693.3 | 14 |
| Charlotte-Gastonia-Concord | NC | 1,169.8 | -19 | 4,608.0 | 26 | 5,777.8 | 13 |
| San Francisco-Oakland-Fremont | CA | 2,442.9 | -8 | 2,785.9 | 32 | 5,228.8 | 10 |
| San Antonio | TX | 2,194.6 | -11 | 3,674.4 | 26 | 5,869.0 | 9 |
| Seattle-Tacoma-Bellevue | WA | 3,568.3 | 0 | 4,276.0 | 13 | 7,844.3 | 7 |
| Austin-Round Rock | TX | 2,345.7 | -25 | 6,845.5 | 24 | 9,191.3 | 6 |
| Houston-Baytown-Sugar Land | TX | 6,714.1 | -12 | 11,158.6 | 19 | 17,872.6 | 5 |
| Nashville-Davidson-Murfreesboro | TN | 1,941.3 | -40 | 5,571.7 | 42 | 7,513.0 | 5 |
| Phoenix-Mesa-Scottsdale | AZ | 5,084.8 | -2 | 9,309.1 | 8 | 14,394.0 | 4 |
| Atlanta-Sandy Springs-Marietta | GA | 3,323.8 | -28 | 8,012.0 | 28 | 11,335.8 | 4 |
| Las Vegas-Paradise | NV | 1,119.6 | -19 | 2,888.3 | 17 | 4,007.9 | 4 |
| Detroit-Warren-Livonia | MI | 1,666.2 | -11 | 1,748.7 | 19 | 3,414.9 | 2 |
| Los Angeles-Long Beach-Santa Ana | CA | 6,436.0 | -9 | 5,886.2 | 7 | 12,322.1 | -2 |
| Washington-Arlington-Alexandria | DC-VA-MD | 5,025.4 | -17 | 5,998.6 | 10 | 11,024.0 | -4 |
| St. Louis MSA | MO-IL | 1,702.4 | -15 | 1,869.2 | 1 | 3,571.6 | -7 |
| Chicago-Naperville-Joliet | IL | 4,263.6 | -36 | 4,087.9 | 37 | 8,351.4 | -13 |
| Portland-Vancouver-Beaverton | OR-WA | 1,612.4 | -44 | 3,015.3 | 14 | 4,627.7 | -16 |

*Source: Dodge Data & Analytics, Year-to-date through Sept. 2021 ($ millions)*

**Table 7.** The San Diego and Pittsburgh markets logged the biggest year-over-year increases in total construction spending through September 2021 with 92% and 85% increases, respectively. Pittsburgh has a $670-million modernization project underway, and San Diego's contractors are busy with all sorts of downtown mixed-used projects.

WHITE BUTTON® • NON-METALLIC

Made in USA

NEW

# CABLE CONNECTORS

## EASY PUSH-IN INSTALLATION OF ONE OR TWO CABLES

*from* ***OUTSIDE*** *a* ***New Work Box...***



Save money with Arlington's non-metallic NM cable connectors – the *lowest cost* NM cable connectors on the market – and the fastest to install! Easy push-in installation...

Listed for single or multiple cables, Arlington's new **White Button**® 1/2" NM94X and the ***NEW 3/4" NM95X*** offers smooth, easy cable insertion of one *or two* cables into a single opening from inside or outside the box.

***NM94X... BETTER than our popular NM94 AT THE SAME PRICE!***

- 1/2" trade size NM94X holds:
  (1) 14/2 to 6/2, (1) 14/2/2, (1) 12/4,
  (1) 12/2/2, (1) 14/3 to 10/3,
  (2) 14/2 to 10/2, (2) 14/3,
  (2) 12/3,
  (1) 14/2 and (1) 12/2,
  (1) 14/2 and (1) 10/2,
  (1) 12/2 and (1) 10/2

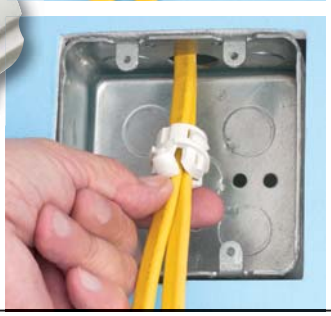


NM94X

- **Easy** removal with pliers or screwdriver
- **Listed.** Exceeds UL/CSA pullout requirements

*or* ***INSIDE*** *an* ***Existing Box.***







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Product info aifittings.com/landing/NM94X

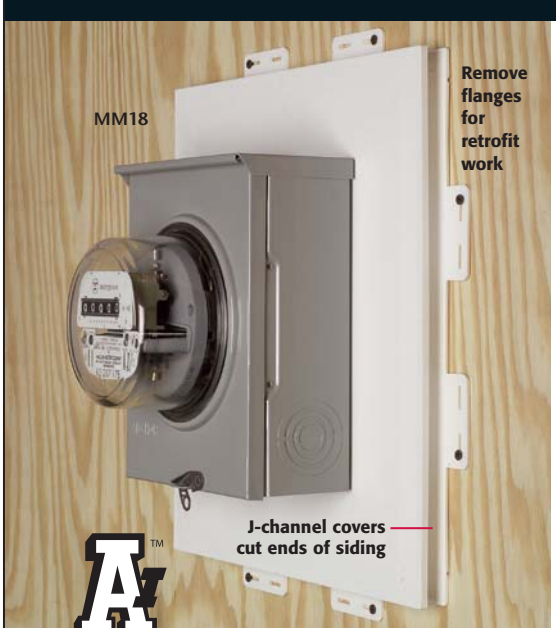
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ONE-PIECE • NON-METALLIC

Made in USA

# METER MOUNTING BASE

## INSTALLS ON SIDING – AND OTHER SURFACES




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

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

UV rated, paintable plastic for long outdoor life.

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

NEW 5x7






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Product info aifittings.com/landing/mm7

NEW

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

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total construction spending through September 2021 with 92% and 85% increases, respectively. Pittsburgh has a $670-million modernization project underway, and San Diego's contractors are busy with all sorts of downtown mixed-use projects.

*EC&M's* editors have also found that the pace of residential and light-commercial construction closely correlates with population growth. One interesting way to measure how fast a local market is growing is to calculate the number of new residents moving into the area. The Phoenix and Dallas metropolitan areas lead the pack with 243.8 per day and 205.3 per day, respectively, moving into town (**Table 8**).

## MOVING FORWARD

With the historic price increases, supply chain shortages, and lingering concerns over COVID-19, 2022 won't be a cakewalk for anyone. But companies throughout the electrical construction industry proved their resilience during the depths of the pandemic. It's these crisis management skills they honed during the past 18 months that will help them navigate what hopefully will be a much more tolerable economic climate in 2022. EC&M

**Looking for Population Growth? Follow the Moving Truck to These Top 25 Metros**

| Metropolitan Statistical Area-State | New residents per day | 2020 Population Estimate | Net Migration: 2019-2020 | 2019-2020 Increase | 2019-2020 % Change | 2015-2020 Increase | 2015-2020 % change |
|---|---|---|---|---|---|---|---|
| Phoenix-Mesa-Chandler, AZ | 243.8 | 5,059,909 | 88,970 | 106,008 | 2.14 | 479,564 | 10.5 |
| Dallas-Fort Worth-Arlington, TX | 205.3 | 7,694,138 | 74,920 | 119,748 | 1.58 | 651,816 | 9.3 |
| Austin-Round Rock-Georgetown, TX | 145.9 | 2,295,303 | 53,266 | 67,197 | 3.02 | 292,489 | 14.6 |
| Tampa-St. Petersburg-Clearwater, FL | 133.7 | 3,243,963 | 48,816 | 43,843 | 1.37 | 258,488 | 8.7 |
| Houston-The Woodlands-Sugar Land, TX | 121.5 | 7,154,478 | 44,347 | 91,078 | 1.29 | 483,675 | 7.3 |
| Charlotte-Concord-Gastonia, NC-SC | 96.9 | 2,684,276 | 35,367 | 44,159 | 1.67 | 234,770 | 9.6 |
| Atlanta-Sandy Springs-Alpharetta, GA | 94.2 | 6,087,762 | 34,374 | 60,531 | 1.00 | 399,179 | 7.0 |
| Las Vegas-Henderson-Paradise, NV | 89.9 | 2,315,963 | 32,824 | 40,079 | 1.76 | 218,131 | 10.4 |
| San Antonio-New Braunfels, TX | 76.7 | 2,590,732 | 27,991 | 40,585 | 1.59 | 211,375 | 8.9 |
| Seattle-Tacoma-Bellevue, WA | 66.1 | 4,018,598 | 24,121 | 40,813 | 1.03 | 276,887 | 7.4 |
| Orlando-Kissimmee-Sanford, FL | 63.1 | 2,639,374 | 23,024 | 31,101 | 1.19 | 249,797 | 10.5 |
| Jacksonville, FL | 62.8 | 1,587,892 | 22,939 | 26,086 | 1.67 | 142,273 | 9.8 |
| North Port-Sarasota-Bradenton, FL | 60.3 | 854,684 | 21,992 | 16,701 | 1.99 | 86,764 | 11.3 |
| Raleigh-Cary, NC | 58.5 | 1,420,376 | 21,350 | 28,020 | 2.01 | 148,708 | 11.7 |
| Cape Coral-Fort Myers, FL | 56.2 | 790,767 | 20,504 | 18,499 | 2.40 | 90,524 | 12.9 |
| Nashville-Davidson-Murfreesboro-Franklin, TN | 54.7 | 1,961,232 | 19,978 | 27,777 | 1.44 | 155,244 | 8.6 |
| Lakeland-Winter Haven, FL | 53.5 | 744,552 | 19,536 | 19,585 | 2.70 | 95,729 | 14.8 |
| Myrtle Beach-Conway-North Myrtle Beach, SC-NC | 52.6 | 514,488 | 19,181 | 17,083 | 3.43 | 82,816 | 19.2 |
| Boise City, ID | 48.1 | 770,353 | 17,560 | 20,303 | 2.71 | 95,180 | 14.1 |
| Riverside-San Bernardino-Ontario, CA | 39.2 | 4,678,371 | 14,318 | 35,523 | 0.77 | 219,371 | 4.9 |
| Deltona-Daytona Beach-Ormond Beach, FL | 38.8 | 679,948 | 14,160 | 10,402 | 1.55 | 58,271 | 9.4 |
| Denver-Aurora-Lakewood, CO | 37.5 | 2,991,231 | 13,683 | 26,420 | 0.89 | 176,848 | 6.3 |
| Tucson, AZ | 33.9 | 1,061,175 | 12,362 | 11,914 | 1.14 | 51,685 | 5.1 |
| Portland-Vancouver-Hillsboro, OR-WA | 33.4 | 2,510,259 | 12,177 | 17,780 | 0.71 | 126,905 | 5.3 |
| Charleston-North Charleston, SC | 33.3 | 819,705 | 12,144 | 14,621 | 1.82 | 73,561 | 9.9 |

***Source:*** *U.S. Census Bureau's 2020 Population Data. Net migration is the difference between the number of residents moving into and out of a geographic area.*

**Table 8.** One interesting way to measure how fast a local market is growing is to calculate the number of new residents moving into the area. The Phoenix and Dallas metropolitan areas lead the pack with 243.8 per day and 205.3 per day, respectively, moving into town.

ECONOMICAL • INTERLOCKING

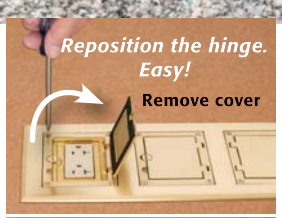
# GANGABLE FLOOR BOX

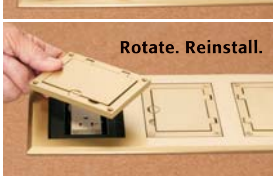
## FOR NEW CONCRETE




## HERE'S HOW IT WORKS...




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**NEW! PLASTIC**

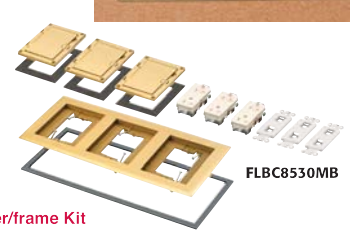
**Listed Cover/frame kits NOW IN PLASTIC, FIVE Colors!**




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***.

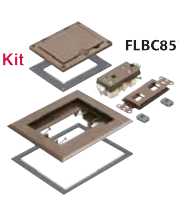
*Fast and easy installation.* Install the frame on the box. Add the devices. Attach the gasketed cover to the frame. ***Install the cover with the hinge on either side.***




**NEW!**

**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

**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**




Arlington®

Patented

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

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



Photo courtesy Trimble Buildings

Visualize and interact with 3D data on site from any angle at true-to-life scale.

# Crossing the Chasm

By Jordan Lawver, Trimble Inc.

On today's electrical projects, mixed reality has become today's reality.

The integration and use of mixed reality technology in the electrical construction industry is no longer a futuristic concept. It has crossed the chasm from the days of early adoption a few years ago to an integral part of the connected construction workflow — and continued growth is expected. Research from IDC found that spending for augmented and extended reality increased by 78.5% between 2019 and 2020, and the market is set to see a compound annual growth rate of up to 77% through 2023.

Mixed reality technology merges real and virtual worlds to create brand new environments where physical and digital components can interact simultaneously. It's considered "mixed" reality because it encompasses both virtual and real environments via immersive technology, enabling users to see the existing space overlaid with holographic data from a 3D model.

While the original vision of connecting digital and physical worlds took decades to develop, it has now become an integral tool to improve efficiency that delivers a proven return on investment for electrical engineers and contractors.

Mixed reality is transforming the way electrical engineers and contractors consume and interact with information, letting them go beyond the constraints of a 2D screen by superimposing the digital model on the physical environment to provide a clear understanding of the design intent. This capability is especially helpful because it gives project teams the detail and the perspective they need to understand

NON-METALLIC

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# THE SCOOP™

## ENTRANCE PLATES, HOODS, DEVICES




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

Our newest **CABLE ENTRY DEVICES** come with *or without* a wall plate for efficient cable management. **HOODS** for decorator-style wall plates, single and two-gang **PLATES** install facing in or out...and save time!

- Low voltage cable protection
- Best way to run cable



CED130
entry device
w slotted cover

Patented













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

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

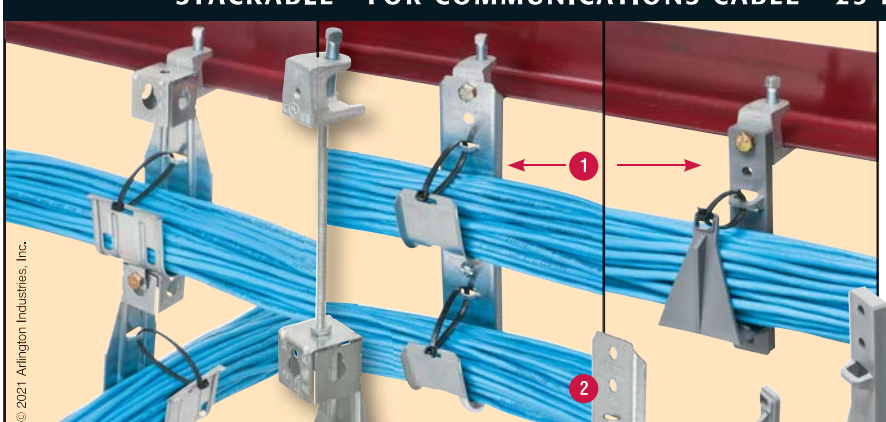
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STEEL AND PLASTIC

Made in USA

# NEW LISTED CABLE HOOKS

## STACKABLE • FOR COMMUNICATIONS CABLE • 25 LB SUPPORT RATING







*CHS1 also works with threaded rod (not included)*

Available in heavy duty **Plastic** and ***two styles*** in **Steel,** Arlington's Cable Hooks can handle any jobsite condition. They're super convenient for communications cable!

- 25 lb Support Rating – maintains integrity of high performance data cable
- Supports *up to 90* Cat 5e cables with the center radius of bundle spread over 2" opening
- Listed for air handling spaces
- **Parallel or perpendicular stackability** for vertical support of multiple cable tiers
- Easy attachment to various supports, beam clamps and strut

**Features on All**

1 Eyelets for cable tie
2 Openings for attachment to beam clamp
3 1/4" holes for stacking hooks

UL LISTED

Patented

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Product info aifittings.com/landing/Cable-Hooks

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Photo courtesy Trimble Buildings

Design and installation professionals using mixed reality technology can easily view 3D designs on the job site.

and visualize the design in the context of the physical job site before they start the work and mitigate any clash detection/overlap before construction crews arrive on site.

## IMMERSIVE VISUALIZATION

Mixed reality simplifies and accelerates access to building information modeling (BIM) data on the job site — anytime, any place. This way, workers can leverage mixed reality to compare plans against work completed. Advanced visualization extends the ability for users to view assigned tasks and capture data with on-site measurement tools. This reduces human error, making projects much more efficient.

This technology also helped electrical contractors overcome the COVID-19 travel restrictions by giving clients the ability to visualize the progress of their project and to align with all stakeholders on any design adjustments or changes from remote locations.

Using mixed reality technology, an apprentice can view the current condition, review the steps necessary to complete the task, and resolve any issues. As a result, electrical contractors benefit by reducing costs, accelerating project schedules, and improving the quality of their work. Another benefit of mixed reality technology is the ability to conduct remote assistance with technicians and provide 3D guided sequencing, which reduces the time needed for training and minimizes the possibility of errors during the assembly process.

## IMPROVED EFFICIENCY AND QUALITY ASSURANCE/CONTROL

Mixed reality technology is being used in the electrical industry for a variety of purposes, such as remote site walks, quality assurance and quality control, clash detection, install verification, project controls, and remote assist.

Electrical contractors benefit from the ability to visualize 3D models in an immersive environment to communicate and collaborate with others — both collocated and remote — while immersed in the design. In addition to clash detection, mixed reality applications overlay designs in the real world to simplify tasks (such as renovation visualization) and train workers and field crews to virtually explore their assignments before actual construction begins. For example, users can superimpose transmission and distribution line designs against the backdrop of the real world to visualize and validate designs. They can also review lighting designs superimposed on future sites with their customers and crew to validate details like light pole configuration and placement before construction.

Understanding the design in context can also increase confidence and reduce rework by effectively conveying and clarifying design intent and impact to all stakeholders.

## REAL-WORLD EXAMPLES

Indiana-based Bowen Engineering is one company that is reaping big benefits from the use of mixed reality technology. A majority of the company's work takes place in existing facilities that are already packed with infrastructure, making it difficult to find a viable route to install new utilities. The work is often installed in very tight spaces, and it can be difficult to accurately verify tie-in points and avoid clashes with existing elements in the facility. Using a mixed reality solution helped the Bowen Engineering team visualize its designs and drawings in 3D while on the job site, significantly improving the company's pre-planning process and workflow.

"We put on the XR10 with HoloLens 2 and right away noticed that one of our T-posts was hitting a valve and needed to be shifted over," said Colton Motz, project engineer at Bowen Engineering. "It looked clear in the model, but when we walked the site (overlayed with the model) and could actually see it and touch it, we could see right away that what was in the model wasn't going to work."

Bowen Engineering managers estimate that mixed reality technology saved them more than $4,000 in labor costs on one project alone by helping them discover an issue that, if left undiscovered,

STEEL BOX WITH BRASS COVER

# LISTED SINGLE GANG FLOOR BOX KITS

## CONVENIENT, FLUSH-TO-THE-FLOOR RECEPTACLE INSTALLATION



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



**FLB5331MB**
Single gang Kit
w brass cover

© 2016 Arlington Industries, Inc.

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

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

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

*Covers also sold separately.*

for NEW or EXISTING FLOORS



**FLB5331MB**
Single gang steel box
kit w brass cover

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

Product info aifittings.com/landing/floor-box-kits/

c UL us

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# IN BOX® RECESSED COVER KITS

## *INSTALLS INSIDE* 4.5" CONCRETE BOXES

NEW!










© 2018 Arlington Industries, Inc.

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

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

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




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




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

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

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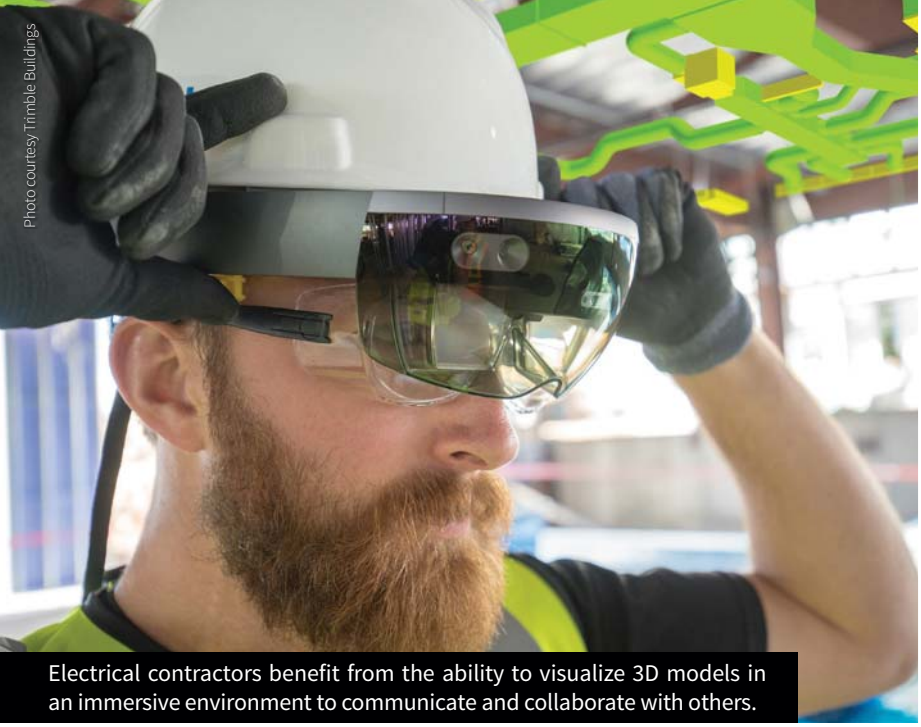


Photo courtesy Trimble Buildings

Electrical contractors benefit from the ability to visualize 3D models in an immersive environment to communicate and collaborate with others.

would have required an additional 16 to 24 hours of crew time between delays and rework.

In another instance, Montreal-based MA-TH, an engineering firm, was experiencing many misinterpretations of engineering documents, including BIM models and point clouds, that resulted from a lack of knowledge of common software and data extraction. The company used mixed reality technology to implement a process for design review that allowed the client and its operating team members to preview their project on site and reduce the risk of misunderstanding the BIM model or engineering documents. This resulted in cost savings of more than $25,000 in site modifications that were identified during the design review process.

"Before, our clients could only visualize their projects on a computer screen, but now they can easily walk the site and see firsthand all of the details of the design," said Félix Therrien, co-founder of MA-TH.

## CONNECTED CONSTRUCTION DEMOCRATIZES THE MODEL

With the integration of mixed reality technology taking root, what does the construction site of the future look like? Although it provides extreme value in the field, mixed reality technology also eases the process of sharing project information with those in the office. Using hardware and software connected to the cloud makes the model available to more people so stakeholders across a project can collaborate on all different types of design files together in a common location.

Electrical engineers can also leverage their investment in BIM by using mixed reality to grow the capabilities of the technology and get more value out of their data. With two-way communication, users always have the most up-to-date data on their site, which accelerates decision making and reduces downtime by enhancing communication and collaboration between local and remote teams.

In addition, the ability to use this type of technology via hard hat-compatible hardware allows workers to have their hands free so they can view the models and install wiring or conduits at the same time.

The innovation in mixed reality technology doesn't stop here. As more widespread adoption occurs, the democratization of the model makes data more accessible to more people than ever before. By enabling everyone to visualize the same desired result, teams can develop a shared understanding of the project and the work to be completed, enhancing communication and coordination to improve productivity and reduce costly rework. EC&M

*Jordan Lawver is the Business Area Director, AR/MR/VR at Trimble Inc. He has led the product management and marketing activities for Trimble Building's mixed-reality product portfolio for the last four years, including tools such as Trimble Connect for HoloLens and Trimble XR10 with HoloLens 2. Prior to his work in mixed reality, Jordan completed Trimble's Rotational Leadership Development program, worked on NASA's Mars Rover and LRO programs, and received engineering degrees in computer vision, photogrammetry, and surveying from The Ohio State University.*

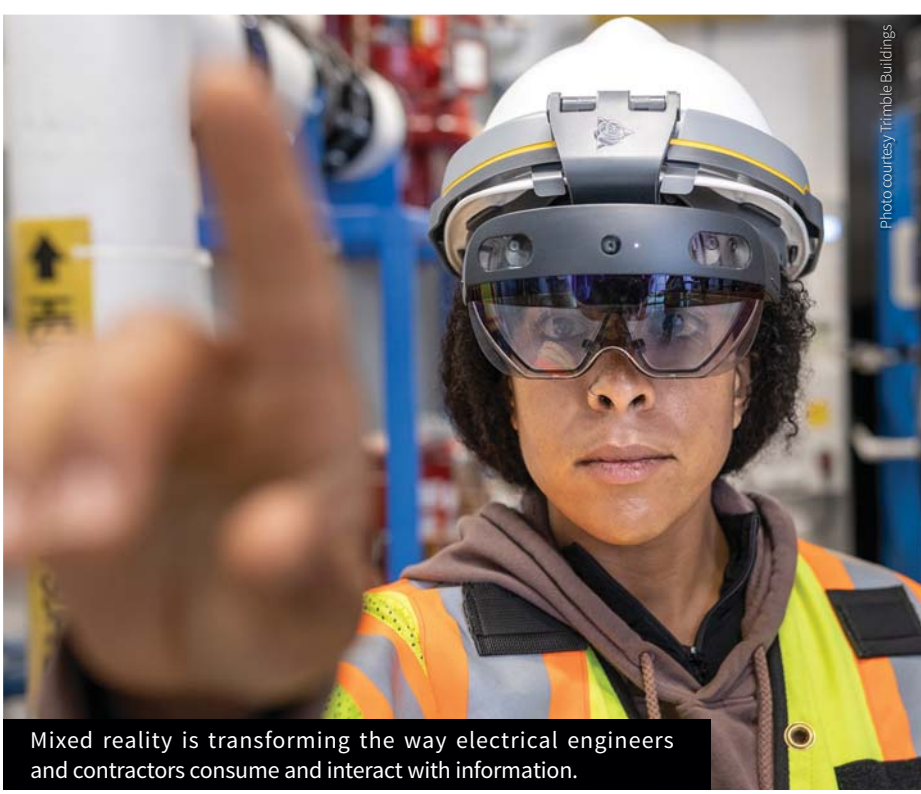


Photo courtesy Trimble Buildings

Mixed reality is transforming the way electrical engineers and contractors consume and interact with information.

ADJUSTABLE • NON-METALLIC • 2-HOUR FIRE RATING

Made in USA

# IN/OUT™ BOX for Ceiling Fixtures

## EASY TO INSTALL... IN NEW CONSTRUCTION



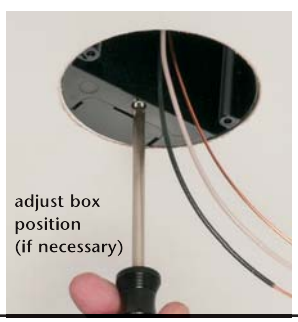

© 2013 Arlington Industries, Inc.

Arlington's IN/OUT BOX ***for ceiling fixtures*** adjusts up to 1-1/2" to accommodate varying ceiling thicknesses, like single or double drywall. And mounts securely to a joist in new construction.



- Pre-set for 1/2" ceiling... Always accessible depth adjustment screw allows installer to adjust box before *or after* the ceiling is in place, up to 1-1/2"
- Complies with 2020 NEC, 314.20 for set back boxes
- Fixture rated


When wall board is complete...


adjust box position (if necessary)

Arlington®

Product info aifittings.com/catalog/specialty-boxes/in-out-box-for-ceiling-fixtures/FA426

800/233-4717 • www.aifittings.com

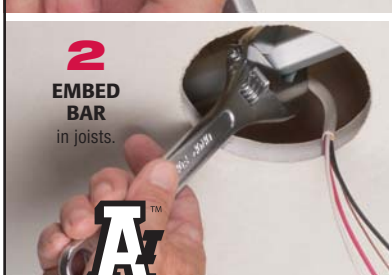
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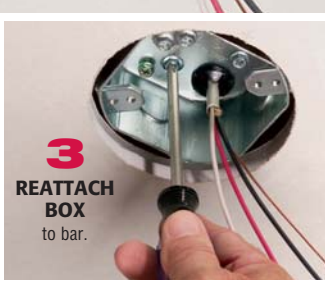
ADJUSTABLE BRACKET • EASY INSTALLATION IN EXISTING CEILING

# FAN/FIXTURE BOX

## HIGHER WEIGHT RATINGS




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

The 20.0 cu. inch FBRS4200R installs *between* rafters with 16" to 24" on-center spacing, holding a fan or fixture securely in place. It's easy...

**REMOVE BOX from bar.**
**INSERT BAR in opening.** Embed bracket ends in joist. Tighten hex, first by hand then with a wrench. Pull wire.
**REATTACH BOX to bar.**

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


FBRS4200R
Patented

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

Arlington®

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aifittings.com/catalog/fan-fixture-boxes/steel-fan-and-fixture-box-with-adjustable-mounting-bracket-for-existing-construction/FBRS4200R

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# Fittings, Pipe Hangers, Clamps, and Ties

## Zinc die-cast fittings

The company recently added diecast zinc options, which protect against corrosion, to its electrical fittings line. These fittings offer secure connections as an alternative to steel and malleable iron fittings. They are available in liquid-tight, rigid, and flex varieties and are suitable for most applications. These precision-cast, smooth, burr-free finished offerings come in both insulated and non-insulated models. Additionally, the fittings are ROHS-compliant, UL-listed, and meet UL Standard 514B.

**Atkore – Allied Tube & Conduit**






## Rain-tight rigid fittings

The 3000-RT and 3100-RT series are compression-type fittings designed to join unthreaded steel rigid conduit to a box or enclosure in a various locations, such as parking garages, loading docks, warehouses, and transit facilities, allowing electricians to save time when installing threadless, rigid conduit in a wet location. The raintight fittings come in ½ -in. through 2-in. trade sizes. All products are cULus-listed to ensure code compliance.

**Bridgeport Fittings**

## Bar joist hanger







The CADDY Truss-T hanger is designed not to need tightening like a traditional beam clamp, providing greater adjustability and speed during system alignment. It easily installs on the top chord of engineered open web bar joists from underneath, limiting overhead work. The attachment slides through the middle slot of open web bar joists and quickly locks into place when put under load. Installation of the system can be accomplished with one hand and requires no additional special tools. Prefabricated single pipe hanger and multi-pipe/tube trapeze assemblies can be prefabricated on the ground or in the shop and easily hung by the installer. It is also UL-listed to support a maximum of 8-in. Schedule 40 pipe.

**nVent**

SAVE MONEY! • IN BOX® FLOOR BOX KIT

# RECESSED FLOOR BOX

## FOR EXISTING FLOORS







FLBR5420BR
BROWN, POWDER-COATED ZINC COVER




**FLBR5420MB** w/ BRASS-PLATED ZINC COVER

Here's the solution for cost-savings and easy installation of a receptacle and low voltage connections in an *existing* floor.

Arlington's FLBR5420 series RECESSED **FLOOR BOX KITS** have *two* low voltage openings, an ultra-thin stamped steel flange, and flush-to-the-floor in-use and blank covers.

The thin flange and **recessed wiring device** reduce the trip hazard caused by plugs protruding from the box. And you can have power and low voltage in the same box without a divider. That's convenience!

- Easy installation with hole saw – 24.5 cu inch box mounts to floor with four mounting wing screws
- UL Listed 20A tamper-resistant decorator-style receptacle
- SIX cover finishes/colors

**Plated Diecast Zinc**
Cover and steel flange



FLBR5420MB
Brass-plated

FLBR5420NL
Nickel-plated

FLBR5420AB
Antique Bronze-plated

**Powder-coated Diecast Zinc**
Cover and steel flange



FLBR5420BL
Black

FLBR5420BR
Brown

FLBR5420LA
Light almond

c UL us

Arlington® TM

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

Circle 33 on Reader Service Card Product info aifittings.com/landing/flbr5420

## Nonmetallic pipe hangers



The heavy-duty, one-piece QuickLATCH pipe hanger with installed strut clips is made from UV-rated plastic for outdoor applications. Conduit snaps into place, locking automatically. It mounts horizontally or vertically. The hanger is listed for use in environmental air-handling spaces per 2020 National Electrical Code requirement Sec 300.22(C). Six models come in trade sizes of ½ in., ¾ in., and 1 in. Hangers are designed to hold EMT, PVC, IMC, and rigid conduit securely on a strut.

**Arlington Industries**

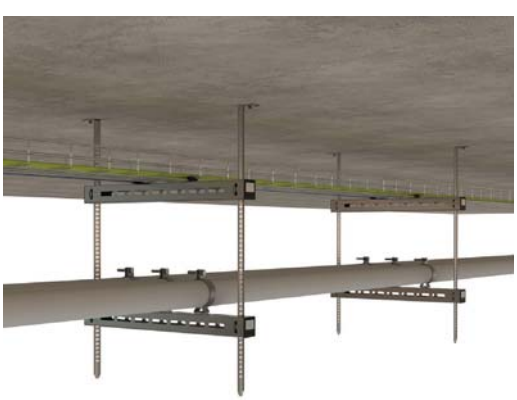



## Cable ties

PowerGRP cable ties are designed to secure wire bundles and harness components easily in almost any application and are available in a range of tensile strengths. The cable ties feature a self-locking design; strong teeth to lock in place; a no-slip tail to aid grip; smooth edges to prevent damage to cables; a curved tip for faster threading; and color options in natural and black. Additionally, the ties can be used indoors or outdoors and are available in 8-in. and 11-in. options.

**NSi Industries**

## Suspension system



The Fast Trak suspension system includes a redesign of the bracket, which allows it to be used with a wider range of accessories and products. The prefabricated, trapeze solution consists of vertical tracks and horizontal brackets, making it easier and faster for contractors to suspend their electrical containment, pipework, regular ductwork, and other mechanical services, especially in restricted spaces. The suspension system features a range of solutions, including twin loading and low-profile brackets, a range of conduit clamps, a bracket cover for a discreet finish, and J-hook to accommodate pipes and cables.

**Gripple**



## Hinged beam clamp

The Unistrut P2788 hinged beam clamp is designed to pivot up to 18° so the strut installation can remain level even when the ceiling is not. It eliminates the need to modify products to accommodate sloped ceilings. The beam flange width ranges from 4 in. to 12 in., and has a thickness of up to ⅞ in. It is compatible with any 1⅝-in. strut profile. The serrated inside face prevents slippage. It is available in base metal, electrogalvanized, Unistrut Defender, hot dip galvanized, Perma-Green, Perma-Gold, 304 stainless steel, 316 stainless steel, and aluminum options.

**Atkore – Unistrut**

THE SPACER™

Made in USA

# CABLE SPACER

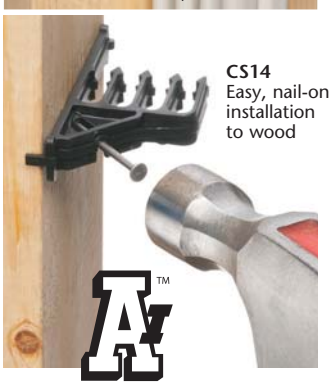
## FOR POWER and LOW VOLTAGE CABLE




***The SPACER***™, Arlington's versatile cable spacer holds up to eight individual cables *centered* on a 2x4.




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




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

***Also available...***
***Screw-on CS14SC***

**Product info**
**aifittings.com/landing/spacer**

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

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* 2-HOUR FIRE RATING

Made in USA

# PLASTIC ONE BOX™

## FOR NEW OR OLD WORK



**NEW**
**Box set too far forward or back? Back the screws out and reposition.**



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

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

- Angled screws INSIDE attach ONE-BOX to stud
- No wings – no wobble
- Fast, easy to install
- Extra-large 22 cubic inch capacity (single gang)

NM cable connector supplied



**F101** *Single gang*
**F102** *2-gang*



**F101H** *Single Horizontal*

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

**Product info**
**aifittings.com/landing/one-box**

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

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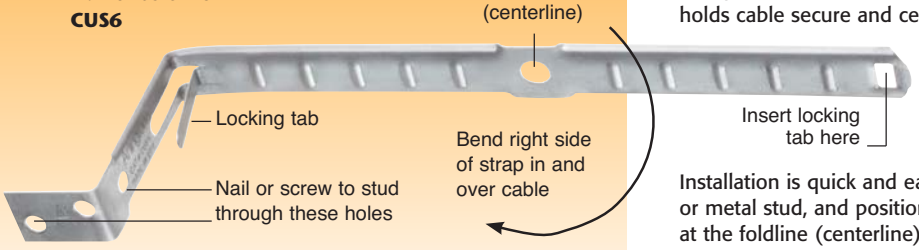
GALVANIZED STEEL

Made in USA

NEW

# CABLE SUPPORT

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



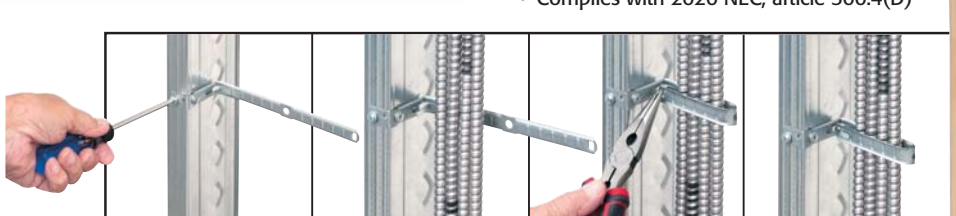

*Holds up to four MC cables centered on a 2x4!*

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

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

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

- Complies with 2020 NEC, article 300.4(D)





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

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

**Product info aifittings.com/landing/cus6/**

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# The Differences Between Grounding and Bonding — Part 12 of 12

## For communications systems installations, some Chapter 8 requirements add to the grounding and bonding requirements of Art. 250.

By Mike Holt, NEC Consultant

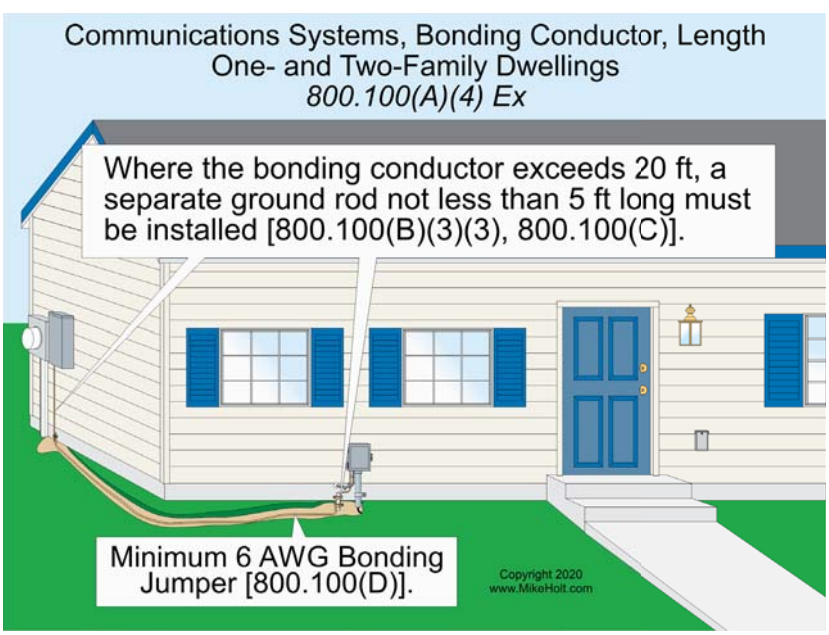



**Fig. 1.** The additional ground rod must be bonded to the power grounding electrode system with a minimum 6 AWG bonding jumper.

*This article is the last in a 12-part series on the differences between grounding and bonding. It is based on 2020 NEC requirements.*

These three Chapter 8 Articles have significant implications for the grounding and bonding of communications systems:

1. Article 800 [General Requirements for Communications Systems] covers general requirements for installing communications circuits, community antenna television and radio distribution systems, network-powered broadband communications systems, and premises-powered broadband communications systems, unless modified by Art. 805 [Communication Circuits] or Art. 820 [CATV and Coaxial Cable].

2. Article 810 [Radio and Television Equipment] covers antenna systems for radio and television receiving equipment, amateur radio transmitting and receiving equipment, and certain features of transmitter safety. It also includes antennas such as multi-element, vertical rod and dish, and the wiring and cabling connecting them to the equipment.

3. Article 820 [Community Antenna Television (CATV) and Radio Distribution Systems (Coaxial Cable)] covers the installation of coaxial cables to distribute limited-energy high-frequency signals for television, cable TV, and closed-circuit television (CCTV). CCTV is often used for security purposes.

### ARTICLE 800

Bonding conductors and grounding electrode conductors must be:

- Listed and permitted to be insulated, covered, or bare [Sec. 800.100(A)(1)].
- Copper or other corrosion-resistant conductive material, stranded or solid [Sec. 800.100(A)(2)].
- At least 14 AWG with a current-carrying capacity of at least that of the grounded metallic sheath member(s) or protected conductor(s) of the communications cable or coaxial cable and doesn't have to be larger than 6 AWG [Sec. 800.100(A)(3)].
- As short as practicable [Sec. 800.100(A)(4)]. For one- and two-family dwellings, the bonding conductor or grounding electrode conductor can't exceed 20 ft in length. Exception: If

LOWEST COST • L-SHAPED

Made in USA

# FAN/FIXTURE BOX

## SECURE MOUNTING TO SINGLE, DOUBLE JOISTS




**FB442**
13.4
cu. inch

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

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

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

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

Arlington®

Product info aifittings.com/catalog/fan-fixture-boxes/l-shaped-fan-and-fixture-mounting-boxes/FB442

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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 running behind 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

Arlington®

Patented

Product info aifittings.com/catalog/fan-fixture-boxes/low-profile-sconce-box/FSC405R

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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*



DBVMA1C
clear cover

ADJUSTABLE Depth



DBVMA1W

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



DBVME1W

Built-in FIXED FLANGE

© 2011-2015 Arlington Industries, Inc.

***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

for Help in Maintaining CONTINUOUS INSULATION in foam sheathing applications



***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.*

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the bonding conductor or grounding electrode conductor is more than 20 ft long for one- and two-family dwellings, a separate ground rod at least 5 ft long [Sec. 800.100(B)(3)(3)] with fittings suitable for the application [Sec. 800.100(C)] must be installed. The additional ground rod must be bonded to the power grounding electrode system with a minimum 6 AWG bonding jumper [Sec. 800.100(D)] (**Fig. 1** on page 52).

- Run in as straight a line as practicable [Sec. 800.100(A)(5)].
- Protected so as not to be subject to physical damage [Sec. 800.100(A)(6)]. If installed in a metal raceway, both ends of the raceway must be bonded to the contained conductor or connected to the same terminal or electrode to which the bonding conductor is connected.

The bonding conductor must be connected per Sec. 800.100(B)(1), (B)(2), or (B)(3):

(1) Buildings with an Intersystem Bonding Termination. The bonding conductor must terminate to the intersystem bonding termination as required by Sec. 250.94.

(2) Building Without Intersystem Bonding Termination. The bonding conductor or grounding electrode conductor must terminate to the nearest accessible location of one of the seven items enumerated in (B)(2). For example, it can terminate to the service disconnect enclosure (but never on a door or in a way that interferes with a door).

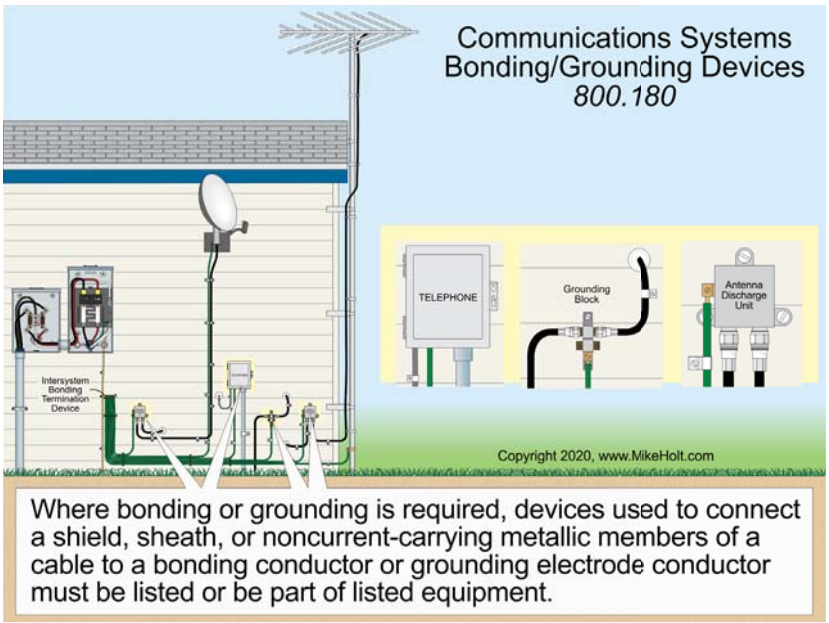



**Fig. 2.** The use of listed equipment is a must on any project.

(3) In Buildings Without Intersystem Bonding Termination or Grounding Means. If the building has no intersystem bonding termination, connect the grounding electrode conductor to one of the three items enumerated in (B)(3). For example, you can connect it to an individual grounding electrode described in Sec. 250.52(A)(5), (A)(7), and (A)(8) [Sec. 800.100(B)(3)(2)].

Connections to grounding electrodes must comply with Sec. 250.70 [Sec. 800.100(C)].

Terminations at the grounding electrode must be by exothermic welding, listed lugs, listed pressure connectors, or listed clamps. No more than one conductor can terminate on a single clamp or fitting unless the clamp or fitting is listed for multiple connections. Grounding fittings that are concrete-encased or buried in the earth must be listed for direct burial.

If a separate grounding electrode (such as a rod) is installed for a communications system, it must be bonded to the building's power grounding electrode system with a minimum 6 AWG copper conductor [Sec. 800.100(D)].

Where bonding or grounding is required, devices used to connect a shield, sheath, or noncurrent-carrying metallic members of a cable to a bonding conductor or grounding electrode conductor must be listed or be part of listed equipment [800.180] (**Fig. 2**).

## ARTICLE 810

Unlike other Articles in this chapter, Art. 810 is not covered by the general rules in Art. 800. So it stands alone in the NEC unless a rule in Art. 810 references a specific rule elsewhere in the Code.

Outdoor masts and metal structures that support antennas must be bonded per Sec. 810.21 unless the antenna and its related supporting mast or structure are within a zone of protection defined by a 150-ft radius rolling sphere [Sec. 810.15].

Informational Note. See NFPA 780-2017 Standard of Lightning Protection Systems regarding the term rolling sphere.

Each lead-in conductor from an outdoor antenna must be provided with a listed antenna discharge unit [Sec. 810.20(A)]. Locate the antenna discharge unit as near as practicable to the point of entrance (inside or outside doesn't matter), but not near combustible material or in a hazardous (classified) location as defined in Art. 500 [Sec. 810.20(B)]. The antenna discharge unit must be

Unlike other Articles in this chapter, Art. 810 is not covered by the general rules in Art. 800. So it stands alone in the NEC unless a rule in Art. 810 references a specific rule elsewhere in the Code.

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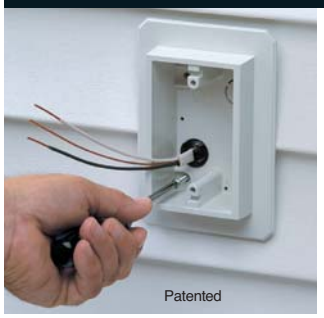
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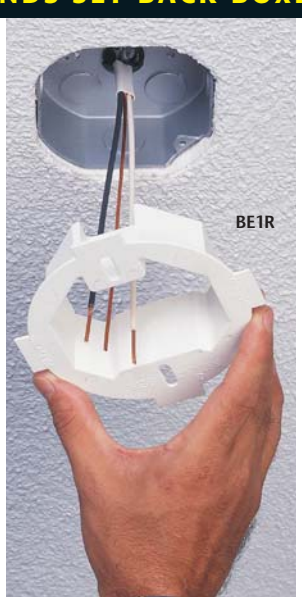
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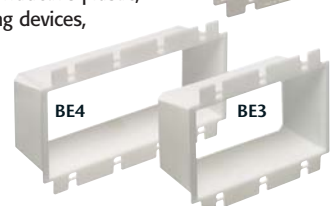



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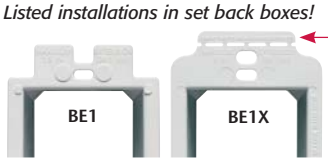



Made of heavy-duty, non-conductive plastic, they level and support wiring devices, protecting wires against damage and stripping.

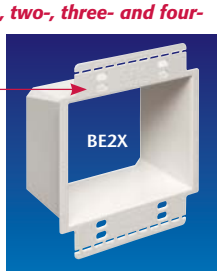



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bonded or grounded per Sec. 810.21 [Sec. 810.20(C)].

Bonding conductors and grounding electrode conductors must meet the requirements of Sec. 810.21(A) through (K). These include things you would expect, such as they must be run in a straight line and physically protected. They also include things that are not so obvious, such as the fact these conductors do not have to be insulated.

Grounding the lead-in antenna cables and the mast helps prevent voltage surges caused by static discharge or nearby lightning strikes from reaching the center conductor of the lead-in coaxial cable. Because the satellite dish sits outdoors, wind creates a static charge on the antenna and on the cable to which it is attached. This charge can build up until it jumps across an air space, often passing through the electronics inside the low noise block down converter feedhorn (LNBF) or receiver.

In addition to complying with Part III of Art. 810, antenna systems for amateur (ham) and citizen band transmission and receiving stations must comply with Sec. 810.11 and Sec. 810.15.

Each conductor of a lead-in for outdoor antennas must be provided with an antenna discharge unit or other suitable means to drain static charges from the antenna system [Sec. 810.57]. But an antenna discharge unit or other suitable means is not required where the:

- Lead-in is protected by a continuous metallic shield that is grounded with a conductor per Sec. 810.58 [Exception No. 1].
- Antenna is grounded with a conductor per Sec. 810.58 [Exception No. 2].

Bonding conductors and grounding electrode conductors for these radios must comply with Sec. 810.58(A) through (C):

(A) Other Sections. All bonding conductors and grounding electrode conductors for amateur and citizen band transmitting and receiving stations must comply with Sec. 810.21(A) through (C) (corrosion-resistant material, insulation not required, securely fastened in place).

(B) Size of Protective Bonding Conductor or Grounding Electrode Conductor. The protective bonding conductor or grounding electrode conductor for transmitting stations must be as large as the lead-in and at least 10 AWG copper, bronze, or copper-clad steel.

(C) Size of Operating Bonding Conductor or Grounding Electrode Conductor. The operating bonding conductor or grounding electrode conductor for transmitting stations must be at least 14 AWG copper or its equivalent.

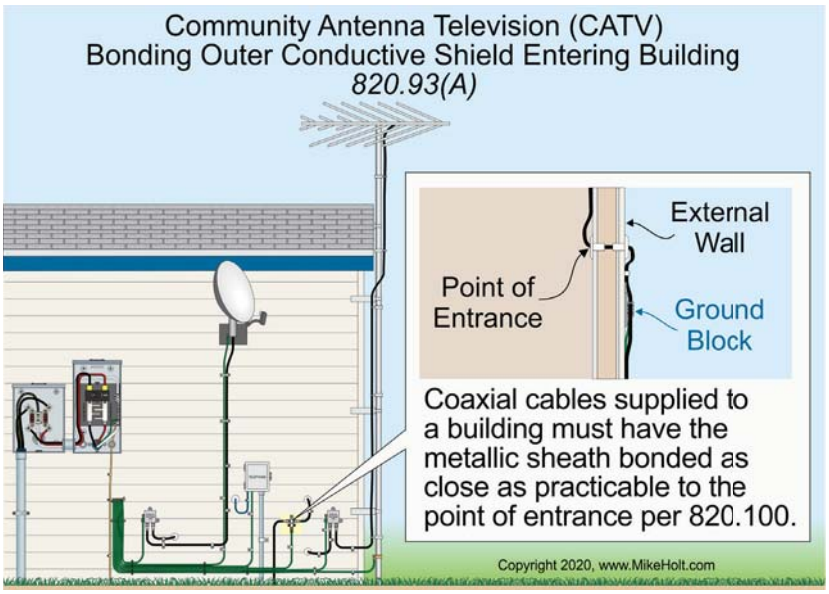



**Fig. 3.** Pick a grounding block location that helps keep the bonding or grounding electrode conductor as short as practicable.

When a communications system uses an outdoor antenna, you have another path that can carry undesired current.

## ARTICLE 820

Coaxial cables supplied to a building must have the outer conductive shield bonded or grounded as close as practicable to the point of entrance per 820.100 [820.93(A)] (**Fig. 3**).

Pick a grounding block location that helps keep the bonding or grounding electrode conductor as short as practicable.

The outer conductive shield of a coaxial cable must be bonded or grounded per Sec. 800.100(A) and (B).

Exception: For systems using coaxial cable completely contained within the building (i.e., they do not exit the building) and isolated from outside cable systems, the shield can be bonded by a connection to an equipment grounding conductor as described in Sec. 250.118. This connection can be made through a grounded receptacle using a dedicated bonding jumper and a permanently connected listed device. You cannot use a cord and plug for the connection to an equipment grounding conductor.

## THE CRUX OF THE MATTER

When a communications system uses an outdoor antenna, you have another path that can carry undesired current. Static buildup from just the wind can result in a dangerous discharge. By eliminating differences of potential around the antenna system, you can prevent such a discharge. One benefit is this protects the input and signal processing stages of the equipment. But a more important benefit is it reduces the risk of fire or electrocution. 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.*

# Triggered by Definitions

## Why Sec. 406.4(D)(4) may undergo more changes in the near future

By Russ LeBlanc, NEC Consultant

Section 406.4(D)(4) of the 2020 National Electrical Code (NEC) is a prime example of why understanding the definitions in Art. 100 is of the utmost importance when it comes to deciphering and applying the rules of the Code.

The definition of "receptacle outlet" in Art. 100 is "an outlet where one or more receptacles are installed." A good example of this would be a duplex receptacle in an outlet box. In contrast, the Art. 100 definition of "receptacle" states in part that a receptacle is "a contact device installed at the outlet for the connection of an attachment plug, or for the direct connection of electrical utilization equipment designed to mate with the corresponding contact device." Understanding the difference between a receptacle and a receptacle outlet is needed to help understand the AFCI protection requirements specified in Sec. 406.4(D)(4). This Section has undergone several changes over the past few Code revision cycles, and I expect more changes will be coming soon.

Presently, the literal wording in Sec. 406.4(D)(4) triggers AFCI protection requirements when a receptacle outlet located in any area specified for dwelling units [Sec. 210.12(A)], dormitory units [Sec. 210.12(B)], or guest rooms, guest suites, and patient sleeping rooms in nursing homes and limited-care facilities in [Sec. 210.12(C)] is replaced but does not trigger AFCI protection requirements where only the receptacle itself is replaced. Do you think that is the intent of this rule?

Based on the previous wording of Sec. 406.4(D)(4) in the 2017 Code and the revisions made in the First Draft Report based on Public Input that was submitted for the 2023 edition, I believe the intent of the present wording in Sec. 406.4(D)(4) was to trigger the AFCI protection requirements even when performing a simple receptacle replacement. However, the literal wording does not quite get there, since it only applies where a receptacle outlet is replaced. While receptacle outlet boxes are sometimes replaced, I think replacing the outlet box is a much less likely occurrence than replacing only the receptacle.




Perhaps the 2023 Code will provide some much-needed clarity on the intent of these rules, but until that time comes, we will need to continue to do our best for keeping our customers safe and to have professional and productive conversations with our AHJ to make sense of these sometimes confusing rules. EC&M

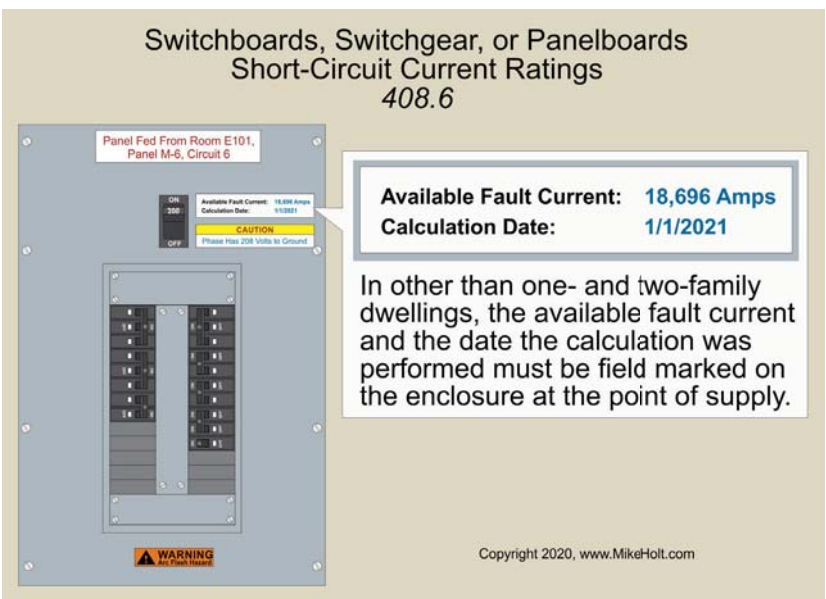
# Stumped by the Code?

By Mike Holt, NEC Consultant

*All questions and answers are based on the 2020 NEC.*

**Q.** What does the NEC require for short-circuit current rating of switchboards, switchgear, or panelboards?

**A.** Switchboards and panelboards must have a short-circuit current rating of not less than the available fault current. In other than one- and two-family dwellings, the available fault current and the date the calculation was performed must be field-marked on the enclosure at the point of supply. The marking must be of sufficient durability to withstand the environment involved following Sec. 110.21(B)(3) [Sec. 408.6] (See **Figure**).




The marking must comply with Sec. 110.21(B)(3).

**Q.** What are the NEC requirements for GFCI protection of appliances?

**A.** The following appliances rated 150V or less and 60A or less must be GFCI protected by Class "A" protective device(s) [Sec. 422.5(A)]:

(1) automotive vacuum machines,

(2) drinking water coolers and bottle fill stations,

(3) cord- and plug-connected high-pressure spray washing machines,

(4) tire inflation machines,

(5) vending machines,

(6) sump pumps, and

(7) dishwashers.

Note: Sec. 210.8 specifies requirements for GFCI protection for the receptacle outlets where the location warrants such protection.

In addition, the GFCI must be readily accessible and located in one or more of the following locations [Sec. 422.5(B)]:

(1) a GFCI circuit breaker,

(2) a GFCI device or receptacle,

(3) a GFCI integral with the attachment plug,

(4) a GFCI within the supply cord not more than 12 in. from the attachment plug, or

(5) a factory-installed GFCI within the appliance.

**Q.** What is the Code requirement for sizing the overcurrent device and conductors for an electric water heater with a capacity of 120 gallons or less?

**A.** The branch-circuit overcurrent device and conductors for fixed storage-type water heaters that have a capacity of 120 gal or less must be sized not smaller than 125% of the rating of the water heater [Sec. 422.13].

How do size the conductors and overcurrent protection device? Let's run through an example to show you how.

**Example:** What size conductor and overcurrent protection are required for a 4,500W, 240V water heater, having a wiring method or Type NM cable?

Solution: First, determine the branch-circuit rating and conductor size.

Circuit Current = 4,500W ÷ 240V = 18.75A

Circuit Rating = 18.75A × 125% = 23.44A

Circuit Conductor = 10 AWG rated 30A at 60°C [Sec. 110.14(C)(1)(a)(2), Sec. 334.80, and Table 310.16]

Next, determine the overcurrent protection rating.

Circuit Current = 4,500W ÷ 240V = 18.75A

Circuit Protection = 18.75A × 125% = 23.44A, use next size up rule: 25A [Sec. 240.6(A)].

Note: Sec. 422.11(E)(3) permits the overcurrent protective device to be sized up to 150% of the appliance rating.

Circuit Protection = 18.75A × 150% = 28.75A, use next size up rule: 30A [Sec. 240.6(A)]

**Q.** What is the NEC requirement for the listing of appliances?

**A.** As per Sec. 422.6, appliances supplied by 50V or higher must be listed. EC&M



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# Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

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

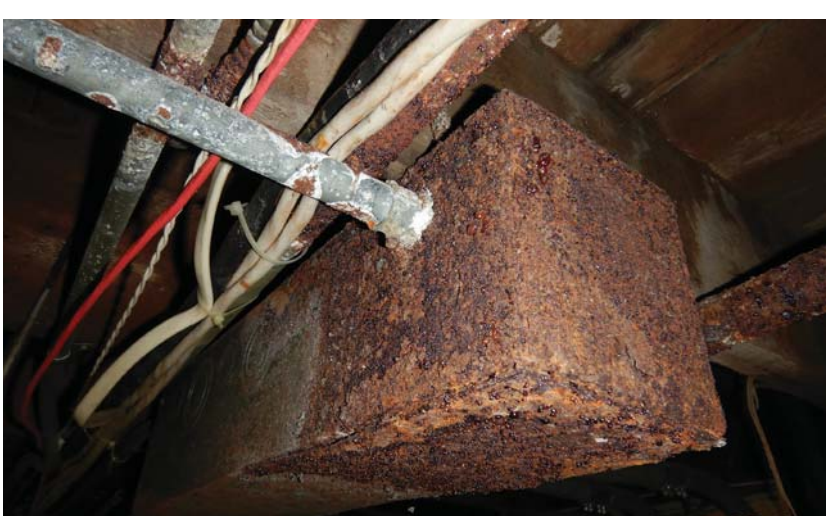
## DOUBLE DUTY CONNECTOR




Using the clamp screw of an NM cable connector for terminating the equipment grounding conductor (EGC) is a violation of Sec. 250.8. EGCs, grounding electrode conductors (GECs), and bonding jumpers are permitted to be connected by listed pressure connectors such as twist-on wire connectors, terminal bars, pressure connectors listed for grounding and bonding, exothermic welding, machine screw fasteners that engage at least two threads or are secured with a nut, thread-forming machine screws engaging at least two threads into the enclosure, connections made as part of a listed assembly, or other listed means. Using an NM cable connector for connecting an EGC is not one of the eight permitted means specified in Sec. 250.8. This installation probably does not comply with Sec. 250.12 either because the paint was not scraped off the surface of the enclosure to ensure electrical continuity between the connector and enclosure. The NM cable connector may be listed for securing NM cables, but I'm sure it is not listed for grounding and bonding purposes. As such, this would be a violation of Sec. 110.3(B) as well.

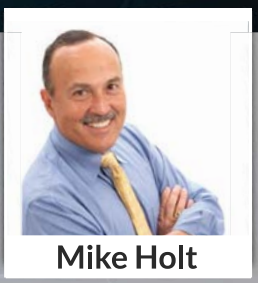
## CORROSION CATASTROPHE

I spotted this installation in the basement of a commercial business located in an old building having a fieldstone foundation. This type of foundation can be notorious for allowing water seepage through the foundation walls. That was certainly the case for this building. The basement was extremely humid and damp with moisture dripping from many surfaces. I think this basement would certainly fit into the Art. 100 definition of a damp location. All the moisture in this basement has certainly taken its toll on the metal wiring methods installed here. Section 300.6 requires raceways, cable armor, boxes, cabinets, fittings, supports, support hardware, and other materials and equipment to be made of materials suitable for the conditions. Perhaps some better choices could have been made here. Sec. 376.12(2) prohibits metal wireways from being used where subjected to severely corrosive environments.



Installing a nonmetallic wireway might have been the better option. Section 320.12(2) prohibits AC cable from being used in damp or wet locations. Section 334.12(B)(4) prohibits NM cable from being used in wet or damp locations. The NM cables and other cables secured with cable ties to the rusted EMT raceway do not comply with the provisions specified in Sec. 300.11(C).

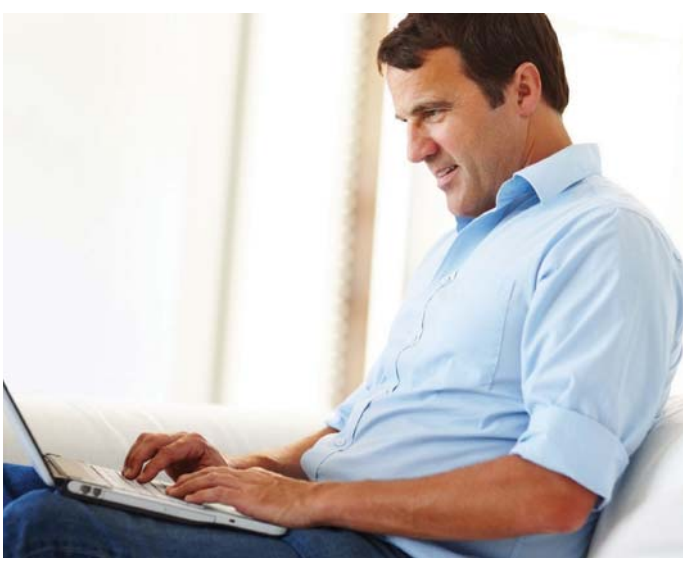
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# What's Wrong Here?

By Russ LeBlanc, NEC Consultant

How well do you know the Code? Think you can spot violations the original installer either ignored or couldn't identify? Here's your chance to moonlight as an electrical inspector and second-guess someone else's work from the safety of your living room or office. Can you identify the specific Code violation(s) in this photo? Note: Submitted comments must include specific references from the 2020 NEC.

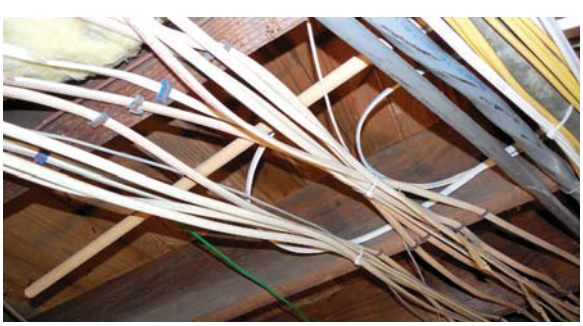
**Hint:** Missing and damaged parts




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

*Using the 2020 NEC, correctly identify the Code violation(s) in this month's photo — in 200 words or less — and you could win an Arlington Industries 18" 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.*

## OCTOBER WINNERS



Our three winners this month are Bob Zielinski, Evart, Mich.; Steve Terry, New York; and Robert A. McCuen, Savannah, Ga. They all knew that NM cables cannot be installed or used in this manner.

Where NM cables are installed at angles with joists in unfinished basements and crawl spaces, Sec. 334.15(C) requires NM cables smaller than two 6 AWG or three 8 AWG to be either run through holes bored in joists or installed on running boards. Most of the cables here were not installed using either of those options. Larger NM cables are permitted to be secured to the bottom edges of the joists. Using NM cables as a means of support for other NM cables, raceways, or nonelectrical equipment is prohibited by Sec. 300.11(D). Section 338.10(B)(4)(a) requires the SER feeder and branch-circuit cables installed here to follow the same installation rules for the NM cables. This basement was very dry, so I do not think there were any violations of Sec. 334.12(B)(4), which prohibits NM cables from being used in damp or wet locations.




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