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The New Stance on IT

Mobile devices in hand, electrical pros adopt the modern technology pose for speedier dialogue

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A Penton Media Publication

January 2013, Vol. 112/No. 1

EC&M®

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Editorial (and Business) Office: Penton Media, Inc., 9800 Metcalf Ave., Overland Park, KS 66212-2216.

Subscription Rates: Free and controlled circulation to qualified subscribers. Non-qualified persons may subscribe at the following rates: USA (one year) $48.00; Canada (one year) $80.00; international (one year) $120.00; single copies $10.00. Prices subject to change.

Subscription Services Department: For subscriber services or to order single copies, call customer service at (866) 505-7173 (U.S.) or (847) 763-9504 (Outside U.S.) — or e-mail ebcs@pbsub.com.

Postmaster: Send address changes to *EC&M*, P.O. Box 2100, Skokie, IL 60076-7800 USA.

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Calculations on the Go

By Michael Eby, Editor-in-Chief

Back in July 2011, we published our first article on software apps being used in the electrical market ("An App for That"). References were made to GPS-based apps, camera phone-based apps, document viewing apps, and more. A year later, I presented some growth projections in the app market and listed some specific technical-based apps in my Industry Viewpoint, which I'd run across in my travels and heard about through discussions with readers ("Rise of the Apps"). I also took the opportunity to ask you to share some of your favorite apps with me. Based on the feedback I received from this request and additional research uncovered by the *EC&M* editorial team, we felt it was worthwhile to revisit this topic and present some new real-life examples of how readers are using electrical apps to get the job done.

Our cover story this month, "The New Stance on IT," starting on page 6, provides a more recent snapshot of how electrical engineers, electrical contractors, electrical technicians, and electricians are using the power of mobile device software to complete their daily work activities. We learned how field workers are using smartphone and tablet PC apps to help them properly bend and size conduit. They're also using apps to check voltage drop levels, perform load calculations, and size wire/cable for branch circuits and feeders. Service professionals are using information sharing and communications apps to meet today's accelerated pace of business. Engineers are relying on apps to aid in product selection, verify adherence to new and revised code requirements, and even monitor and control their customer's electrical systems. Plant engineers and technicians rely on apps to monitor energy usage, manage maintenance activities, and analyze the merits of upgrades.

After reading this story, I think you'll have a hard time denying the merits of mobile technology in today's workplace. But I'd like to point out a couple of items that concern me. The first focuses on end-users blindly following the results of an app calculation without truly having a firm grasp on the "old school" way of calculating the result. The second deals with the mental and physical distractions caused by the use of mobile devices while on the job.

If you have any experience at all with software programs and apps, you know how easy it is to plug in some data fields and get a quick answer. If you don't have the right level of experience with the task at hand, you might improperly apply the app calculation and/or its subsequent results. This is especially a concern with entry-level workers or those with limited real-world experience. Although each of us needs to police ourselves in this area, I think it puts even more pressure on supervisors and managers to closely monitor individuals who report to them. What concerns me even more, however, is the danger that can arise from distracted use of mobile devices. We're all guilty of pulling out our smartphone and checking messages at any given moment. We do it in the middle of performing a task in the field. We do it while walking around the job site. We even do it on the factory floor near working machinery and moving vehicles. Getting distracted when performing work near energized equipment or during a dangerous test and measurement task could be life threatening.

Each and every one of us needs to first take a moment and really assess our actions when placed in these situations. Set up a list of basic rules to follow using your smartphone or mobile PC. Clearly define where and when it's appropriate to use mobile devices and under what circumstances. After getting your own actions in order, make sure you do the same for those individuals you supervise. With the addiction level we all seem to have reached with our mobile devices, it's imperative for you to create rules in this area in order to help prevent individuals from hurting themselves or others on your watch.

Michael Eby

The New Stance on IT

MOBILE DEVICES IN HAND, ELECTRICAL PROS ADOPT THE MODERN TECHNOLOGY POSE FOR SPEEDIER DIALOGUE

By Tom Zind, Freelance Writer

Head down, palm up. That's how we're choosing to engage with information technology nowadays, our eyes fixed — transfixed some would say — on smartphones and other mobile digital devices not just for fun and diversion, but for productive reasons, too.

Electrical professionals are joining the wireless mobile fray, e-mailing, texting, navigating the web, and using the ubiquitous apps that deliver quick answers, manage and customize information consumption, and hasten communication. Now, with information at their fingertips, electrical pros at all levels are armed with ever more powerful on-demand IT capabilities. Tasks that used to demand laborious hand calculations or time-consuming diversions to consult hefty code books — and the conveyance of information via face-to-face meetings, phone conversations, and e-mails that are becoming the equivalent of smoke signals as expeditious means of communication — are being sped up and simplified.

EC&M recently conducted a non-scientific online poll that showed 68 of 126 respondents indicating that they use mobile device apps daily or weekly to complete electrical tasks more efficiently. Yet 44 said they never did. There's a lot of room for more adoption, but clearly many are using mobile IT — from electricians and contractors to plant/utility personnel to engineers and designers. The uses vary, but all are seeing benefits.

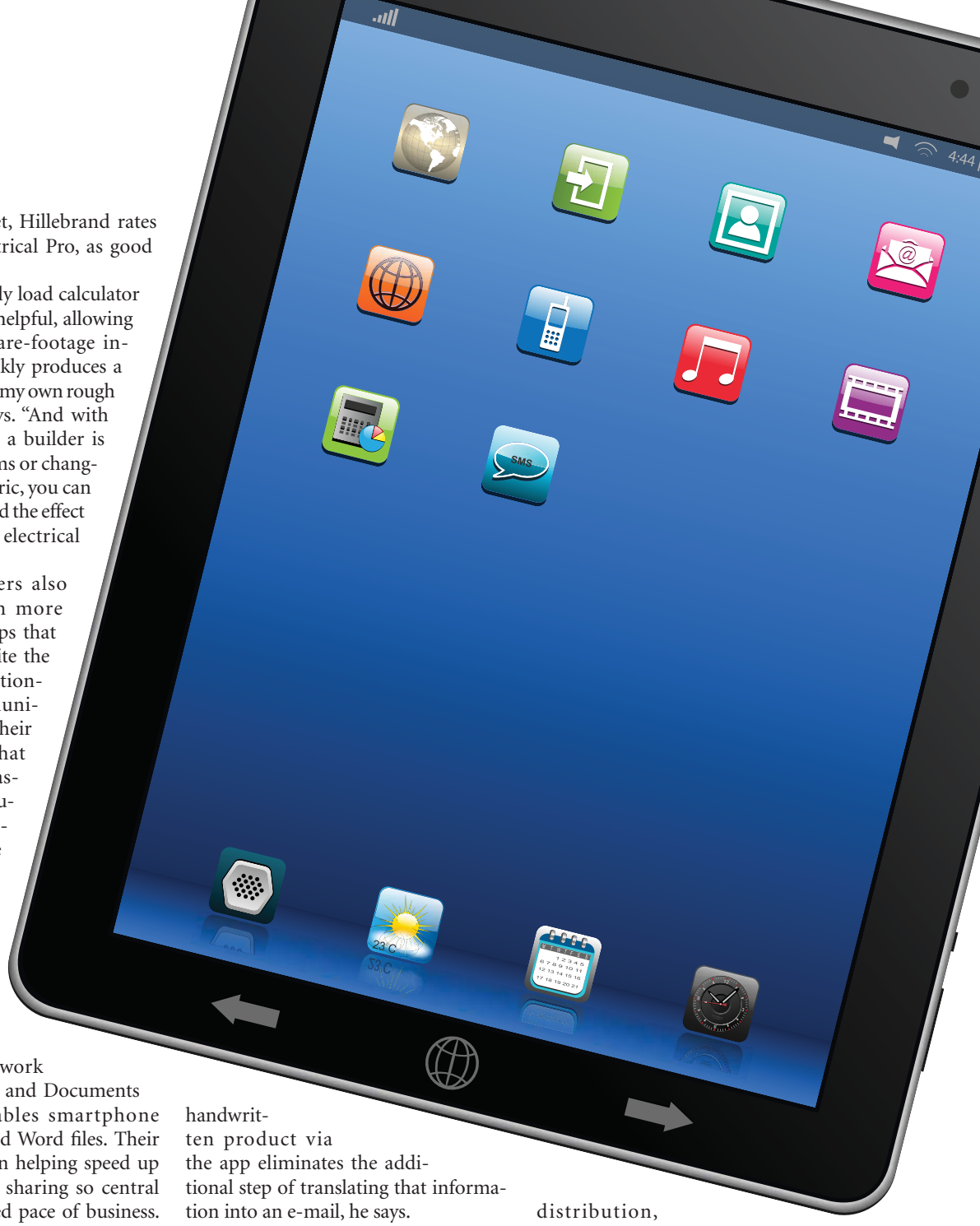
Toolbox time-savers. Electrical service providers to residential and commercial markets are sending more workers into the field and arming more project designers with mobile devices that amount to another tool in the toolbox. While the degree of reliance on apps that perform calculations and facilitate communications varies, more electricians and contractors are at least assessing apps and mobile device functions that in the right hands can produce more efficiencies.

Apps that deliver quick answers to questions on sizing, design, product selection, critical values, Code requirements, simulations, and other key variables are finding favor with electricians like Brandon Birdsell. A journeyman commercial electrician with Bosley Electrical Co., Sacramento, Calif., Birdsell has found himself relying more on apps that allow him to sidestep plodding manual calculations.

From iBend Pipe used to figure conduit bends to Elec Ref that calculates values for typical variables like conduit fill, feeder size, ground sizing, voltage drop to Electrical Calc that serves as a comprehensive resource needed for complex jobs, the apps Birdsell uses are helping him navigate jobs more quickly and confidently. Rather than having to consult the NEC and make calculations, he can quickly activate a pertinent app, plug in values, or consult tables and have at least the shape of an answer needed to move ahead.

"These apps provide a much quicker and more efficient reference in the field," he says. "iBend Pipe, for instance, helps me figure out tough bends like rolled offsets or parallel bends. I come out looking like a professional pipe bender without spending time racking my brain figuring out the math. Apps like this allow us to get started more quickly or get estimates to customers in a much more efficient time frame."

Some electricians and contractors are starting their foray into calculation apps by looking for those that meet a niche need. Bill Hillebrand, partner and general manager at Romanoff Electric, Louisville, Ky., has begun sifting through the growing library of apps available, searching for those with the most relevance to his type of work. With the company heavy into the residential



construction market, Hillebrand rates some, such as Electrical Pro, as good supplemental tools.

"The multi-family load calculator on that app is very helpful, allowing me to plug in square-footage information that quickly produces a figure that can verify my own rough calculations," he says. "And with single-family, when a builder is adding HVAC systems or changing from gas to electric, you can show them in the field the effect it will have on the electrical service."

Service providers also are tinkering with more general-purpose apps that enhance and expedite the important information-sharing and communications aspects of their businesses. Apps that create, capture, massage, and deliver documents, data, and visuals more quickly are being adapted for use in the field and other work stages.

Hillebrand uses apps like CamScanner, which converts digital images of handwritten paperwork to PDF documents, and Documents To Go, which enables smartphone viewing of Excel and Word files. Their value, he says, lies in helping speed up the process of data sharing so central to today's accelerated pace of business. These, combined with a smartphone digital camera, enable quick relay of information from the field.

"These days, everything is [available] to you right away, and things are expected back right away," he says. "There are times you wish that wasn't the case, but this mobile technology has helped in that regard."

Birdsell has grown fond of JotNot Scanner Pro, a document conversion app he uses to transform sketches, paper notes, and diagrams to jpeg, pdf, or Word files that can be more readily shared. Simply capturing a digital image of the handwritten product via the app eliminates the additional step of translating that information into an e-mail, he says.

Design aids. Though their work environments are different, engineers designing and building electrical equipment and installations are using mobile IT for many of the same reasons as contractors and electricians. But their interests may skew more toward apps that aid component selection, consulting code requirements, and even providing remote control and monitoring of client installations.

Chuck Arthur, vice president of Arthur Engineering, Inc., an Elk Grove, Calif.-based designer of power distribution, lighting, and control systems for industrial facilities, has been on a self-described app "binge" since replacing his Blackberry with an iPhone. Among those he likes are NEC Changes, an NFPA app that logs recent code updates; an NEC Quick Reference app that produces frequently used tables; and calculator apps like Conduit Fill Calculator, Voltage Drop Calculator, and Arc Blast Calculator that provide ready answers to respective queries. An emerging favorite are those that streamline product selection and deliver product data specs.

"Apps created by electrical

equipment manufacturers and distributors help specify components and pull up data sheets and manuals," he says. "One manufacturer has one where you scan the bar code on a piece of automation equipment or enter its part number, and specifications and manuals are pulled up. It's a major time-saver in the field."

In his design engineering role, Arthur likes the timesaving attributes of apps that enable quick referencing and calculations, and is eager to expand their use. One intriguing prospect is an app tied to the company's billing software that could enable logging of project hours via a Smartphone. But a functionality gap he sees with some favored apps is the inability to produce a log of activity.

"There may be times you want to record calculations made with an app, but many don't come with the ability to email them to yourself or put them into a project file as explanatory information for design drawings," he says.

Apps and mobile handhelds won't handle the nitty gritty of design anytime soon, but Rich Bender, an electrical engineer with Girtz Industries/Z-Power, a Monticello, Ind., provider of turnkey power packaging solutions, finds apps like Conduit Fill, Partial Reel, and Voltage Drop handy for quick calculations. He also likes an app associated with AutoCAD WS, which is handy for ready viewing of project schematics, though the best format

Girtz Industries' Rich Bender, left, and Doug Ohime, consult mobile apps for a capital improvement project.

for that is a larger-screen tablet device rather than a phone. Whether he's in the estimating, planning, or installing phase, Bender finds select apps beneficial when virtually every project is one-of-a-kind and time-sensitive.

"You can make decisions on the fly on an installation," he says. "We had a discrepancy on a wire size on a recent project, and we used an app to settle the confusion. Everyone may know what wire size is needed for a 400A service, for instance, but there are often oddball sizes where you may have had to guess. Now the answer can be at the tip of your fingers."

Being engineers, both Bender and Arthur are also intrigued by exploring an expanding frontier of mobile device and app functionality: remote control. Arthur's company is evaluating apps from home automation companies that could be used to enable iPhone or iPad-based remote environmental control for a high-end winery client's visitor center. Arthur also is monitoring progress by companies to develop mobile app versions of database-driven, web-accessible control and monitoring systems for industrial environments. Such a dashboard-style app could redefine the concept of total control, he says.

With Girtz's containerized power products outfitted with sophisticated touch screen control panels, Bender is closely watching remote control developments on the mobile app front. Apps like C-more Remote HMI that provide a range of monitoring and control capabilities from an iPhone or iPad would offer another affordable layer of flexibility and protection for critical, high-value power systems.

"An app like that is cheap, but the equipment it's operating is expensive," Bender says. "I think apps that give you touch-screen control like this are going to become very popular."

Covering more ground. In power environments where a unique challenge is monitoring and maintaining a multitude of dispersed assets, mobile IT conveys some distinct advantages that electrical professionals are starting to appreciate.

Joseph Wolfe, a senior electrician at Northern Virginia Community College Medical Campus, in Springfield, Va., has found mobile technology useful for both routine maintenance and calculating the precise impact of upgrade projects.

To help sell his idea of installing "greener" LED lighting around campus that would generate energy savings without impacting the need for light still powerful and bright enough to provide security and safety, Wolfe used the Electrical Calc Elite iPhone app to calculate the impact on lumens and wattage load. He recently used that same app, along with an infrared camera and data logger, to verify the need to replace a drives-

controlled rooftop HVAC unit.

That app, used in tandem with specialized conduit bending and sizing apps, has proven to be a powerful resource as he traverses the campus to maintain, repair, and assess electrical systems. It has proven especially helpful as a quick electrical math resource in the course of performing preventive maintenance on electric motors, lighting systems, and other assets.

"Input your numbers, hit 'enter,' and it tells me wire sizes, ampacity, load, what you can and can't do with containing devices, lighting factors, and lumens; it's the major math app I use when I come across new projects or make sure that what's installed is working properly," says Wolfe.

In Riverside, Calif., the city-owned electric utility has been exploring new ways to leverage IT for keeping tabs on its infrastructure and improving the efficiency of its service and maintenance crews, says David Miller, utility electric superintendent for Riverside Public Utilities (RPU). Built around apps that enable quicker identification of the condition and location of utility assets and more rapid response to problems, RPU initiatives are examples of how thinking creatively about IT's potential can open the door to new uses.

The one that's closest to being rolled out is a customer-targeted streetlight app that will produce an automatic streetlight-outage alert to utility repair crews. The process starts with an RPU app utility customers can download to their smartphones. A customer noting an outage takes a digital picture of a dead streetlight and GIS coordinates in the phone relay the precise location to the utility's 3-1-1 call center. Asset management software then forwards that information to utility service crews equipped with tablet computers loaded with the utility's app that provides a full map of the city's streetlights.

With quicker alerts and detailed outage information, RPU is hoping to improve service crew productivity to the tune of $80,000 annually, Miller says, and shave five days off the time it takes between notice of an outage and a repair. Such tech-enabled improvements, playing largely off the expanding mobile theme, are destined to become a bigger part of RPU's drive to shoulder its responsibilities with more foresight and certainty.

"This app was an example of us taking an app our IT department developed and making it apply to our business," Miller says, noting an app that will help crews better track and maintain condition of transformers is in development. "If we can predict the outcome, we can program it — and everything that's predictable we can automate with an app."

But not all electrical industry adaptations of IT tools are the result of such well-laid plans. Sometimes serendipity comes into play, as the Electric Power Board of Chattanooga's quality control manager discovered. After getting a point of view camera as a gift from his son, he had the idea to mount it on an extendable hot stick and use it to

Attention Deficits and Corner Cutting: A Mobile Device Risk?

As reliance on mobile devices grows, some special safety concerns arise with their use in the electrical work environment. Two stand out: inattention to surroundings and blind reliance on calculation apps. If devices are increasingly valued for their communication and electrical app powers, job-site restrictions on their use could ease, possibly resulting in more instances of potentially dangerous divided attention.

"Things are constantly changing on a typical job site, so I've trained myself to get off to the side and out of the main work area when I'm using my smartphone," says devoted app user, Brandon Birdsell, an electrician with Bosley Electrical Co., Sacramento, Calif.

Electrical calculation apps may be handy, but exercising caution with how and when they're used is important, says Joseph Wolfe, a senior electrician Northern Virginia Community College Medical Campus in Springfield, Va.

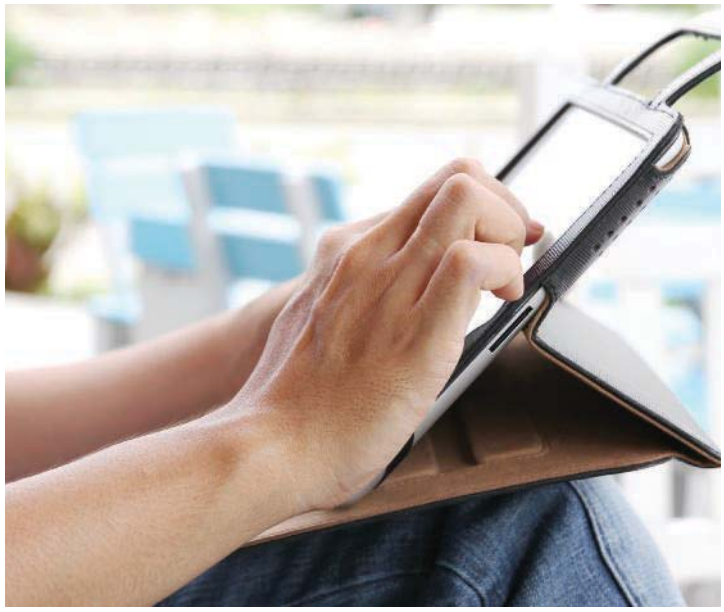
"If I'm testing an electric motor live, I won't be consulting an app," he says. "There's almost no circumstances where that information needs to be crunched while you're doing the work."

That number crunching is much easier with apps, but that in itself poses a safety concern. Namely, greater reliance on calculation apps that may not account for special circumstances and their availability to underqualified or less-seasoned workers who may not know the math behind the answers.

"An app may not factor in the need to consult the Code book if you're dealing with different temperature differentials in calculating wire ampacity," Birdsell says. "If you're not trained to understand those things, an app can cause you to mess something up."

App accuracy also can be a concern, which argues for using apps initially as a verification tool. Marty Riesberg, director of curriculum development for the National Joint Apprenticeship and Training Committee, Upper Marlboro, Md., says apps have to be used with some caution and can't substitute for thorough training and understanding of electrical concepts.

"It's important that these apps come from a reputable source," he says. "I'm not sure you pull them off Google Play or the Apple store without verifying the source of the information."



Sturdy toughbook tablets are accompanying more electrical pros into the field.

inspect hard-to-see spots at the tops of electrical poles. Now, instead of relying on the naked eye or binoculars, he's able to more confidently spot wood rot and evaluate the condition of connectors and insulators. In a municipal utility that's already well ahead of the curve on using mobile IT resources and automation, Phillips' innovative idea is an example of the synergy that's achievable with the form-and-function play that personal digital, mobile IT resources deliver.

Across the electrical construction, design and maintenance spectrum, wireless mobile devices seem poised to play a more important day-to-day role. They won't substitute for knowledge and expertise grounded in education and real-world experience, but with communication, speed, and efficiency becoming more paramount on the business side, the mobile IT platform is clearly a jumping-off point for improving processes and outcomes. **EC&M**

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BIM and the Lighting Professional

When it comes to lighting design, is BIM good, bad, or both?

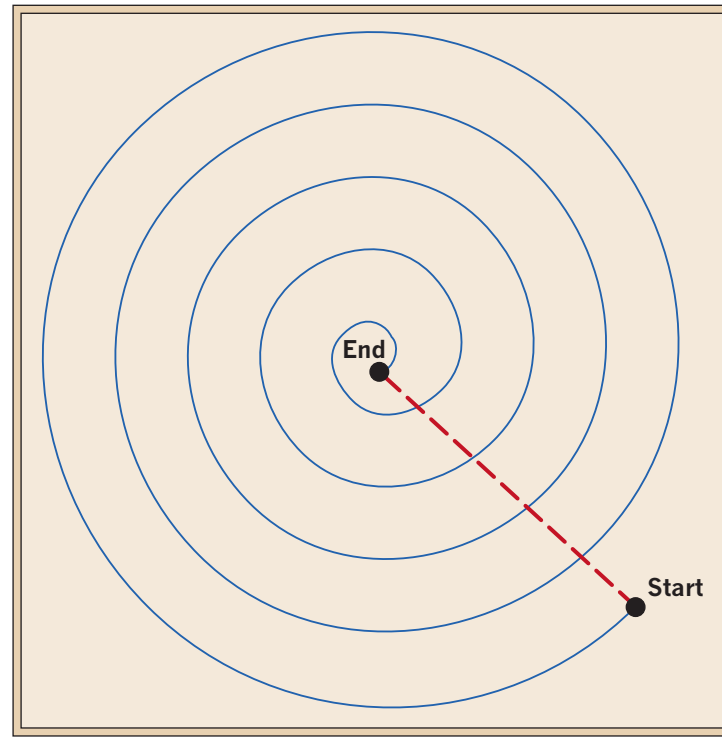

Fig. 1. Sample design iteration sketch.

By James S. Bates, P.E., LC, LEED AP, and Kenz Meliani, P.E., LC, LEED AP, HDR Architecture, Inc.

Although building information modeling (BIM) technically originated in the late 1980s, true implementation of this technology didn't start to gain real traction until much later. We've come a long way since the early days of BIM adoption on the design delivery front, but there's always room to grow. Today, we are beginning to understand how BIM and digitally informed design can significantly modify how we work. However, while there are many obvious advantages to these new work tools and processes, some distinct disadvantages still exist. This article will explore the impact of digitally informed lighting design today as well as look at the trends of tomorrow.

BIM and the design process. Design is an iterative process. The more a design is reviewed and revised, the more refined it becomes. As soon as we create a model of our design, the iterative cycle begins, as is illustrated by the spiral in **Fig. 1**. The line, intentionally dashed, represents the shortest — yet most difficult — route to a solution.

BIM offers the ability to facilitate iteration dynamically. Designers can see changes, make choices, and finalize decisions quickly and earlier in the process. This is a departure from the past, where numerous drawings were marked up to reflect even a single change. But as the design industry has evolved from hand drafting to two-dimensional computer-aided drafting (CAD) to three-dimensional BIM, it is interesting to explore

what we have gained — and perhaps lost — along the way.

"There was a transition moving from hand drafting to CAD, but we viewed that as a productivity increase and time saver in the long run," notes Steve Hefferan, principal of Hefferan Partnership Lighting Design (HPLD) in Boulder, Colo. "The chemistry of the team is, as it always was, vital to creating a successful lighting design."

Karen Murphy, senior lighting designer at HDR Architecture, believes the software is a great tool for the lighting designer and has helped advance the global industry's capabilities. BIM is particularly advantageous for contractors, according to Jason Massoth, senior project manager at MC Dean, Fort Belvoir, Va. "Typically, before BIM was used on projects, conflicts resulted in re-mobilization and change order costs to the owner," he explains.

With BIM, Massoth adds, the building is modeled, and problems are worked out prior to constructing it in the field. Yet, while software does facilitate design, Murphy cautions the downside is that software makes the design process look almost too easy. Software cannot and does not replace the knowledge of a professional, she argues, as it cannot understand the nuances associated with lighting strategies. Skillful and talented professionals are needed to make decisions. BIM does not replace the value a professional must bring to a project to ensure its success. Additionally, increased costs, layered with the added complexity of the software, training, and hardware, can present a disadvantage.

Strategies for effective BIM use. Successfully using BIM includes exploration of documentation and modeling responsibilities. BIM provides real-time coordination between disciplines, given the fact that even the slightest change can have multiple impacts. For example, a modification to a reflected ceiling plan (RCP) flows to all associated plan, section, schedule, and detail views. Designers can capitalize on the database functionality of BIM, automating take-off and energy assessment tasks, and even providing rendering tools for model visualization — tasks that previously were more time and labor intensive.

According to Paul Daniel, senior lighting designer with HDR Architecture, Princeton, N.J., designers need to remember there is a learning curve associated with using this software, and it takes time to master. He recommends investigating the many training mechanisms available commercially from software vendors, along with a few lighting design specific tools.

When setting up working views, it is typically desirable to see ceiling, equipment, furniture, and floor plans achieved by a cut plane at task level — for example, at 2 ft, 6 in. above finished floor (AFF) with the bottom of the view range at zero and the top at 10 ft (**Fig. 2** on page 16).

Two types of labeling parameters are available for fixture elements. Instance parameters are unique to one device, such as a circuit number. Type parameters are global; one change updates all associated devices. For example, a fixture type change within a fixture schedule simultaneously changes all associated devices throughout the model.

Two types of lighting fixture placement configurations are offered. Level-based fixtures provide an independent component, allowing changes such as the height or location, independent of the architecture. Face-based fixtures are hosted to architecture. For example, when a ceiling is moved, the associated fixtures move; when a wall is deleted, the associated fixtures are deleted.

With so much digital content accessible to various disciplines, trust is imperative for successful project delivery, as is an initial understanding of the BIM delivery ownership and team structure. Project size is one criterion that can be used successfully to structure the model (**Fig. 3** on page 16). For example:

• For mid-size to large projects, lighting devices reside within the architecture model independent of the engineering model.

• For large projects, architectural ceilings and lighting devices reside in one model alone for computing efficiency.

• For small projects, the lighting devices reside within the engineering model, where coordination of lighting and architecture is more difficult due to the separate models, yet manageable.

While useful for portions of a project, some software programs are not appropriate at all phases, particularly if lighting design decisions are being pushed forward well before

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other crucial design decisions have been finalized, according to HPLD's Hefferan. Tom Lyman, director of lighting design at HDR Architecture, shares this view. "BIM does not necessarily replace the idea of developing concept sketches and relaying them to people," he notes.

This is particularly true for daylighting design. Clarence Waters, a professor of architectural engineering at the Durham School of Architectural Engineering and Construction University of Nebraska-Lincoln (Omaha Campus), emphasizes that daylighting must be considered before lines are placed on paper or into BIM. "It needs to be considered from the very, very concept," he says.

One way to provide daylighting analysis earlier is by using Google SketchUp and OpenStudio, recommends Rob Guglielmetti, daylighting engineer at the National Renewable Energy Laboratory (NREL), Golden, Colo. Guglielmetti reports that very little modeling time is required to rapidly build up a series of results from different energy conservation measures and actually see integrated results. NREL's Jennifer Scheib, lighting engineer, offers the following analogy: You need both the sequence of operations as well as the circuiting diagram and RCP. The installer relies on the plans and the contractor to purchase equipment. However, in terms of accepting the solution and pushing a solution in operating mode, that sequence of operations is extremely critical. There is overlap and different approaches to lighting design but typically concept narratives, discussions, and sketches are considered, daylighting and electric lighting software is used, and then BIM is implemented.

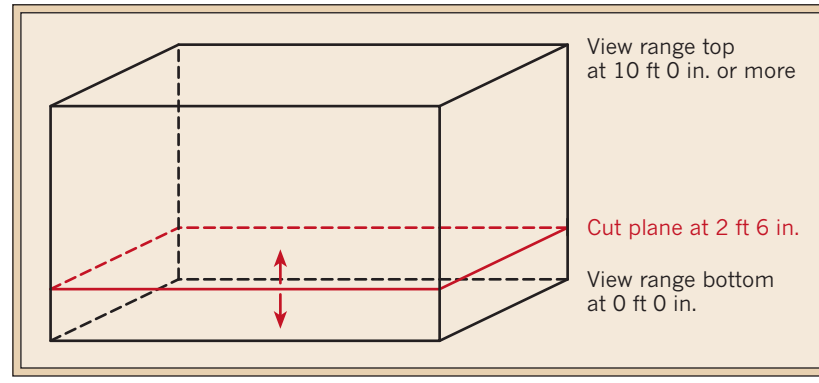

Fig. 2. A typical lighting plan setup used in the design process.

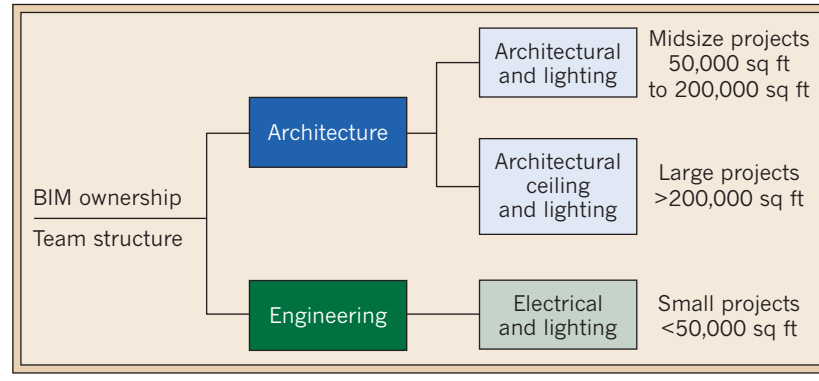

Fig. 3. Suggested team structure per project size example.

The future of BIM in lighting design. With the integrated approach BIM provides, intelligent content is readily available to the design team, which can be very successfully employed under the right circumstances. Cost savings for contractor, design-build, and A/E firms are easily realized. BIM combines documentation, coordination, and scheduling tools in one platform.

When all disciplines share devices, courtesy is essential, or problems will abound. Jon Brooks, principal of Architectural Engineering Design Group, Inc., Denver, recommends that firms use state-of-the-art computers. This is because older computer models that may run CAD may not be able to run BIM programs effectively. Additionally, in the short-term, there are training costs associated with BIM with a dearth of electrical specific trainings available.

Blythe von Reckers, outside specification sales with Pacific Lighting Systems, Seattle, receives requests for BIM devices for all of the fixtures her firm represents. "Lighting manufacturers' BIM devices need to be simple, reducing complications while increasing digital libraries for lighting representatives and designers," she says. "Development of lean BIM content, appropriate for efficient implementation, is needed."

When all disciplines share devices, it creates new ways of approaching lighting design as AEDG's Brooks points out. He sees BIM as much more than a design-draft; the architect or engineer is actually drawing as they are designing.

At the University of Nebraska, architectural engineering is a new program that has stemmed from such industry demands. Professor Waters says that what began as hand drafting and then evolved to CAD has now evolved to teaching lighting software tools and BIM.

Another big revolution is solid-state lighting (SSL) technology and all the different types of product and product cycles, according to Hefferan of HPLD. With shrinking project budgets and schedules paired with changes in technology and energy use policies, firms are looking for efficiencies while maintaining a high level of quality. Appropriate use of these various resources and BIM tools by the lighting design professional is paramount to provide the best design software, at the best time, in the best manner, so as to best serve the client. **EC&M**

Bates and Meliani are electrical engineers with HDR Architecture, Alexandria, Va. They can be reached at James.Bates@hdrinc.com and Kenz.Meliani@hdrinc.com.

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Sand Processing Plant Doubles Production

By Amy Fischbach, Freelance Writer

The Midwest often endures severe winters with frigid temperatures, ice storms, and heavy snowfall. Because Preferred Sands, a sand processing facility in Genoa, Neb., depends on water to process its sand, the freezing temperatures and other inclement weather conditions often halt production at its wet sand processing facility, leaving the final dry plant short of good sand for processing before the winter ends. Thanks to new upgrades and automated controls, however, Preferred Sands is now able to process enough sand through the wet facility to keep its dry plant in Genoa running year-round.

The slurry tank shown in the background is where sand and water are combined to create the pumpable slurry mixture that is sent from the mine site down to the wet plant for processing.

Expanding a plant. Preferred Sands first turned to Interstates, an electrical contractor headquartered in Sioux Center, Iowa, to work on an expansion at its dry plant. At this processing facility, which is located away from the river, the company dries out the sand, sizes and grades it, and then prepares it for its customers. After successfully completing the job, Preferred Sands then hired Interstates to develop a scope of work for the wet plant portion of the processing facility. In turn, Interstates pulled in its electrical engineering and instrumentation teams to assist the automation and construction groups on this portion of the project.

The wet plant, located near the mine site along the river canal, pumps dredged sand from the mine site through its processing equipment and then up to the dry plant storage location. At the wet plant, the company begins the process of sorting the sand and disposing of the substandard sand. Later on in the process, the company sorts the sand further into specific grades and ships it out, depending on clients' needs.

Improving productivity. On top of updating the existing equipment at the site, the contractor was responsible for installing and incorporating new mining equipment into the control system. Before Interstates began working on the system, the plant had an antiquated automated control system, but opted to run the facility in manual mode, says Jeff Miller, the director of project management for Interstates.

"We tried to create less manual work for them, improve the quality in their wet plant processes, and get more production out of the overall facility," Miller says. "They needed to be able to process enough sand through the wet plant so the dry plant could run all winter."

To help its client increase energy efficiency and productivity, Interstates' electrical team installed variable-frequency drives (VFDs) on critical slurry pumps. The new large horsepower motors can now operate in a state of barely turning to full speed. By investing in these VFDs, Preferred Sands can control the flow and density of sand via its centralized control room.

The contractor also implemented more sophisticated harmonic filtering support on the distribution system to give the client cleaner power and help them to run things more efficiently, says Jason Wyenberg, electrical engineer.

Solving a plugging problem. Before working with Interstates, the company's sand would sometimes reach too high of a density level when the workers were pumping large quantities of sand from the quarries or the transfer piping to the dry plant storage area. Consequently, the pipes would plug up, requiring 12 to 18 hr of clean out time.

Prior to implementing the new system, Preferred Sands only moved the product via manual controls at both the mine site and the wet plant. This offered limited communication, control, and visibility between the two facilities. Since installing the new control system, however, Preferred Sands has experienced a dramatic improvement in the capabilities and control of the system, practically eliminating plugging concerns.

Due to the large amount of new equipment that was brought into the plant as well as the new control system, Preferred Sands was able to double the amount of production in the mining

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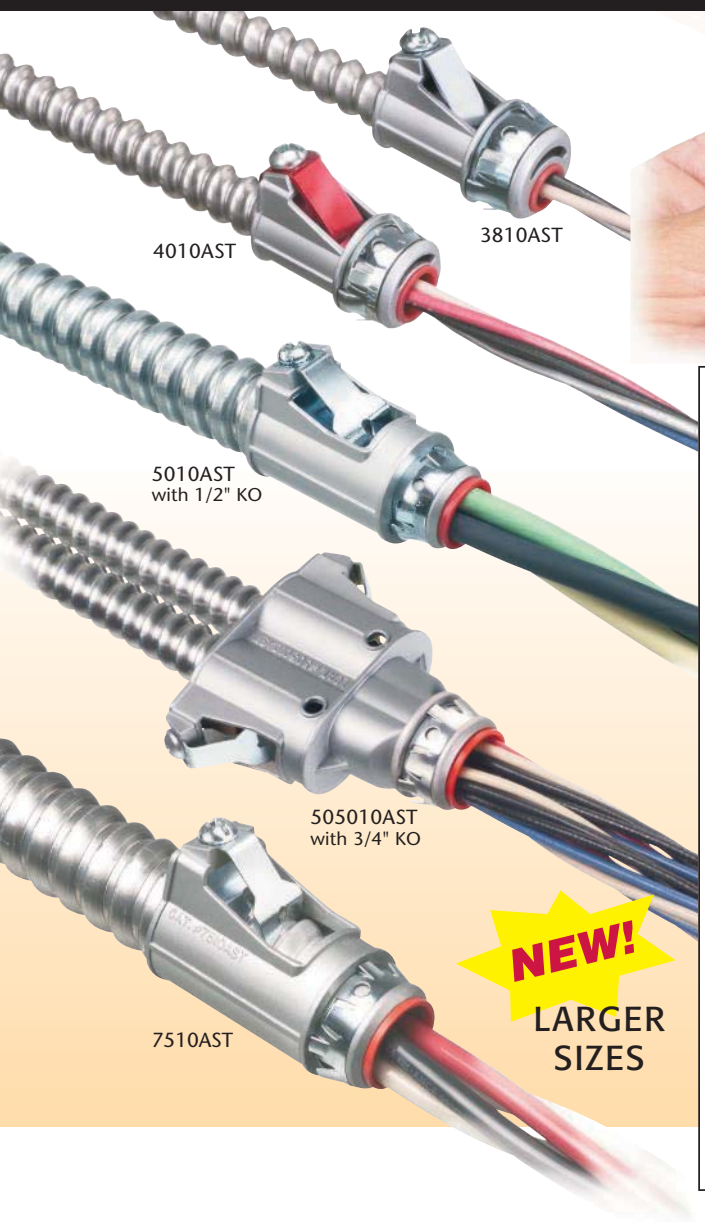

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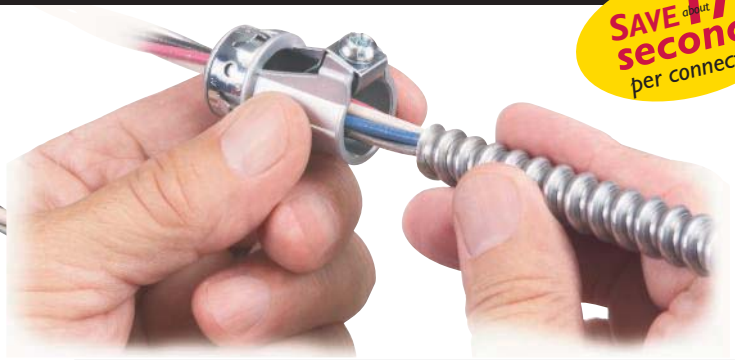

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area that brought sand into the plant.

"They now have the system set up so they can get more production capacity with very little effort," Miller says. "They can monitor the density, affect the flow rate, and get the amount of production they need right from the control room."

Confronting challenges. Because the Preferred Sands project was the team's first time working in the mining industry, Interstates took special precautions to protect its field workforce. For example, its employees wore goggle-style safety glasses to protect their eyes from blowing sand as well as ventilating face masks to provide breathing protection.

"Clouds of sand would come across the site, and our field guys would still have to go out and get the work done," says Randy Noecker, Interstates' on-site project manager.

The crew members also had to acclimate to working around the gargantuan mining equipment. Additionally, because of the tight schedule, many other contractors were also on the project, requiring added levels of organization.

"When we got on site, there were so many things taking place, and so many little things being done," Miller says. "Coordinating our efforts with other contractors took time, but Preferred Sands made sure that there weren't too many tradespeople in one spot at any given time."

To solve this problem, Interstates' foremen participated in daily "standup meetings," in which they met with the other trade foremen to decide when and where each should be working that day, Miller says.

Interstates also faced other challenges on the project. Because the contractor often deals more with value-added agricultural projects than mining jobs, the workers had to learn how to deal with a new product — sand slurry. In addition, engineers had to incorporate different methods of measuring the level inside the process tank, which raised and lowered very quickly. This was done using guided wave radar inside stilling wells in order to stabilize the measurements, due to the turbulence and fast changing levels, says Adam Dittbenner, service manager for Interstates' instrumentation group. The team also learned to use nuclear technology to measure the density of sand in the process lines. This was accomplished by installing a nuclear source on one side of a pipe and a detector on the opposite side. The concentration of sand in the slurry would affect the density of the flowing product, and further affect the radiation field transmitted from the source to the detector, thus measuring the density of the slurry.

Team members test/troubleshoot a portable PLC/power distribution unit for portable mining equipment.

Coming together. Interstates, which has been in business for 60 years and employs 550 people across four main business groups, was able to finish the job on schedule despite the tight time frame. When the contractor arrived on site, Preferred Sands had just come out of shutdown for the winter, and it needed to get sand up to the dry plant before it ran out.

"From day one, the schedule was the biggest challenge coming at us," says Noecker. "It took a lot of teamwork on our part and within our group to pull it off. We got the project in the first part of January, and we had to have it up and running by the time the mining season was ready to begin."

The company wanted to pump water before the contractor could get equipment on site. By working with its vendors, however, Interstates was able to secure the hardware faster than anticipated, provide an integrated solution, and get the plant up and running on time.

The ability to prefab materials was instrumental to the success of the project, Noecker says. At its prefab facility, Interstates preassembled disconnects for the large motors, conduit racks, cable trays, and lighting assemblies. The workers then labeled each item for appropriate placement in the assembly and shipped it to the work site. Interstates' electricians then installed the equipment at the plants.

"We approached the job with a plan and the technology to get the equipment to the site ready to install," Noecker says. "It was plug-and-play on a huge scale."

The Interstates team spent four months on the dry plant and three months on the wet plant. By bringing all of its business units together, Interstates was able to finish the job on schedule.

While Miller describes the end of the project as a "race to the finish," the contractor successfully helped its client meet its goal of doubling production and improving efficiency. **EC&M**

Fischbach is a freelance writer based in Overland Park, Kan. She can be reached at amyfischbach@gmail.com.

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Health Care Market Prepares for Rebound

By Amy Fischbach, Freelance Writer

Economist Ken Simonson expected the hospital construction market to experience a significant rebound in 2012. Instead, the construction starts are expected to slip 16% to 63 million sq ft, and the dollar value of starts could drop 12% to $20 billion, according to the McGraw-Hill Construction forecast.

"I've been quite disappointed," says Simonson, chief economist with the Associated General Contractors of America in Arlington, Va. "I'm puzzled as to why we didn't see more of a pickup in health care construction."

When the stock market began to rebound, Simonson expected private hospitals to resume their plans for construction due to favorable financial conditions. With their renewed ability to secure bonds at low interest rates, he predicted that hospitals would plan to catch up with their significant backlog of modernization and expansion. Instead, both hospital and clinic construction saw sharp drops in spending due to an increase in hospital mergers, cuts in federal spending, and an "uncharacteristically low" number of groundbreakings for major health care construction projects.

Economic uncertainty may also be to blame for the deferment in capital expansion plans, according to the Dodge forecast. Now that the uncertainty surrounding the presidential election and health care reform has dissipated, however, the health care industry may start to show an increase in spending, but it won't be a rapid or dramatic pickup, Simonson says.

Dodge also forecasts that the weakness in health care facilities will be short-lived, and starts should rebound 2% in 2013 to 64 million sq ft. Most spending will likely be focused on renovations, due to the number of aging facilities coupled with the growing elderly population's demand for state-of-the-art technology, amenities, and services.

Pyramid Electrical Contractors worked with a team to renovate the emergency department at a hospital in Belleville, Ill.

While other electrical contractors may not experience relief until next year, Pyramid Electrical Contractors in Fairview Heights, Ill., has already enjoyed a surge in health care work. In fact, health care now accounts for 28% of its business after increasing 10% in one year. With both the commercial and industrial sector down, the health care market is the only growing segment of Pyramid's business.

"Health care is the fastest growing segment of our company," says Ken Keeney, CEO. "I think it can be attributed to the graying of America and that health care is the No. 1 spending item for Americans once they reach retirement."

The technology in the medical field is changing at lightning speed, Keeney says, which is driving renovation projects throughout Illinois. The contractor is currently working on several projects at Gateway Regional Medical Center, including power requirements for X-ray and MRI renovations, preventive maintenance work, a motor control replacement, ADA upgrades, and power distribution for a 100% redundant emergency power system.

In addition, the company has partnered with Memorial Hospital in Belleville, Ill., on an assisted-living project and the build-out of a medical office building. Pyramid also installed the wiring for the emergency power distribution system and renovated patient floors at Touchette Regional Hospital in Centreville, Ill. Currently, its electricians are also installing the wiring for voice/data, fire alarms, nurse call, and access control systems at St. Francis Hospital in Lichfield, Ill.

While the health care construction market slipped in 2011 and 2012, electrical contractors nationwide could gain more opportunities in 2013 as hospitals strive to meet patients' needs. "The health care industry is changing so quickly that hospitals are trying to remain competitive and improve service in any way they can," Keeney says. EC&M

Fischbach is a freelance writer based in Overland Park, Kan. She can be reached at amyfischbach@gmail.com.

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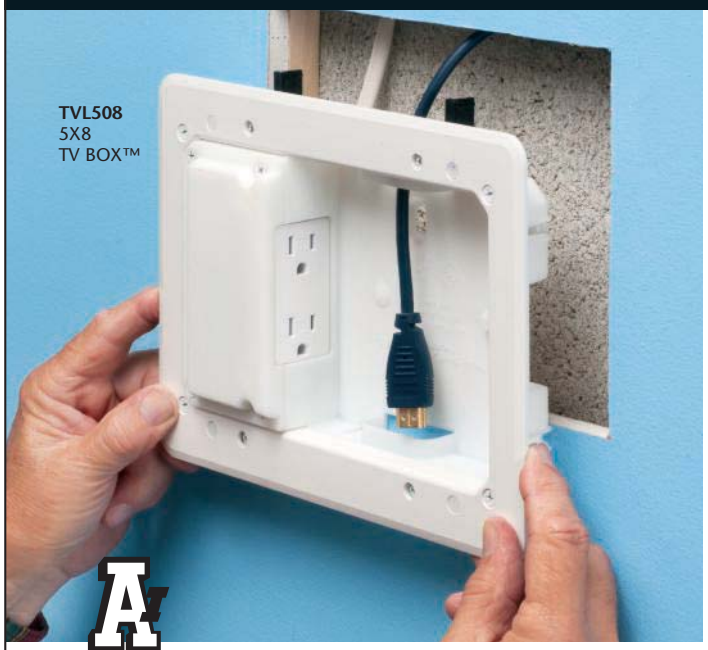

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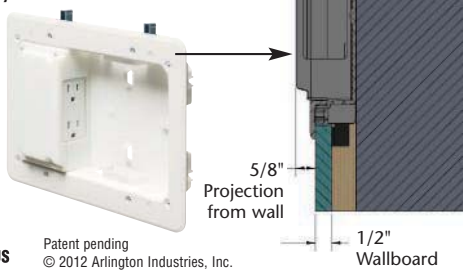

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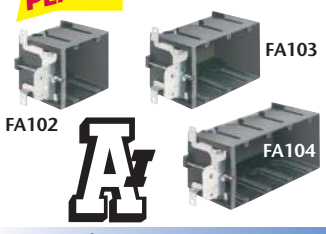

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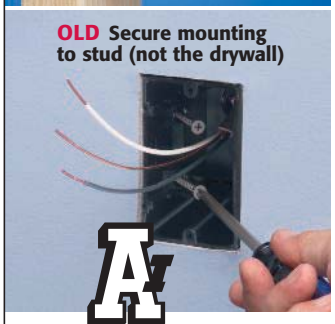

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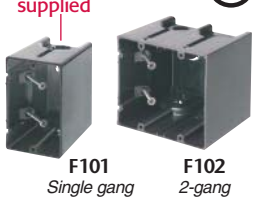

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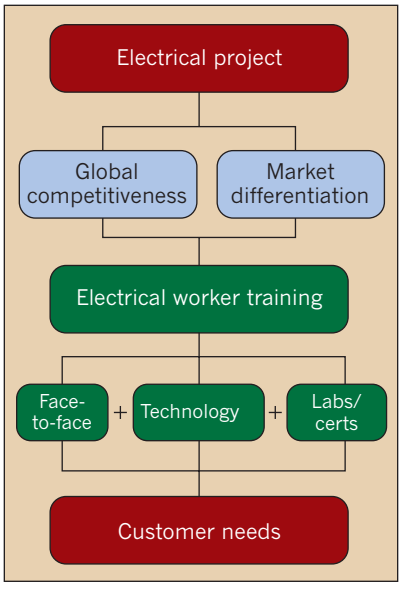
Training the Electrical Workforce of Tomorrow

The latest technology enables trainers to bridge the gap between theoretical knowledge taught in the classroom with hands-on application skills needed on the job site

By Michael Callanan, National Joint Apprenticeship and Training Committee (NJATC)

Over the past 10 years, a transformation has occurred in the way projects are designed and built — and in the ways in which we install, maintain, and troubleshoot electrical systems and equipment. During this time, trade publications like *EC&M* have reported in detail the significant adaptations that designers and manufacturers of electrical equipment and systems have undertaken. The changes and pace of these changes have been breathtaking. Perhaps somewhat surprisingly, another transformation accompanied these well-documented electrical industry changes that received far less attention. I am talking about the transformation that occurred in the classroom and on the job site related to the way we are training the next generation of electrical workers (see the **Figure**).

For those of us in the electrical industry charged with training and skill development, these changes were somewhat more apparent. Nevertheless, in a sense, this has happened even to us right before our very eyes. Seemingly overnight, even the basic core electrical skills that were traditionally taught on the job — skills that every new entrant to the electrical industry must master as he or she learns the craft — were shifted to the classroom. The changes in training and skill development have resulted in a new paradigm that has turned our classrooms upside down. It has altered the way we develop and deliver training — both for those who will comprise the next generation of electrical workers as well as those who seek to improve existing skills and abilities.



In this article, I will discuss the forces that have created this transformation and establish a foundation for a series of subsequent articles that will highlight the intersection of this new model of training on traditional electrical topics. While there are numerous factors that contributed to the transformation of our training methods, there are three forces or drivers that have played the largest role in redefining how training in the electrical industry will proceed in the years ahead. These three forces are: 1) technology; 2) global competitiveness; and 3) electrical market differentiation.

Technology. By far, the most significant development in the last 10 years in training and workforce development has been the emergence of transformational technology that has redefined the traditional classroom of yesterday into today's active learning environment. Instructors in the electrical trade today literally have the world at their fingertips, given their ability to incorporate the Internet and digital media content into their classrooms. In our 300 training centers in the United States and Canada, instructors are using virtual tools; simulations and animations; and game theory or "gamification" technology to teach both theoretical and practical applications of the electrical craft. A recent study by McKinsey & Company, *Education to Employment: Designing a System that Works*, found that this use of technology is an important strategic component for teaching hands-on skills. "Serious game simulation could become the apprenticeship of the 21st century. In a sense, the future of hands-on learning may well be hands-off."

Chances are any journey-level electrical worker today that learned his or her craft 20 or even 15 years ago would hardly recognize the classrooms we use today to teach many of the same skills and abilities they learned. Today's

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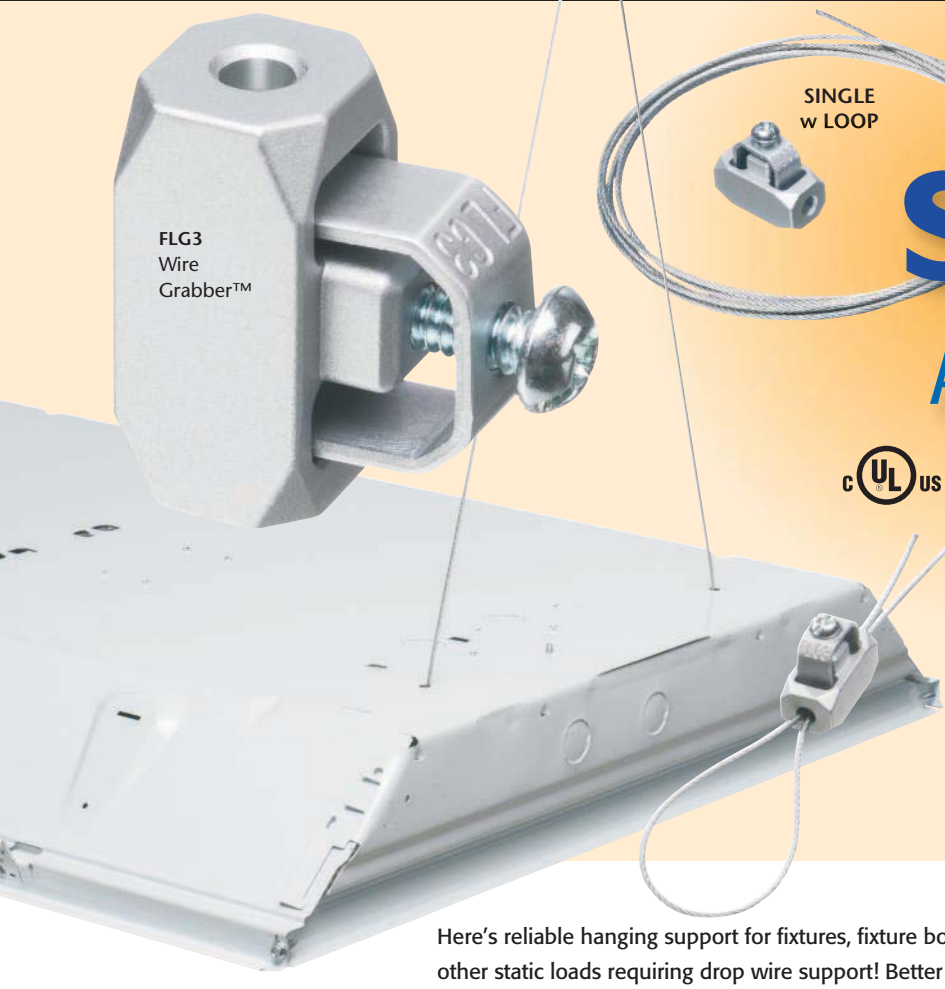

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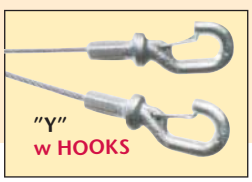

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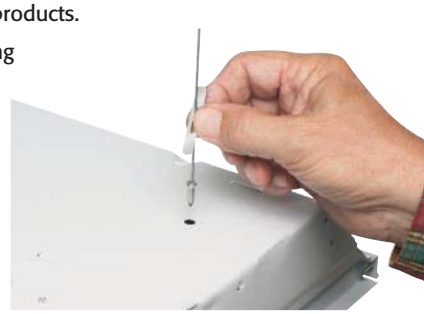

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classrooms replicate — and closely resemble in many ways — the actual job site an apprentice works at every day. Interestingly enough, what cannot be physically replicated in the classroom is being replicated virtually. Simulation technology is now being used to develop skills as diverse as conduit fabrication to electrical safe work practices.

Primarily developed by the U.S. military as a form of web-based online training, referred to as Learning Management Systems (LMS), this simulation approach has significantly evolved. LMSs are now commonplace in the educational environment (K-12 and post-secondary) as well as with corporate training. Blending online LMS immersive activities with face-to-face classroom content delivery enhances the learning to a higher level. Couple this approach with physical hands-on lab activities, and craft competency requirements — a vital recipe for training the next generation of electrical workers to greatly increase the ability to meet the customer's needs — have been achieved.

Global competitiveness. A second driver of change for electrical industry training has been the impact of global competitiveness. For about the last 75 years, the predominant model to train the next generation of electrical workers has been apprenticeship. New entrants into the electrical industry spent four years literally holding the ladder and handing material to a journey-level worker. Their primary responsibility was to observe, to assist the journey-level worker, and to wait for their turn to put their hands on the equipment and install the circuit.

Electrical industry apprentices don't spend much time standing at the bottom of the ladder these days. One effect of increased global competitiveness has been a dramatic change in the trajectory of the learning curve for new entrants into the electrical industry. These workers must learn increasingly more complex applications and wiring schemes — and do so in a manner that prepares them to be a productive part of the workforce at an earlier point in their careers. The result of this has been the expansion of "boot camps" and "pre-apprenticeship" training that better prepares new entrants into the electrical trade for the challenges they will confront the first day on the job.

Whether we realize it or not, increased global competitiveness has changed our industry. Customers seeking electrical construction services today demand the benefits that global competitiveness has brought to them in the other areas of their lives. Our model must accommodate their demands and focus on producing the safest, most productive, and best trained electrical workers in the world. In the end, we must exceed the customer's needs — a goal that is only achieved by the continuation of improvements in training.

Electrical market differentiation. Not only has the pace with which new entrants to the electrical industry must learn their trade quickened, but the breadth and scope of what they must know has also increased. Over the past 10 years, there has been an extensive escalation in the knowledge, skills, and abilities that electrical workers must acquire to demonstrate their mastery of the craft.

When I was an apprentice 25 years ago, there was a fairly good chance that — over the course of my apprenticeship — I would have the opportunity to work on, or at least be exposed to, the majority of the types of electrical equipment, systems, and components that were predominately used in most commercial and industrial installations. For today's new entrant into the electrical industry, that likelihood is far less. And if that were not enough, on top of the ever-increasing list of skills that an electrical worker must master, we have seen a growing pattern of market differentiation for system and equipment in the electrical industry. Apprentices learning their craft in Southern California, for example, will most likely work on systems and equipment that look different from those found in Maine. Our training models have had to accommodate this market differentiation, and permit a greater degree of latitude in training and skill development based on specific electrical market needs and demands. Therefore, curriculum must maintain a core set of training to allow all electrical workers to possess the primary set of skills and the flexibility of selectable advance courses to meet the local needs of the customer base.

Reaching new heights. The challenge of training tomorrow's electrical worker and upgrading the skills of existing electrical workers faced with the need to improve their current skill levels is one our industry must tackle head on. Our challenge is immense. There is no doubt that the impact of the past four years has not made our task any easier. Fortunately, for those of us responsible to meet this challenge, the technological advances that seemingly change our lives on a daily basis has begun to emerge as tools for us to use in training and skill development in the electrical industry. Our success will depend, to a large extent, on the degree to which we can leverage technology to improve the efficiency and effectiveness of our training and skill development for these groups of electrical workers.

In 2013, members of my staff will be sharing their insights and strategies as part of this monthly "Tech Training" column on how the NJATC is leveraging technology to train electrical workers. Topics ranging from grounding and bonding to security access systems will be addressed.

The bottom line is technology has changed the game. Those of us devoted to preparing the next generation of electrical workers have a choice. We can either lament the good old days when new entrants learned their craft at the foot of the ladder like we did, or we can confront the challenge head on — armed with an impressive array of technological solutions that open up the electrical industry to a new group of skilled workers excited about learning their craft in ways unimaginable to many of us. EC&M

Callanan is the executive director of the National Joint Apprenticeship and Training Committee based (NJATC) in Upper Marlboro, Md. The NJATC is the training arm of the International Brotherhood of Electrical Workers (IBEW) and the National Electrical Contractors Association (NECA). He can be reached at mic@njatc.org.

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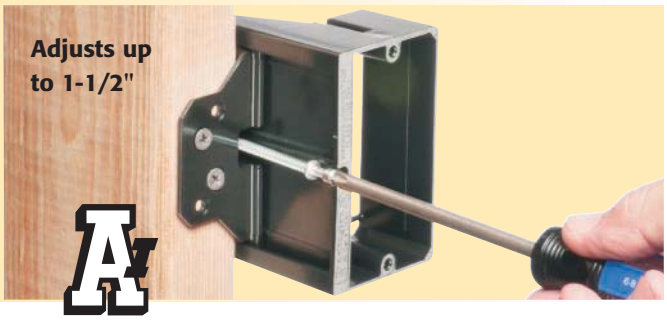

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ARLINGTON

Wiring Methods for PV Systems and the NEC

Taking Code requirements into account will help keep your PV installations safe and operating smoothly for years to come

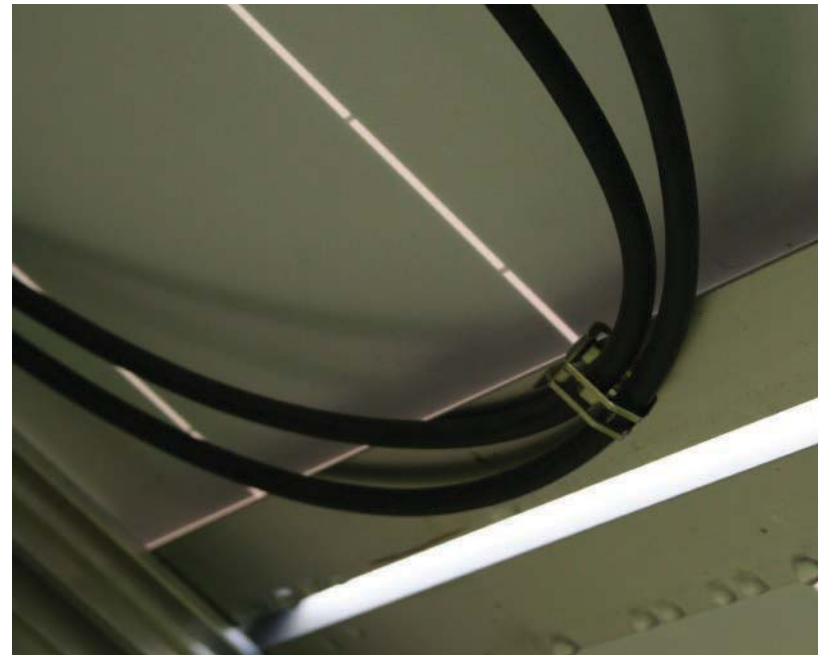

Photo 1. Conductors that are properly supported to the module frames are less likely to cause long-term problems. Various products are now available that are designed to clip to the module frame and hold PV conductors in place.

By Ryan Mayfield, Renewable Energy Associates

In general, the wiring methods presented throughout the Code are applicable for photovoltaic (PV) systems. More specifically, Part IV of Art. 690 is titled "Wiring Methods," which helps us establish the fundamental requirements for conductor selection and installation for PV systems.

Conductor types. One of the most significant allowances for PV systems is the ability to use exposed single-conductor cables for the circuits within the PV array as called out in 690.31(A). USE-2 and PV wire (a relatively new, double-jacketed single conductor cable) are specifically called out as acceptable conductors. Nearly all PV modules available today are shipped from the manufacturer with two single conductors pre-installed to the module's junction box. The cables also have quick-connect plugs installed to facilitate easier field wiring associated with PV modules.

The home run cables from the modules to the external junction or combiner box for the entire array will use the USE-2 or PV wire called out in 690.31(A).

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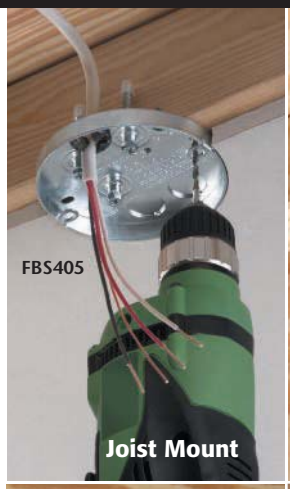

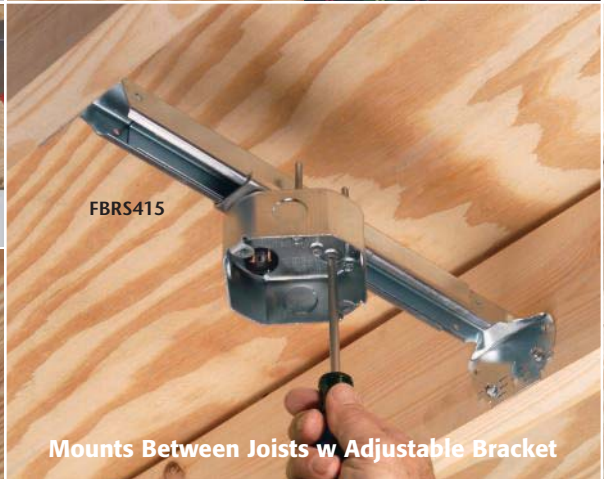

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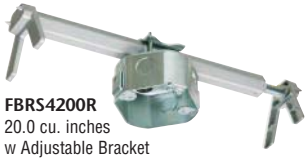

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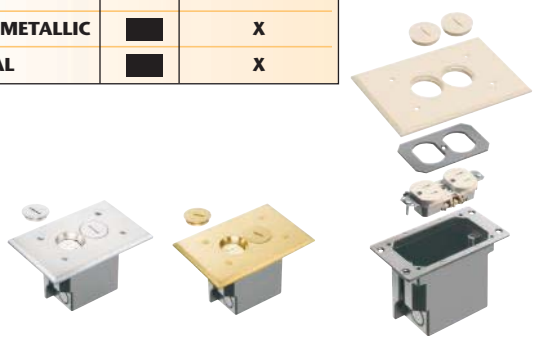
Material	Shape	Threaded Blanks
NON-METALLIC	■	X
METAL	■	X



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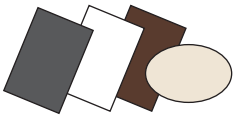

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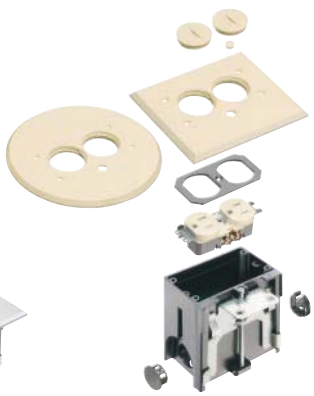
COVER OPTIONS

Material	Shape	Flip Lid	Threaded Blanks
NON-METALLIC	■	X	X
	●		X
METAL	■		X
	●		X



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These conductors are usually 12 AWG or 10 AWG, have a matching quick connect to mate to the module wiring on one end, and are terminated on a terminal block or overcurrent protection device at the array junction box or inverter location. At first glance, it may appear these conductors must be color-coded to identify the grounded current-carrying conductor. For these specific conductors, the Code allows the identification to happen at all terminations via use of distinctive marking [200.6(A)(6).] Thus, it's common to see only black conductors within the array and the terminations marked to indicate polarity. Although color-coded conductors are available, in terms of longevity of insulation, black conductors are considered to have the highest UV resistance and expected lifespan.

Wire management. While not directly covered in Part IV of Art. 690, one area of the installation that can prove very difficult is properly managing the conductors associated with the modules and home run. The pre-installed conductors are great because they make fast field connections; however, they need additional attention during the installation. PV installations should be done with the intention that they will operate for more than the 25-year power warranty that associates most modules with very little maintenance. Considering the harsh locations for most PV modules and associated wiring, the management of these conductors should be a part of all installers' plan from the beginning.

The array location will have a lot to do with the wire management selected for that array. PV modules mounted on residential rooftops can be some of the most difficult when it comes to wire management. Often, these arrays are mounted with only a few inches between the back of the module frames and the roof surface. To complicate matters, there are often multiple rows of modules with the conductors running in between. As an installer, your No. 1. goal is to keep the conductors secure and free from potential damage. If the conductors aren't secured and held in place, they can abrade against the roof surface, leading to potential faults. In areas of high snow and ice events, loose wiring can get pulled, damaging connection points and module junction boxes. Another problem is damage caused by animals chewing on the insulation of the conductors.

To help aide the installation community, a number of manufacturers offer different wire management products. One popular line promotes wire clips, typically made of stainless steel, which hold the conductors snug to the module frames (**Photo 1** on page C12). The S-shaped clips typically have a barbed slot that slides onto the module frame and bites into the frame for a secure connection. The other portion of

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the clip has a grooved slot to hold the conductor(s) in place. These clips are available for different wire types and gauges, so make sure you know what wire size you will be working with before ordering them.

Other common solutions include UV-resistant zip ties and the optional accessories that are available for use in conjunction with zip ties. There are products specifically designed to clamp to the edge of module frames that incorporate a zip tie or other clamping mechanism to hold the conductors in place. Some installers question the longevity of such solutions; they feel that even the UV-resistant zip ties will not outlast the system's expected lifespan. Ultimately, as the installer, you need to make the judgment call on all materials used in your installation.

For systems that are mounted in areas considered to be readily accessible, 690.31(A) has an exception that requires such conductors to be installed in a raceway when the maximum system voltages are greater than 30V. This will be the case for nearly all PV installations, even those using micro-inverters — as most modules have rated open circuit voltages greater than 30V — before temperature corrections.

The most common scenario for this raceway requirement is ground-mounted PV arrays (**Photo 2**). Given the fact that most modules do not have provisions for attaching raceways to their integrated junction boxes, this is not always a simple task. This situation leaves the installer two choices: make the wiring not readily accessible, or find an ingenious way to incorporate a raceway to protect the conductors. Most AHJs will accept a height of 8 feet from grade as an acceptable method for making the conductors not readily accessible, but that generally isn't an option for ground-mounted arrays. The more common method is to include some sort of barrier, such as a fence, to restrict access to the wiring. Fencing can take the traditional form, enclosing the array or some material connected directly to the racking structure to remove access to the conductors.

Installers have also successfully used wireways, gutters, and modified conduit assemblies to satisfy the AHJ in relation to this requirement. My suggestion is to think through a method that will be effective for your particular installation and make that proposal to the AHJ beforehand.

DC conductors in a building. Section 690.31(E), "Direct-Current Photovoltaic Source and Output Circuits Inside a Building," was revised in the 2011 NEC. The 2008 language associated with this section was confusing and, in many cases, led to interpretations that included AC circuits. In 2011, the main language of this section was clarified, and four subsections were added to help further define the requirements associated with the DC conductors running in buildings.

The general rule states that the DC source and output circuits from a PV array shall be contained in metal raceways, MC cable that complies with 250.118(D), or metal enclosures from the first point of penetration to the first readily accessible disconnecting means. One of the clarifications addresses that this requirement is intended for the DC circuits only — not any AC circuits associated with the inverter's output. The inclusion of MC cable was new to 2011, so be sure to make sure your AHJ is accepting that change if you plan to use this wiring method.

Photo 2. Unsupported conductors can result in damage to the PV system and put anyone in contact with the array at risk of electrical shock. Not only are the conductors of this array not supported properly, but they also are considered readily accessible and would require proper protection.

To help keep the circuits safe after the installation and for future maintenance, 690.31(E) now includes subsections restricting conductor location and requiring additional labeling. The first requirement is that when PV circuits are run below roof surfaces — outside of the array perimeter — they shall be no less than 10 inches from the roof decking. This means that if you have a horizontal pipe run that is not directly below the PV array, the pipe must be at least 10 inches below the roof decking. The intention here is to protect firefighters who may need to cut a hole in the roof for ventilation during a fire.

The labels and markings in this section are new as well. They are in place to help ensure the PV circuits are able to be properly identified and no one tries to tap into these conductors at a later date. 690.31(E)(3) describes what components need to be marked and labeled, such as exposed raceways and junction box covers. These require a permanent label that reads, "Photovoltaic Power Source." These labels must be appropriate for the particular installation environment, requiring proper UV resistance and special adhesives in some cases. These generic labels are available from label manufacturers or can be printed using specific label makers.

The labels must be visible after installation and need to be placed on every section of the wiring system that is separated by walls or partitions — and be spaced no more than every 10 feet. This requirement applies to any exposed wiring method, including wiring methods on a rooftop, attic spaces, and exterior runs.

Ungrounded systems. One type of system that is quickly gaining popularity is one that uses an ungrounded, or transformerless, inverter. These inverters offer a number of advantages

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over their transformer-based counterparts. However, to install them properly, there are additional Code requirements you must take into account. In terms of wiring methods, 690.35 covers the specific requirements that need to be followed, some of which are very different than the transformer-based installations.

One such difference is the disconnecting means and overcurrent protection. In a transformerless inverter, neither the positive nor negative conductor has a bond to ground. The result is that you no longer have a grounded current-carrying conductor. This requires both conductors in each circuit to be protected with OCPDs and have disconnecting means as required in Art. 690, Part III. This difference can result in larger combiner boxes and disconnects specially designed for ungrounded systems. Even though the current-carrying conductors do not have a bond to ground, there is still a ground fault protection circuit as part of the inverter. This requirement, which is outlined in 690.35(C), is very similar to that set in 690.5.

The conductors used in the PV source circuits are also subject to requirements different than the transformer-based inverters. In 690.31(A), two types of conductors were called out as appropriate, but in ungrounded systems, only PV wire is allowed for exposed, outdoor locations. Other options include conductors installed in raceways and nonmetallic jacketed multiconductor cables, but neither of these are effective options, given the construction of PV modules today. If installing an ungrounded inverter, the PV modules used must come with the PV wire attached to them, not USE-2. Although most manufacturers have already made this change, it is not universal at this point.

The differences in installation requirements wouldn't be complete without some additional labeling requirements. For PV systems using ungrounded electronics, all locations where conductors may be exposed during service need to have a label warning of the ungrounded conductors. 690.35(F) includes the specific language required for such components.

As you can see form this brief review, there are a number of considerations and requirements focused solely on the wiring methods for PV systems, specifically on the DC side of the system. Putting that little extra effort into wire management procedures during the installation process will pay off in the long term, helping to ensure your system operates safely and efficiently for many years. **EC&M**

Mayfield is a principal with Renewable Energy Associates, Corvallis, Ore. He can be reached at ryan@renewableassociates.com.

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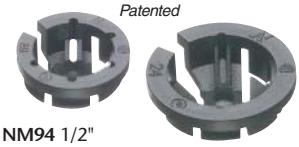

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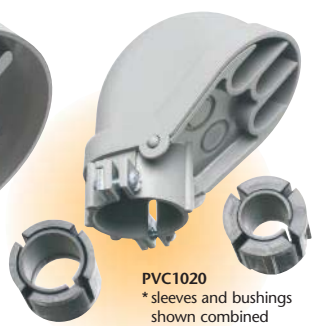

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ARLINGTON

The Battle Over Solar Installations in Massachusetts

The commonwealth's solar integrators and electrical professionals go to court over solar licensing requirements

By Beck Ireland, Staff Writer

In some ways, 2012 was a turbulent year for the U.S. solar photovoltaic (PV) industry. It weathered cuts in government incentives, unfair trade practices by international module manufacturers, and a weak global economy. Yet, with 684MW of PV capacity installed, third quarter 2012 marked the third largest on record. Total installed capacity through the first three quarters of the year reached 1,992MW, already surpassing 2011's annual total of 1,885MW. In its "U.S. Solar Market Insight Q3 2012" report, the Solar Energy Industries Association (SEIA) was expecting an additional 1,200MW of PV capacity to be installed in the fourth quarter of 2012 alone, bringing the total for the year to 3,200MW.

This amount of installed megawatts provided generous business opportunities for solar PV installers in an otherwise sluggish construction economy. However, some solar integrators in the Commonwealth of Massachusetts say that for the last four years they have been prevented from taking advantage of that growth in the domestic solar industry. They claim stringent and unnecessary electrical licensing requirements for solar PV installations keep them from soliciting and performing installations in their state.

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RTS4
9" wide

RTS421
21" wide

12" HEIGHT

RTS12
9" wide

RTS1221
21" wide

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Patent pending

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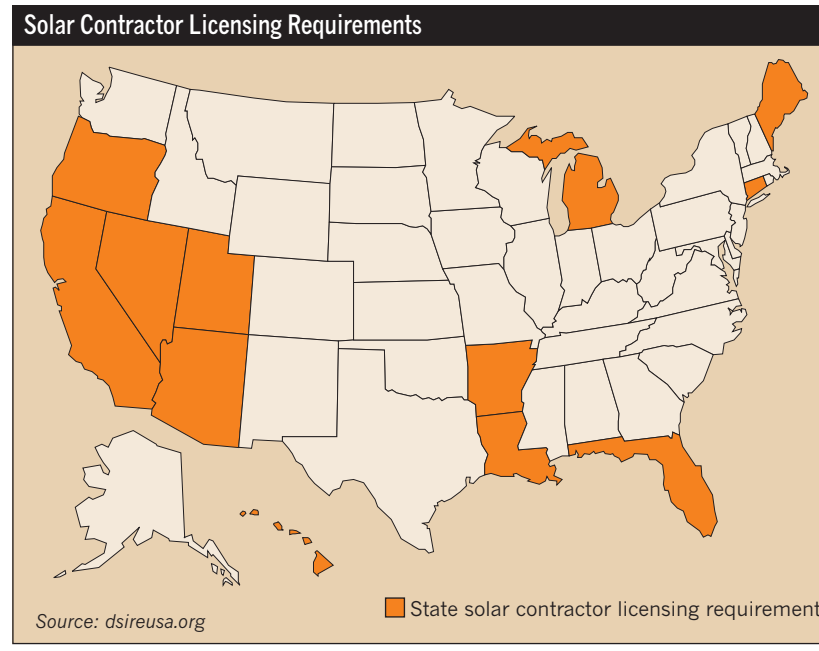
State Examiners of Electricians (BSEE) passed a ruling requiring all aspects of solar electric installations to be performed by a state-licensed electrician. The BSEE based its ruling on commonwealth law, which states that anyone who installs "wires, conduits, apparatus, devices, fixtures, or other appliances for carrying or using electricity for light, heat, power, fire warning, or security system purposes" must be a licensed electrician. As a result of the ruling, Massachusetts' licensing requirements became the strictest of any state, including those with solar licensing mandates. (To read more on this, see "Experience Required" in *EC&M's* April 2010 issue).

Previously, solar integrators that did not hold an electrical license followed the general contracting model, subcontracting work to licensed specialists. Licensed electricians were hired for the wiring measures, which some estimates say represent only around 10% to 20% of work on a solar installation. Other licensed crafts were also included, such as plumbers, welders, roofers, carpenters, sheet metal and steel workers, glaziers, and electronics technicians.

Opposition to the ruling won a brief stay, which was instituted on March 25, 2009. But on April 27, 2009, the ruling was reinstated by a vote of the BSEE, which then notified all wiring inspectors in the state, advising them that no PV installations should be approved that have been installed by anyone other than a licensed journeyman electrician or a properly supervised apprentice.

Enforcement actions. As a result of the ruling, in the fall of 2009, several BSEE enforcement actions against general contractors advertising and providing solar electric installations were brought about. Prompted by complaints alleging the use of illegal, unlicensed workers at job sites, the Division of Professional Licensure (DPL) began investigating several companies building solar projects in Massachusetts.

The International Brotherhood of Electrical Workers' (IBEW) Boston division, Local 103, started an online campaign against installation practices for a 5.6MW PV project in Canton, Mass., alleging that illegal and unsafe installation work was taking place. The union group alleged Southern Sky Renewable Energy (SSRE) violated Massachusetts law during construction by allowing installation of some plant components by non-electricians and before an electrical permit for the site was issued. Under the state's law, all PV array support structure, including racking components, must be properly grounded and bonded by licensed electricians.



Twelve states and Puerto Rico have solar contractor licensing requirements.

However, Frank McMahon, principal at SSRE, says the Canton project followed standard permitting procedures for this type of installation. "All electrical work is being completed by Massachusetts-licensed electricians," McMahon told *Solar Industry*. "Installation of the racking system falls under the building permit — not the electrical permit — and is not electrical in any way."

In the case involving a PV project site in Southbridge, Mass., the National Electrical Contractors Association of Greater Boston (NECA) alleged "unlicensed, unqualified" temporary workers were installing conductive solar electric components at the project site. As a result, NECA filed complaints with DPL against Michigan-based Patriot Solar, Albion, Mich., as well as Absolute Staffing and Commonwealth Electrical Technologies, both located in Worcester, Mass. The general contractor on the project, Martifer Solar USA, San Francisco, subcontracted the installation work to Patriot Solar, which then secured workers from the local temporary staffing firm Absolute Staffing.

A posting on Craigslist for "general laborers installing solar panels" tipped NECA off to the situation, according to Matthew Lash, assistant executive manager at NECA of Greater Boston. A phone call to the firm confirmed the positions were in Southbridge for the subcontractor, Patriot Solar. NECA staffers then paid a site visit and photographed the alleged violations. Contractors and workers supported the allegation that unlicensed workers were handling conductive rail, racking, and conduit installations.

"Sadly, we're seeing this approach taken all across the commonwealth, especially on these large-scale installations," Lash told *Solar Industry* magazine. "Folks need to either come here and obey the law, or not come here and let the responsible contractors install."

Lash also contacted Southbridge town officials, whom he says were "unresponsive." Nonetheless, in the *Worcester Telegram,* Nicola Tortis, the town's building inspector, accused the NECA chapter of making trouble because its members hadn't won the contract for the

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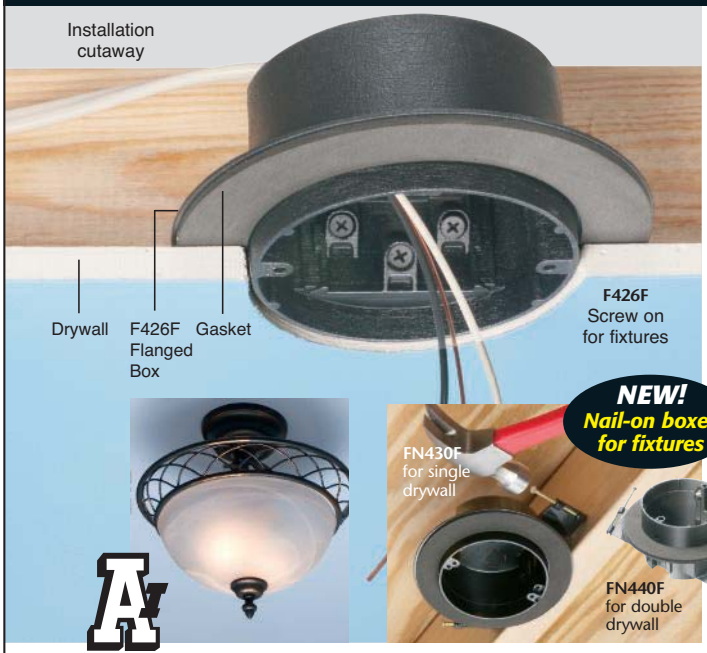

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Catalog Number	Trade Size	Cable O.D. Min	Cable O.D. Max	Wire Bundle O.D. Min	Wire Bundle O.D. Max	Conductor size # of Conductors* (AWG/KCMIL)
8412	1"	.780	1.120	.660	1.000	6/3, 6/4, 4-3, 4-4, 2-3, 2-4, 1-3
8413	1-1/4"	1.000	1.460	.870	1.370	2-3, 2-4,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

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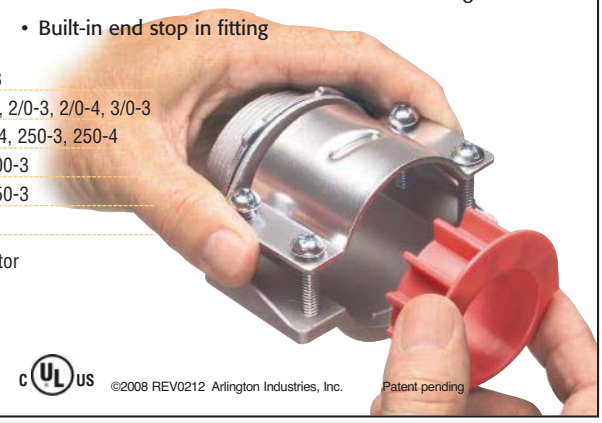
*Examples of 3- and 4-conductor cables accommodated.



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installation job. According to Tortis, two sets of permits were issued. Commonwealth Electrical was issued a permit for electrician-only duties. Another permit was for non-electrical work such as concrete structures, trench-digging, knocking down trees, pulling stumps, and setting up trailers. "[The temporary workers were] bolting stuff together like an erector set," said Tortis. "They [NECA] claim that the brackets and the channels are electrical in nature. Well, they're not."

Summary judgment. Defending the general contractors, the Harvard Law School Emmet Environmental Law Policy Center and Clinic took on the cases pro bono. Over three years, the BSEE extended repeated hearing date delays, which spurred Harvard Law School to file a separate lawsuit, known as the Carroll case, which includes some of the pioneering solar firms in Massachusetts as plaintiffs.

In July 2012, the Superior Court issued a summary judgment in the Carroll case in favor of the solar contractors licensed as general contractors. Although some opponents of the original BSEE ruling view the decision as a victory, the solar PV industry in Massachusetts is far from returning to how it was operating before the 2009 BSEE ruling.

After the judgment, the BSEE dropped some of the charges in the enforcement actions against two contractors. Michael Borkowski, managing partner at EPG Solar, told the *Worcester Telegram* that licensed electricians would be used for future work on the Southbridge project. He also maintained that non-electricians can, in fact, legally perform racking installations and similar duties, per the outcome of the recent court case.

Still, the court's decision mainly focuses on the role of general contractors that don't hold an electrical license in building PV installations in Massachusetts. General contractors can now advertise and sell solar PV projects and perform non-electrical installation work. Electrical permits will still be required for the hard wiring portion of the work, and electricians will still be responsible for hard wiring both AC and DC aspects of the projects.

But confusion remains regarding what constitutes electrical tasks requiring a licensed electrician on PV projects. "The exact point at which general contractors must subcontract with a licensed electrician should be decided on a case-by-case basis and may be enforced through individual proceedings," reads the court's ruling.

"The judge's decision dealt primarily with the ability of the so-called general contractor not licensed as an electrician to advertise for and subcontract with a licensed electrician for solar installations," NECA's Lash said. "It did not clear unlicensed individuals to install electrical components of a solar array, as some may erroneously claim."

The BSEE sent a guidance memo to local inspectors explaining the case's outcome in late October. According to the board's memo, installation of racks and rails qualifies as electrical work, whereas drilling holes in a roof as part of array prep work, for instance, is considered non-electrical. The BSEE has scheduled an appeal hearing for February 2013.

Solar license. Legal problems aside, some PV developers and integrators have reported that the higher costs associated with using strictly licensed electricians has deterred them from entering the solar market in Massachusetts. A solution to these obstacles, say some solar installers, is a statewide solar-specific license.

Currently, only 12 states and Puerto Rico have enacted separate solar licensing requirements, according to the Database of State Incentives for Renewables and Efficiency (DSIRE), an ongoing project of the North Carolina Solar Center, Raleigh, N.C., and the Interstate Renewable Energy Council (IREC), Latham, N.Y. (see **Map** on page C24). In fact, in 23 states, solar PV installation falls in varying degrees under state electrical licensing rules.

According to information on the DSIRE website, solar-specific contractor licensing started in the 1980s with the introduction of incentive programs for solar water heating. State regulation and licensing of solar contractors continues to evolve as the industry grows, but it usually follows the incentives. Many electric utilities require PV projects to be installed by either licensed or certified contractors in order to qualify for their rebate programs. Even in states that do not have contractor licensing requirements, financial incentive programs often include installer requirements, such as pre-approval, or, in some cases, certification by the North American Board of Certified Energy Practitioners (NABCEP), which, on Feb. 2, 2013, will be called the NABCEP Certified PV Installation Professional.

NABCEP is a nationally recognized, independent, voluntary certification program for PV and solar-thermal system installers. To become NABCEP-certified, installers must attain at least one year of installation experience and document all training and installations. Installers must also pass a rigorous exam, sign a code of ethics, and take continuing education courses for re-certification every three years.

Although intended as a voluntary, value-added credential, NABCEP certification is now either mandatory or preferred for contractors who seek to install systems eligible for state incentive programs. For example, to be eligible for state rebate funds in Maine, Minnesota, or Wisconsin, a PV system must be installed by a NABCEP-certified professional, according to DSIRE. California, Delaware, and Massachusetts rebate programs prefer or recommend NABCEP-certified professionals. In Utah, NABCEP-certification is a prerequisite for qualifying for a state solar contractor license.

In most cases, solar is a specialty classification under the general electrical or plumbing licenses, and all appropriately licensed contractors can install solar systems without the solar specialty license. However, contractors can obtain the solar specialty license and install systems without having the full electrical or plumbing license. This reduces the cost of licensure for contractors who only install solar systems.

Licensing and certification have different advantages and disadvantages. While licensing is mandatory for certain practices, certification is a voluntary standard that installers attain to differentiate themselves from competition and to instill confidence in consumers. From a financial point of view, voluntary national

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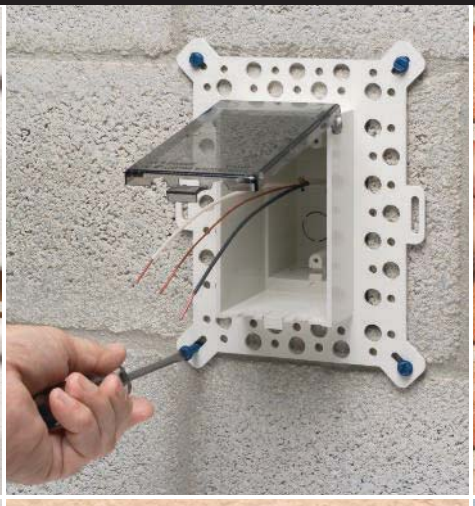

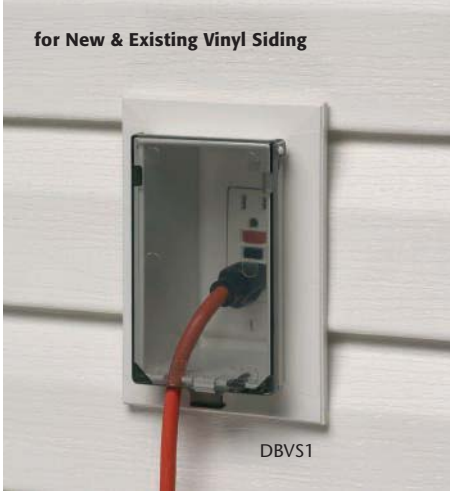

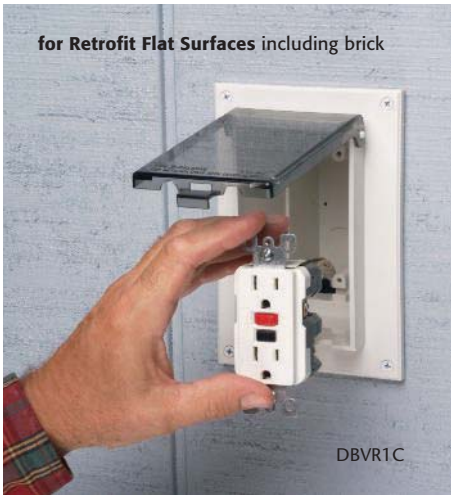

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certification is preferable to mandatory state licensing because it results in a lower cost of installation and provides greater consumer choice, according to the DSIRE site. In states that do not require solar contractor licensing, certification can provide a baseline level of quality. State licensing may be restrictive, as state licenses do not typically transfer, so firms are limited to the geographic areas they can serve. However, state licensing can protect consumers from potential safety hazards and will help ensure systems are installed properly. While both licensing and certification have drawbacks, requiring solar contractors to be licensed or certified is preferable to no quality control of system installation.

The installation of racking components has been a heated point of discussion.

Permits required. Until the change in licensing for solar installations in 2009, the Massachusetts Building Code had never officially required building permits for solar electric installations and had a waiver of the building permit requirement for solar thermal systems in place. In August of that year, the Board of Building Regulations and Standards (BBRS) issued a determination that building permits were required for all solar installations. This has added extra regulatory red tape for solar installers in the state. But Massachusetts isn't alone in its permitting problems.

Recently, Clean Power Finance published a nationwide study of solar permitting and the obstacle it poses to widespread adoption of residential solar. The study — the largest of its kind to date — reveals the negative effects complex permitting regulations have on U.S. solar installers and also on the authorities having jurisdiction (AHJs), including municipalities and utilities, who oversee permitting processes.

Clean Power Finance undertook a survey of 273 residential installers as part of preparations for the National Solar Permitting Database (NSPD), a free, online database of permitting requirements from across the United States that is funded in part by Clean Power Finance and in part by a Department of Energy SunShot Initiative grant. The study's objective is to establish baseline metrics prior to the deployment of the NSPD that can be compared to metrics taken after the NSPD is fully implemented, and to provide direction to the industry about areas for improvement.

"Strong initial interest in the National Solar Permitting Database makes it clear that people want to address permitting obstacles but aren't quite sure where to start," said James Tong, senior director at Clean Power Finance and project lead. "This study provides valuable data that will help identify areas for improvement and cooperation that will bring down costs for everyone and advance the adoption of solar."

The study reveals an overall lack of sophistication on the part of AHJs and solar installers, as well as inefficiencies on both sides. According to the results of the study, more than one in three installers avoids selling solar in an average of 3.5 areas because of associated permitting difficulties. Permitting processes are limiting the adoption of solar in otherwise viable solar markets, constraining a robust and growing industry. Additionally, installer unwillingness to expand to new territories may allow incumbent installers to capitalize on the lack of competition and develop virtual monopolies, leading to market inefficiencies and potentially higher costs for consumers.

Permitting varies widely and usually involves two — and up to five — distinct agencies, each with different processes. The more entities involved in the permitting process, the more likely there are to be mixed messages and/or different rules that result in delays and increased costs for installers not to mention more paperwork for AHJs.

Eleven percent of installations encounter a situation where requirements for solar permitting have not even been set. This indicates that AHJ policies and processes have not kept pace with the growing solar market — and that more cooperation and transparency regarding permitting regulations may solve many existing problems.

On average, AHJs require nearly eight work weeks to complete their tasks, but staff times for installers average just 14.25 hours. Because installers typically make a large upfront equipment purchase, permitting processes can tie up thousands of dollars for almost two months or force installers to use credit, both of which can impede installer profitability or force them to pass on additional costs to consumers.

"Clearly, not all cities are bad, but we need to call out the ones that are particularly problematic," says Patrick Redgate, president and CEO of Ameco Solar, Inc., Paramount, Calif.

Some cities are already responding and trying to ease the permitting process. "We're working with multiple city governments to make the permitting processes easier," says Amy Heart, the solar program manager for Milwaukee who has been tackling permitting issues as part of Grow Solar Wisconsin under the auspices of the Department of Energy's Rooftop Solar Challenge. "It's a challenge to get everyone on the same page; even the installers don't necessarily agree on what needs to be done." **EC&M**

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NMLT907	3/4"		✔
NMLT10	1"	✔	
NMLT9010	1"		✔

METALLIC

Catalog Number	Trade Size	Straight	90°
LT5	1/2"	✔	
LT905	1/2"		✔
LT7	3/4"	✔	
LT907	3/4"		✔
LT10	1"	✔	
LT9010	1"		✔


NMLT905


LT7


LT905

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LED vaporproof luminaire

The VXLED26 is a 26W vaporproof luminaire that produces light output equivalent to a 200W incandescent fixture, lasts 50 times longer, uses 85% less energy, and offers a 50,000-hr life, according to the company. UL-listed for wet locations, the luminaire is available in cool, neutral, and warm color temperatures as well as in ceiling- and wall-mount options. Features include a housing made of all die-cast aluminum construction; high temperature silicone gasket; and a natural, shot-blasted aluminum finish. In addition, the product features a guard and a shock-resistant frosted globe that produces a smooth and uniform light distribution. Additional globe colors are include amber, blue, green, ruby, and opal.

RAB Lighting

Circle 250

Cloud service

This cloud service stores time and attendance records and safely transfers the data from a remote location to a centralized office. The cloud service works with the company's wireless JobClock Hornet, the mobile PocketClock/GPS app or the JobClock/EX. Designed to quickly transfer and manage millions of time records, digital images, voice recordings, and other work-site data each day, employees can sync their time records to the service, which wirelessly delivers digital records to the company's TimeSummit office time and attendance software. This allows business owners to collect records from almost anywhere in the world in near real-time.

Exaktime

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Switchboard

The Evolution Series switchboard is designed for use in 24/7 critical power applications. Featuring instantaneous zone-selective interlocking (I-ZSI) and waveform recognition (WFR) technologies, the switchboard provides users with a combination of full selective coordination and simultaneous arc flash protection. When responding to a fault, the product has the intelligence to tell circuit breakers to respond either immediately or as a backup, depending on the situation. Features include front access to the neutrals and ground; factory-installed splicing; a stationary 4,000A, 100%-rated main circuit breaker; remote racking devices; and expanded ratings up to 6,000A, with bus densities as low as 667A/in^2.

GE

Circle 252

Snap-in connector

The EZfitt snap-in connector is designed to accommodate a range of cable sizes and type. Features include preassembled anti-short bushing and secure grounding. In addition, the product requires no pull-out, is reusable, and connects/disconnects simply by pressing the device's buttons.

Neekson

Circle 253

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Outdoor LED luminaire

The Navion LED outdoor luminaire features the company's AccuLED Optics system, which allows lumen output and energy consumption to be customized by the user. With efficiencies as high as 95%, the luminaire is suitable for new construction projects as well as retrofitting inefficient fixtures. The product also offers 30% to 70% energy savings when compared to typical HID models, according to the company. Features include a 60,000-hr life at 90% lumen maintenance, a choice of 10 optical packages, and five configurations that provide 3,600 lm to 22,000 lm. Designed to operate over a -40°C to 40°C temperature range, the product offers a 4,000K CCT and a 70 CRI with an optional 6,000K CCT (70 CRI) and 3,000K CCT (80 CRI) available. In addition, the device is 3G vibration rated and comes standard with 10kV dual-mode surge protection.

Cooper Lighting

Circle 254

Solar luminaires

The Solo stand-alone lighting system for commercial pathways and residential roadways features a stainless steel mounting and luminaire design along with a support package. Designed to operate autonomously without depending on the grid or any outside wiring, the system allows users to access simple-to-use tools to estimate solar performance (hours of lighting and profile capabilities) for specific locations as well as typical spacing for various lighting applications. Featuring the company's LB800 light bar, the batteries and controls are pre-wired and stored in a sleek enclosure that is mounted to a clear-coat silver pole.

SolarOne

Circle 255

Box/conduit hanger support system
The BCHS-10 box and conduit hanger support system features an octagonal plate that holds the metal electrical box and multiple conduit lines. Constructed from 15-gauge galvanized steel, the plate measures 10.75 in. × 10.75 in. in diameter and accommodates 4-in. and $4^{11}/_{16}$-in. square electrical boxes with ½-in. to 1¼-in. knockouts. In addition, up to eight lines of conduit (½ in. to 1¼ in.) can be connected to the electrical box, and the product allows conduit installation from any angle. Pre-drilled pin holes facilitate strap installation, and the octagonal plate includes pre-stamped markings to provide installation guides.
Orbit Industries
Circle 256

AFCI receptacle
The SmartlockPro outlet branch circuit (OBC) AFCI receptacle is designed to detect and provide protection from parallel and series arc faults downstream and series arc faults upstream from its location. For enhanced safety, the receptacle features a shutter mechanism that blocks access to the contacts from most foreign objects. Features include a reset/lockout function that automatically tests the AFCI every time the RESET button is pushed in. According to the company, the device will not reset if the AFCI circuit is not functioning properly. Available in white, ivory, light almond, gray, black, and brown finishes, the product meets UL 1699A.
Leviton
Circle 257

LED luminaires
The 17W Pancake, 17W Eclipse, and 14W Security Light with PhotoCell are now listed on the Lighting Design Lab's (LDL) interim qualified products list, qualifying them for rebates for 1 yr by most utility companies in the Pacific Northwest. According to the company, the products deliver a 50,000-hr L70 life, contain no mercury or hazardous materials, and operate without emitting IR and UV radiation. In addition, they offer a minimum CRI of 80, are UL- and cUL-listed for damp locations, and operate on a 120V lighting system.
MaxLite
Circle 258

PV rail-mounting system
The Classic PR is a rail-mounting system for mounting PV panels on pitched roofs. Featuring universal mid and end clamps, the product's design reduces installation time on the roof, and the clamps can be used with any framed module, according to the company. Designed for portrait or landscape positioning, the PE-certified, ASCE 7-05- and IBC2006-compliant system is offered electrocoated (E-coat) and comes in 20-ft sections.
DynoRaxx
Circle 259

DALI ballasts
Crestron Green Light DALI ballasts feature an optional power monitoring feature that gives users the ability to measure, monitor, and manage power to each light fixture, while enabling daylight harvesting and load shedding. Operable between 120V and 277V, the ballasts support dimming for a wide range of linear fluorescent lamps from 1% to 100%.
Crestron
Circle 260

LED floodlight
Offered in 5,500-lm (40 LED) and 11,000-lm (80 LED) packages, the Magniluter MLED Series floodlight delivers controlled illumination with 50% to 60% energy savings and offers a 60,000-hr life, according to the company. Weighing 20 lb, features include a L90 rating, 4,800K CCT, a variety of distribution options, and beam patterns available in 3×3, 5×5, and 7×7. In addition, the luminaire is IP65-rated and UL 1598-listed for use in wet locations and offered with a dark bronze housing finish with optional black, gray, and white finishes available.
Hubbell Outdoor Lighting
Circle 261

Energy management system
The EcoView wireless energy management system offers users visibility into energy use as well as HVAC and lighting control from one central point. According to the company, the product's wireless equipment and drop-in thermostats require no new wiring. In addition, it is scalable, capable of monitoring multiple locations, and allows for the scheduling control and monitoring of HVAC, lighting, and other energy loads from either on-site or remotely through the Internet-enabled EcoView Web application via wireless devices or mobile smartphone apps.
Siemens
Circle 262

Slider/clamp

Designed to run flex conduit up to 1 in. thick through metal studs, the FlexSlider features a securing clamp to hold the flex in place with 360° protection of conduit and cable. To use, simply clip the base clip into the metal stud opening, run conduit (tie to the box), and secure the run by sliding the clamp onto the clip approximately every 4 ft. Weighing 0.05 lb per piece, the product comes in 55-piece bags featuring 35 slider clips, 15 securing clamps, and five hole punches.

FlexSlider

Circle 263

Power distribution blocks

PDS Power Stud Blocks are recognized under UL standard 1059 and CSA-certified to Standard C22.2. Approved up to 840A and up to 10,000 symmetrical amps, the products are designed for use with listed crimp-type lugs. Certain sizes feature a hinged cover to prevent accidental contact, and an optional cover is available on remaining sizes. Additionally, the blocks are suitable for use with flexible conductor.

Ilsco

Circle 264

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Cable tray system

The Aluminum Redi-Rail cable tray system now features an I-beam side rail design, which the company says reduces design time, installation cost, and total material procurement costs by up to 15%. This enhancement also makes the product easier to cut, handle, and install while maintaining a NEMA 12B load rating. Additionally, the I-beam design increases the material beneath each rung, creating positive rung support for increased safety and lifespan. Other enhancements include pre-punched rung and splice holes that are strategically positioned at the top and bottom of the I-beam web along the entire length of straight sections and fittings, which eliminates the need for any field drilling due to splicing or accessory attachment.

Cooper B-Line

Circle 265

Linear luminaire accessories

Compatible with the company's standard Lightbar and high-output Lightbar Plus, these accessories include a diffuser lens, in-line motion sensor, and in-line dimmer control. The diffuser lens is available in five lengths (from 6 in. to 48 in.) and does not increase the overall depth or width of the Lightbar. In-line motion sensors automatically activate the luminaire when a warm moving object is detected and offer a range of up to 6 ft. In addition, light can be set to remain on for 10 sec up to 12 min. The in-line dimmer allows users to tap it to turn the luminaire OFF/ON and hold it to dim. In addition, this accessory includes an end-to-end connector, bar-to-bar joiner, flat mounting clip, and power line interconnector.

Nora Lighting

Circle 266

Junction boxes

Plexo metallic and plastic junction boxes can be installed on any Cablofil wire mesh cable tray. Each box features a clip that connects firmly to the wires of the tray. The box then clicks into this clip via Cablofil's Plexo connectors. By turning the box 45°, users achieve a secure junction box connection in seconds, according to the company. Available in 3.1-in. and 4.1-in. sizes, the 3 and 4 models of plastic junction boxes feature membrane glands for attachment without the need for cable connection hardware. These boxes have an ingress protection rating of IP55. Offered in 4 in. and 4.7 in. sizes, TC4 and TC5 models are metal twist-on junction boxes that can be installed on the side, bottom, or corner of any CF series Cablofil wire mesh tray.

Legrand/Cablofil

Circle 267

Electrical assemblies

CADDY ALL-IN-ONE electrical assemblies combine an electrical box, support bracket, mud ring, far-side support, and ground wire pigtail into a single solution that is ready to use right out of the box. The system provides users with the flexibility to wire from the front or the back of the assembly. The open-back design allows for easier access when installing conduit connectors or multiple circuits. Models are available with integrated, removable, or without mud rings. According to the company, the unit stays fixed in place when the mud ring is removed.

ERICO

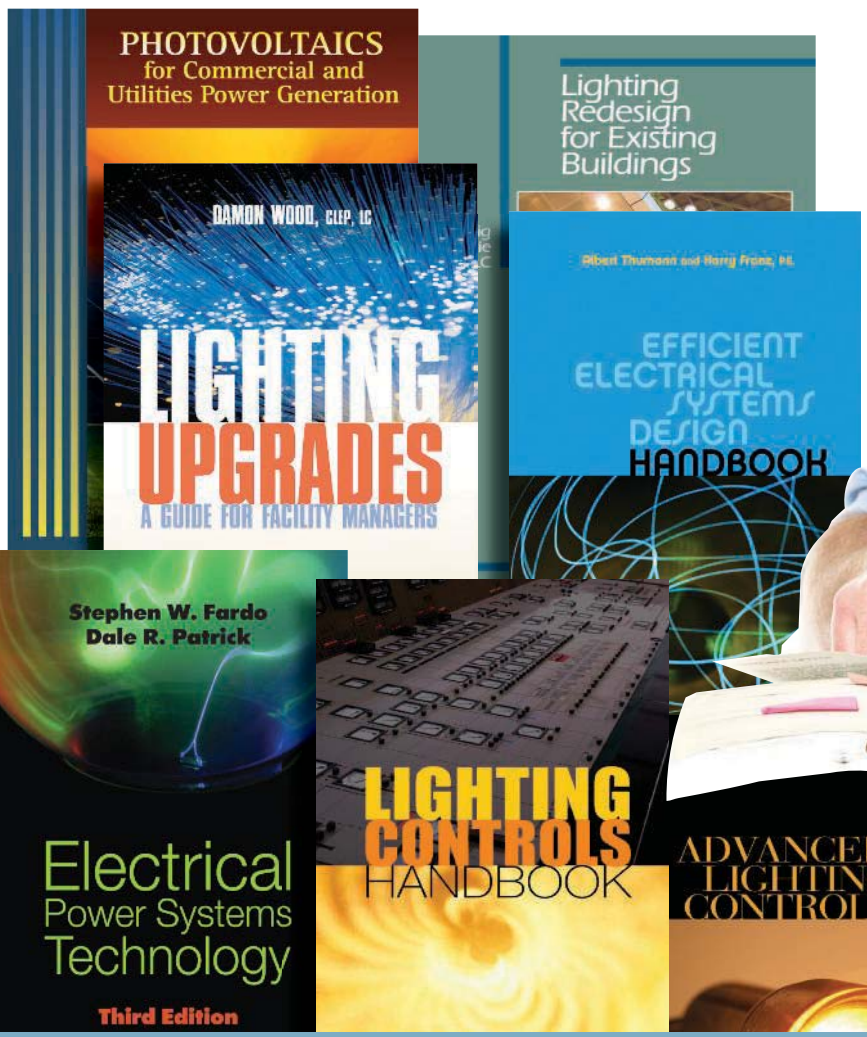
Circle 268

Bright Idea(s)

Check out the Lighting category at the *EC&M* Book Store.

In addition to the other valuable resources you'll find at the *EC&M Book Store,* we now offer books on lighting. These new titles cover a variety of topics from redesigns and retrofits to advanced controls technology.

Take a look. Build your lighting library today.



EC&M BOOKS

Find us at ecmweb.com → Electrical Topics of Interest → Lighting

Tray cable connectors

This line of tray cable connectors is designed for use with TC, ITC, PLTC, and other commonly used types of tray cable. Featuring a compensating displacement seal that provides ingress protection to NEMA 4X and IP68 standards, the connectors feature a seal insert that allows each gland to terminate the broadest cable range available in a single hub size. Manufactured in aluminum, stainless steel, and nickel-plated brass, the products offer an operating temperature range of -60°C/-76°F to 110°C/230°F and come in trade sizes ranging from ½ in. to 4 in. NPT threads are standard, while metric is available as an option. Other options include an adapter/reducer and earth tags.

Appleton

Circle 200

Power converters

The Universal Power Converter Platform (UPCP) includes a 30kW inverter that delivers 480VAC, 3-phase power and supports grounded PV arrays without an internal or external transformer. Weighing 94 lb compared to 1,200 lb conventional 30kW 480VAC PV inverters with isolation, the unit conforms to UL1741 and achieves a CEC-weighted efficiency of 96.5%. System configurations of one to 10 inverters are typical.

Ideal Power Converters

Circle 201

Clamp-on meters

The Models 407 and 607 clamp-on meters feature a safety rating of 1,000V CAT IV and are able to wirelessly extract data stored in memory via Bluetooth technology. In addition to the standard measurement of volts, amps, frequency, resistance, and continuity, the meters measure TRMS voltage and current as well as all types of inrush. Additionally, the IP54-rated devices are capable of measuring power in the megawatt range down to 1W resolution and record up to 1,000 data points.

AEMC Instruments

Circle 202

LED linear luminaires

The CS Series of LED linear luminaires uses 40% to 50% less energy than comparable linear fluorescents and delivers up to 120 lm/W, a 90 CRI, and a 75,000-hr life, according to the company. Featuring the company's MicroMixing optics, the luminaire comes standard with 0V to 10V dimming control to 5%.

Cree

Circle 203

Arc flash suppression blanket

The ArcGuard blanket helps protect users from arc blasts in underground vaults, switchyards, tunnels, and other confined spaces. Tested and rated per ASTM F2676, the blanket attaches via Kevlar webbing strips to fixed points near the arc flash hazard area to redirect the release of energy that may occur. In addition, the product meets OHSA 1910.269(T)(7) and NFPA 70E-2012, and offers a maximum arc current rating of 25kA and break-open threshold performance of 362kA cycles.

National Safety Apparel

Circle 204

Antimicrobial switches/wallplates

The Arrow Hart line of switches and wallplates features EPA-registered CuVerro antimicrobial copper surfaces. According to the company, laboratory testing has shown that, when cleaned regularly, these surfaces kill more than 99.9% of bacteria within 2 hr. The line includes single, 3-way and 4-way decorator switches as well as specification-grade, standard size wallplates in multiple gangs and configurations. All products have been tested and are compliant to UL standards.

Cooper Wiring Devices

Circle 205

Fuse blocks

The Class R, H(K) & J knifeblade fuse blocks feature a snap-together design for easy assembly of required poles at point of application. Available in factory-assembled 2-pole and 3-pole configurations, optional high-clarity, see-through, finger-safe covers feature test probe holes. Wire terminations inspections or thermography measurements can be performed without opening the cover, and built-in standard barriers between poles enhance safety.

Cooper Bussmann

Circle 206

Gen-sets

The company's line of stationary diesel gen-sets — ranging from 680kW to 2,750kW — is now start Tier 4 interim certified. According to the company, the gen-sets are able to start and assume load in less than 10 sec and achieve rated load in a single step. Optional factory-integrated exhaust aftertreatments reduce emissions for high-hour use in environmentally sensitive locations.

Cummins Power Generation

Circle 207

Wall-mounted cabinets

Eclipse Dual Access wall-mounted cabinets provide a rigid and strong enclosure for high-density LAN cabling and 19-in. patch panels as well as for any 19-in. electronic equipment. The unit consists of a heavy-duty wall mounting rear and base through which cables enter the enclosure, the main body, and a solid or window lockable front door. The body and the door are independently hinged, with 120° opening to give unrestricted access to the front and rear of mounted equipment. All sections are constructed from 14-gauge steel finished in RAL 7035 light gray. Seamless poured-in-place gaskets provide protection against dust, oil, and water to NEMA type 3R, 12, 4, and IP66. Standard available sizes range from 16 in. high × 24 in. wide × 15 in. deep to 48 in. × 24 in. × 24 in. Other features include a pair of fixed 19-in. panel rails, tapped 10/32 that are pre-installed at the front, and additional optional mounting angles that can be added at the rear of the body.

Hammond Mfg.

Circle 208

freeproductinfo.net/ecm

LED downlight

The LRD LED retrofit downlight offers up to 70% energy savings and a 50,000-hr life, according to the company. Designed to secure to the existing, installed rough-in kit via its modular bracket system, the downlight is mercury free and dimmable down to 10% via 0V to 10V or line dimming (if control gear is already installed into the existing fixture). In addition, the luminaire can be installed into existing wired rough-in kits from below the ceiling.

LumenOptix

Circle 209

Power management system

The Critical Power Management System (CPMS) monitors and controls transfer switches, paralleling control switchgear, gen-sets, circuit breakers, power distribution, and other gear so it can intelligently interact with a facility's building management system. The CPMS also enables customization of monitoring and control through a facility or campus through the use of ASCO PowerQuest.

Emerson Network Power

Circle 210

Focus on Boxes & Enclosures

Television box

The TVB810 TV Box is designed for installations of wall-mounted televisions in retrofit applications. Designed to install horizontally or vertically, the UL-/CSA-listed box accepts standard-style plates with receptacles and decorator-style devices with plates, as well as the company's entrance plates and hoods. Features include mounting wing screws to secure the box in a wall and a 1½-in. knockout for ENT or other low-voltage wiring. In addition, the product includes cover blanks, a wall plate, cable entry device, and cable connectors.

Arlington Industries

Circle 300

Explosionproof enclosures

The XCESX Series of Div. 1/Zone 1 explosionproof enclosures is constructed from stainless steel 316L. Suitable for use in highly corrosive environments, the enclosures carry UL, cUL, ATEX, and IECEx approvals for global applications. In addition, the products are available in five standard sizes, ranging from 10 in. × 14 in. × 8 in. up to 24 in. × 36 in. × 10 in. Features include a watertight gasket and stainless steel cover bolts for Type 4X/IP66 ratings, stainless steel hinge kit, mounting panel, removable lifting eye bolts, cover alignment device, cast-on mounting lugs, and internal/external ground screws. A flat plate cover allows for additional working area for viewing windows and operating devices.

Adalet

Circle 301

Dual-compartment enclosures

The DCH Series of dual-compartment IP65 enclosures features an upper compartment with an easily removable, transparent cover that allows users to view meters and other indicators and to access system components that may require frequent maintenance. The lower compartment is designed to protect delicate components and contain electrical components that could pose a touch hazard. Cover styles include screw-on and hinged, and both are sealed with a durable oil-resistant silicone sponge gasket. Five models are offered, ranging in size from 6.34 in. × 6.54 in. × 3.66 in. to 11.06 in. × 11.65 in. × 6.22-in.

Bud Industries

Circle 302

Nonmetallic boxes

The Carlon Draft-Tight nonmetallic box features a flanged gasket and cable entry seals that prevent the free flow of air through the box and eliminate the need for caulking and sealants, according to the company. Designed to meet the 2012 International Energy Compliance Code (IECC), the boxes are constructed of high-strength polycarbonate that will not shatter in cold temperatures or warp in hot temperatures.

Thomas & Betts

Circle 304

Shedding Light on Article 410

Inside the NEC rules for installing lighting on larger voltage systems

By Mike Holt, NEC Consultant

First, let's make the distinction between Articles 410 and 411 of the 2011 NEC. Article 410 provides the requirements for installing luminaires, lampholders, lamps, and decorative lighting products on circuits greater than 30V. Article 411 addresses lighting systems operating at 30V or less.

Don't let this Article's length and degree of detail throw you. It's nicely broken up into 16 parts (see **Breaking Down Article 410** on page 23), most of which won't apply to a given application.

LEDs in closets. Only the following types of luminaires are permitted to be installed in a clothes closet [410.16(A)]:

- Surface or recessed incandescent or LED luminaires with an enclosed light source.
- Surface or recessed fluorescent luminaires.
- Surface-mounted or recessed LED luminaires identified for use within the closet storage space.

Incandescent luminaires with open or partially open lamps and pendant-type luminaires must not be installed in a clothes closet [410.16(B)].

Luminaires must maintain a minimum clearance from the closet storage space as follows [410.16(C)]:

- 12 in. for surface-mounted incandescent or LED luminaires with an enclosed light source.
- 6 in. for surface-mounted fluorescent luminaires.
- 6 in. for recessed incandescent or LED luminaires with an enclosed light source.
- 6 in. for recessed fluorescent luminaires.

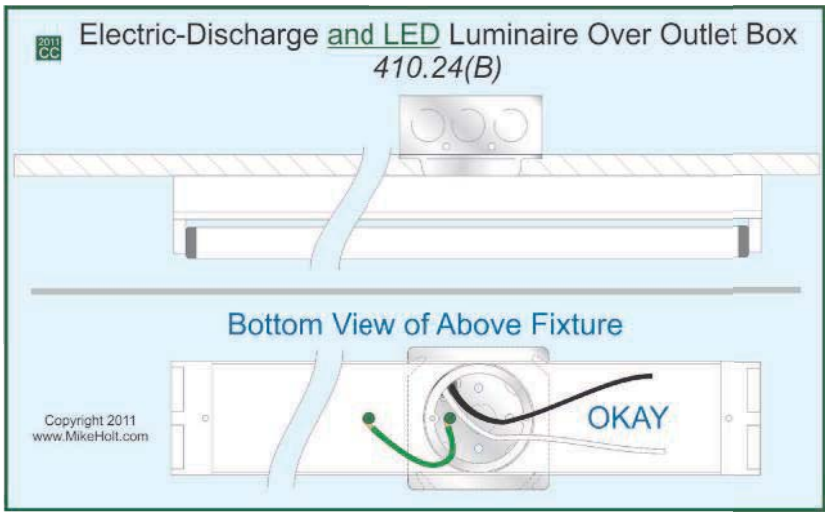


Fig. 1. When an electric-discharge luminaire or LED is mounted over an outlet box, the luminaire must permit access to the branch circuit wiring within the outlet box.

Surface-mounted fluorescent or LED luminaires are permitted within the closet storage space if identified for this use.

The 2008 NEC added allowances for LED luminaires in clothes closets [410.16]. However, its wording inadvertently required special identification for the application of an LED luminaire in a closet. The intention was to require special identification to install it in the storage space. New wording in the 2011 NEC clears up this confusion.

Connection of electric-discharge and LED luminaires. The 2011 Code changed the requirements for boxes and wiring methods for electric-discharge luminaires to include LED luminaires.

- Electric-discharge and LED luminaires supported independently of the outlet box must be connected to the branch circuit with a raceway or with Types MC, AC, or NM cable [410.24(A)].
- When an electric-discharge luminaire or LED luminaire is surface-mounted over a concealed outlet box and not supported by the outlet box, the luminaire must be provided with suitable openings that permit access to the branch circuit wiring within the outlet box [410.24(B)] (**Fig. 1**).
- Electric-discharge luminaires can be cord-connected if the cord is visible for its entire length and is plugged into a receptacle — and the installation complies with 410.62(C).

Bonding. In previous editions of the NEC, the rules addressing the bonding of luminaires have been a hodgepodge of requirements in an illogical arrangement. Revisions in the 2011 NEC resulted in a more user-friendly Code, but no technical changes were made.

Luminaires must be connected to an equipment grounding conductor of

a type recognized in 250.118. If of the wire type, the circuit equipment grounding conductor must be sized in accordance with 250.122, based on the rating of the overcurrent device [410.44].

Exception No. 1: If an equipment grounding conductor isn't present in the outlet box for a luminaire, the luminaire must be made of insulating material and must not have any exposed conductive parts.

Exception No. 2: Replacement luminaires can be installed in an outlet box that doesn't contain an equipment grounding conductor if the luminaire is connected to one of the following:

1) Grounding electrode system [250.50].

2) Grounding electrode conductor.

3) Panelboard equipment grounding terminal.

4) Service neutral conductor within the service equipment enclosure.

Exception No. 3: GFCI-protected replacement luminaires aren't required to be connected to an equipment grounding conductor of a type recognized in 250.118 if no equipment grounding conductor exists at the outlet box.

This is similar to the rule for receptacle replacements in locations where an equipment grounding conductor isn't present in the outlet box [406.4(D)(3)].

Wiring. Because LED drivers and electric-discharge luminaires are similar, the logical place to include LED requirements is alongside electric-discharge luminaires. Where LED luminaires are supplied via a cord-and-plug connection, they must now comply with the provisions of 410.62(C).

A luminaire can be cord-connected if:

1) The luminaire is mounted directly below the outlet box, and

2) The flexible cord:

- Is visible for its entire length,
- Isn't subject to strain or physical damage [400.10], and
- Terminates in an attachment plug, canopy with strain relief, or manufactured wiring system connector complying with 604.6(C).

Luminaires as raceways. In previous editions of the NEC, to see if you could use a luminaire as a raceway, you'd find your answer in 410.64. The answer was a resounding "no," it isn't permitted. Section 410.65, however, provided an exception to this rule. This was confusing. The exception to the rule logically goes in the section that provides the rule. Deleting 410.65 from the 2011 NEC and incorporating this text into 410.64 ended this particular confusion. Now 410.64 clearly states the conditions under which conductors can be pulled through luminaires:

- When the luminaire is listed and marked for use as a raceway [410.64(A)].
- Luminaires identified for through-wiring as permitted by 410.21 [410.64(B)].
- Luminaires connected together can include wiring to feed the interconnected luminaires, within limits [410.64(C)] (**Fig. 2** on page 23).

Installing lampholders. Previous editions of the Code specified that lampholders in damp or wet locations must be of the weatherproof variety. While this makes sense for wet locations, it doesn't seem to make sense for a damp location. The 2011 NEC now requires that these lampholders be listed for the environment in which they're installed [410.96].

Section 410.11 has long required that luminaires installed near combustible material contain shades or guards to prevent the ignition of surrounding products. While that requirement certainly makes sense, there's a gaping hole in the rule — it doesn't address lampholders.

Lampholders often contain lamps that produce more heat than a standard luminaire, yet very seldom has an apparatus been designed to contain that heat. Because lampholders aren't included in the

definition of luminaires, the 2011 Code added section 410.97. The location of this new section in Part VIII is logical.

"410.97 Lampholders Near Combustible Material. Lampholders must be constructed, installed, or equipped with shades or guards so that combustible material isn't subjected to temperatures in excess of 90°C (194°F)."

Recessed luminaires. Part X of Art. 410 applies to luminaires installed in the recessed cavities of walls and ceilings. That would suggest that it applies to luminaires in suspended ceilings. But does it, actually? Previous editions of the NEC didn't say, thus leaving installers in suspense on this issue. The 2011 NEC clarifies that these rules apply to suspended ceilings [410.110].

With the increasing popularity of LED luminaires, the Code needed to address requirements for their installation. Where these are of the recessed type, they must be marked as "Type IC," or must have a clearance of 3 in. from thermal insulation [410.116(B)].

Electric-discharge lighting (1,000V or less). The NEC defines electric-discharge lighting as systems of illumination that use fluorescent lamps, HID lamps, or neon tubing [600.2]. Even though this term is used in more than one Code Article, it is defined in 600.2. The general rule is that when a defined term is used in two or more articles, the definition of that term should be included in Art. 100.

Indoors, fluorescent luminaires that use double-ended lamps (typical fluorescent lamps) and contain ballasts and that can be serviced in place must have a disconnecting means [410.130(G)]. If an existing luminaire doesn't have such a disconnect, the 2011 NEC now requires you to add it when you replace the ballast for that luminaire (**Fig. 3**). Considering the low cost of these disconnects and the increased safety, few people seem to be against this.

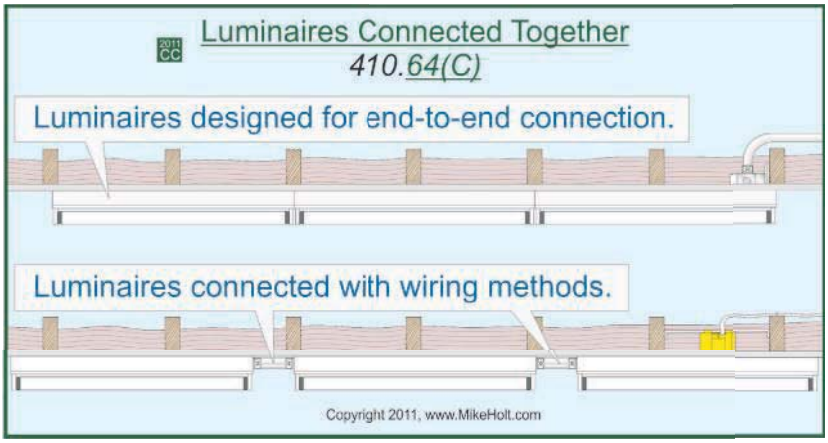


Fig. 2. Luminaires designed for end-to-end connection, or connected together by wiring methods, can contain a 2-wire branch circuit or one multiwire branch circuit to supply the luminaires. One additional 2-wire circuit is permitted.

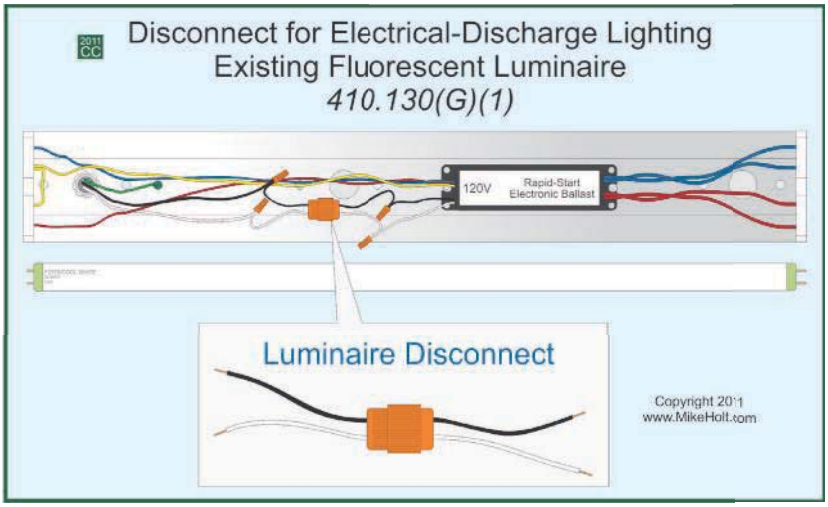


Fig. 3. For existing installed fluorescent luminaires without disconnecting means, a disconnecting means must be added when a ballast is replaced.

The requirement for the ballast disconnect doesn't apply to:

- Dwellings and associated accessory structures [410.130(G)(1)].
- The emergency illumination required in 700.16 [410.130(G)(1), Exception No. 2].
- Cord- and plug-connected luminaires, if you install an accessible separable connector (or an accessible plug and receptacle) as the disconnecting means [410.130(G)(1), Exception No. 3].
- Industrial establishments with restricted public access where written

Breaking Down Article 410

The first five parts of Art. 410 are in a logical sequence. The requirements they provide are mostly mechanical in nature. This sequence is followed by the luminaire wiring requirements in Part VI.

The seventh, ninth, and tenth parts provide requirements for manufacturers. Specify and install only equipment that conforms to these requirements. Part VIII provides requirements for installing lampholders. The rest of Art. 410 addresses specific types of lighting.

procedures and conditions of maintenance and supervision ensure that only qualified persons will service the installation [410.130(G)(1), Exception No. 4].

If you install more than one luminaire and it's supplied by a branch circuit that isn't of the multiwire type, do you have to install a disconnecting means for every luminaire? Not if you provide a means of disconnecting such that the illuminated area will not be left in total darkness [410.130(G)(1) Ex 5].

Multiwire branch circuits. When fluorescent luminaires are on multiwire branch circuits, the disconnect must simultaneously break all circuit conductors of the ballast. This includes disconnecting the neutral conductor, otherwise, a false sense of security can result in an unexpected shock.

The disconnecting means must be accessible to qualified persons. If it's external to the luminaire, it must be a single device located in sight from the luminaire.

Efficiency. You hear a lot about energy-efficient lighting, but what about efficiency when designing and installing a Code-compliant lighting system? The key to this efficiency is to greatly reduce the amount of reading you must do without missing applicable requirements.

First, work with a reputable electrical distributor to ensure the components are genuine and manufactured to the requirements of Parts 7, 9, and 11 of Art. 410.

The first four Parts of Art. 410 occupy only about three pages, but reading all of that for each lighting design still takes time. If you've read them recently, just scan the subsection headings (such as, "Bathtub and Shower Areas") for those that apply to your specific installation.

Don't scan through Part V or Part VI. Instead, read them with an understanding of what they are trying to accomplish:

- The main goal of Part V is that you bond non-current-carrying metallic objects just as you do for any other installation.
- The main goal of Part VI is to ensure that the wiring on or within luminaires is properly protected and supported.

Then, check the remaining Parts to see which may be relevant to your specific installation. EC&M

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Stumped by the Code?

By Mike Holt, NEC Consultant

All questions and answers are based on the 2011 NEC.

Q. What wiring methods are allowed by the Code in spaces above a lay-in ceiling?

A. Section 300.22(C) applies to spaces used for air-handling purposes, but not fabricated for environmental air-handling purposes. This requirement doesn't apply to habitable rooms or areas of buildings, the prime purpose of which isn't air handling.

Informational Note 1: The spaces above a suspended ceiling or below a raised floor used for environmental air are examples of the type of space to which this section applies.

Informational Note 2: The phrase "other space used for environmental air (plenum)" correlates with the term "plenum" in NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, and other mechanical codes where the ceiling cavity plenum is used for return air purposes, as well as some other air-handling spaces.

Electrical metallic tubing, rigid metal conduit, intermediate metal conduit, armored cable, metal-clad cable without a nonmetallic cover, and flexible metal conduit can be installed in cavity plenum space. If accessible, surface metal raceways or metal wireways with metal covers can be installed in cavity plenum space [300.22(C)(1)].

PVC conduit [Art. 352], electrical nonmetallic tubing [Art. 362], liquidtight flexible conduit, and nonmetallic cables aren't permitted to be installed in spaces used for environmental air, because they give off deadly toxic fumes when burned or superheated.

Plenum-rated control, signaling, and communications cables and raceways are permitted in a plenum space:

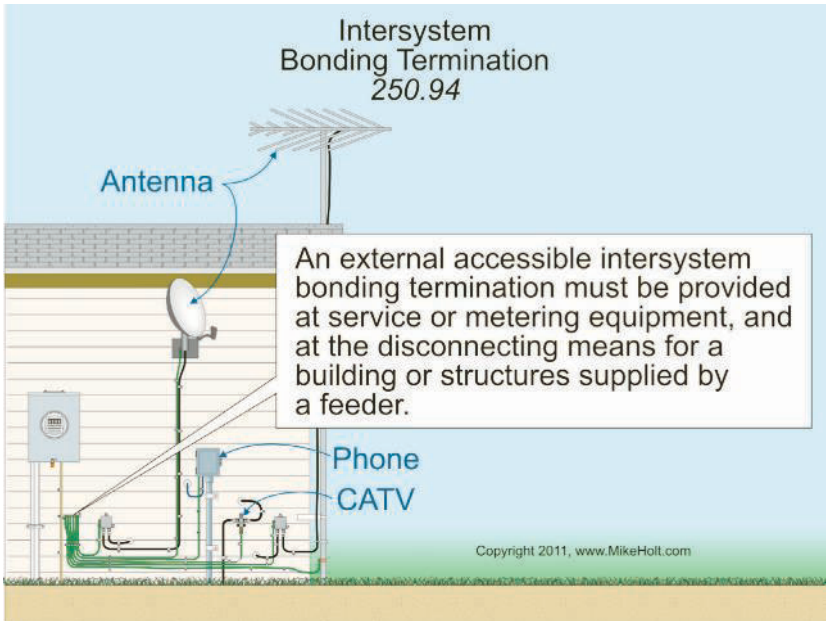
– CATV [820.179(A)]
– Communications [800.21]
– Control and signaling [725.154(A)]
– Fire alarm [760.7]
– Optical fiber cables and raceways [770.113(C)]
– Sound systems [640.9(C) and 725.154(A)]

Any wiring method suitable for the condition can be used in a space not used for environmental air-handling purposes.

Metal cable tray systems can be installed to support the wiring methods and equipment permitted by this section [300.22(C)(2)(a)].

Electrical equipment with metal enclosures is permitted to be installed in a plenum space [300.22(C)(3)].

Examples of electrical equipment permitted in a plenum space would be air-handlers, junction boxes, and dry-type transformers; however, transformers must not be rated more than 50kVA when located in hollow spaces [450.13(B)].



The intersystem bonding termination shall comply with six specific requirements.

Q. What is the Code requirement for an intersystem bonding termination, and what is to connect to it?

A. An external accessible intersystem bonding termination for the connection of communications systems bonding conductors must be provided at service equipment or metering equipment enclosure and disconnecting means for buildings or structures supplied by a feeder [250.94], as shown in the **Figure**. The intersystem bonding termination must:

1) Be accessible for connection and inspection.

2) Consist of a set of terminals with the capacity for connection of not less than three intersystem bonding conductors.

3) Not interfere with opening the enclosure for a service, building/structure disconnecting means, or metering equipment.

4) Be securely mounted and electrically connected to service equipment, the meter enclosure, or exposed nonflexible metallic service raceway, or be mounted at one of these enclosures and be

connected to the enclosure or grounding electrode conductor with a minimum 6 AWG copper conductor.

5) Be securely mounted to the building/structure disconnecting means, or be mounted at the disconnecting means and be connected to the metallic enclosure or grounding electrode conductor with a minimum 6 AWG copper conductor.

6) The terminals must be listed as grounding and bonding equipment.

According to Art. 100, an intersystem bonding termination is a device that provides a means to connect communications systems grounding and bonding conductors to the building grounding electrode system.

Exception: At existing buildings or structures, an external accessible means for bonding communications systems together can be by the use of a:

1) Nonflexible metallic raceway,

2) Grounding electrode conductor, or

3) Connection approved by the authority having jurisdiction (AHJ).

Informational Note 2: Communications systems must be bonded to the intersystem bonding termination in accordance with the following Code requirements:

- Antennas/satellite dishes [810.15 and 810.21]
- CATV [820.100]
- Telephone circuits [800.100]

All external communications systems must be connected to the intersystem bonding termination to minimize the damage to them from induced potential (voltage) differences between the systems from a lightning event.

Q. If a single receptacle is installed behind a washing machine within 6 ft of a laundry tub in a dwelling unit, is GFCI protection required?

A. GFCI protection is required for all 15A and 20A, 125V receptacles located within an arc measurement of 6 ft from the outside edge of the sink in dwellings and for other than kitchen sinks [210.8(A)(7)].

Q. Does the rule for GFCI protection of receptacles within 6 ft of a sink apply to undercounter receptacles for dishwashers and kitchen waste disposers in dwellings?

A. No. GFCI protection is required for all 15A and 20A, 125V receptacles that serve countertop surfaces in a dwelling unit [210.8(A)(6)].

GFCI protection is required for all receptacles that serve countertop surfaces, but GFCI protection isn't required for receptacles that serve built-in appliances, such as dishwashers or kitchen waste disposers. See 210.52(C) for the location requirements of countertop receptacles. EC&M

Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

HACK-N-SMASH

Apparently, this installer thinks it's okay to leave a big open hole in the ceiling. There's no way the sheetrock can be properly patched now that this electrical work has been completed.

Section 300.21 requires us to maintain the fire resistance integrity of fire-resistant-rated ceilings, walls, floors, or partitions. In this case, an installer can meet this requirement by patching up the sheetrock or using some other approved methods. In addition, Sec. 314.21 requires repairing of broken or incomplete non-combustible surfaces around boxes using a flush-type cover or faceplate. Repairs must be made so there is no greater than $^{1}/_{8}$-in. gaps or spaces around the box.

The next problem we can point out is the lack of a connector to secure the EMT to the box. Section 300.10 requires metal raceways and metal enclosures to be "metallically joined together." The raceway must be connected to the box in order to "provide effective electrical continuity."

Next on the violations "hit list" is Sec. 406.5(C), which states receptacles mounted to and supported by covers must be "held rigidly against the cover by more than one screw," unless the assembly is listed for use with a single screw.

Overall, this certainly violates the "neat and workmanlike" requirements of 110.12.

LITERALLY CUTTING CORNERS

I can only assume the installer who did this does not own a hole saw or a punch kit — although he sure does have a sharp hacksaw! Cutting and bending away the corner of this panelboard creates several Code violations.

Section 312.5 requires cables and conductors entering enclosures to be protected against abrasion. Those cut metal edges are razor sharp, and could easily cut through the NM cable jacket and conductor insulation.

Section 312.5(A) requires the huge opening to be "adequately closed." It's obvious no attempt was made to close the opening. This could easily allow debris to enter the top of the cabinet and cause serious damage to the internal parts.

Section 312.5(C) requires cable wiring methods to be "secured to the cabinet, cutout box, or meter socket enclosure." That obviously did not happen here.

I would additionally say that 110.12(B) has been violated. The last sentence in this section alerts us to the fact there shall be no damaged parts, including parts that are cut "that may adversely affect safe operation or mechanical strength of the equipment."

Huge unprotected openings, razor sharp metal edges, and unsecured cables could easily lead to a personal injury or arc-flash event at this location.

E-Mon D-Mon Smart Meters

Submeters for energy, power quality and BAS integration offer basic to advanced functions, load control, net metering and more. UL/CUL listed and ANSI C12.20 certified, most series models provide dual-protocol communications for simultaneous operation with multiple BAS systems, billing packages or M&V reporting.

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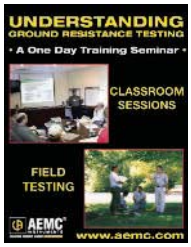

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What's Wrong Here?

By Russ LeBlanc, NEC Consultant

How well do you know the Code? Think you can spot violations the original installer either ignored or couldn't identify? Here's your chance to moonlight as an electrical inspector and second-guess someone else's work from the safety of your living room or office. Can you identify the specific Code violation(s) in this photo? *Note*: Submitted comments must include specific references from the 2011 NEC.

Hint: It's mind bottling

— 'TELL THEM WHAT THEY'VE WON...' —

Using the 2011 NEC, correctly identify the Code violation(s) in this month's photo — in 200 words or less — and you could win something to put in your toolbox. E-mail your response, including your name and mailing address, to neccodeguy@hotmail.com, 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. Winners will receive a fluorescent lighting tester from Milwaukee Tool, valued at $199. The product allows complete lamp, ballast, and pin testing, before or after install, without dismantling fixtures.

*(*Please allow six to eight weeks for delivery of tools.)*

November Winners

Our winners this month include: Vincent Hueber, P.E., facility engineer, Syracuse Housing Authority, Syracuse, N.Y.; Perry R. Kruse, owner, Perry Kruse Electric, Northfield, Minn.; and Jayson Sorum, electrician, Grand Forks Public School District, Grand Forks, N.D. They all correctly identified the following violations associated with this damaged conduit.

It looks like this installer may have been absent from class on pipe bending day, or perhaps he took the class, "How to Bend Pipe with Hammers 101." In any case, the EMT has been damaged, and its internal diameter has been effectively reduced. This is clearly a violation of 358.24, as proper pipe bending techniques were not used on this EMT. The installation is also not very "neat and workmanlike," as required by 110.12.

Damaging the EMT in this manner can cause problems with the conductors as they get pulled through the pipe. Imagine yourself trying to pull a bundle of conductors through the kinks on that bend. Some of the kinks in this pipe are so bad that they could even prevent the wires from being pulled in at all.

Many different types of pipe benders are available for electricians to use. Hammers, however, don't make for a good pipe bender!

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