

# EC&M®

## Who's In Charge Here?

*Federal dollars are driving the EV charging infrastructure market, but inconsistent state/municipal regulations make it difficult to keep projects on schedule and on budget. Read more on [pg. 20](#)*

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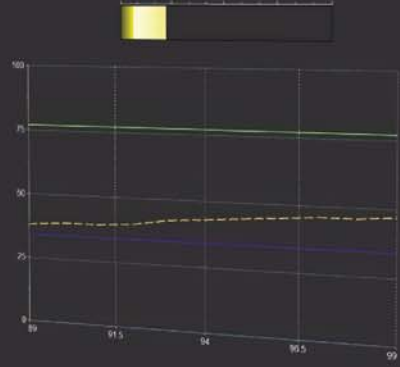


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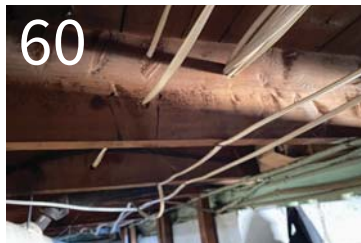
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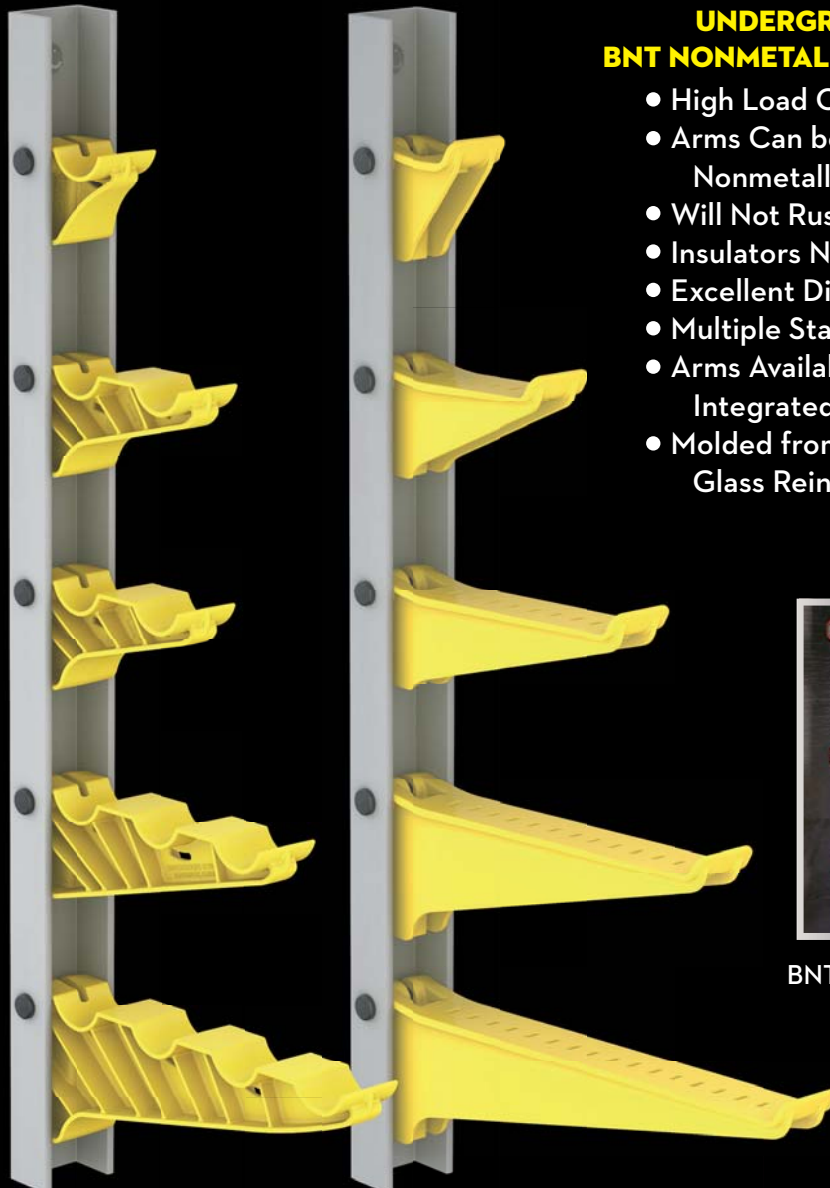
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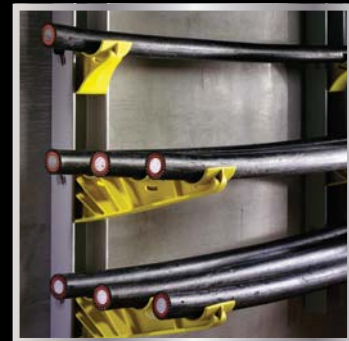


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**CODE CONVERSATIONS PODCAST — PANELBOARD VERSUS PANELBOARD ENCLOSURE**

**Podcast** ▶ Editor-in-Chief Ellen Parson and Code Consultant Russ LeBlanc talk about whether or not labels should really be installed on the panelboard itself. [ecmweb.com/21274523](http://ecmweb.com/21274523)



**TAKING RESPONSIBILITY FOR MAINTENANCE MISHAPS**

**Maintenance, Repair & Operations** ▶ Electrical Consultant Mark Lamendola shares steps for identifying causes of failure and preventing maintenance issues. [ecmweb.com/21274758](http://ecmweb.com/21274758)



**2023 TOP 50 ELECTRICAL CONTRACTORS' PROJECT SPOTLIGHT — PART 1**

**Gallery** ▶ This year's Top 50 Electrical Contractors share details on their most notable projects from 2022. [ecmweb.com/21272935](http://ecmweb.com/21272935)

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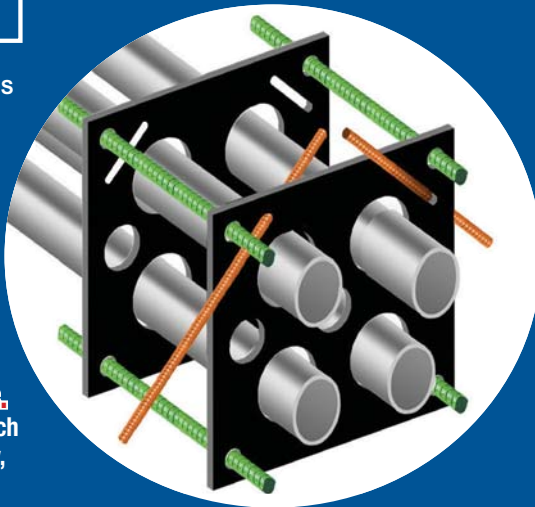
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# Takeaways from NECA 2023 Show in Philadelphia

By Ellen Parson, Editor-in-Chief



Since returning home in early October from the 2023 NECA convention and trade show in Philadelphia, held September 29 to October 2 at the Pennsylvania Convention Center, I realize there's a lot to unpack from the three-day event. After walking the extensive exhibit hall floor, seeing all of the latest new products and services exhibitors had to offer, meeting with manufacturers to learn more about their strategic initiatives as well as what they believe are the "next big things" for our audience, attending valuable educational workshops presented by subject matter experts, and talking with attendees about what challenges and opportunities they're seeing in the field, I came away with a renewed sense of inspiration and optimism about all things electrical. Although there are obviously a significant number of obstacles that persist in the electrical construction and maintenance industry going forward — supply chain issues, material price increases, equipment delivery delays, and the skilled worker shortage to name a few — it seems like there's never been a better time to be in the electrical trade.

A few key themes definitely stood out to me at this year's show. Job-site productivity and ergonomics are always top of mind for electricians, so it was no surprise we saw lots of upgraded tools, new slick software capabilities and apps, and integrated accessories/components on display that promise users the ability to do their jobs more efficiently, effectively, and safely at this year's show. Prefabrication and pre-assembled solutions also

seemed to pique many attendees' interest, especially those working on large-scale electrical projects. Along those same lines, talk of how electrical professionals can harness the power of emerging artificial intelligence (AI) tools to maximize productivity and boost revenue was also a hot topic. Still considered by many as an existential threat not only to the skilled trades but also to society in general, AI is inevitably here to stay, so savvy electrical professionals who figure out a way to gain a competitive advantage with this technology will ultimately reap the benefits.

Stemming from the influx of federal dollars expected over the next five to 10 years from the Infrastructure Investment and Jobs Act (IIJA), everyone was talking about much-needed electric grid updates and what doors that may open for new technologies and innovation, adoption of more renewable resources (solar and wind) as well as battery storage, distributed generation, and microgrid applications in the future. Another obvious trend at this year's show was the prevalence of electric vehicle (EV) chargers and software products. You'd be hard pressed to pass more than a few booths before you saw another EV charging solution. They were everywhere. Considering the current IIJA goal of building out a national network of 500,000 public EV charging stations by 2030, it's no surprise most manufacturers are jumping on this bandwagon — even if this won't be a core market for them (which it won't be for the majority), making sure they have at least a few horses in this race will open up a new revenue stream, nonetheless.

In conjunction with these key themes, this month's issue features several articles that should be of interest to the majority of our audience. The cover story by Freelance Writer Tim Kridel on page 20 provides a timely update on electric vehicle charging regulations. Is the power grid really ready to handle electric vehicles? Turn to the article from Tommy Northcott on page 26, and find out. On a similar note, Freelance Writer Amy Fischbach examines what building and maintaining the grid of the future will actually entail on page 32. And the piece from Sean Nacey of Wesco on page 42 on the pros and cons of pre-assembled solutions for solar farms provides unique perspective on what contractors in the field are experiencing firsthand. Following all of my discussions with attendees and manufacturers, I'm excited to see how all of these trends shape up in the coming year.

*Ellen Parson*



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## 10 Local Markets to Watch in 2024

These 10 metros have powered through 2023's turbulent business conditions and look like good bets for solid growth in 2024.

By Jim Lucy, *Electrical Wholesaling*

When evaluating your local market's growth prospects, you can use some pretty simple economic indicators to gauge where business may be headed in the near future. You can't go too far wrong by first looking at one key filter: Comparing your local county, Metropolitan Statistical Areas (MSAs), or state with the national growth rate for these key indicators:

- Population growth from 2017 to 2022 and from 2021 to 2022
- Electrical contractor and/or electrician employment
- Single-family and multi-family building permits
- Construction projects in the planning process or getting ready to break ground

The fastest-growing local markets are usually cranking along at double the national rate of growth (or their state's rate of growth) for population, electrical contractor or electrician employment, and building permits. The **Table** on page 10 shows our picks for the 10 MSAs that will offer solid growth potential in 2024. We chose a mix of large, medium, and small markets to give you a sense of the growth opportunities in metropolitan areas of various sizes. It's tough to limit our picks to just 10 markets, and we could have easily added the Atlanta and Seattle metros as well because they continue to grow at an impressive rate. Ditto for the fast-growing MSAs along Florida's Gulf Coast, which year-after-year (YOY) see double-digit population growth to fuel demand for new vacation homes, senior housing, and single-family homes for new residents from colder climates. Unfortunately, some of the growth of these markets over the past



Over the past year, many measures, the Dallas-Fort Worth-Arlington, Texas, MSA has been the fastest-growing metro in the United States. The MSA's electrical contractors in the market are hiring like crazy. In total, they have more than 31,560 workers (up 6.7% over last year).

year must be attributed to reconstruction efforts from last fall's Hurricane Ian. Industrially oriented electrical contractors may also want to compare their local markets with some of the areas seeing a surge of business from the new electric vehicle factories, EV battery plants, or semiconductor fabrication facilities now being built. Arizona, Georgia, Kansas, Kentucky, Michigan, Ohio, and Tennessee are just a few of the states cashing in on these new projects.

This article will give you some ideas on where you can find data on your local market for electrician or electrical contractor employment; population growth; building permits; or new construction projects. Much of it is available for free from the U.S. Bureau of Labor Statistics ([www.bls.gov](http://www.bls.gov)) or the U.S. Census Bureau

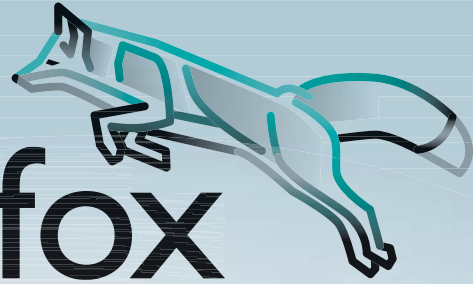
([www.census.gov](http://www.census.gov)). *Electrical Marketing*, EC&M's sister publication, also provides local employment, building permit, and population data, as well as a quarterly update on construction projects of more than \$100 million in total contract value as part of a \$99 annual membership ([www.electricalmarketing.com](http://www.electricalmarketing.com)).

### EMPLOYMENT DATA

The U.S. Bureau of Labor Statistics provides construction employment data at the county, MSA, state, and national level and electrician data at the MSA, state, and national level. The trick is that the data comes out in different release cycles, and you have to massage the local construction employment data to get an estimate for electrical contractor employment.



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## 10 Markets to Watch in 2024

Metropolitan Statistical Areas (MSAs)	Electrical Contractor 2Q 2023 Employment Estimate	EC YOY # Change	EC YOY % Change	2022 Electrician Employment	2019-2022 Electrician Employment # Change	2019-2022 Electrician Employment % Change	Electrician 2022 Hourly Wage	Single-Family Building Permits through July 2023	Multi-Family Building Permits through July 2023
Austin-Round Rock, TX	10,807	433	4.2	5,690	930	19.5	27.12	9,202	10,543
Charlotte-Concord-Gastonia, NC-SC	9,954	368	3.8	7,150	1,020	16.6	25.03	11,174	5,910
Dallas-Fort Worth-Arlington, TX	32,054	2,019	6.7	17,600	250	1.4	26.46	24,088	14,374
Fayetteville-Springdale-Rogers, AR-MO	2,093	208	11.0	1,960	840	75.0	22.74	3,293	791
Indianapolis-Carmel-Anderson, IN	8,116	472	6.2	4,900	(180)	-3.5	31.79	3,996	2,634
Jacksonville, FL	6,773	264	4.1	3,510	(20)	-0.6	24.62	7,032	5,290
Myrtle Beach-Conway-North Myrtle Beach, SC-NC	1,634	117	7.7	530	(200)	-27.4	23.35	6,693	566
Nashville-Davidson-Murfreesboro-Franklin, TN	7,839	451	6.1	5,600	1,550	38.3	28.19	8,669	5,536
Orlando-Kissimmee-Sanford, FL	11,158	(143)	-1.3	6,050	430	7.7	24.05	10,020	6,106
Phoenix-Mesa-Scottsdale, AZ	20,497	819	4.2	12,330	1,200	10.8	25.61	13,302	10,432

Source: Employment data from U.S. Bureau of Labor Statistics and Electrical Wholesaling estimates for electrical contractors at the MSA level. Figures in parentheses represent a decrease.

Rapid population growth in these MSAs has created substantial demand for new homes and commercial construction projects.

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**Electricians.** BLS releases electrician data for the previous year annually. The 2022 electrician employment data (tabulated for May 2022) was released in April 2023 at [www.bls.gov/oes/tables.htm](http://www.bls.gov/oes/tables.htm). Included in this data is information on mean hourly and mean annual wages.

**Electrical contractors.** The U.S. Census Bureau releases national electrical contractor employment data each month at <https://www.bls.gov/ces/>, but it does not break out its electrical contractor data by state, county, or MSA. However, you can use the total construction employment data published each month at [www.bls.gov/sae](http://www.bls.gov/sae) for MSAs and states and [www.bls.gov/cew](http://www.bls.gov/cew) each quarter for counties, and then multiply it by 13% to get a realistic estimate for the contractor count in those markets. *EC&M's* editors have compared the national electrical contractor data to the national construction data going back to 2000 and have found that it's almost always 13% of the total. While local markets do vary, this multiplier will give you a good starting point. If you are working with the monthly data, it's a good idea to use an average for the current month and the preceding two months to smooth out some of the volatility in the data. It's frustrating that the county data published in the Census Dept.'s Quarterly Census of Employment and Wages report is always at least six months old, but it's the best available source of data for this geography.

### POPULATION GROWTH

Why the interest in population growth? There's a direct correlation between the number of new residents moving into (or leaving) a market area and the level of residential construction activity, which in turn feeds the construction of strip shopping centers and other retail areas, new schools and hospitals,

and other commercial and institutional construction. You can use annual and historical population data at the state, MSA, and county level from the U.S. Census Bureau to measure a geographic area's growth.

Population data can help you develop two other interesting local growth indicators — the number of residents moving into or out of a local area each day and the number of building permits per 1,000 residents. Tabulating the new residents per day in a local market is a quick and easy indicator that gives you a sense of just how fast a market is growing (or shrinking, if the population is declining, and more people are moving out of an area than moving into it).

The U.S. Census Department releases population data at the county, MSA, state, and national level annually at [www.census.gov/data/datasets/time-series/demo/popest/2020s-total-metro-and-micro-statistical-areas.html](http://www.census.gov/data/datasets/time-series/demo/popest/2020s-total-metro-and-micro-statistical-areas.html).

County data is available at [www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html](http://www.census.gov/data/datasets/time-series/demo/popest/2020s-counties-total.html).

### BUILDING PERMITS

The U.S. Census Bureau publishes monthly building permit data at the national, MSA and state level at [www.census.gov/construction/bps/msamonthly.html](http://www.census.gov/construction/bps/msamonthly.html), and you can always find interesting commentary on residential construction trends at [www.nahb.org](http://www.nahb.org). Calculating the number of building permits/per thousand residents gives you a way to compare large and small markets with each other because you have a common denominator.

By this measure, some fairly small MSAs are ranked among the fastest-growing MSAs, including the vacation/retirement hot spot Myrtle Beach-Conway-North Myrtle Beach, S.C.-N.C. MSA with 12.5 single-family permits per 1,000 residents.

### CONSTRUCTION PROJECT DATA

The two biggest providers of data on local construction projects in the pipeline are the Dodge Construction Network ([www.construction.com](http://www.construction.com)) and ConstructConnect ([www.constructconnect.com](http://www.constructconnect.com)). This information is available on a subscription basis. As mentioned earlier, [www.electricalmarketing.com](http://www.electricalmarketing.com) also provides quarterly updates on construction projects with a total construction value of more than \$100 million as part of a \$99 annual membership.

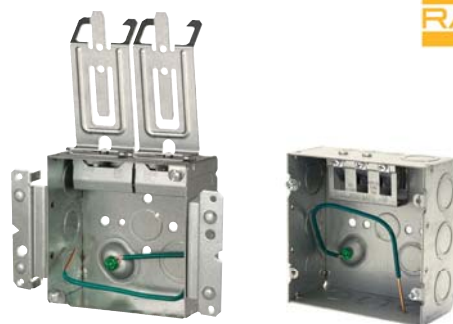
### SUMMARY

You can use the tools described in this article to analyze the growth potential of a local market and compare it to other markets in your state or at the national level. If you have questions on any of the data sources or tabulation methods discussed in this article, please email [jlucy@endeavorb2b.com](mailto:jlucy@endeavorb2b.com). **EC&M**

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# How to Minimize Reliance on Personal Protective Equipment

Shouldn't you try to get the most use from your PPE?

By Mark Lamendola, Electrical Consultant

Certain kinds of products are (when you calculate the ROI) a rip-off — and you should be happy they are.

Take homeowner's insurance as an example. You pay premiums for decades, but never file a claim. That is much better than "getting your money's worth" because your house burned down. The insurance is there in the unlikely event all else fails to prevent the fire (or whatever you are insuring against).

So, we install AFCIs in our homes, discard damaged extension cords, don't set space heaters near combustibles, and do the basic housekeeping that prevents accumulating an excess fuel load. Even with these and other precautions, the unexpected can happen. Few of us would consider it wise to skip the insurance (something you can do if you don't carry a mortgage).

When we redo the math after factoring in the risk and severity of a catastrophic event, it makes perfect sense to pay for something we hope we will never use. Generally, personal protective equipment (PPE) products fall under a similar logic. The fact that you used it (not merely wore it) usually means there was either a safety failure or an unforeseen event.

Fall protection in the form of a harness and lanyard is an example. If you could create a work environment where falls don't happen, you'd make the fall protection gear an apparent "waste of money." Creating such an environment is difficult, so falls do happen. But it's better to "wastefully" discard old gear than to get every penny's worth from it.

After a few hard falls, harnesses and lanyards should be discarded regardless



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of their apparent condition. What if you discard the PPE while it still has a hard fall or two left in it? Did you fail to get your money's worth? No, because the gear was reliable while you had it in service, and that is what counts. It's insurance against a safety failure or unforeseen event.

It is always better to prevent the hazard from occurring than to rely on PPE when it does. One reason is PPE, like anything else, can be incorrectly used, fail, or be circumvented.

For example, every lawn mower owner's manual has warnings to wear safety glasses and hearing protection even though modern mowers are

designed with shields to stop projectiles. The smart user inspects the yard for rocks and bottles before mowing, because it is possible for a rock or glass shard to bounce off of a hardpan on a dry summer day and come up behind your safety glasses or just whack your shin.

## MINIMIZING RELIANCE ON PPE

How can we minimize the work our PPE has to do and thus minimize our reliance on PPE? One method for doing that is based on NFPA 70E, Annex F, Table F.3. The table is titled "The Hierarchy of Risk Control." It contains six levels — in order from the first line of defense to the last line of defense. These are:

1. Elimination
2. Substitution
3. Engineering controls
4. Awareness
5. Administrator controls
6. PPE

The first three levels of control tend to present the most opportunity for “wasting” your PPE expenditures. Let’s look at those three levels and three types of PPE:

1. Fall protection
2. Respirators
3. Safety glasses

It’s important to note that minimizing reliance on PPE doesn’t mean you don’t use it. It’s there as insurance because anything can happen. Similarly, you maintain that homeowner’s insurance policy even though you hope you never collect.

## ELIMINATION

Suppose you have a PM that requires climbing 15 ft above grade to take voltage readings on a motor. The task is made easier because the motor overloads are up there; you don’t have to untape any motor leads to take the readings. You could eliminate the climbing task by relocating the motor overloads to be accessible from grade level.

This principle applies to any electrical measurement tasks at elevation; bring the testing points to grade level and have testing ports (or similar) there. You’ve now eliminated the climbing part of this task.

Coring into walls and floors creates large amounts of silica dust. To eliminate the need for a respirator, choosing a different routing path might work (e.g., go around the wall instead of through it). For green construction, ensuring the openings are made when the wall is poured also eliminates the need for a respirator because it eliminates the need to core into the wall.

Fabrication tasks require safety glasses. Field fabrication (such as boring holes in cabinets) can put significant eye-unfriendly particles into the work area or eject them into the eye. Prefab eliminates the “need” for safety glasses for this aspect of the job. This doesn’t mean you wear safety glasses any less while on the job, it just means they have one less danger to protect you from.

## SUBSTITUTION

Substitution reduces the magnitude of the risk. For example, you replace a 120V control circuit with a 24V one (same example used in Table F.3). There is seldom a substitution solution for fall risk, since a fall from 40 ft is just as deadly as a fall from 200 ft. Generally, substitution will depart a bit from Table F.3 to eliminate rather than reduce a fall hazard.

Earlier, we used the solution of moving the test points to be accessible from grade level to eliminate the climbing part of a measurement task. Substitute automation for manual measurement, and you eliminate the task entirely, not just the climbing part of it. For example, use a local panel meter or a power monitor instead of taking readings manually. If you need motor vibration data, install motor vibration sensors.

Circumstances arise where the choice of elevated equipment location (and thus landing spots) can be significant. For example, it’s better to fall onto a foot traffic aisle in a factory than to fall into the scrap grinder; locating a bus on this I-beam versus that one can matter. It can also matter whether the location is accessible to a scissor lift instead of a ladder climb.

How would substitution work for reducing (or eliminating) dangers that respirators protect against? We have an excellent example in the silica dust protection area. Many years ago, only a few employers cared whether their employees breathed in silica dust.

As more started to care, pressure built on two fronts. One was to get OSHA to adopt silica dust regulations based on the rules these employers were using. That was ultimately successful. Another was answered by manufacturers, mostly in response to the growing number of employers wanting to reduce or eliminate silica dust hazards. Dust collection devices began to proliferate the market — and not just retrofit devices. It became common to incorporate dust collectors into drills and saws. Substituting one of these tools (or a retrofitted one) in place of one with no dust collection abilities has a dust reduction effect like the shock reduction effect of replacing 120V control circuits with 24V control circuits (per the example in Table F.3).

Some manufacturers went far beyond merely reducing the dust. For example, you can now buy a coring device that puts a 4-in. hole into a cement wall with zero dust emission into the operator space. Presumably, this also eliminates the “need” for safety glasses (but keep the lawn mower example in mind).

## ENGINEERING CONTROLS

This typically involves installing barriers between the danger and the worker. A guardrail works for fall hazards, and ventilation often reduces or eliminates respirator requirements. Welding screens eliminate the need for everyone in the area to wear a welding mask to protect their eyes.

Rather than think of engineering controls to eliminate safety glasses, think of ways such controls can render safety glasses less necessary. For example, installing the little plexiglass shields on a grinder puts a “pre-safety glass” close to the source of the eye hazard. Using a jig to properly secure the work for a saw can prevent a severed finger from hitting you in the eye (think about that one for a minute).

## TRY TO WASTE MONEY ON PPE

Which makes more sense? Having an environment so dangerous that fall protection PPE does a “catch” 16 times per week or an environment so safe that fall PPE gets discarded due to age alone? We go back to the homeowner’s insurance example. We all hope we never have to collect and “get our money’s worth” on that insurance.

If you combine elimination, substitution, and engineering controls with the goal of minimizing reliance on PPE, odds are you won’t “get your money’s worth” from the PPE. But you will get your money’s worth from the investment that got you to that point because the work environment will be inherently safer. The money you “waste” on PPE this way is more than compensated for by the benefits of moving the protection closer to the hazard rather than closer to the people you intend to protect. **EC&M**

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# How to Estimate Using Project Management Principles

Recommendations for remaining organized throughout the electrical estimating process

By Don Kiper, Estimating 101



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The purpose of the estimate is two-fold. First, it allows the contractor to enter into a contractual agreement with confidence. Second, it provides an organized, detailed plan to execute the project so it's profitable. In the January 2020 issue of *EC&M*, I wrote a detailed article about the purpose of the estimate, which can be viewed online at <https://ecmweb.com/21119807>.

Therefore, if the second most important purpose of the estimate is to provide a detailed plan to execute the project profitably, the estimate must be prepared with detail and organization with the project management in view.

Preparing an estimate is only one step of three steps that are taken to be

profitable. Let's first review these three steps. The first step is project selection. You must bid on the best projects that your company can perform and still be profitable. The second step is producing an accurate detailed estimate that will allow the contractor to be profitable. The final step is contract performance by installing the project according to the contract documents in the most efficient manner.

The best definition of project management is having the right material, the right labor, the right information, and the right tools in the right place at the right time. If a project manager can accomplish this, the project should be profitable. Project management needs to focus on material deliveries, adequate

tools, and providing the workforce with good information to perform the work as efficiently as possible.

A project manager will perform in the most efficient manner with an organized detailed estimate. This means that the estimator should organize his or her work with project management in view. A detailed and well-organized estimate will give the project manager a jump start in efficiency.

Most projects are comprised of various systems, such as lighting, branch power, feeders, fire alarm, and so forth. When the estimate is organized by these systems, it will provide project management with material listings for each system. If the project is a multi-story building, having a breakdown by floor also provides good information about materials and labor for an efficient installation.

For example, if the project has extensive underground duct banks and conduits, the project manager should be able to quickly get the total materials required for this work from the estimate reports.

Another example would be a multi-story building. When the luminaires are delivered to the project site, having a detailed list of fixture types and quantities by floor will allow the fixtures to be placed on each floor. Hopefully, this will save the contractor from handling the fixtures more than once.

When an estimate is properly organized, and labor codes are used, tracking labor hours used versus labor hours estimated should provide the contractor with great historical data for future estimates.

Let's look at how estimating with project management in view should look like.



## DOCUMENTATION ORGANIZATION

A good record of communications (written, verbal, and electronic) with the architect, engineer, vendors, and general contractor must be kept. An accurate record of all documents used during the bidding process is a must. The estimator might even make notes, comments, and annotations within the documents based on his or her understanding of the project and how it was estimated. One of the first responsibilities of the estimator is a comprehensive review of the specifications. The notes and comments from this review will help the management team know the estimator's understanding of the project. All these communications, documents, and notes are invaluable to the project manager.

## ESTIMATE ORGANIZATION

The focus of estimating is accuracy, and the focus of project management is efficiency. When the estimate takeoff is structured by buildings, floors, and systems, efficiency can be at its best. Project management must be able to know the necessary materials and labor based on the project's structure. This is also vital when changes are initiated by the owner. As I said earlier, the objective of project management is the project manager must have the right material, the right labor, the right information, and the right tools in the right place at the right time. Most leading brands of estimating software provide the ability to organize the estimate into these breakdowns. The wise contractor should abandon any software that does not provide this feature.

## TURNOVER ORGANIZATION

The best project turnover will provide the most efficient installation. Major conflicts in contract documents should be resolved during the bidding process. Asking the right questions during the bidding process will save the contractor money if awarded a project. Providing a list of immediate items and concerns that need to be addressed at the preconstruction meeting will be invaluable for the project manager. A project with a compressed schedule/phasing can be challenging. All important milestone

dates must be documented. A detailed list of all quoted materials, such as lighting, distribution equipment, fire alarm, and security, must be organized and provided to the management team. Copies of all quoted material packages from all vendors must be retained. A detailed list of any owner-furnished materials and equipment must be well documented.

## REPORTS ORGANIZATION

Estimating software should allow for reports to be printed for the best project management. The following reports should prove most helpful to the project manager and the project foreman in the field. Not all these reports would be required for every project. The wise contractor will customize various reports for the specific types of projects in your company.

Consider providing these reports:


1. By multiple buildings, if applicable
2. By floors, if applicable
3. By systems such as lighting, branch power, fire alarm, etc.
4. Labor cost codes for labor reporting
5. Material totals by categories such as conduit & fittings, wire & cable, distribution equipment, devices, fixtures, etc.
6. A listing of site power feeders with conduit and cable lengths
7. A listing of distribution feeders within the building structure
8. A detailed bid summary report

These reports should allow the project management team to have the right materials at the right place at the right time in the right quantities. Typically, these reports should be provided to the project manager and foreman at a project turnover meeting.

In a relay race, the next runner performs better when a smooth handoff of the baton takes place. The better the handoff from the estimator to the project manager, the better the finish. And when the estimator has project management in view, the odds are increased for a profitable project.

**EC&M**

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# Proposed Structure Changes for the 2029 NEC

A look at past Code versions and what is in store for future NEC editions

By Dean Hunter, IAEI

Parallel Structure (2023)			
Wiring and Protection	Wiring Methods	Special Conditions	Communication Systems
<ul style="list-style-type: none"> <li>• 210 Branch Circuits</li> <li>• 215, 225 Feeders</li> <li>• 230 Services</li> <li>• 235 Branch, Feeders and Services</li> <li>• 240 Overcurrent Protection</li> <li>• 242 Overvoltage Protection</li> <li>• 245 Overcurrent Protection</li> <li>• 250 Grounding</li> </ul>	<ul style="list-style-type: none"> <li>• 300 General Requirements</li> <li>• 305 General Requirements</li> <li>• 310 Conductors and Cables</li> <li>• 315 MV Conductors and Cables</li> </ul>	<ul style="list-style-type: none"> <li>• 722 Ltd Energy Cables</li> <li>• 724 Class 1</li> <li>• 725 Class 2 and 3</li> <li>• 726 Class 4</li> </ul>	<ul style="list-style-type: none"> <li>• 800 General Requirements</li> <li>• 805 Communication Circuits</li> <li>• 810 Antenna Systems</li> <li>• 820 Community Antenna Television and Radio Distribution</li> <li>• 830 Network-Powered Broadband Communication Systems</li> <li>• 840 Premises-Powered Broadband Communication Systems</li> </ul>

Fig. 1. This represents where the Task Group stands regarding parallel structure in the current NEC cycle.

Parallel Structure (2026)			
Wiring and Protection	Wiring Methods	Special Conditions	Communication Systems
<ul style="list-style-type: none"> <li>• 210 Branch Circuits</li> <li>• 215, 225 Feeders</li> <li>• 230 Services</li> <li>• 235 Branch, Feeders and Services</li> <li>• 240 Overcurrent Protection</li> <li>• 242 Overvoltage Protection</li> <li>• 245 Overcurrent Protection</li> <li>• 250 Grounding</li> </ul>	<ul style="list-style-type: none"> <li>• 300 General Requirements</li> <li>• 305 General Requirements</li> <li>• 310 Conductors and Cables</li> <li>• 315 MV Conductors and Cables</li> </ul>	<ul style="list-style-type: none"> <li>• XXX General Requirements</li> <li>• 722 Ltd Energy Cables (Move Cables from Ch. 8)</li> <li>• XXX Overcurrent Protection (Class 2, 3, 4)</li> <li>• XXX Overvoltage Protection</li> <li>• XXX Grounding</li> </ul>	<ul style="list-style-type: none"> <li>• 800 General Requirements</li> <li>• 805 Communication Circuits</li> <li>• 810 Antenna Systems</li> <li>• 820 Community Antenna Television and Radio Distribution</li> <li>• 830 Network-Powered Broadband Communication Systems</li> <li>• 840 Premises-Powered Broadband Communication Systems</li> </ul>

Fig. 2. The Task Group will include changes in the 2026 NEC cycle to simplify the transition to the 2029 NEC.

In March of 2022, the National Electrical Code (NEC) Correlating Committee formed a “Structure” Task Group to begin reviewing the current NEC structure to determine if changes are warranted. This wasn’t the first time a group had been formed to address this issue. In the ’90s, the Correlating Committee debated the NEC structure when challenges with medium-voltage (MV) installation requirements arose; however, it was determined that the existing structure was adequate, and the MV requirements were dispersed throughout the Code.

Here is a little trivia for the next shop safety meeting: Does anybody know when the current structure (nine chapters) that we have in the 2023 NEC was introduced? It was in the 1937 NEC. Interestingly enough, when we make a few comparisons from that time in history to today, although the same structure remains, we find that the 1940 edition looked much different than today’s NEC.

As new technologies, products, and their applications emerge, the NEC technical committees are faced with a dilemma — where should this widget be placed in the Code? Also, regarding

the challenges of the current structure, members of today’s Task Group started asking questions like:

- What is the difference between a general requirement and a special requirement?
- Are electrified truck parking spaces a piece of electrical equipment?
- Is a natural and artificial body of water a piece of electrical equipment?
- Is a fire-resistive cable system a condition?

The electrical industry has changed a lot since 1937. Today, the digital revolution has changed how we get our information.

Gen Z will be the first generation to grow up with access to the internet, digital technology, and social media platforms. In addition, we see product standards continue to be harmonized across the world. Now, DC is emerging as the new AC, and since the mid-2000s, renewable technologies have been shifting the paradigm of electric utilities.

When considering these structure changes, the Task Group must ask itself: Where do we want to end up, and what's the end game? The Task Group not only wants to see the NEC continue to be relevant in the quickly evolving electrical industry, but it also wants to leverage the past and make the future even better. The end game is to make the NEC more user-friendly by eliminating redundancy, placing content where it makes sense, utilizing a logical/parallel structure, and improving the limited energy and MV content.

Thankfully, these proposed changes will not happen in one Code cycle. Once it has been determined that the Correlating Committee will move forward based on feedback from the industry, the Task Group would like to continue making changes in the 2026 NEC cycle to simplify the 2029 NEC transition.

The Figures show a small sample of where the Task Group is today (Fig. 1 on page 16), how this might evolve in the 2026 NEC (Fig. 2 on page 16), and finally, where they want to be in the 2029 NEC (Fig. 3 on page 18). Parallel numbering and grouping are

important for the usability of the NEC, so when considering the changes to the 2026 NEC, one thought is to combine Chapter 7 and Chapter 8 requirements by grouping similar wiring methods and installation practices. Also, with the new Articles in place for the MV requirements which happened in the 2023 NEC, those requirements could be numbered and grouped to align more closely with the Chapter 2 wiring and protection requirements.

The Task Group has also considered additional chapters to better group similar equipment, sources, and occupancies. As an example, in the Table on page 18, life safety and emergency systems could be grouped in one location.

In April 2023, the NFPA released the Correlating Committee white paper titled "Keeping the NEC Relevant — Is Now the Time to Modernize?" to describe the need for a revised structure and to socialize the concept. The



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Parallel Structure (2029)			
Wiring and Protection	Wiring and Protection >1,000V	Wiring and Protection Limited Energy	Communication Systems
<ul style="list-style-type: none"> <li>• 200 General Requirements</li> <li>• 205 Conductors and Cables</li> <li>• 210 Branch Circuits</li> <li>• 215, 225 Feeders</li> <li>• 230 Services</li> <li>• 240 Overcurrent Protection</li> <li>• 242 Overvoltage Protection</li> <li>• 250 Grounding</li> </ul>	<ul style="list-style-type: none"> <li>• 300 General Requirements</li> <li>• 305 MV Conductors and Cables</li> <li>• 330 Branch, Feeders and Services</li> <li>• 340 Overcurrent Protection</li> <li>• 342 Overvoltage Protection</li> <li>• 350 Overvoltage Protection</li> </ul>	<ul style="list-style-type: none"> <li>• 400 General Requirements</li> <li>• 405 Ltd Energy Cables</li> <li>• 430 Outside Plant</li> <li>• 440 Overcurrent Protection (Class 2, 3, 4)</li> <li>• 442 Overvoltage Protection</li> <li>• 450 Grounding</li> </ul>	<ul style="list-style-type: none"> <li>• 805 Communication Circuits</li> <li>• 810 Antenna Systems</li> <li>• 820 Community Antenna Television and Radio Distribution</li> <li>• 830 Network-Powered Broadband Communication Systems</li> <li>• 840 Premises-Powered Broadband Communication Systems</li> </ul>

**Fig. 3.** The Task Force is focusing on parallel numbering/grouping to improve its usability by the 2029 NEC cycle.

Chapter 20: Life Safety and Emergency Systems		
2010	Emergency Systems	700
2012	Legally Required Standby Systems	701
2014	Fire Pumps	695
2016	Fire Alarm Systems	760
2018	Circuit Integrity Cables and Electrical Protective Systems (Fire-Resistive Cable)	728
2020	Critical Operations Power Systems (COPS)	708

Similar equipment is likely to be grouped in one location in future NEC cycles.

Task Group continues to meet regularly, review the feedback and comments, and make changes. Since the last meeting, the Task Group has received favorable

letters of support from industry stakeholders including the IAEI, UL, IEC, Minnesota Department of Labor as well as other individuals.

To summarize, at the bottom of the Correlating Committee white paper, there is an opportunity for comments or feedback. Here's a quote from that document: "Ensuring the NEC is reflective of the industry that uses it daily should be of interest to all who use the document."

Please consider sharing your comments and/or suggestions. **EC&M**

*Dean Hunter is the chief electrical inspector for the Minnesota Department of Labor and Industry.*

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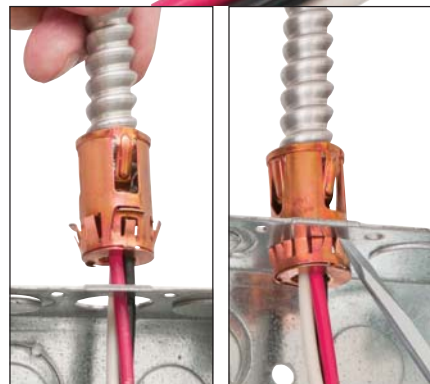


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# WHO'S IN CHARGE HERE?

Federal money and user demand are spurring the market for EV charging infrastructure. But incomplete and inconsistent state and municipal regulations make it difficult to keep projects on schedule and on budget.

First, the good news. Electric vehicle (EV) charging ports are on track to hit 18 million by 2027, according to the research firm Wood Mackenzie. Although most will be in homes, the residential share of the market will start to decline over the next three years as the public and commercial segments grow.

For electrical design firms, this ratio shift means a steady increase in business from shopping center developers, fleet owners, travel plaza chains, and other large companies. For electrical contractors, this trend could fatten profit margins because installing dozens of chargers at a single location incurs lower overhead costs than doing one-off residential jobs all over town.

The bad news is the hodge-podge of state and municipal regulations for installing EV chargers and uncertainty over how utilities can price electricity for the charging market. All of this creates complexity and inconsistency that often wreak havoc on schedules — not only for clients but also for contractors that need to move on to the next project to keep revenue flowing.

“It’s really problematic because you could be in one metropolitan area, and the cities or localities that make up that

area could all have different requirements,” says Tammy Klein, Transport Energy Strategies founder and CEO. “That becomes very onerous, very costly, very confusing, and it really slows the development process.”

This problem scales up exponentially for design firms, contractors, and clients that operate across multiple metros and states. Just ask Love’s Travel Stops, which has more than 644 locations in 42 states.

“One AHJ has a certain specification on how they want things, and then sometimes an AHJ in the jurisdiction right next door has a different sort of requirement,” says Kim Okafor, general manager of zero emissions solutions at Trillium Energy Solutions, the Love’s subsidiary that builds and operates its EV charging infrastructure. “If you’re just working in one jurisdiction, that’s not a big deal. But if you’re like us, working in hundreds of jurisdictions, it adds complexity. It adds time. In some cases, it adds costs. It just makes it difficult to build out quickly.”

## CALIFORNIA LEADS THE CHARGE

In the process, state and local governments are undermining federal initiatives aimed at building out EV charging infrastructure quickly and widely. One example is the \$5 billion for interstate charging networks through the



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National Electric Vehicle Infrastructure (NEVI) Formula Program.

“Each state is given the provision to build its own plan, and there’s a bit of inconsistency,” says Tom Bowen, president of Irvine, Calif.-based Qmerit Solutions, which partners with electrical contractors to provide charging station buildouts nationwide. “In a lot of ways, EV is still a bit of the Wild West when it comes to the infrastructure.”

This can limit business opportunities for electrical contractors that work in areas where regulations are inconsistent or incomplete.

“Charging networks are going for the path of least resistance in where they’re putting [equipment],” says Nick Esch, Wood Mackenzie research analyst.





That's one reason why California has so many charging stations deployed or in the works.

"California has expedited processes for permitting public EV charging for Level 2 and DCFC," says Amaiya Khardnavis, a Wood Mackenzie analyst who covers EV charging infrastructure. "That is why I think a lot of lot of stations are being put out in California pretty quickly compared to the others."

Some design firms agree, such as Henderson Engineers, headquartered in Lenexa, Kan., which does a lot of projects in California.

"I would say they probably do one of the best jobs of detailing out a lot of those very specific requirements. They're getting into not only where or how many

EV stalls there needs to be, [but] also how many need to be installed on day one as opposed to just preparing for the future. They're also looking at [ADA] accessibility of EV parking stalls," says Clif Orcutt, electrical technical manager at Henderson Engineers. "If they're not ahead of the curve, they're where the curve should be, and everybody else is behind. A lot of states don't have anything."

#### **THE DEVIL IS IN THE DETAILS**

Often the problem isn't that state and local regulations create roadblocks by being onerous. Sometimes their vagueness (or even absence) can be just as problematic, such as when there's no local code specifying how far EV chargers need to be from fuel pumps.

The Electric Vehicle Council's *Best Practice Guide for EVSE Regulations* spotlights how some municipalities are providing the kind of detailed framework that helps speed design, installation, and approval. One example is the signage requirements in Kansas City, Mo.: "Information must be posted identifying voltage and amperage levels and any type of use, fees, or safety information related to the EVCS. A public EVCS must be posted with signage indicating that the space is reserved for EV-charging purposes only."

According to Klein, the guide's author and chairperson of the Electric Vehicle Council, you have cities that are faced with questions that they've really never had to contemplate.



Love's Travel Stops was recently awarded \$4.8 million in federal funding to build EV charging stations at eight of its locations in two states.

"You might need to update your comprehensive plan, your zoning, your land-use codes," she says. "Most developers, especially the retailers, actually may know more than the city does. And it's not just cities; it's counties, too."

There is a nascent trend toward mitigating at least some local regulatory hurdles at the state level.

"California passed legislation to require streamlined permitting," Klein says. "It's like this set of requirements: 'This is what you need to consider,' and then you get your permit after a certain time. So, it's like [municipalities] are not allowed to just sit on these things for months and months. New Jersey is [another] one that has enacted those kinds of requirements, but I think that's something that we really need to see around the country. I don't see sweeping, fast change, but I think there's more recognition that that needs to happen."

Until it does, contractors and their clients have to pad their schedules.

"The biggest challenge, the immediate one, is the various permitting requirements per jurisdiction," says Qmerit's Bowen. "We build a fair amount of time into our construction schedules to try to ensure that we can secure the permit in a timely fashion for [our] customers."

Another workaround is going ahead and putting in at least some underlying infrastructure so chargers can be installed quickly later on.

"That's what we started to do with our new truck stops a little over a year ago," says Trillium's Okafor. "We know we're going to need it one day. We put in conduits. We set aside room in our switchgear."

### **DEMAND CHARGING HELPS DRIVE BESS AND SOLAR DEMAND**

Some regulatory environments can create opportunities to upsell clients on solar and battery energy storage systems (BESSs). One example is when the local utility doesn't have enough capacity to fully support, say, a fleet owner's plan to deploy chargers as part of a transition to EVs. If that means building a substation, the utility must run its own permit gauntlet. Add in the shortage of equipment such as switchgear, and the whole process can take 12 to 18 months.

"We're seeing people evaluating batteries as the way to quickly get to market," says Niraj Shetty, a Black & Veatch principal who specializes in EV planning and strategy. "It helps solve the problem of not being able to get utility energy quickly."

Some state laws allow utilities to vary their rates based on demand. This can drive up overhead costs for businesses, such as fleet owners.

"The clients we have are ones that have very specific time-of-day processes that don't want to get affected when switching to EVs," says Henderson's

Orcutt. "They don't want to have a delay in anything, so they are looking for all of that electric load to come at a specific time in a 24-hour cycle. Unfortunately, that tends to coincide when people are home and charging their own vehicles, using their ovens and air conditioning, and whatnot. So, that's becoming the bigger issue from what I've seen."

This issue is helping drive interest in BESSs among public charging providers, too. One example is travel stop operators, which could use it to avoid the need to increase prices across the board or by time of day.

"Battery storage is an option that helps smooth out the curve and provides more predictability," Okafor says. "The difficulty there is that battery storage is additional capital investment on an economic case that's already difficult. So the question that we ask ourselves is, should we wait for utilization to grow to invest more in these stations, or should we add all that capital now? That's really the balancing act. I think batteries and even on-site power generation are going to play a part in this market."

Another factor with a BESS is that it can trigger additional site requirements in some cities and states.

"There have been battery fires, and that has created some very strict additional code requirements — particularly in California and New York — like you've



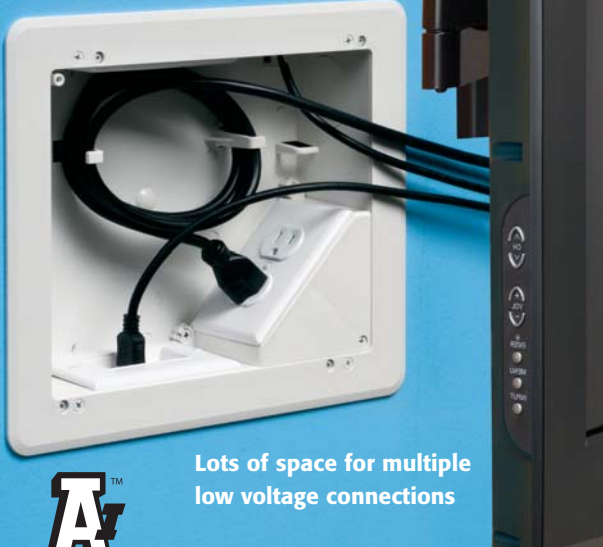


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got to have a big brick wall between the storage [and fuel pumps] or other mitigating factors,” says Paul Stith, Black & Veatch associate vice president for global transportation initiatives.

In other cases, a city might require brick walls to shield big BESS units from public view, such as when the charging station backs to a neighborhood. This also highlights how local aesthetic and safety requirements alike can affect a project’s budget — or scuttle a site altogether.

“If this is the sole site that they have, and it really needs to go forward, then they need to figure that out,” Shetty says. “If it is a programmatic operator or chain or somebody that has multiple locations, it could very much sway that they don’t pick that particular site. I’ve seen that, for sure.”

Sometimes solar can make a site viable for fleet owners, truck stops, and other power users.

“When you’ve got such large loads, those same clients are talking about,

‘What can we do as far as on-site power production to not be so reliant on the utility?’” Orcutt says. “That’s kind of a discussion that’s being had in parallel instead of thinking about it after the fact.”

“That’s definitely microgrid territory. When you’re getting into your own power production to offset your own power needs rather than relying on a utility because for whatever reason — the utility can’t provide that power at a certain time of day or they’re unreliable or you want the redundancy — that’s becoming the bigger need for our clients rather than just that traditional model of ‘I’ll add more load, and the utility will be able to supply it.’”

Finally, regulatory complexity and uncertainty can give some contractors and design firms a competitive edge. One example is being able to expedite a project because the firm already has experience with that jurisdiction’s requirements and preferences. Another

example is showing cities and counties with little or no EV charging experience how they can adopt what works in other communities. That can help fast track installations, such as a travel plaza on a rural interstate.

“Because we’ve done so many sites, in many instances, we’re the first one ever to bring EV charging to a jurisdiction,” says Black & Veatch’s Stith. “One of the key provisions in the regulatory side of this is ADA-accessible facilities. In different jurisdictions, they will need to get clarity about how many stalls need to be accessible, wheelchair ramps, and so forth. It gets pretty tricky, but that’s one of the things that our site-acquisition specialists really help our clients navigate: What are best practices? Even if it’s not code yet, it probably will become code.” **EC&M**

*Tim Kridel is an independent analyst and freelance writer. He can be reached at [tim@timkridel.com](mailto:tim@timkridel.com).*



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# Is the Grid Ready for an **EV Explosion?**

Why the anticipated EV revolution won't have an unbearable impact on the U.S. power grid



Photo courtesy of A Plus Electric

A Plus Electric provides residential services to customers in Virginia, Maryland, and Washington, D.C. This electrical contractor has been focusing on installing Level 2 electric vehicle charging stations in residential homes.

By Tommy Northcott, Jacobs Technology, Inc.

One frequent question I hear all the time relates to whether the power grid can handle the expected increase in public and private electric vehicle (EV) charging stations. A simple internet search on this topic will result in several articles stating why the grid can handle the increased demand while also resulting in a few that are not quite so confident. The reason for the discrepancy is due to the context in which the question is being answered. There are several variables that must be considered when evaluating this issue, but the two main differences come down to whether you're looking at it from a national generation and transmission perspective or a local distribution perspective.

## **WHY IS THERE CONCERN OVER THE POWER GRID?**

Before getting into the answer, it's important to first make sure we understand the potential problem that is the driving force behind the question. EV sales have been increasing in recent years and are projected to continue to grow even more moving forward.

According to the International Energy Agency (IEA), electric vehicle sales increased from 0.2% of total car sales in 2011 to 4.6% in 2021. Due to some government policies and auto manufacturers' claims, S&P Global Mobility expects EV sales





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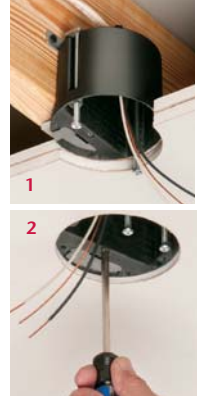
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in the United States could reach 40% of total passenger car sales by 2030, while the IEA projects EV sales could exceed 50% in 2030. Obviously, regardless of what the actual percentage increase turns out to be, this increase in EVs carries with it a need for increased public and private EV charging capabilities. It's forecasts like these that are driving the uncertainty over whether the U.S. power grid is capable of handling the increased demand that will come with the increased EV charging needs.

### HOW DO EVS IMPACT THE GRID?

It is no secret that EVs require electric energy via an electric storage system, or battery, to operate. This battery must be charged before the owner can drive away in their EV. The two primary charging options in use today are home charging or a public EV charging station.

There are two main types of home EV chargers: 120V "Level 1" chargers and 240V "Level 2" quick chargers. Electric vehicles typically come with a Level 1 charger, but having a Level 2 charger at home is often preferred because it allows the EV to reach full charge in less time. The actual power consumed by an individual EV owner will vary depending on the make and model of EV, how many miles per day the EV is driven, and the type of charger that is being used. However, some average statistics can be used to gain some understanding of the potential impact an increasing number of EVs might have on the power grid.

On average, some Level 2 EV chargers use 7,200W, or 7.2kW, of electricity. The amount of power needed to charge the vehicle at home depends on how much the EV was driven, which determines the amount of energy it will take to charge the battery back to full capacity. Kilowatt-hours (kWh) is electrical energy consumption over time, which is how the electric utility measures your energy usage for billing purposes. All electric vehicles have a kWh/100-mile rating — this is the amount of electricity they use per 100 miles driven.

Based on data from fueleconomy.gov, an average value to use is 0.3kWh per mile driven to get an idea of how much energy is needed to charge per week. On average, Americans drive 38.4 miles per day, which equates to an average of 80kWhs of EV charging a week. On its own, this does not seem like a very significant increase in electrical energy demand. However, the Edison Electric Institute predicts 26.4 million EVs will be on the road by 2030, so the 80kWh estimate could be multiplied by 26.4 million across the United States.

### CAN THE U.S. POWER GENERATION AND TRANSMISSION SYSTEM MEET THIS POTENTIAL INCREASED DEMAND?

When evaluating the potential impact of the forecasted increase in EVs coming to the homes of citizens across the country, most industry experts agree that the nation's power grid is up to the task. However, if you evaluate their answers closely, you will start to notice there are some caveats involved in reaching this confidence level.

Some experts have likened this looming demand increase to that of the challenge found as more homes began to add air conditioning, which also resulted in a rapid increase in overall demand on the power grid. According to numbers compiled by the U.S. Energy Information Administration, the United States generated and consumed about 4.12 trillion kilowatt-hours of electricity in 2021 compared to less than one trillion in the



When evaluating the potential impact of the forecasted increase in EVs coming to the homes of citizens across the country, most industry experts agree that the nation's power grid is up to the task. However, if you evaluate their answers closely, you will start to notice there are some caveats involved to reach this confidence level.

early 1960s. Utility providers stepped up to that challenge, and they believe they can do it again.

Based on the forecast number of EVs to hit the market, experts expect that it will drive a 30% increase in electrical energy demand, which is significantly less than the increase required from 1960 to today. Simply looking at those statistics, it's easy to say that the generation and transmission systems could be equipped to handle the 30% increase between now and 2030. But the issue may be more complicated than that.

### CAN THE LOCAL DISTRIBUTION SYSTEM HANDLE THE INCREASED EV CHARGING DEMAND?

The more complicated answer to this question comes when the context shifts to the power grid that is providing power to residential customers. The average residential home will use less than 2kW of power. This amount will fluctuate as appliances like an HVAC unit or refrigerator turn on, but the average use during peak hours is less than 2kW.

As mentioned earlier, a Level 2 EV charger can require 7.2kW of power. Keeping in mind that consumer demand will likely result in the market providing chargers that will charge EVs faster, which, in turn, will increase the kW power demand. To complicate the potential issue, the typical EV driver will want to get home and plug in/charge their car immediately, which will put this increased load on at peak times across the grid as multiple EVs are charging at the same time.

Obviously, the power distribution systems vary from neighborhood to neighborhood, but let's take two common examples to put this into perspective. These examples will be simplified for the purpose of making a clear point on how these charging stations can impact the local distribution system.

In a rural area, for example, a single house may have a dedicated pole-mounted single-phase transformer that provides low-voltage power to the house. A 5kW transformer would



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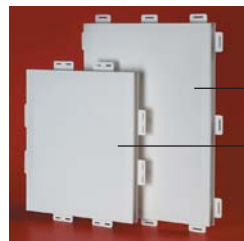
Arlington's one-piece non-metallic mounting bases provide a smooth, flat mounting surface for meters on *any kind of siding*, before or after it's installed.

Available in two sizes, they're also "gangable" so you can create the mounting base you need to hold your meter.

- UV rated, paintable plastic for long outdoor life
- 1" overhang covers the cut edges of siding



Gangable...to hold most meters



Meter  
Mounting  
Base

MM23  
23" X 17-5/8"

MM18  
17-5/8" X 15-7/8"

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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
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for Help  
in Maintaining  
**CONTINUOUS  
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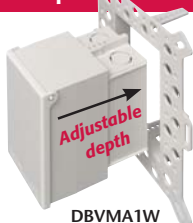


DBVME1W

Built-in FIXED FLANGE

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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



Product Info [aifittings.com/landing/db-series](http://aifittings.com/landing/db-series)

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

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



DBVME1W  
white cover

Patented/Additional patents pending

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be a common size that might have been chosen by the utility to provide more than sufficient capacity for a large house for several years. The house may have an average peak demand of 2.5kW, which is easily provided through this pole-mounted transformer. But when customers want a Level 2 charging station added to efficiently charge their new EV, this is now adding 7.2kW of demand based on our earlier example. The charger alone exceeds the rating of the transformer and would require the utility to upgrade it to a larger capacity transformer.

Let's look at a city subdivision as another example. Today's subdivisions will often have a green pad-mounted transformer that will provide power to anywhere from four to 10 houses, depending on proximity to the transformer. Assume a 25kW transformer is providing service to five different houses. This would allow for an average of 5kW per house of power demand during peak hours. If one or two of those houses installed a Level 2 charger for their EV, then there probably would not be an issue. But if four or five followed suit, the transformer would not be sufficiently rated for the potential maximum demand.

While these are grossly oversimplified, generic examples, they do highlight the very real potential problems that could arise if the percentage of citizens who own EVs and EV charging stations increases. If these situations can be problematic for homeowners, one can only imagine the impact on apartment buildings or other high-density residential areas — and this is only looking at the issue of power demand. Another consideration is the impact these charging stations might have on power quality issues, such as voltage imbalance, voltage sag or swell, transients, and total harmonic distortion. In addition, due to the nonlinear nature of the EV chargers, the temperature of the transformer and its associated loss rise during EV battery charging, which can result in reducing the transformer's life expectancy.

## WHAT'S THE SOLUTION?

Just as the problem has some complexity, so does the potential solution. The generation and transmission grid is predominantly an aging infrastructure in need of modernization and upgrading. The U.S. government and major electric utility providers are poised to spend significant amounts of money in modernizing and upgrading the electric infrastructure in the coming years. This is convenient timing to allow for increasing generation and transmission capacity in time to meet the potential EV charging demand. In addition, the current grid was designed with large power stations, such as coal plants, distributing power like the spokes of a bicycle. As a result, there is potential for the grid of the future to become much more of a distributed system — with power generation coming from many smaller smart microgrids at the local point-of-use level. As these changes take place, utility providers will certainly have future demand capacity in mind.

At the current local distribution level, the solution becomes a little more complicated. As a side note, there were no previous examples related to public charging stations because these are typically designed and installed directly off commercial-sized power systems that are more readily capable of handling the additional demand. In the residential zones, it is not practical for the utility to just replace/upgrade the majority of those systems similar to how the generation and transmission systems will execute their improvements. Certainly, there will be

cases of replacing individual transformers with larger capacity transformers to meet discrete demand needs, but there must be other options deployed on a larger scale.

## SMART CHARGING SYSTEMS

One way to help avoid overloading the local transformer is to avoid charging EVs during peak times. The distribution system is sized to have sufficient capacity to handle the time of day or night when the demand for power is at its highest level, or peak demand. The peak demand occurs at different times depending mostly on the time of year. Typical variables that impact peak times are when most people are home and when the HVAC or heaters are running the hardest. One method that utilities have already incorporated to incentivize consumers to limit their power use during peak times is to apply time-of-use rates to their billing structure. This means that the energy a home uses during the established peak hours costs more per watt-hour than energy consumed during non-peak hours.

Basic smart charging systems can take advantage of the lower cost energy by scheduling the charger to start charging the vehicle during non-peak times. However, there still could be some complications if multiple houses on the same transformer chose the same time frame to rapidly charge their EVs. There is also the potential for some smart chargers to allow permission for the utility provider to directly control when the EV gets charged. EV owners could tell the utility when they will need their EV to be fully charged, and then the utility would direct the EV owner's home charging station to deliver electricity at the time and speed with the lowest impact on the power grid. There are even some experts who are discussing vehicle-to-grid technology that would allow the connected EVs to be used by the utility as a power source during high-demand times. As demand for EVs and charging stations increases, more technological advancements will come to market to help minimize cost to the customer and risk to the reliability of their power source.

## LOOKING AHEAD

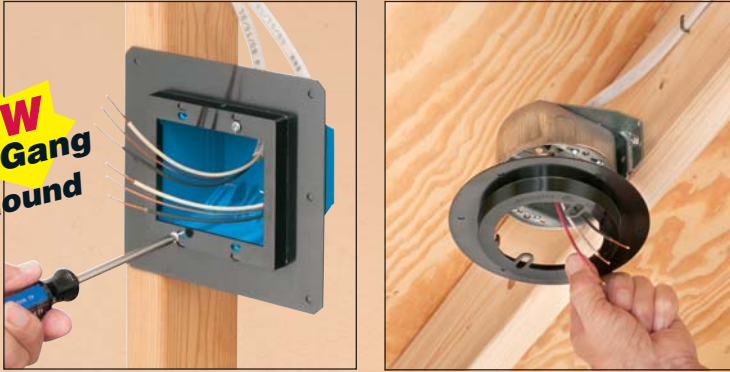
The forecast of increased EVs and associated EV charging stations is a reality whose magnitude will only truly be known as it manifests. At some level, the power grid will see an increase in demand as technology moves forward. There were predictions that computers would become as big as a house, but as technology advanced, those "supercomputers" turned into smart devices that fit into our pockets. The automotive industry will continue to make advancements — whether it is in the EV market or some other emerging technology. But if the EV forecasts become a reality, there are solutions that can be applied at various levels in our electrical distribution system that can help us successfully adapt to the new demands. The EV revolution will undoubtedly have an impact on the power grid, but it is not a problem we will be unable to solve. **EC&M**

*Tommy Northcott is a professional engineer licensed in the state of Tennessee and a senior power engineer with Jacobs Technology, Inc., in Tullahoma, Tenn. He is also an NFPA 70E compliance subject matter expert, a principal member of the NFPA 70B Committee, electrical safety trainer, certified maintenance and reliability professional, and certified reliability leader. He can be reached at [Thomas.Northcott@Jacobs.com](mailto:Thomas.Northcott@Jacobs.com).*

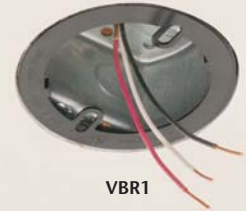
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and Round



Round or Octagonal  
ceiling boxes



VBR1

Single and  
Multi gang boxes



VB2

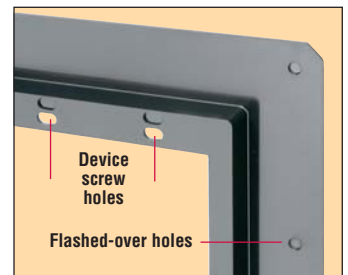


For help  
Obtaining  
**ENERGY  
STAR**  
rating

Arlington's vapor barrier covers prevent air infiltration around single, and **NOW two- and three-gang outlet boxes and round and octagonal ceiling boxes, without the need for a gasket.**

Installation is easy. Two screws hold the vapor barrier cover temporarily in place during the installation of 1/2" or 5/8" drywall, through the device screw holes or the flashed-over holes in the flange. After the drywall's installed remove the screws, *if using the device screw holes*, and install the device.

Designed for new work, VB1 and the **new VB2, VB3** and the round **VBR1** install on most plastic or steel boxes.



**Arlington**®



VB1



VB2



VB3




for single-gang round  
or octagonal boxes

VBR1

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# Building and Maintaining the Grid of the Future

Electrical contractors nationwide are partnering with utilities to support projects to drive energy efficiency, reliability, and resiliency.

By Amy Fischbach, Freelance Writer

By 2035, the Biden-Harris Administration strives to achieve 100% clean electricity. To meet the country's growing demands for clean energy and resiliency, transmission systems will need to expand 60% by 2030 — and may even need to triple by 2050, according to independent estimates shared by the Department of Energy (DOE). Today's electric utilities are powering electric vehicle (EV) charging stations, launching renewable energy and storage projects, expanding transmission capacity, and modernizing aging infrastructure. To help the nation meet these goals, electric utilities and contractors are paving the way to a greener future.

Greg Darkenwald, president of Capital Electric Line Builders, expects to see continued growth in all sectors of the transmission, distribution, and substation markets.

“Our utility customers have steadily grown their operations over the last five to 10 years to meet continually increasing demand,” Darkenwald says. “While we don't have visibility to their funding sources for their work, we expect to see continued growth for the foreseeable future.”

In the electric utility industry, federal funding is continuing to drive growth, especially in those markets related to transmission expansion and EV charging infrastructure. By 2030, the Biden-Harris Administration has set the goal of building a national network of 500,000 public EV charging stations and reducing greenhouse gas emissions by 50% to 52% below 2005 levels.

To support the EV industry, the Bipartisan Infrastructure Law (BIL) will invest \$7.5 billion in EV charging, \$10 billion in clean transportation, and more than \$7 billion in EV battery components, critical minerals, and materials, according to [WhiteHouse.gov](https://www.whitehouse.gov). The Inflation Reduction Act (IRA) is investing in clean energy jobs and resources to improve access to EV and charging infrastructure.

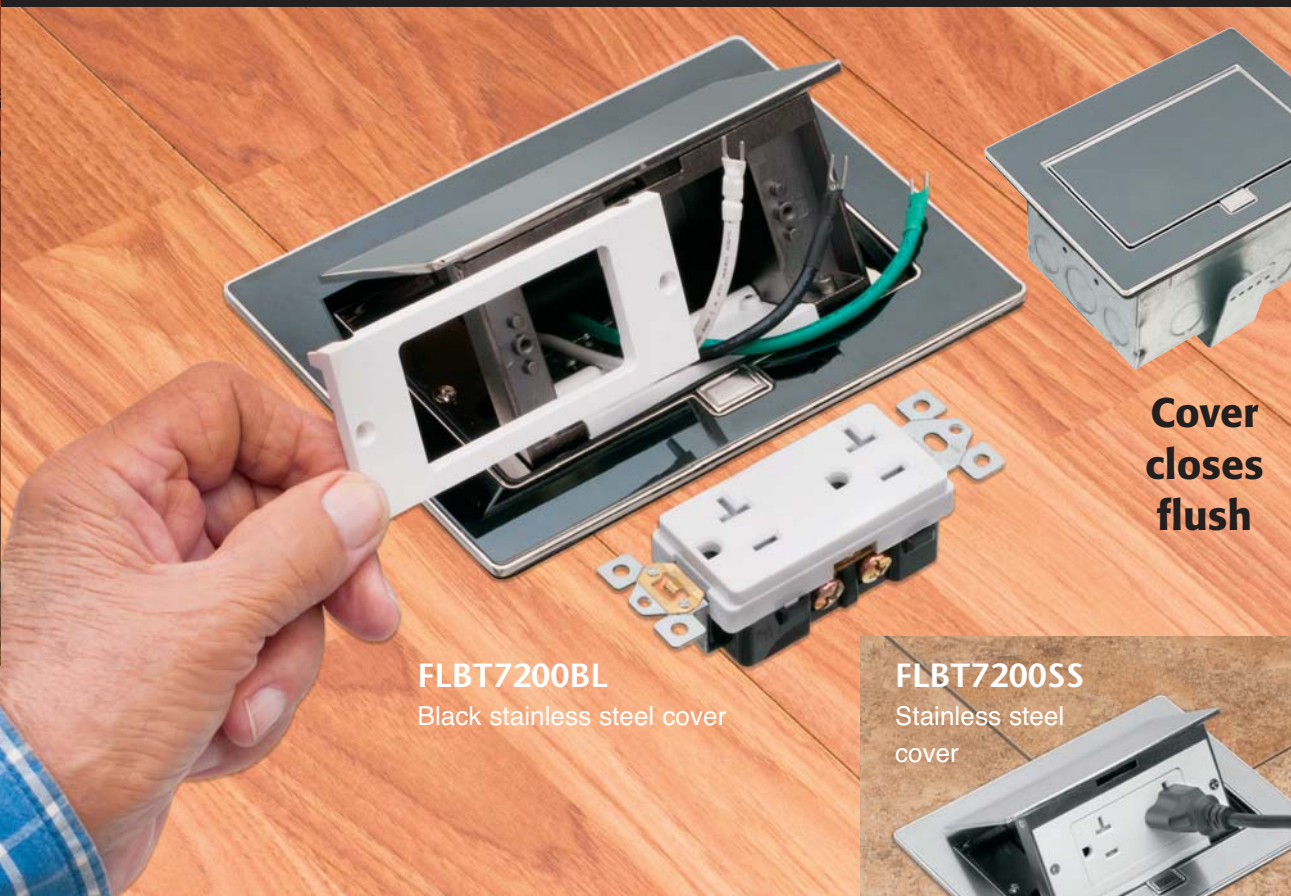
According to *EC&M's* 2023 Top 50 Electrical Contractors, EV charging is getting the biggest boost from federal infrastructure funds when it comes to projects they're working on, followed by renewable installations and electrical grid updates. Here's a



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closes  
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**FLBT7200BL**  
Black stainless steel cover



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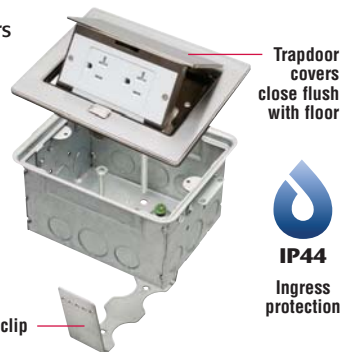
Arlington's **Pop-up COVER/BOX KITS** provide options for installing a device in a floor – or a countertop!

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- Easy **'No Glue'** installation – the spring steel clip holds box securely against the surface when screws are tightened
- Fits surfaces up to 1-1/2" thick
- Uses standard rectangular receptacle, and GFCI, and GFCI/combination receptacles



Trapdoor covers close flush with floor

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Spring steel clip holds box against surface

Patent pending



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Drone view of the Northern New York battery storage project, with construction completed. The Willis substation is adjacent to the facility.

look at each of these market opportunities for contractors.

### CHARGING THE FUTURE

In March 2023, the Administration opened applications for a new multi-billion-dollar program to fund EV charging and alternative-fueling infrastructure nationwide. While utilities are partnering with companies across the country to install the charging stations, this infrastructure is especially sought after in California — where more than 500,000 EVs have been sold in Pacific Gas & Electric’s (PG&E’s) service territory, representing one in seven EVs in the country.

After California Governor Gavin Newsom signed an executive order stating that by 2030, all new passenger cars, trucks, and SUVs sold in the state must be zero-emission vehicles, PG&E launched a program to offer no-cost charging infrastructure and resources to underserved communities. Oftentimes, EV adoption may be low in these areas due to high upfront vehicle costs and inadequate access to public charging stations.

“We serve a diverse population and want to ensure all of our customers have the resources they need to make EV ownership an attainable goal,” says Jason Glickman, PG&E executive vice

president of engineering, planning, and strategy. “These new programs align with our core focus to support EV adoption, proactively prepare the grid for the future, and increase access to charging infrastructure.”

Through the Empower EV program, PG&E is offering a free Level 2 charger (valued at \$500) to about 2,000 eligible

customers. In addition, the utility will cover up to \$2,000 per eligible household for panel upgrades by the program’s approved electrician.

California is not the only state investing in EV charging infrastructure and providing new revenue streams for electricians. For example, in the Washington D.C. metropolitan area, Master Electrician Dennis McDade, CEO of A Plus Electric, is helping his customers charge their electric vehicles at home.

The electrical company, which is based out of Northern Virginia, provides residential services to customers in Virginia, Maryland, and Washington, D.C. Recently, the contractor has focused on installing Level 2 electric vehicle charging stations in residential homes in its licensing areas. The chargers offer a higher power output and use a 240V outlet similar to clothes dryers or air conditioners, and they can be installed in residential or commercial settings.

“With the current mass production of electric vehicles, there’s a high demand for residential charging stations in the DMV area,” McDade says. “A Plus Electric has accepted this opportunity to provide customers with clean, efficient, and reliable charging stations in their homes. With several hundred charging stations installed so far in 2023, we



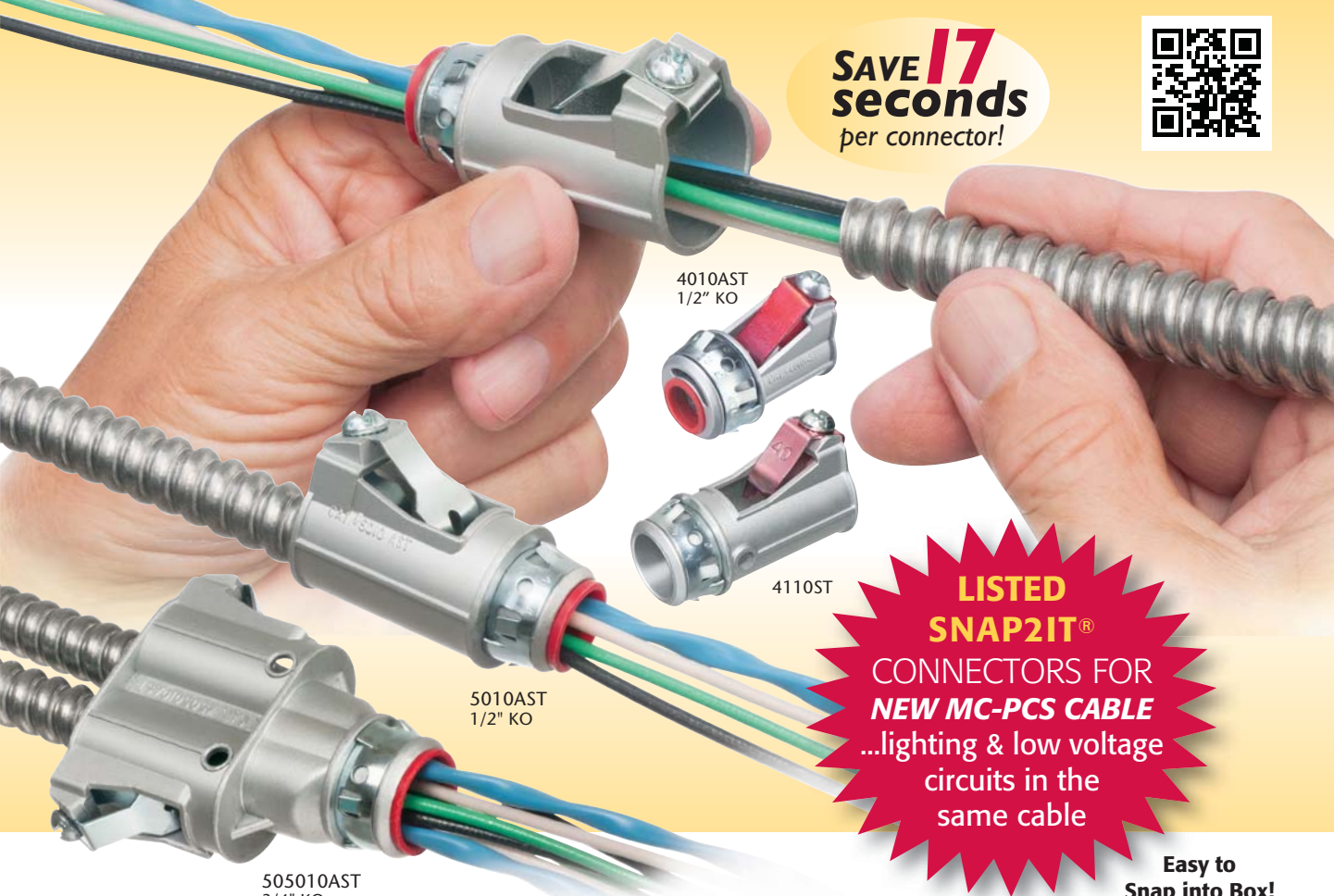
A Plus Electric installs Level 2 chargers for its residential clients in its service area.



# SNAP<sup>2</sup>IT<sup>®</sup> CONNECTORS

EASIEST CABLE INSERTION • NO TOOLS • SECURE HOLD

SAVE **17**  
seconds  
per connector!



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1/2" KO

4110ST

5010AST  
1/2" KO

505010AST  
3/4" KO

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

Easy to  
Snap into Box!

Fully assembled, SNAP<sup>2</sup>IT<sup>®</sup> fittings handle the widest variety of MC cable AND THE NEW MC-PCS cables.

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

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



**NEW!**  
4141107ST



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CATALOG NUMBER	DESCRIPTION	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
<b>NEW!</b> 4141107ST	Duplex Snap in, 3/4" KO	(2) .525 to .690

Patented. Other patents pending.

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Photo courtesy of Silver Tree Films

The Ovarions Development, a Bombard Renewable Energy project, is shown in progress in Las Vegas.

expect to triple the number of installations in the upcoming fiscal year.”

To take advantage of the EV charging market, electricians can enroll in certification programs from the charging station companies, McDade says. By obtaining his master electrician’s license, however, McDade says he received thorough training in the planning and installation of EV charging stations per the National Electrical Code standard.

## GENERATING AND STORING RENEWABLE ENERGY

Beyond installing EV charging infrastructure, electrical contractors are also embracing opportunities in the renewable energy markets. To handle the increased workload, many utilities are partnering with contractors with renewable energy divisions. Through this collaboration, utilities are striving to increase power reliability, efficiency, and resiliency. For example, MDU Construction Services Group (CSG), one of *EC&M*’s Top 50 Electrical Contractors, owns a subsidiary named Bombard Electric, an IBEW Local #357 electrical contractor with a division called Bombard Renewable Energy. The company was recently named one of the top solar contractors in the nation by *Solar Power* magazine.

Since the electrical contractor launched Bombard Renewable Energy nearly 20 years ago to meet Nevada’s demand for green energy, its team has installed more than 800MW of solar photovoltaic energy across Nevada. As part of its business, the company has not only specialized in commercial, industrial, government, low-income, and nonprofit work, but it has also taken on utility-scale renewable energy projects to provide energy off the grid, produce electricity on tribal lands, and offer renewable electricity options to utility customers. For example, Bombard installed 1.9 million modules and 48 inverters for a ground-mount utility-scale solar installation in Clark County, Nev.

On the transmission and distribution side of the renewable sector, MDU CSG’s operating companies are building wind farm collector systems, substations, and transmission lines. The electrical construction companies complement that work by building commercial and utility-scale solar PV systems, EV charging stations, and battery energy storage systems.

In the electric utility industry, energy storage can help to enable renewable energy growth and relieve transmission constraints. For example,

in New York, the New York Power Authority (NYPA) just began operating a utility-scale energy storage system. The 20MW facility, which is owned and operated by the NYPA, connects to the state’s electrical grid.

Five 53-foot walk-in enclosures include more than 19,500 batteries grouped in modules and stacked in racks. Each container can disperse 4MW of power — enough to power about 3,000 homes, according to the NYPA. In addition, the system includes inverters, transformers, a control house, and a back-up generator, which are all connected to a nearby substation.

O’Connell Electric Company of Victor, N.Y. constructed the project, which provides 20MW of power using a lithium-ion battery system. As the general contractor for the design-build contract, O’Connell managed both the engineering and construction of the battery system and supported the interconnect equipment, says Lynne Smith, media relations for the NYPA.

In Arizona, Salt River Project (SRP) is supplementing other storage options on its system with a new long-duration energy storage project called Desert Blume. The non-lithium technology can deliver 5MW of power for at 10 hours per cycle.



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for 4" hole

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THAT FIT SEVERAL CABLE SIZES



NEW SIZE!

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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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Built-in end stop

8418 for 1000 Mcm wire and TECK90

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

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

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3-1/2"  
8418



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Photo by Philip Kamrass/New York Power Authority

Kyle Murray, NYPA Construction Engineer, walks the Northern New York battery storage project after construction is completed. The Willis substation is adjacent to the facility.

The pilot project is the third phase of a project at Cooper Crossing Energy and Research Center. The first two phases include the addition of two flexible natural gas turbines and a utility-scale advanced solar generation facility capable of generating up to 55MW of solar energy.

SRP is partnering with CMBlu Energy on the project, which aims to store energy for SRP's customers, mostly derived from solar power, and return the energy to the grid throughout the night. According to SRP, it will store enough energy to power 1,125 average homes for 10 hours.

"This resource will supplement SRP's power system helping provide stored power for longer periods, especially in times of fluctuating, high energy demand from customers in the Valley," says Jim Pratt, CEO of SRP. "It will be a helpful addition to SRP's significant number of renewable resources and storage projects, which generally only store energy for up to four hours."

## MODERNIZING INFRASTRUCTURE

Electric utilities are not only launching utility-scale renewable energy and storage projects to provide clean,

green electricity to their customers, but they are also focusing on constructing new transmission lines to support these projects.

Recently, the U.S. DOE announced \$300 million for Transmission Siting and Economic Development, which was established as part of the IRA. States, tribes, and local governments can now apply for grants to accelerate and strengthen electric transmission permitting and siting processes. The funding is designed to overcome state and local challenges by expanding transmission capacity while supporting communities with new and upgraded lines. Accelerated transmission line development is critical to meet the country's growing clean electricity and resiliency demands, states the DOE.

Along with building new transmission lines, electric utilities are also challenged with upgrading aging infrastructure throughout their service territories. For example, Darkenwald says Capital Electric Line Builders' utility clients are implementing system integrity programs to replace aging transmission and distribution infrastructure.

"Our customers are enhancing the electrical grid through the addition of

new facilities as well as rebuilding existing facilities to handle the capacity necessary to support this growth," he says.

Capital Electric Line Builders is a subsidiary of MDU CSG Construction Services, which has been serving the power utility market since the company was founded in 1997 with the acquisition of a T&D contracting company. Since that time, MDU has acquired additional T&D companies with complementary services to meet customer demand across the company. The MDU CSG subsidiaries focused on the utility market provide all aspects of transmission and distribution construction services, including overhead and underground transmission and distribution and substations. In addition, they perform maintenance services for existing services as well as new construction.

"We're proud to be part of the network of companies that help deliver safe, reliable power to consumers and businesses," Darkenwald says.

In the transmission and distribution sector, the MDU subsidiaries, as well as other line contractors, often help utilities improve power reliability and resiliency. When hiring contractors to upgrade their system, utilities often embrace the

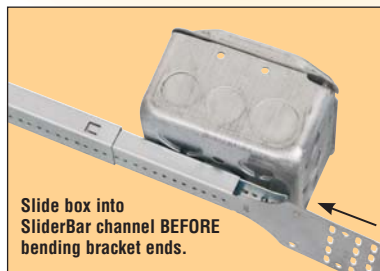
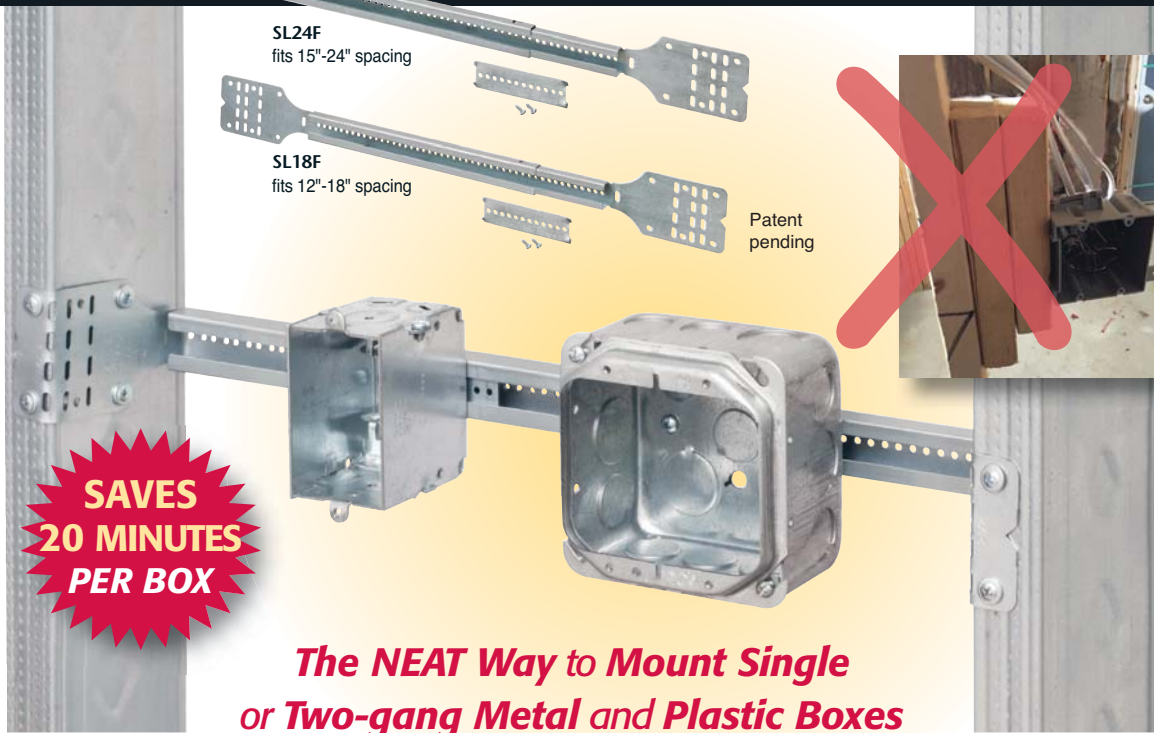


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**WITH FLAT BRACKETS**



Here's the easy way to mount single or two-gang boxes between wood or metal studs with non-standard stud cavities.

Arlington's steel SLIDERBAR<sup>™</sup> looks great and **saves about 20 minutes per box** over cutting, nailing and placing extra 2x4s! It's available in two styles – with pre-bent brackets – or FLAT BRACKET ends. And in two adjustable sizes for studs spaced 12 to 18 inches – or 15 to 24 inches apart.

The extra convenient SliderBar with FLAT brackets comes with a steel mounting bracket for installing almost any metal box, and our plastic SLB101 and SLB102 boxes, on the bar anywhere in the stud cavity.

Use the SL18BKT mounting bracket to add another metal box on FLAT SliderBar.

- **Guides on bracket ends** assure proper positioning on studs
- **Interlocking tab stop** prevents accidental disassembly
- **Pre-punched pilot holes** on BOTH sides of SLIDERBAR allow for easy attachment of boxes



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

**SL24F FLAT SLIDERBAR KIT** Adjusts to fit between studs, 15" to 24" o.c.

SL18F, SL24F include flat SliderBar, steel mounting bracket, (2) #8 x 1/2" screws

**SL18BKT** Steel Mounting Bracket w mounting screws

**SLB101 PLASTIC BOX** Single gang • pre-formed screw holes

**SLB102 PLASTIC BOX** Two gang • pre-formed screw holes



Metal boxes mounted on SliderBar are rated for non-metallic and MC, AC and Flexible Metal Clad cable

**Arlington<sup>®</sup>**

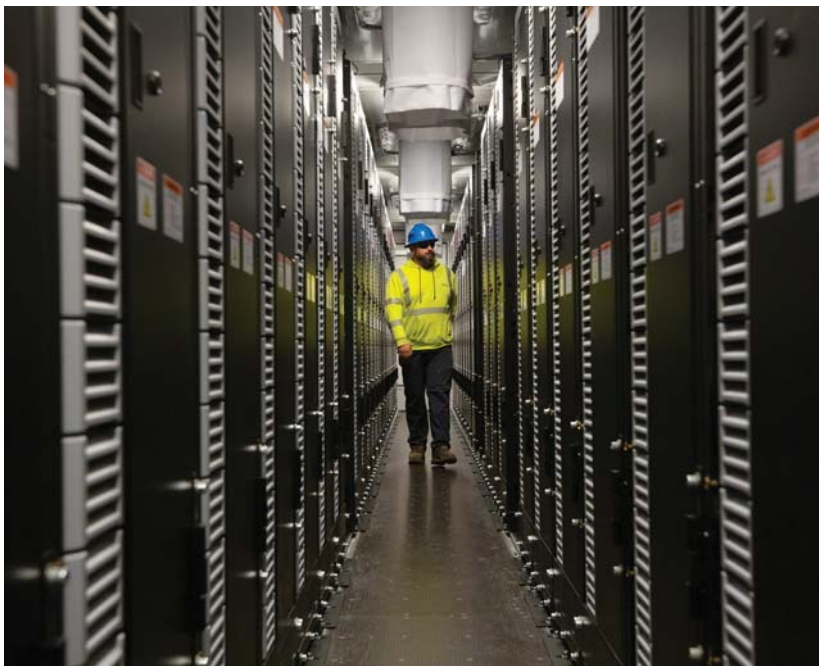
[www.aifittings.com](http://www.aifittings.com) Scranton, PA 18517 800/233-4717

Product info [aifittings.com/landing/sliderbar](http://aifittings.com/landing/sliderbar)



Construction of the long-duration energy storage project is expected to begin in early 2025 and be operational in December 2025.

Photo by Philip Kammas/New York Power Authority



Kyle Murray, NYPA Construction Engineer, walks through one of the battery units at the Northern New York battery storage project. The Willis substation is adjacent to the facility.

opportunity to harden their system with more storm-resistant infrastructure to reduce outages.

Nationwide, electric utilities are continuously challenged with severe weather conditions, leading to tree strikes on power lines, toppled towers/poles, and downed lines. To stand up to storms and keep the lights on for their customers, electric utilities often partner with

contractors to perform reconducting projects to replace existing cable with upgraded technology to improve reliability. Lineworkers are also undergrounding lines in areas at an elevated risk for wildfires or installing stronger, more resilient poles and wider crossarms to minimize power outages in high-wind conditions.

Lineworkers are also installing new technology on infrastructure and using

the latest tools and techniques out in the field. To embrace emerging markets, electrical contractors working for utilities must train their field workforce. For Capital Electric Line Builders, the team is continually adapting to new technology such as tools, software, and techniques in all sectors. Darkenwald says education and training are an ongoing and vital commitment.

“Our operating companies share knowledge and collaborate daily, and we partner with our customers and subcontractors to maximize the benefits of technology on every project,” Darkenwald says. “We also work directly with companies creating new technology to train our teams.”

Looking to the future, Darkenwald says he’s proud to be a part of the grid modernization projects.

“Capital Electric Line Builders and its sister companies will continue to serve our customers, supporting the ever-growing demand for EV charging stations, T&D power, and fiber-optic/communications systems,” he says.

By staying in tune with technology and providing the proper training and resources, electrical contracting companies can help utilities to meet their clean energy goals and power America both today and in the future. **EC&M**

*Amy Fischbach (amyfischbach@gmail.com) is a freelance writer and editor based in Overland Park, Kan.*



ECONOMICAL • INTERLOCKING

# GANGABLE FLOOR BOX

## FOR NEW CONCRETE FLOORS

**NEW  
COVERS!**

with  
**FLIP LIDS**

**PLATED,  
PLASTIC or  
POWDER-COATED**

(1) **FLBC8530BL**  
Black plastic  
cover/frame kit  
  
(3) **FLBC8500**  
boxes

### HERE'S HOW IT WORKS...



**FLBC8500**  
Single gang  
box

**FLBC8500**

Connections on  
sides lock single gang  
FLBC8500 boxes  
securely together

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

**Covers open in  
Both Directions**

**PLASTIC**

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



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

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

**Cover installs with hinge on either side.**



Made in USA

**Plastic Cover/frame Kit**  
**Single gang**

- FLBC8510BR Brown
- FLBC8510BL Black
- FLBC8510GY Gray
- FLBC8510CA Caramel
- FLBC8510LA Lt Almond

**Two-gang**

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

**Three-gang**

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

FLBC8510BR



# Arlington®

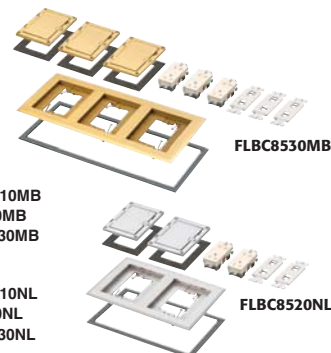


**Metal  
Cover/frame Kit**  
**Brass finish**

- Single gang FLBC8510MB
- Two-gang FLBC8520MB
- Three-gang FLBC8530MB

**Nickel finish**

- Single gang FLBC8510NL
- Two-gang FLBC8520NL
- Three-gang FLBC8530NL



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Patented





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# SOLAR FARM CONSTRUCTION CONSIDERATIONS

Shining a light on the benefits of building solar farms with pre-assembled components

By Sean Nacey, U.S. Construction and Energy Solutions, Wesco

Enhancing an aged electric grid to accommodate 21<sup>st</sup> century energy demands is top of mind for many countries' governments, and the United States is no exception. The U.S. push toward increased domestic manufacturing, energy independence, and the projected massive investments into electrification (including solar) has led to the construction of utility-grade, industrial, and residential solar farms. However, these large-scale solar projects are running into two primary issues affecting job execution: unpredictable weather (rain, hail, wind, snow, and excessive heat) and the lack of skilled labor (**Photo 1** on page 44).

Unfortunately, these workforce challenges have come at an inopportune time, as solar farm projects are becoming larger and more complex, and, as a result, are requiring more skilled labor than ever before. This creates a vicious cycle. When these challenges are significant enough, projects run behind and put electrical contractors at risk of liquidated assets that erode profit margins. So, how can solar developers and



## 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

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

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

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

*Covers also sold separately.*



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



**for NEW or existing floors**



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Product info [aifittings.com/landing/flb5331-flb5551-kits](http://aifittings.com/landing/flb5331-flb5551-kits)

# IN BOX® RECESSED COVER KITS

INSTALLS INSIDE 4.5" CONCRETE BOXES



Plugs stay inside recessed cover



**FLBC4560DNL**



Slotted in-use cover



Easy to install in concrete box

**FLBC4560**

FLOOR BOX FOR NEW CONCRETE

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

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

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

**FLBC4560DMB**  
Brass

**FLBC4560DNL**  
Nickel-plated

Cover blank  
Slotted cover

**FLBC4560DBR**  
Brown

...and plastic in FIVE colors.

**FLBC4560DGY**  
Gray

**FLBC4560DCA**  
Caramel

**FLBC4560DBL**  
Black

**FLBC4560DLA**  
Light almond



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Product info [aifittings.com/landing/inbox-cover-kits/](http://aifittings.com/landing/inbox-cover-kits/)





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**Photo 1.** Two main issues (unpredictable weather and lack of skilled labor) affect construction of large-scale solar farms, such as this one located in Joshua Tree, Calif.

contractors mitigate the unpredictability of Mother Nature and staffing shortages, particularly on large-scale solar projects? Consider pre-assembled solutions.

### MANUAL MISHAPS AND A HEATED LABOR FORCE

Pretend it's 115°F outside (if you spent any time in Arizona this summer, you don't have to imagine). Workers are outside on the job trying to crimp connectors, assemble combiner boxes, and maneuver large cable reels. Cell phones are so hot they are turning off, and powered equipment is overheating. Given the excessive heat, crews working in pairs can only work in 10-minute increments — 10 minutes on and 10 minutes off in the shade to ensure they don't overheat (**Photo 2** on page 46). Beyond the 50% productivity loss, these conditions also mean mistakes are more likely to be made — e.g., wire is stripped incorrectly to conductors, a wrong reel is pulled, or the high temperature impacts torque settings on wires, which causes an incorrect torque for connectors.

Heat aside, hand tools used in the field are often not being calibrated consistently, and they can wear down quickly. Manual tools also lend themselves to error, such as a torque tool being too tight, breaking a seal, and letting

Pre-assembled solutions take the time-consuming and highly critical terminations out of the field, helping to reduce the risk of electrical failures.

moisture into the cables. Pre-assembled solutions take the time-consuming and highly critical terminations out of the field, helping to reduce the risk of electrical failures.

If those challenges weren't enough, finding a skilled labor force to do this work in such conditions is a challenge. While the workers on these large-scale solar farm projects can have high earning potential compared to the industry average, these long, hot days in the field are demanding. By contrast, pre-assembled solutions can decrease the number of skilled professionals needed on a job

site because the work was already completed in a warehouse — not out in the field — and shipped directly to the site for faster roll-out.

### BENEFITS OF WORK DONE IN WAREHOUSES

Bringing labor out of the field and into the controlled environment of a warehouse helps ensure several things:

1. *More time on prep and less time in the field.* Utilizing solutions like pre-terminated jumpers and pre-loaded feeder cables helps reduce on-site installation time. This can eliminate potential downtime due to weather and improve the time to completion.

2. *Material quality and meeting manufacturer requirements to limit liability.* Most things are going to be incrementally easier to do in a clean and temperature-controlled environment. Using connectors is just one example. In warehouses, workers have high-tech installation equipment to assist with wire pulling, cutting, stripping, terminating, and packaging; that equipment is inspected and calibrated regularly, along with regular quality control checks to help ensure that processes and specific build instructions are being followed, and materials are clear of dust or dirt. In most cases, these are





ADJUSTABLE BRACKET • FOR NEW CONSTRUCTION

## FAN/FIXTURE BOX

FLUSH CEILING INSTALLATIONS



Captive screws attach bracket ends to joists



Attach to joists, adjust box position



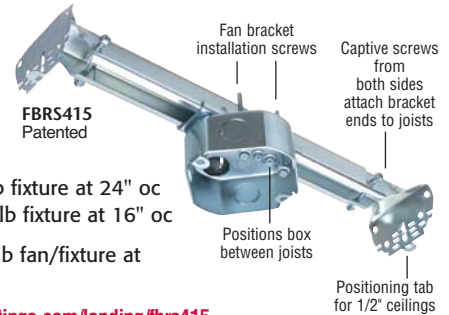
Arlington's heavy-duty, plated steel fan/fixture box has an adjustable bracket that mounts securely between joists spaced 16" to 24" o.c.



### Flush ceiling installations

FBR5415 is designed for ceilings up to 1-1/4" thick. For 1/2" ceilings, use the pre-bent positioning tab. For other ceiling thicknesses, bend along the appropriate score line.

- 15.6 cu. inch box ships with captive screws, mud cover, installed NM cable connector



FBR5415 Patented

### UL ratings

- 70 lb fan/90 lb fixture at 24" oc
- 70 lb fan/150 lb fixture at 16" oc

CSA rated 50 lb fan/fixture at 16" and 24"

Product info [aifittings.com/landing/fbrs415](http://aifittings.com/landing/fbrs415)

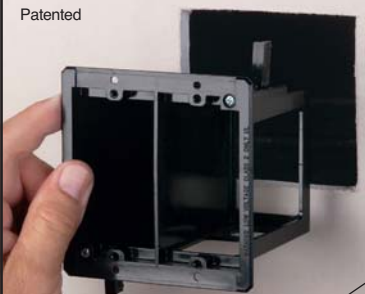
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POWER & LOW VOLTAGE

## COMBO BOX

FOR RETROFIT PROJECTS

Patented

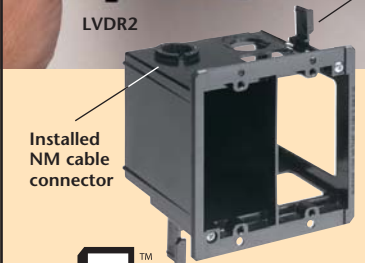


LVDR2

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

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

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



Installed NM cable connector

Product info [aifittings.com/landing/combo-boxes](http://aifittings.com/landing/combo-boxes)



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LOWEST COST • L-SHAPED

## FAN/FIXTURE BOX

SECURE MOUNTING TO SINGLE, DOUBLE JOISTS



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

FB442 13.4 cu. inch

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

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

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



Patented

Product info [aifittings.com/landing/joist-mount-fan-fixture-box](http://aifittings.com/landing/joist-mount-fan-fixture-box)

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**Photo 2.** One of the greatest challenges when it comes to solar farm installations is working in the elements. On a large-scale solar farm, such as this one located in the California desert, crews may only work in short increments due to the excessive heat.

problems that won't come to light for a few years after the heat cycles back off and expose the failures. One prime example of this would be in the locking of solar connectors. An electric connection can be made, but a physical connection of the equipment is not made if the lock doesn't make an audible click. In this case, the connection is not seated and is likely to have issues in the future. Another example is solar connector housings that can keep moisture out of the electrical connection. If the housings are not torqued to the manufacturer's specifications, there is an increased chance of moisture ingress to the connector, which also adds to the potential for failures of that connector in the future. In a facility, wire can be pre-terminated, cut to length, labeled, and then terminated so that it can be an easy plug-and-play solution on site.

3. *No temperature limitations.* You can't pull cable when it's too cold, and when cutting cable, cutting to the exact length is a greater challenge when it is being done on site. Working in a warehouse, there typically isn't lost productivity due to weather-related breaks, and materials can be stored at specified temperatures when applicable.

In a real-world example, a customer compared two job sites — one that utilized off-site pre-assembly services and the other that conducted a traditional on-site job installation. By leveraging pre-assembled solutions, the customer achieved net savings of 30% and completed the pre-assembled portion of work 60 days ahead of schedule.

### PRE-ASSEMBLED PROS AND CONS

While pre-assembled solutions make sense for several reasons, this approach does take more time upfront. Dialing in engineered final product drawings to match the engineered site plans can require multiple reviews between parties, as well as first articles — all to ensure that pre-assembled solutions meet construction design requirements. While it may be faster to simply order bulk materials, the gain with pre-assembled solutions is in the labor savings and quality of the project. Using pre-assembled solutions, contractors can reduce their labor in the field significantly.

According to a Dodge Data & Analytics SmartMarket report, 90% of contractors say they achieve improved productivity, improved quality, and

increased schedule certainty compared with traditional construction methods. Additionally, given the service model of pre-assembled solutions, the costs may be higher upfront, but when factoring in the entire expense of the project with labor included, it can ultimately end up costing less. Operations and maintenance costs can also be reduced.

If your organization is looking to move to pre-assembled solutions, consider engaging with partners early on, and be sure they will stand behind their installations, offer engineering to make the solutions as efficient as possible, communicate about changes along the way, and have a solid QA/QC process in place.

While many of the same physical material components are the same if installed in the field or constructed on pre-assembled solutions, the devil is in the details. This approach is not completely about the products used but rather the process needed to execute a successful project on time and on budget. That element alone can be a distinct competitive advantage. **EC&M**

*Sean R. Nacey is senior vice president and general manager, U.S. Construction and Energy Solutions, Wesco.*

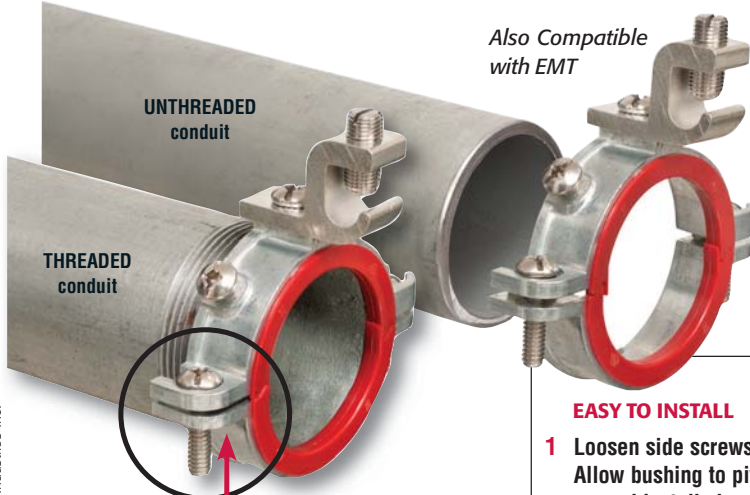




## SPLIT GROUNDING BUSHINGS

for **THREADED** and **UNTHREADED RIGID** and **IMC**

**EC&M**  
Product of the Year  
2023 Category Winner



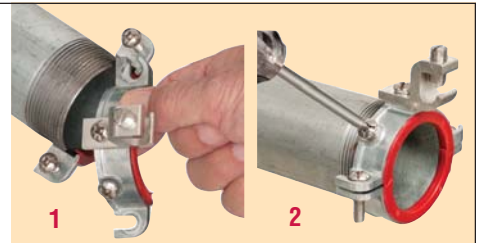
Also Compatible with EMT

Get convenience and time-savings with Arlington's 550 series **SPLIT grounding bushings**. The split allows the addition of a bushing **AFTER** conductors are installed in threaded or unthreaded Rigid/IMC conduit. Great for tight spaces!

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

### EASY TO INSTALL

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



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**SPLIT**



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### GALVANIZED STEEL



# CABLE SUPPORT

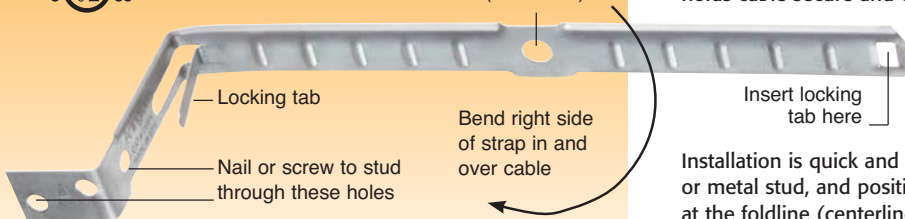
**ECONOMICAL...HOLDS UP TO FOUR MC CABLES • EASY TO INSTALL**



Nail or screw on **CUS6**

Foldline (centerline)

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



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

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

- Complies with 2020 NEC, article 300.4(D)

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



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

Product info [aifittings.com/landing/cus6/](http://aifittings.com/landing/cus6/)

# All Together Now

Demand is booming for networked lighting, low-voltage, and other smart home technologies. So why aren't more electrical contractors seizing the opportunity?



Photo courtesy of Lutron Electronics

The global market for commercial and residential smart lighting is expected to top \$40 billion by 2028, according to research from IMARC Group.

By Tim Kridel, Freelance Writer

In 2022, the global market for commercial and residential smart lighting alone was worth \$13.5 billion, according to IMARC Group. By 2028, the research firm expects it to top \$41.2 billion. Those figures are big partly because networked lighting is now a mainstream technology: a feature that builders are increasingly making standard and that homeowners want for new construction and remodels alike. Networked lighting and low-voltage smart home systems such as motorized window shades can be a lucrative part of your business.

"We do a lot of new construction at the higher end, so pretty much all my houses now have some form of smart home," says Drew Swansborough, owner of Definitive Electric in Abbotsford, B.C., Canada. "Our builders will put in a starter kit, two or three switches, and the homeowners love them. They're like, 'Can we add more?' We've never had somebody who doesn't like it once they lived with it."

Networked lighting often is one component in a larger smart home ecosystem, so it opens the door for electrical contractors to expand into those adjunct technologies for additional revenue and market differentiation. For example, Swansborough initially did only smart lighting.

"I was in a training session, and the rep goes, 'Who wants to sell [motorized] shades?' It's 30 to 35 of us in there, and they're all my competitors. Nobody puts their hands up. I'm like, 'Well, I guess I'm going to.'"

Another example is speech control, which can be particularly attractive for seniors and people with mobility issues because it frees them from crossing the room to flip a switch.





RECESSED FOR FLUSH-TO-THE-WALL MOUNTING OF LED, HI-DEF TV's

## STEEL TV BOX™ KIT

COMBO BOXES FOR USE WITH METAL RACEWAYS



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**NEW WORK**

Mounting screws hold box on stud

2-GANG TVBS505



Arlington's recessed STEEL combination power/low voltage TV BOX™ is the best way to mount an LED or Hi-Def TV flush against a wall.

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

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

- Steel box; non-metallic paintable white trim plate
- Easy, secure installation
- Optional covers

Patented



3-GANG TVBS507



**RETROFIT**

Mounting wing screws hold box in the wall



**NEW!**

1-GANG TVBS503



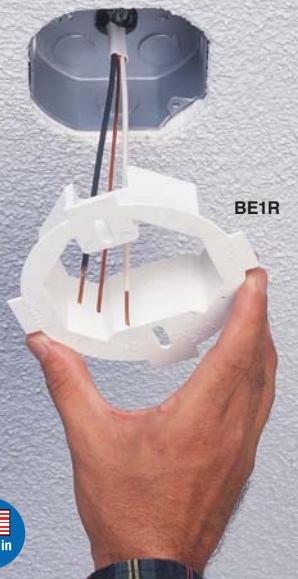
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Product Info [aifittings.com/landing/recessed-tv-boxes](http://aifittings.com/landing/recessed-tv-boxes)

UL LISTED • 2-HOUR FIRE RATING

## LISTED BOX EXTENDERS

EXTENDS SET BACK BOXES UP TO 1-1/2 INCHES

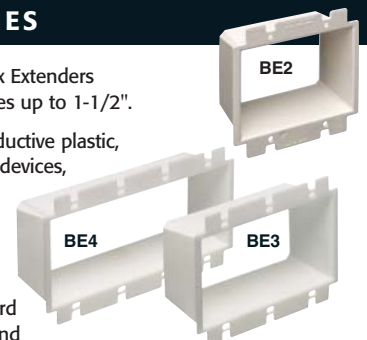


Arlington's **UL/CSA Listed** Box Extenders extend set back electrical boxes up to 1-1/2".

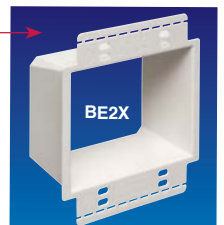
Made of heavy-duty, non-conductive plastic, they level and support wiring devices, protecting wires against damage and stripping.

BE1R for round or octagonal boxes, the single-gang (BE1), two-gang (BE2) for all standard devices, switches and GFCIs and **three- and four-gang box extenders for multiple gang boxes!**

Try them all, including our Patented 'Larger Flange' one-, two-, three- and four-gang styles, for the safe, easy way to obtain Listed installations in set back boxes!



**TWO HOUR FIRE RATING** for use with Metallic and Non-Metallic boxes



Larger Flanges (patented)

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Product Info [aifittings.com/landing/box-extendors/](http://aifittings.com/landing/box-extendors/)



Whole-home smart lighting and other building technologies require not only a reliable network but also a secure one. That's why some electrical contractors are also designing and installing Wi-Fi solutions.

"We see a lot of voice control for lighting," says Rich Shumway, field supervisor at Hyattsville, Md.-based Wilcox Electric. "I believe most people have smart lighting installed to control them with their smart speakers and set up lighting scenes or routines.

"Personally, I love that when I walk through my front door and say, 'Hey Google. I'm home,' and all my first-floor lights turn on. When I wake up in the morning, I say, 'Hey Google. Good morning,' and my kitchen lights turn at 30% brightness."

## NOT JUST NEAT-O, BUT NECESSARY

Gee-whiz applications, such as asking lights to turn themselves on or off, are one reason why homeowners buy networked lighting. Another more mundane motivation is helping architectural features meet code requirements.

"We're getting a lot of phone calls [where] it's not that they want smart homes; they just want the shades because they have really high windows or there's a lot of glare," Swansborough says. "In Canada, we can't have cords hanging off shades for safety reasons so kids don't strangle themselves. So when you have a window that's 15 feet up, what are you going to do?"

Motorized shades can also help homeowners meet energy-efficiency

goals, especially when paired with sunlight sensors and other devices.

"That will save a huge amount: another 15%, probably, just in the summer," Swansborough says.

Smart shades can be integrated with lighting as another way to reduce a home's carbon footprint or even take it off-grid.

"Daylight harvesting is an energy-efficient solution that uses sensors, smart lighting, and smart shades to ensure the right amount of light in an area," Shumway says. "These systems brighten/dim lights and/or raise/lower shades to achieve optimum lighting levels. We have not worked on any projects that utilize daylight harvesting yet, but I am hearing about it more and more."

This also highlights how knowledge of these use cases and technologies can give an electrical contractor an edge when targeting builders, homeowners, and interior designers in the burgeoning green market.

"It adds extra revenue for us for sure, [but] it's also just more appealing to that customer, whether it's a builder or a high-end homeowner," Swansborough says. "They may only want us for electrical, but we put that bug in their ear that we do more than electrical."

## SHOW ME THE MONEY

The electrical industry has a chronic employee shortage, with roughly 11% of all positions unfilled through 2031,

according to the U.S. Department of Labor. That means most contractors are struggling to keep up as it is. So why take on additional work in the smart homes market?

One reason is to wring maximum revenue out of the limited number of employees they have by focusing on fat-margin projects. Another is to add value in the eyes of builders and homeowners by offering a bigger portfolio of services — including to the point that it eliminates the need to bring in another sub just for the smart home technologies.

"Electricians are a dime a dozen out here," Swansborough says. "It's kind of a race to the bottom. We have a really good reputation, but builders say, 'Your quote is \$5,000 to \$10,000 more.' Okay, so be it because I know the quality of work we do versus what other people quote and end up giving you.

"We were trying to just diversify ourselves out of that, and that's where smart houses and networking came in. We kind of give everybody a package deal. Shades are more of a gravy thing for us. If we sell them, cool. They're a high-margin item."

Motorized shades are also typically the first thing cut when the budget gets tight, Swansborough says. But that doesn't necessarily mean lost business.

"We're rough wiring the house for the shades because six months down the line, you may have the money, and now you want shades," Swansborough says. "The wire is cheap in the grand scheme of things. Just put the infrastructure in, and then you have the ability to play around with it down the line."

## IF ELECTRICIANS WON'T DO IT, SOMEONE ELSE WILL

Considering the opportunities, why don't more electrical contractors pursue the smart home market?

"Where I think a lot of electricians get lost is they limit themselves to just wiring," Swansborough says. "I'll hire guys and say, 'We run low voltage,' and they'll be like: 'I don't really want to do that. I just want to run wire.' Well, what's the difference? I think it's more of a mentality thing."

Initially, manufacturers of smart home technologies assumed that electrical contractors would jump at the chance to sell and install their products — only to get the cold shoulder.



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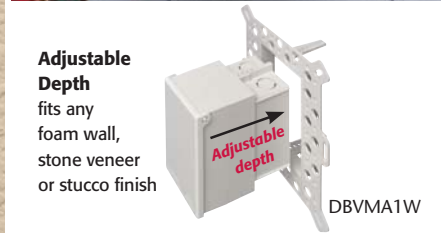


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“They said, ‘We have these awesome products, and we would love to sell them to electricians,’” says Joe Borress, CEO of Malibu, Calif.-based Tri Star Electric & Automation. “They looked at it and said: ‘I don’t want anything to do with this. I don’t even know how to use a computer.’ They were just straight-ahead electricians.’ Then these manufacturers said: ‘Holy crap! Nobody wants to buy our stuff. What are we going to do? Oh, let’s get the AV guys because they’re already in there doing the speakers and the TVs.’”

In the process, electrical is effectively ceding the market and its margins to audio-video (AV) integrators, IT firms, security contractors, and even cable broadband providers.

“The electrician gets just the grunt work on the job, doesn’t get any of the smarts and parts and any of the glory of the markup,” Borress says. “That’s why now is the time for electricians that do residential to jump on board. I believe that in time, it will be in the commercial business, as well, where AV integrators are doing the networks for office buildings, video conferencing, voice and data securities, access control, and surveillance. They will eventually get into lighting and temperature control, as well.”

Lighting and other smart home/smart building technologies all require not just a network, but a reliable, secure one. That’s another business opportunity for electrical contractors willing to invest in skills such as designing and installing Wi-Fi.

“The hardest thing we’re finding with the low-voltage side of things is nobody out here thinks about their networking,” Swansborough says. “They think that their internet provider gives them their little Wi-Fi modem, and that’s as good as it gets. We’ve done jobs where we’ve put access points in the house, and people are amazed at how good their Wi-Fi can actually be.”

By offering network design and installation, electrical contractors also avoid the risk that their perfectly installed lighting, shades, and other smart technologies aren’t undermined by someone else’s shoddy work. This also benefits the builder and homeowner because they don’t have to deal with two contractors pointing fingers at each other.

“Having everything under one [roof] makes everybody’s life easier — lots easier,” Swansborough says. “Now I

don’t have to talk to low-voltage guys or anything like that. I don’t have to rely on them to make my stuff work.”

## KNOWLEDGE IS POWER

Although networked lighting and other smart home technologies are now a mainstream phenomenon, the most lucrative opportunities tend to be at the high end of the market. It’s not just that a bigger home has a bigger budget. It’s also because a week spent installing dozens of networked lights, motorized window shades, and other smart devices at a single house is more profitable than running all over town doing a couple each at dozens of single-family homes.

“On a \$300,000 [project], we’re going to have a much smaller budget — probably like \$3,000 to \$5,000 versus \$20,000 to \$30,000 [on a million-dollar home],” John Moffitt, an Overland Park, Kan.-based realtor and custom home builder, told *EC&M* in 2020.

For some electrical contractors, networked lighting and other smart home technologies have become the tail that wags the dog.

“It gives us a huge advantage over our competition,” Swansborough says. “I’ve had builders contact us just because I do smart homes and then offering the electrical on the side of that. Having everything in-house makes it more appealing to them.”

Some have gone even further by offering a bundle of services, which can help capture a bigger share of a project budget. One example is New York City-based James Stanley NY, which specializes in high-end residential renovations.

“I started out as an architect and interior designer, and I was so sick of dealing with subcontractors,” Stanley says. “I have an engineering background. An accountant of mine said, ‘Why don’t you get licensed, and we’ll pull this in-house?’ Now we’re able to sit at the table and be the contractor, the architect, and the design firm. It puts me in a really unique position to wear all the hats and see things from many different angles.”

That can also help me compete against firms that can’t provide a holistic view of a project because they offer only some services. The catch is that it takes money to make money: For this strategy

to work, electrical contractors must invest in skills such as programming.

“Some of these systems are easy to set up while others require special training,” Shumway says. “For instance, we had to complete training to become a [manufacturer-certified] pro shop and download their programming software. We paid a couple of our electricians for three or four hours to go through the training. Then we bought a few of the switches and installed them in our office so our guys could do some real programming. We don’t want them to be learning this on the job.”

Another example is knowledge of fixtures and finishes.

“If you’re going to sell lighting, you need to know everything about that,” Borress says. “Go meet with the manufacturer. They’ll train you for free. What size are its fixtures? How can they get orientated? Are they trimmed? Are they good for insulated ceilings? Are the lenses interchangeable? All that stuff.”

Custom homes offer the most opportunity for electrical contractors to demonstrate and monetize their design expertise.

“The developers, all they care about is ROI,” Borress says. “Nine out of 10 times, when an electrical contractor gets a set of plans for a commercial-style MDU, they have no input in anything. They’re just, ‘Give me a price for what’s on the drawings.’ There are no cool bespoke brands.”

Another challenge is getting a seat at the table early on in a project before budgets are spent and designs are locked in. For example, when electrical is there with the builder, homeowner, and architect, it’s an opportunity to bring up how daylight harvesting can meet the project’s energy-efficiency goals.

“Just like an architect is hired and interior decorators hired, we should be hired as consultants,” Borress says. “If I was a developer, I would want to meet with electrical contractors and electrical designers like ourselves because we also do a lot of design and consulting, not just installs. We’re really trying to push more toward the design part of our business because I feel like it’s really undervalued.”

**EC&M**

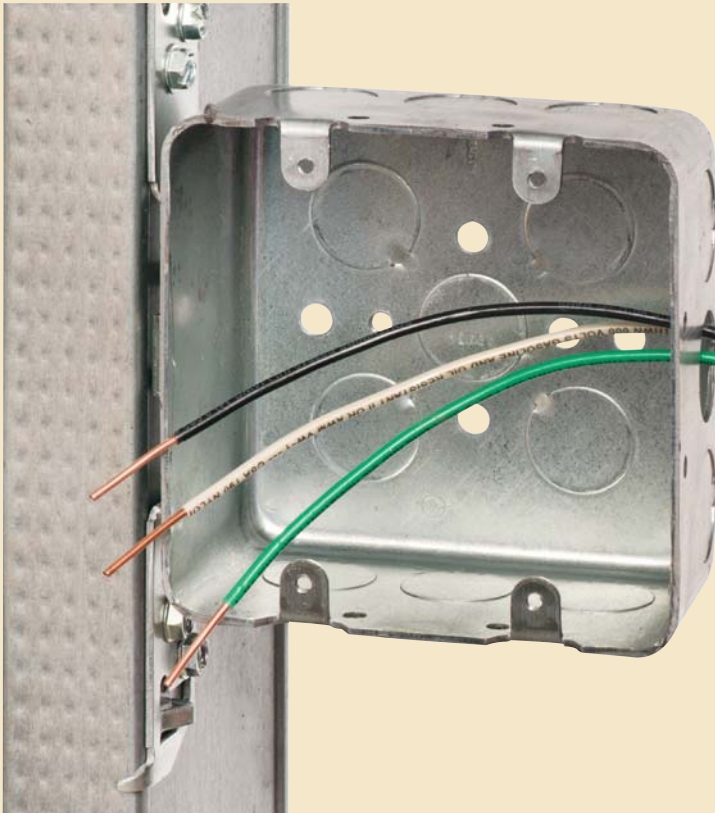
*Tim Kridel is an independent analyst and freelance writer. He can be reached at [tim@timkridel.com](mailto:tim@timkridel.com).*



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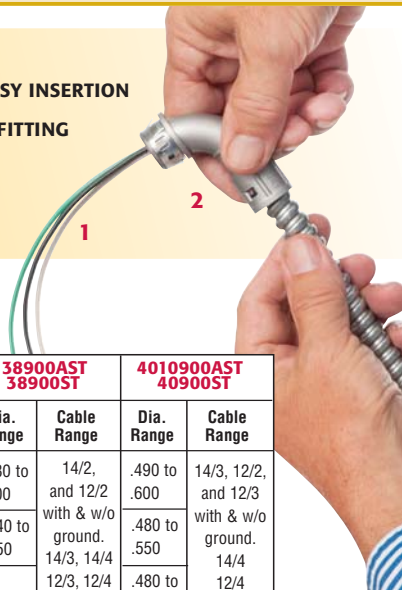
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MCI-A Steel & Aluminum	.440 to .550	14/3, 14/4	.480 to .550	14/4
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## Wire Tracers

The 2062 Advanced Pro wire tracers accurately and safely troubleshoot energized and de-energized wires up to CAT IV 600V. The product consists of two parts: a transmitter, which generates a signal and sends it along the wire, and a receiver, which detects the signal in AC or DC current. The wire tracers feature different modes and functions and are designed to protect electricians from the most dangerous levels of transient overvoltage — spikes up to 8,000V — that can occur in industrial and utility environments. The patented smart sensor technology locates and displays energized wires within walls, floors, and ceilings on a high-resolution 3.5-in. color display. While the tip sensor provides an audible tone when locating wires, the smart sensor helps visualize and pinpoint the orientation of energized wires, eliminating guesswork.

*Fluke*



## GFCI Outlet Tester

The GFCI tester detects the most common wiring problems in standard and GFCI receptacles. The product works on GFCI outlets and confirms operation of the ground-fault protective device. The tester is durable with a hard shell built to withstand a 6.6-ft drop. Other features include nominal voltage of 110V/125VAC at 50 Hz/60 Hz in 3-wire outlet, easy to read lights that make determining faults simple, and built-in GFCI trip that tests outlet protection.

*Jonard Tools*



## Conduit Seal

Seal core drill and sleeve openings with ease by using a seal that fits various outside diameters of conduits and pipes in the same sized opening. PHPS Conduit Seal - Sleeve Seal uses segmented ring technology that allows individual adjustments to the pipe diameter on site. Ideal for smaller pipes, or multiple pipe ODs covered with one seal, the product is available in 1.575-in.-wide EPDM or NBR rubber. According to the company, the product is completely gas-tight and watertight. In addition, PHPS segmented ring technology allows the fitting of numerous pipe sizes within a single seal without the need to consult a sizing chart. This product is an ideal option to keep in inventory or on service trucks.

*American Polywater Corp.*



## Adjustable Box

The universal mounting internal adjustable box, UMIAB-35, is a 4-in. square, 3.5-in.-deep box with a built-in adapter designed to simplify the rough-in for oversized life safety devices. Internal adjustment screws allow the box to be adjusted before and after dry wall installation. The box can mount directly to stud or used with the company's SSB system for between stud (with SSB-T5) and drop ceiling applications (with SSB-TBAR) and features an adjustability range of ½ in. to 1½ in. via set of internal Tri-Combo hex screws. UL listed, it is available in red for oversized fire life safety devices.

*Orbit Industries*



## Fish Tape

The 75-ft high-flex fish tape is designed to be stronger than fiberglass fish tapes and more flexible than steel fish tapes. Key features include a triple strand polyester design that provides increased strength and is four times more flexible than fiberglass and eight times more flexible than steel, according to the company. Additionally, the product's polyester material delivers flexibility to easily glide around difficult corners/joints, and an optimized feed angle allows for decreased payout effort and easier rewind. Finally, the bright orange strand woven into triple strand tape provides better visibility and location of the tape in low light while the polypropylene case and handle offer high-impact resistance.

*Klein Tools*



## Clamps

The Smart Strut clamp SSC allows installers to secure tubing or pipe to strut channels without tools. It was designed with safety and productivity in mind, saving customers time when installing conduits and pipes on strut channels, including pipe, electrical, cable, and mechanical systems. The product is a multidiameter clamp made of nylon and doesn't require any tools or accessories for the installation. In addition, the nylon properties provide greater performance against expansion due to the temperature contrast of the tubes, according to the company.

*CELO Fixings*





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CER1



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# NEC Requirements for Hazardous Locations

Article 500 prepares you for properly applying Arts. 501 through 516.

By Mike Holt, NEC Consultant

A hazardous (classified) location is an area (not necessarily room or building) where the possibility of fire or explosion exists due to the presence of flammable or combustible vapors, or flammable gases, combustible dusts, or easily ignitable fibers/flyings. Electric arcs, sparks, and/or heated surfaces can serve as a source of ignition in such environments.

Article 500 provides the foundation for applying Art. 501 (Class I Locations), Art. 502 (Class II Locations), and Art. 503 (Class III Locations). This Article also provides a foundation for using Arts. 510 through 516.

Before you apply any of the Articles just mentioned, you must understand and use Art. 500, which is fairly long and detailed. It contains many Informational Notes you should review. Although Informational Notes are not NEC requirements [Sec. 90.5(C)], they help you better understand the related NEC rules.

## DOCUMENTATION

All areas designated as hazardous (classified) locations must be properly documented on an area classification drawing. The documentation must be available to those who are authorized to design, install, inspect, maintain, or operate the electrical equipment [Sec. 500.4].

Proper documentation of hazardous areas assists the designer, installer, and authority having jurisdiction (AHJ) in ensuring adherence to the stringent requirements in Arts. 501 through 516.

## CLASSIFICATION

Determining the classification of a specific hazardous area is the responsibility

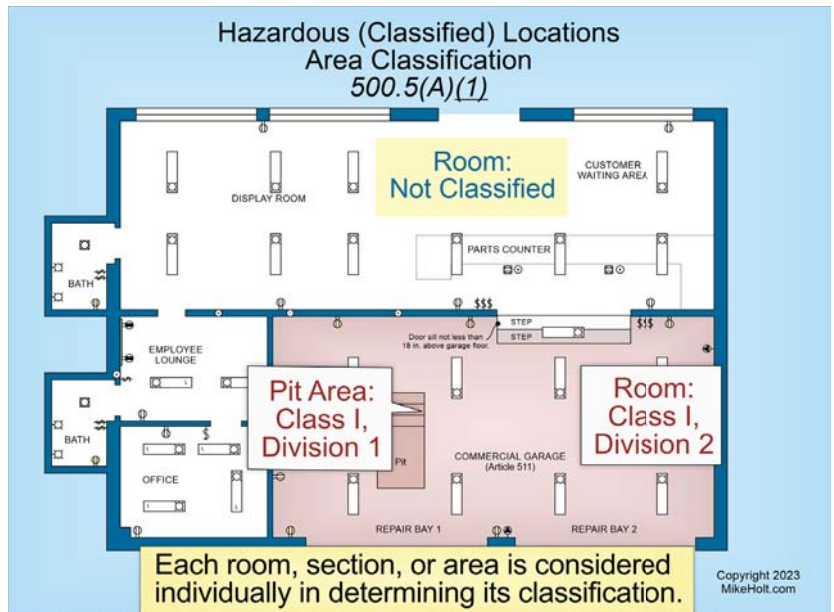


Fig. 1. Locations are classified according to the properties of the hazard.

of those who understand the dangers of the products being used. These people include the fire marshal, plant facility engineer, and insurance underwriter. It is not the responsibility of the electrical engineer, electrical contractor, or electrical inspector. Before performing any wiring in or near a hazardous (classified) location, contact the plant facility and design engineer to ensure that proper installation methods and materials are used. Be sure to review Sec. 500.4(B) for additional standards that might need to be consulted.

Locations are classified according to the properties of the flammable gases, flammable liquid-produced vapors, combustible liquid-produced vapors, combustible dusts, or easily ignitable fibers/flyings that may be present, and

the likelihood that a flammable or combustible concentration will be present [Sec. 500.5(A)].

Each room, section, or area is considered individually in determining its classification (Fig. 1).

*Informational Note:* To reduce the need for expensive equipment and expensive wiring methods, use some ingenuity to locate as much electrical equipment as possible in an unclassified location.

## CLASS I LOCATIONS

A Class I location is an area where flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors may be present in quantities sufficient to produce explosive or ignitable mixtures [Sec. 500.5(B)].



(1) Class I, Division 1 Location. A Class I, Division 1 location is a location in which:

(1) Ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors may exist in the course of normal operations, or

(2) Ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquids above their flash points may exist due to repair or maintenance operations or because of leakage, or

(3) Breakdown or faulty equipment might release ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors, and the electrical equipment becomes a source of ignition.

The Informational Note provides a list of 15 locations that are examples of Class I, Division 1 locations (there were 10 in the 2020 NEC).

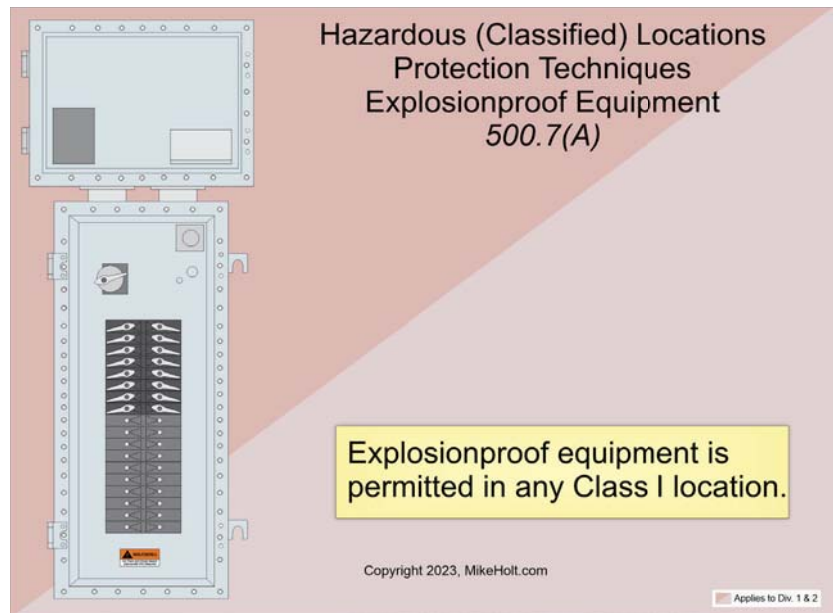
(2) Class I, Division 2 Location. An area where volatile flammable gases, or combustible or flammable liquid-produced vapors, would become hazardous only in case of an accident or of some unusual operating condition, or under any of the following conditions:

(1) If flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors

Determining the classification of a specific hazardous area is the responsibility of those who understand the dangers of the products being used. These people include the fire marshal, plant facility engineer, and insurance underwriter.

are handled, processed, or used, but are normally confined within closed containers, and the gases would escape only in the case of accidental rupture or breakdown or in the case of abnormal operation of equipment.

(2) If ignitable concentrations of flammable gases, flammable liquid-produced vapors, or combustible



**Fig. 2.** Explosionproof equipment is permitted in any Class 1 location for which it is identified.

liquid-produced vapors are normally prevented by positive mechanical ventilation but might become hazardous through failure or abnormal operation of the ventilating equipment.

(3) Areas adjacent to a Class I, Division 1 location and to where flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors might occasionally be

(1) Class II, Division 1 Location. A Class II, Division 1 location is an area where combustible dust may exist under any of the following conditions:

(1) Under normal operating conditions combustible dust is continuously or periodically suspended in the air in sufficient quantities to produce mixtures that will ignite or explode, or

(2) If faulty equipment releases ignitable mixtures of dust and the equipment becomes a source of ignition, or

(3) In which Group E combustible dusts may be present in quantities sufficient to be hazardous in normal or abnormal operating conditions.

Informational Note: Dusts containing magnesium or aluminum are particularly hazardous; use extreme precaution to avoid ignition and explosion.

(2) Class II, Division 2 Location. An area where combustible dust would become hazardous under any of the following conditions:

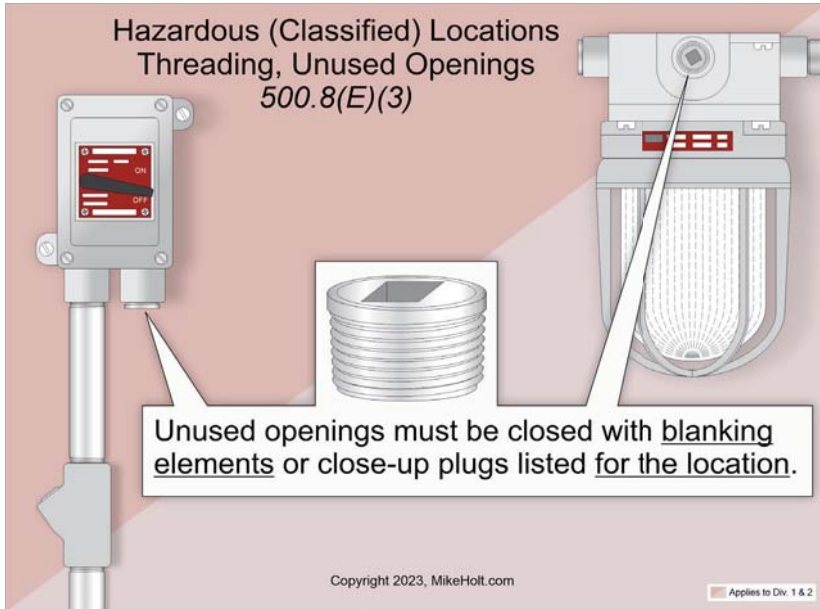
(1) If combustible dust, due to abnormal operations, may be present in the air in quantities sufficient to produce explosive or ignitable mixtures, or

(2) If combustible dust accumulation is normally insufficient to interfere with the normal operation of electrical equipment, but where malfunctioning

communicated unless prevented by adequate positive-pressure ventilation with effective safeguards against ventilation failure.

### CLASS II LOCATIONS

Class II locations are hazardous because of the presence of combustible dust [Sec. 500.5(C)].



**Fig. 3.** Unused raceway and cable openings must be closed with listed metal close-up plugs or approved blankets.

equipment may result in combustible dust being suspended in the air, or

(3) If combustible dust accumulations on, in, or near electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment or could be ignitable by abnormal operation or failure of electrical equipment.

### CLASS III LOCATION

A Class III location is an area where easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used and are not likely to be suspended in the air in quantities sufficient to produce ignitable mixtures [Sec. 500.5(D)].

(1) Class III, Division 1 Location. A Class III, Division 1 location is an area where easily ignitable fibers/flyings are manufactured, handled, or used.

(2) Class III, Division 2 Location. A Class III, Division 2 location is an area where easily ignitable fibers/flyings are stored or handled other than in the manufacturing process.

### PROTECTION TECHNIQUES

Electrical and electronic equipment in hazardous (classified) locations must be protected by one or more of the techniques enumerated in Sec. 500.7(A)

through (U). In the 2020 NEC, this list ended at (P). Some examples:

(A) Explosionproof Equipment. Explosionproof equipment is permitted in any Class 1 location for which it is identified (Fig. 2 on page 57).

(C) Dusttight Enclosures. Dusttight enclosures are permitted in Class II, Division 2 or any Class III location.

(D) Purged and Pressurized Systems. Purged and pressurized systems are permitted for equipment in any hazardous (classified) locations for which they are identified.

(I) Oil-Immersed Contacts. Oil-immersed make-and-break contacts can be installed in a Class I, Division 2 location.

(J) Hermetically Sealed Contacts. Hermetically sealed contacts can be installed in Class I, Division 2; Class II, Division 2; or Class III locations.

### EQUIPMENT

Articles 500 through 503 require equipment construction and installation that ensure safe performance under conditions of use and maintenance. You'll find requirements for suitability and approval in Sec. 500.8(A) and (B). For example, equipment installed in any hazardous (classified) location must be identified for the class and the explosive, combustible,

or ignitable properties of the specific gas, vapor, dust, or fiber/flyings that will be present [Sec. 500.8(B)(1)].

For Class I equipment, the Table 500.8(C)(4) temperature marking must not exceed the autoignition temperature of the specific gas or vapor that may be encountered [Sec. 500.8(D)(1)].

Class II equipment must not have exposed surfaces operating at a temperature in excess of the autoignition temperature of the specific dust as contained in Sec. 500.8(C)(4) [Sec. 500.8(D)(2)].

Threaded conduits must be made wrenchtight to prevent arcing when ground-fault current flows through the raceway system and to ensure the explosionproof or dust-ignitionproof integrity of the raceway system.

Threaded entries into explosionproof equipment must be made up with at least five threads fully engaged [Sec. 500.8(E)(1)].

*Exception: Listed explosionproof equipment with factory NPT entries must be made up with four and one-half threads fully engaged.*

This requirement ensures that if an explosion occurs within a raceway or enclosure, the expanding gas will sufficiently cool as it dissipates through the threads. This prevents hot flaming gases from igniting the surrounding atmosphere of a hazardous (classified) location.

Unused raceway and cable openings must be closed with listed metal close-up plugs installed per Sec. 500.8(E)(1) or (E)(2) [Sec. 110.12(A)] (Fig 3).

### KEEP THE GOAL IN MIND

Remember, it is assumed the flammable atmosphere outside the raceway will seep into the raceway system over time. The goal of the Code is to contain any explosion that occurs inside the raceway so such an event will not ignite the flammable mixture outside the raceway. This fact has repercussions throughout the next 12 Articles of Chapter 5.

**EC&M**

*These materials are provided by Mike Holt Enterprises in Leesburg, Fla. To view Code training materials offered by this company, visit [www.mikeholt.com/code](http://www.mikeholt.com/code).*



# Stumped by the Code?

By Mike Holt, NEC Consultant

All questions and answers are based on the 2023 NEC.

**Q.** What are the conditions flexible metal conduit (FMC) can be used and installed?

**A.** According to Sec. 348.10 of the NEC, FMC is permitted to be installed exposed or concealed.

**Q.** Under what conditions can LFMC not be used and installed?

**A.** Section 350.12 states that LFMC must not be used where subject to physical damage.

**Q.** What is the minimum and maximum FMC trade size permitted?

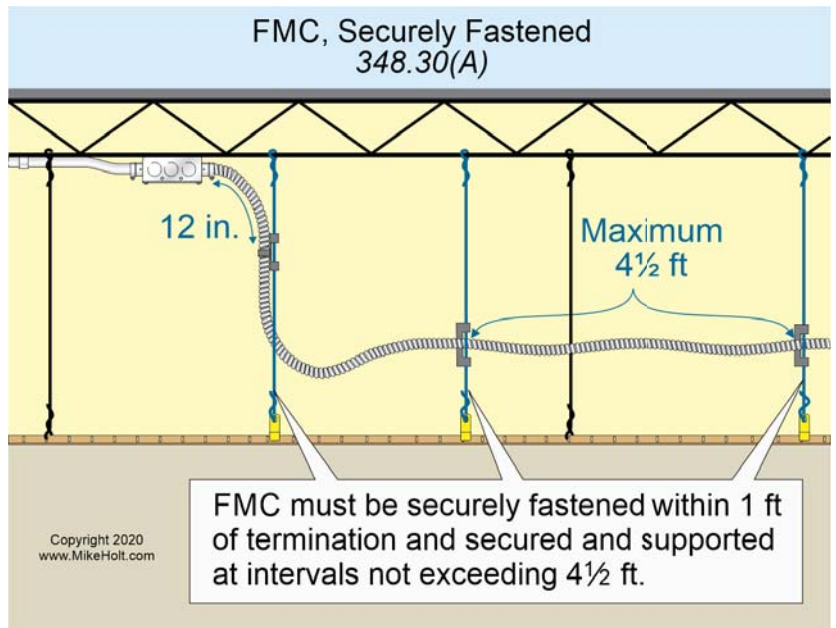
**A.** The minimum and maximum FMC trade sizes permitted are found in Sec. 348.20.

- (A) Minimum. Trade ½, except trade size ¾ is permitted for the following applications:
- (1) For enclosing the leads of motors.
  - (2) Not exceeding 6 ft in length:
    - a. For utilization equipment,
    - b. As part of a listed assembly, or
    - c. For luminaire tap connections in accordance with Sec. 410.117(C).
- (B) Maximum. Trade size 4.

**Q.** What is the minimum and maximum LFMC trade size permitted?

**A.** The minimum and maximum LFMC trade size permitted is listed in Sec. 350.20.

(A) Minimum. LFMC smaller than trade size ½ is not permitted to be used.  
*Exception:* LFMC can be smaller than trade size ½ if installed in accordance with Sec. 348.20(A).



(B) Maximum. LFMC larger than trade size 4 is not permitted to be used.

**Q.** What are the requirements for securing and supporting FMC?

**A.** Section 348.30 gives the requirements for securing and supporting FMC.  
 (A) Securely Fastened. FMC must be securely fastened by a means approved by the authority having jurisdiction within 1 ft of termination, and it must be secured and supported at intervals not exceeding 4½ ft (see **Figure**).

Where cable ties are to be used to secure and support Type FMC, they must be listed and identified for securing and supporting.

*Exception No. 1:* Type FMC is not required to be securely fastened or supported where fished between access points through concealed spaces and supporting is impractical.

*Exception No. 2:* If flexibility is necessary after installation, unsecured

lengths from the last point the raceway is securely fastened are not permitted to exceed:

- (1) 3 ft for trade sizes ½ through 1¼
- (2) 4 ft for trade sizes 1½ through 2
- (3) 5 ft for trade sizes 2½ and larger

*Exception No. 4:* Lengths not exceeding 6 ft from the last point where the raceway is securely fastened can be unsecured within an accessible ceiling for a luminaire(s) or other equipment. Listed fittings are considered a means of securement and support.

(B) Horizontal Runs. FMC installed horizontally in bored or punched holes in wood or metal framing members, or notches in wooden members, at intervals not more than 4½ ft is considered supported, but the raceway must be secured within 1 ft of terminations.

**EC&M**

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

# Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

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

## ALLEY WHOOPS!

I spotted this installation while walking through an alleyway on a recent visit to a big city near me. The air conditioning unit sitting on the brackets made of strut (below the windows) has no disconnecting means anywhere within sight. Section 440.14 requires a disconnecting means to be located within sight from — and readily accessible from — the air-conditioning or refrigeration equipment. *Exception 1* allows the disconnecting means to be located remote from the air-conditioning or refrigeration equipment if the equipment is essential to an industrial process at a facility with written safety procedures and qualified people if the disconnect is lockable in accordance with Sec. 110.25. This is a residential building, so *Exception 1* is not applicable. The power for this unit is being supplied by what appears to be a UF cable secured to the refrigerant lines with cable ties. Section 225.21 refers installers to the requirements in Sec. 230.51 when installing multiconductor cables on the surfaces of buildings or structures. There does not appear to be any Code sections that specifically prohibit installing and supporting UF cables in this manner. However, Sec. 340.12(9) prohibits installing UF in direct sunlight unless the cable is identified as being sunlight resistant.



## BASEMENT BLUNDER



These NM cables are installed in the unfinished basement of a single-family home. Running cables smaller than two 6 AWG or three 8 AWG perpendicularly to the joists and securing the cables directly to the underside of the joists is a violation of Sec. 334.15(C). These smaller NM cables must be either run through holes bored through the joists, or they must be installed on running boards. Where cables are run through bored holes, Sec. 300.4(A)(1) requires the holes to be bored so the edge of the hole is no closer than 1/4 in. from the edges of the wood member. If this distance cannot be maintained, protective steel plates must be installed to provide protection against penetration from nails or screws. That does not appear to be a concern here. However, installers must be aware that building codes may have additional requirements about where holes may be drilled and what size holes may be drilled in various wooden framing members. For example, holes may not be permitted to be drilled in the middle one-third of the span of a floor joist or closer than 2 in. to the edge of the joist. The holes drilled through these joists may or may not comply with your locally adopted building code.



# Breaking Down “Barriers”

Could duct seal be used to cover the supply-side terminals to comply with Sec. 230.62(C) barrier requirements?

By Russ LeBlanc, NEC Consultant

**Photo 1** shows two examples of protective barriers permitted to be installed on the supply-side terminals of a circuit breaker used as a service disconnect. **Photo 2** shows duct seal covering the supply-side terminals. A question was recently asked by Willy Geezer, a member in the more than 46,000-member Electrical Code Discussion group of Facebook as to whether duct seal could be used to cover the supply-side terminals to comply with Sec. 230.62(C) barrier requirements. When I first read Willy’s question, I instinctively wanted to say, “No way!” But when I read the wording in Sec. 230.62(C) again, I had second thoughts.

Product standards for panelboards allow certain barriers to be metal, nonmetallic, or even slate or marble. Product standards for enclosed switches also permit barriers to be metal, nonmetallic, and vulcanized fiber. Field-installable barrier kits are also available for panelboards and enclosed switches. Barriers that are installed as part of a panelboard, enclosed switch, or other service equipment or barriers installed as a field installable accessory kit for any of this equipment would be subjected to passing stringent product standard testing criteria. There are many kinds of duct seal, but I’m not sure which product standards, if any, these sealants would be classified under. While using duct seal as a barrier to satisfy Sec. 230.62(C) may not be specifically permitted, it is also not specifically prohibited either. This leads me to some other questions, too. Would silicone sealant be OK? Would simply covering the terminals with rubber tape be OK? Would PVC tape be OK? I suppose installers would want to have a discussion with the AHJ prior to choosing duct seal or any of these other “creative” ideas as the method of providing the required barrier.

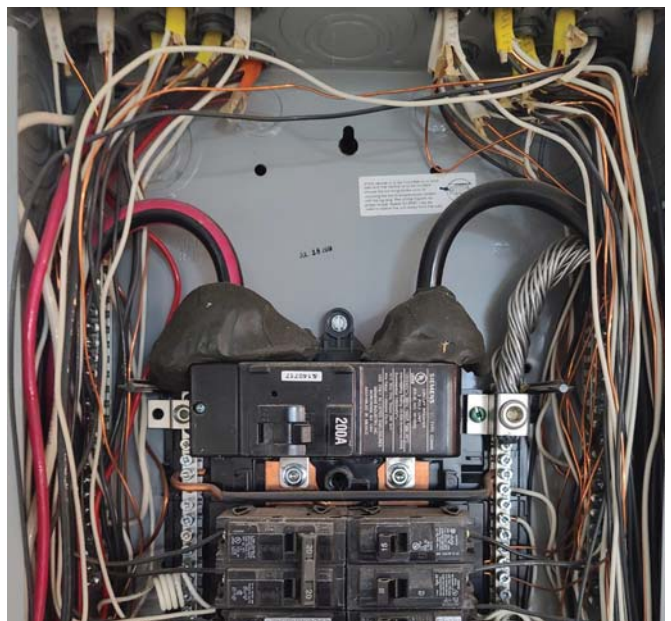
If I was the AHJ and saw duct seal covering the energized supply-side terminals, I would need some assurances that the duct seal will be able to perform as effectively as a barrier that is specifically designed by the manufacturer for this application. Section 230.62(C) does not presently require these barriers to be identified or listed, but a discussion with the AHJ would be a good idea to determine what barriers he or she might approve.

Thanks for the great question, Willy! A big thank you also goes to Tyrus James, owner of James Family Electric in Northfield, N.H., for sharing the photo of the duct seal installation he discovered while performing some work at a customer’s property.

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**Photo 1.** Protective barriers are permitted to be installed on the supply-side terminals of a circuit breaker used as a service disconnect.



**Photo 2.** Duct seal was used to cover these supply-side terminals.



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## What's Wrong Here?

By Russ LeBlanc, NEC Consultant

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

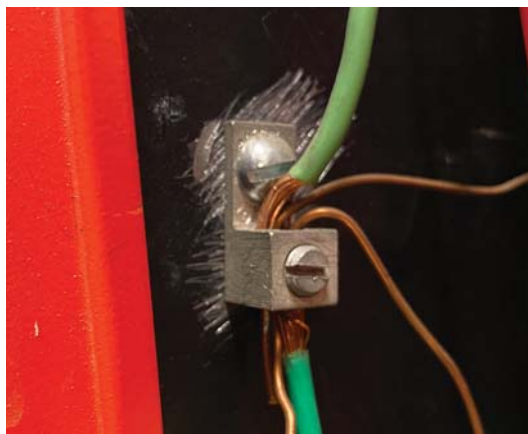
**Hint:** Not-so-flexible metal conduit



‘TELL THEM WHAT THEY’VE WON...’

Using the 2023 NEC, correctly identify the Code violation(s) in this month's photo — in 200 words or less — and you could win an Arlington Industries 18-in. Slider Bar and plastic box for mounting between studs with non-standard spacing. E-mail your response, including your name and mailing address, to [russ@russleblanc.net](mailto: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.

### AUGUST WINNERS



Our winners this month were Chuck Ross with Wired Up Electric LLC in Olney, Md.; HT Neighbors with HT Electric in Wellston, Okla.; and Benjamin Bull, an *EC&M* reader from Elberon, Va. They knew installing five conductors in a lug designed for only one is a no-no!

Unfortunately, I see this problem quite often, especially when it comes to equipment grounding conductors. As specified in Sec. 110.14(A), terminals for more than one conductor must be specifically identified for that purpose. I have seen terminals of equipment grounding bars installed in panelboards that were, in fact, designed and identified for connection of one, two, or even three equipment grounding conductors! However, I have never seen this kind of foot lug (a.k.a. a separately installed pressure connector) designed and identified for five conductors. I'm not sure such a creature exists.

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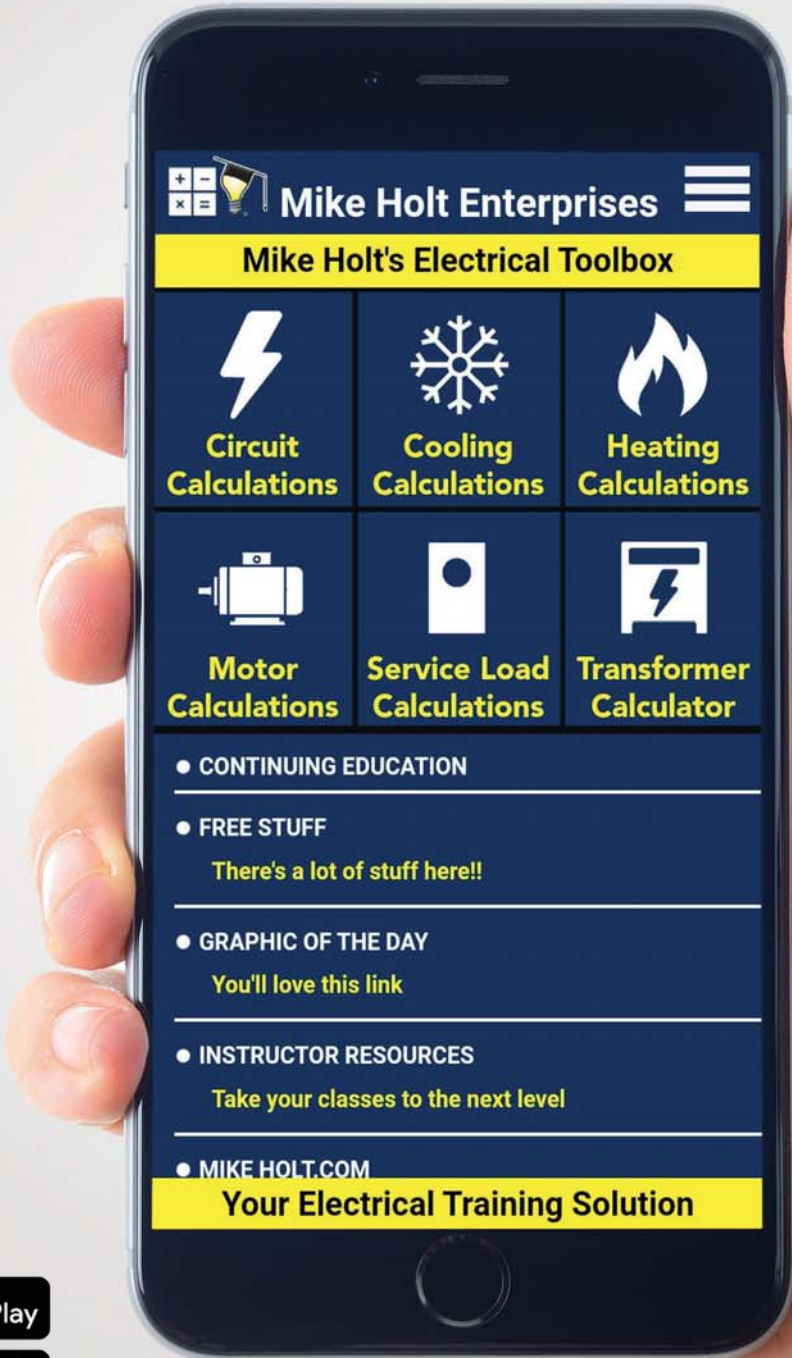
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"...as for me and my house, we will serve the Lord." [Joshua 24:15]



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