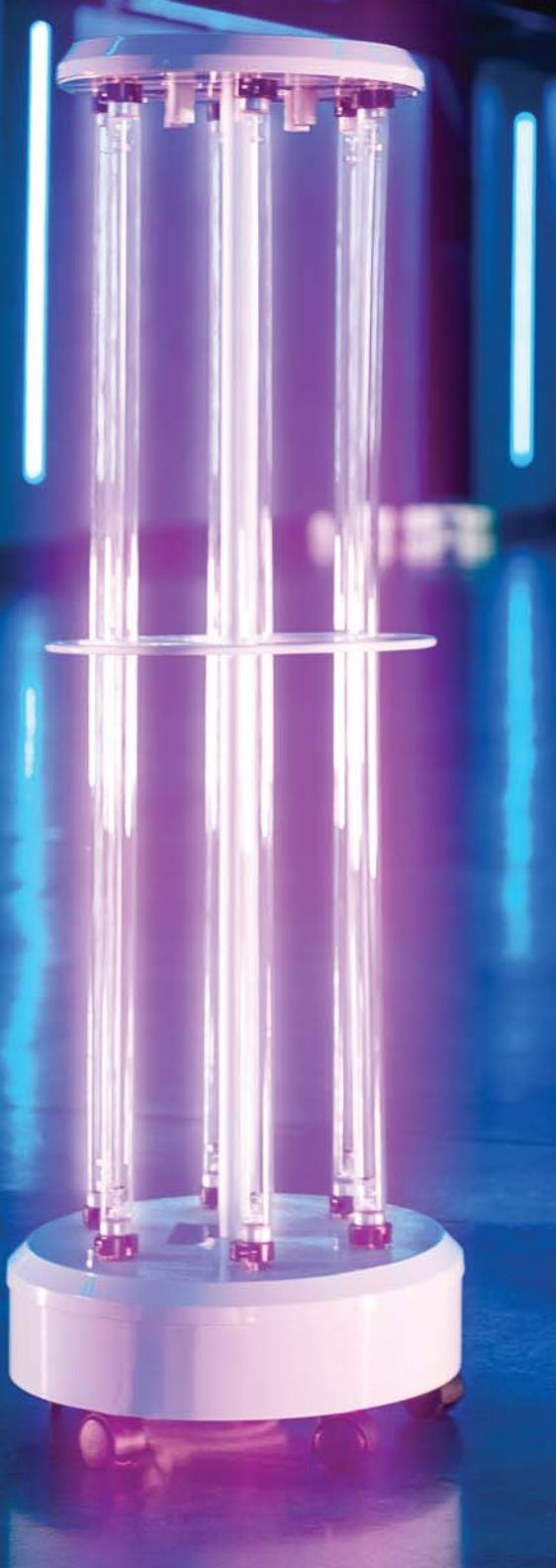


THE LATEST TRENDS IN DISINFECTION LIGHTING

COVID-19 triggered a change in how and why end-users disinfect buildings — a reality that creates opportunities for electrical professionals in various lighting applications.



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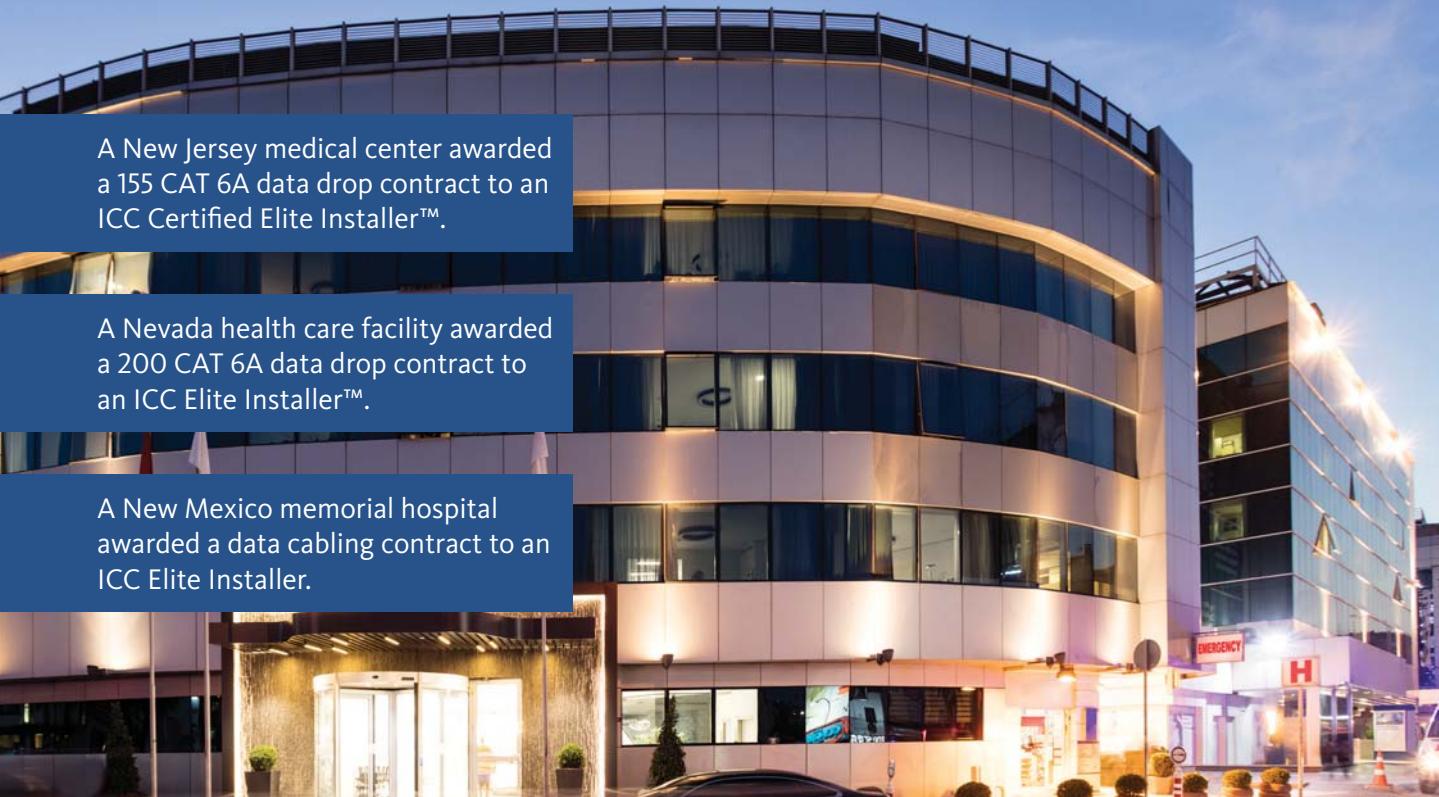


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International Ultraviolet Association (IUA)

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April 2022 • Volume 121 • Number 4



Avis Lighting

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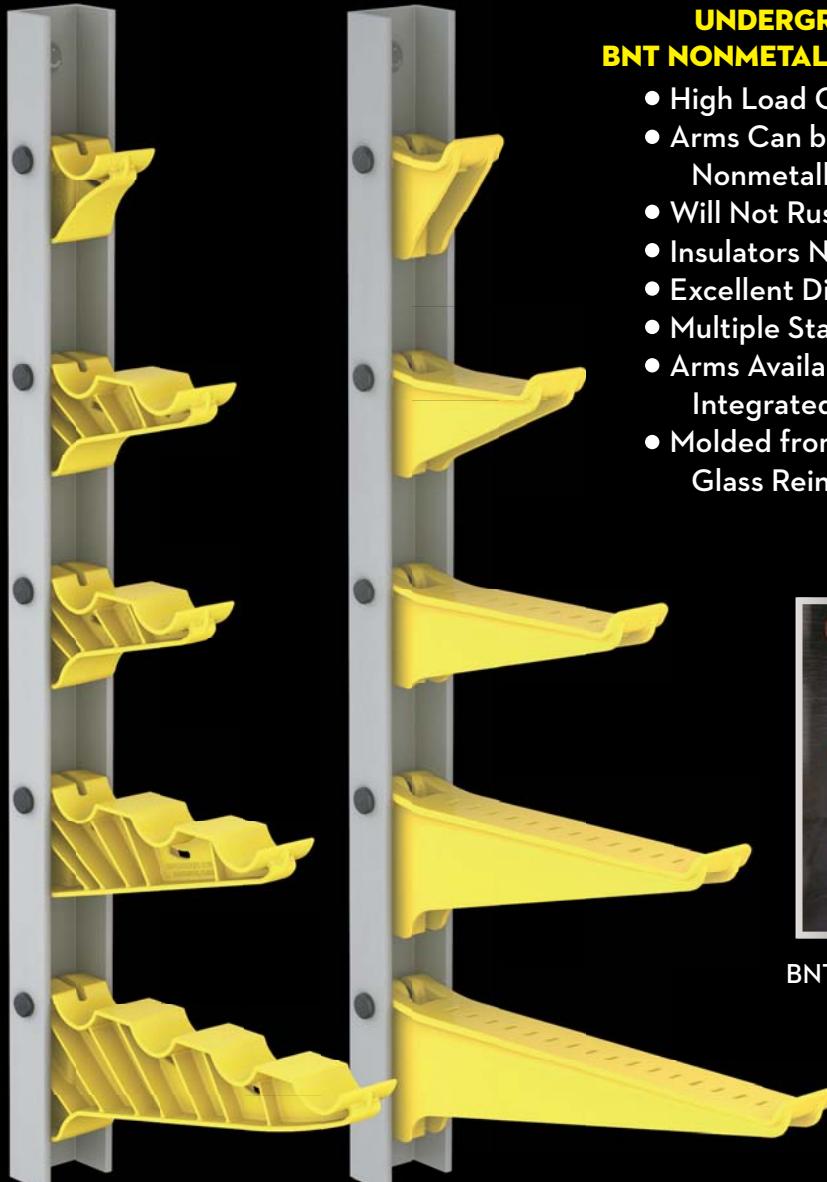


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CODE QUIZ OF THE WEEK: NO. 328

Quiz ▶ Test your knowledge of the 2020 National Electrical Code (NEC) requirements with this weekly quiz.

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Editorial

Group Editorial Director - Buildings & Construction: Michael Eby, meby@endeavorb2b.com

Editor-in-Chief: Ellen Parson, eparson@endeavorb2b.com

Senior Associate Editor: Ellie Coggins, ecoggins@endeavorb2b.com

Associate Editor: Michael Morris, mmorris@endeavorb2b.com

Senior Art Director: David Eckhart, deckhart@endeavorb2b.com

Consultants and Contributors

NEC Consultant: Mike Holt, mike@mikeholt.com

NEC Consultant: Russ LeBlanc, [rusleblanc.net](mailto:russ@rusleblanc.net)

Sales and Marketing

Vice President: Mike Hellmann, mhellmann@endeavorb2b.com

Regional/Territory Account Manager: Jim Carahalios, jcarahalios@endeavorb2b.com

Regional/Territory Account Manager: David Sevin, dsevin@endeavorb2b.com

Regional/Territory Account Manager: Jay Thompson, jthompson@endeavorb2b.com

Media Account Executive – Classifieds/Inside Sales: Steve Suarez, ssuarez@endeavorb2b.com

Production and Circulation

Production Manager: Brenda Wiley, bwiley@endeavorb2b.com

Ad Services Manager: Deanna O'Byrne, dobyrne@endeavorb2b.com

User Marketing Manager: Sonja Trent, strent@endeavorb2b.com

Classified Ad Coordinator: Terry Gann, tgann@endeavorb2b.com

Endeavor Business Media, LLC

CEO: Chris Ferrell **CFO: Mark Zadell**

President: June Griffin **COO: Patrick Rains**

EVP, Special Projects: Kristine Russell

Chief Administrative and Legal Officer: Tracy Kane

EVP, Group Publisher – Design & Engineering, Energy, Buildings & Construction: Reggie Lawrence

Editorial Office: Endeavor Business Media, LLC, 1233 Janesville Ave, Fort Atkinson, WI, 53538.

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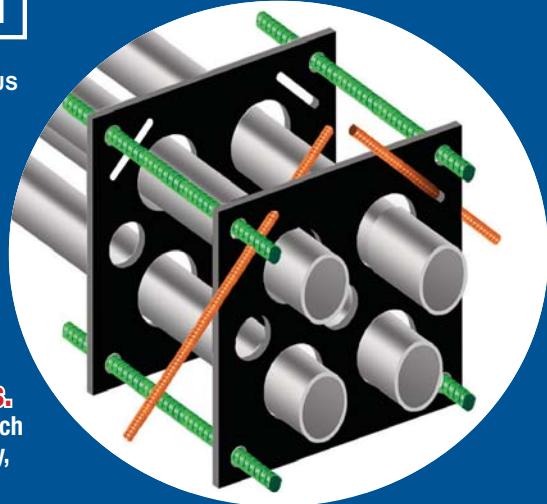
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Lighting the Way Forward

By Ellen Parson, Editor-in-Chief



More than two years after the start of the pandemic, it certainly seems like society is finally getting back to some semblance of normalcy. For many of us in the workforce, that means traveling again to industry trade shows and events like the LEDucation conference held in March (see page 46 for highlights), attending more in-person meetings, and heading back into corporate office settings. This trend is evidenced in *EC&M's* recent 2022 Top 40 Electrical Design Firms survey results, which will be featured in the June print issue as well as online. Two years ago at this time, 69% of Top 40 firms were allowing at least 90% of their labor force to work from home (who weren't doing so pre-pandemic). That number dropped to 44% in 2021 and then to 14% this year, indicating a drastic shift toward more in-person work environments. However, an unprecedented 100% of respondents also reported that their firms will allow remote employees to continue working from home in a part- or full-time capacity after the pandemic is deemed "under control." That being said, the tricky part is what one employee now considers "normal" might be completely different than his or her counterpart. In order to survive and thrive over the last two years, many businesses were forced to reimagine their definition of office space, bringing about a fundamental shift in the way in which many employees work (especially those who hold traditional office jobs) as well as what they expect in a workspace — not to mention how it all comes together to promote a healthier work/life balance. This reality not only

raises the bar for remote home office design and functionality, but it also introduces the need for serious modifications to outdated corporate office settings — and lighting is at the heart of all of it.

That's not just based on speculation. There's gobs of industry research to prove it, at least from a perception standpoint. And with perception comes power. Here's just a sample of a few of the significant stats. One recent study, conducted by the American Society of Interior Designers (ASID), showed that 68% of employees were dissatisfied with the lighting situation in their offices. According to another survey (conducted by Staples and cited in a recent article on the WeWork website at <https://we.co/3reUywN>), one-third of workers indicated they'd be happier at work if they had better lighting in their offices. Of those respondents, 80% maintained that having good lighting in the office was important to them. Also coming from ASID, a test case on its new Washington, D.C. headquarters examined the impact of design in the workplace, revealing all employees "have knowledge on circadian lighting and its effects on their health and well-being." In fact, this research determined that 25% attributed circadian lighting at their new office space to enhanced sleep quality.

As we have done for years, our April issue focuses on the latest developments in lighting and control. This year, we're proud to present a compilation of articles that will help get you up to speed.

- In our cover story on page 26, Freelancer Tim Kridel takes the complicated topic of disinfection lighting and makes it manageable for all, highlighting the latest trends in ultraviolet germicidal irradiation (UVGI) and how this niche presents opportunities for electrical professionals.

- A Building Science Leader at Lutron, Craig Casey explores "A Contractor's Guide to Luminaire Level Lighting Controls" on page 32, revealing how LLCCs can save time, add value, and future-proof jobs.

- For a technical overview of "How Lighting Helps to Prepare for the Future Integration of IoT Sensors," turn to page 36 for a report from Cooper Lighting's Martin Mercier, P.Eng. on how lighting control systems are being deployed for a plethora of purposes outside the traditional energy savings strategy.

- On page 42, Howard Yaphe, CEO of Axis Lighting, dives into how "Dynamic Lighting Provides Designers Future Adaptability," highlighting how today's demanding office configurations require flexible lighting solutions.

And don't miss the lighting and controls product showcase, starting on page 48, which presents a roundup of the latest innovative products introduced to the market recently. As the definition of a safe and productive workspace continues to evolve, lighting will inevitably play a critical role in that transformation.

Ellen Parson

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Identifying Estimator Errors

An inside look at the most common mistakes estimators make and how to prevent them

By Don Kiper, Electrical Estimating 101



One of the main goals in estimating is accuracy. Therefore, mistakes must be minimized. A major mistake could be fatal to a project's profitability. When dealing with mistakes in the estimating process, the estimator must work at minimizing them and developing a good process to identify and correct them.

The very nature of the estimating process is fertile ground for making mistakes. With so many factors that can affect the accuracy and quality of the estimate, the estimator must be vigilant.

Estimating requires the ability to quantify a project's materials, labor risks, and all project costs in a very short time. There can be added stress when an employee is managing and estimating multiple projects.

We all make mistakes because we are human. Here are five mistakes estimators tend to make:

- **Poor interpretation.** The contract documents provide the estimator with the ability to properly estimate a project. From the drawings, the estimator can accurately "quantify" a project. In today's world of engineering, not all drawings are 100% complete for construction. Architects and engineers issue drawings that are sometimes only 50% complete. This can be challenging for the contractor. The specifications provide product details and how to install the materials. The estimator must properly understand area classifications as

well as code requirements of the Authority Having Jurisdiction and the National Electrical Code. The contractor's work will be judged by the contract documents. Care must be taken in making assumptions of the engineer's intent. Interpreting intent can be costly. When the risks are too great, clarification must be sought from the architect and/or the engineer.

- **Bad judgment.** When we make a judgment, it is typically based on careful thought. Our thoughts are influenced by our experience in the trade. Therefore, our judgment improves with historical data. The best judgments are made on facts, not gut feeling, which has little place in the world of quality estimating. Analyzing previous projects and several types of installations will provide the estimator with the ability to make the best judgments. Labor reporting from the field will provide accurate historical data for making judgments related to the current project.

- **Manual calculations.** Estimating software, spreadsheets, and calculators are tools that perform calculations. Performing calculations "in your head" is a sure way to make a mistake. Manual calculations must be avoided. Most estimating software programs provide features for determining the bid price within the software. The contractor should be careful using estimating software in conjunction with an Excel spreadsheet. This creates an environment for human mistakes. Estimators

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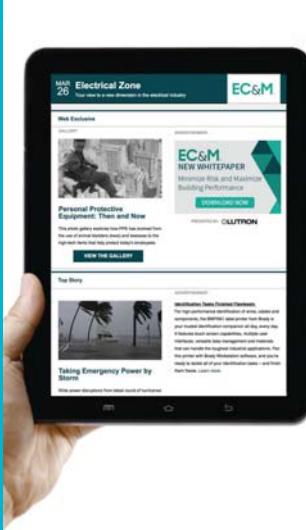


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should use the best features of software to minimize mistakes. Quality software provides the ability to complete an estimate from beginning to end.

- **Not using software as designed.**

Computers allow an individual to work efficiently. I began estimating manually with pencil and paper in the mid-1980s. In those days, we used the NECA Labor Manual for labor units and a National Pricing Service book for material prices. Today, this has been simplified with estimating software. When I transitioned to computerized estimating, I wanted the estimating software to "think like a manual estimator." This is unwise. The estimator MUST allow the best features of estimating software to change his or her methodology in the estimating process. Using software as designed, you will increase your efficiency and minimize mistakes. Transposing labor and material totals from estimating software to an Excel spreadsheet to summarize an estimate is counterproductive and risky. Mastering the functions of estimating software will provide the best outcomes. Every software feature has an intended purpose and should be used accordingly.

- **Omissions.** An omission is something neglected or left undone. This could be a missing quotation, a general or specific drawing note not addressed, or a missed drawing not quantified. Every estimator should have an estimating sequence that is followed to ensure that the estimate is complete. Constant procedures will produce constant results. The unchecked estimate will prove detrimental to the quality of the estimate.

So your goal should be to avoid these mistakes as much as possible. But how do you go about doing so? Here are six tips to help you avoid making those mistakes.

- **Use a "Request for Information" for clarity.** Contractors are installers, not engineers. Therefore, ask the architect or electrical engineer for clarification when in doubt of the project's document's intent. The reason we have questions is that we do not know. So, when you are unsure, ask a question.

- **Master your estimating software.** Learn every feature that your estimating software provides. Seek training, and find an online lesson to help.

- **Avoid distractions.** Minimizing distractions is essential. A closed office door is better than an open one. Background music may be relaxing, but talk radio and constant news stories can occupy one's mind. On bid day, put a "Do Not Disturb" sign on your office door.

- **Focus on the task at hand.** Multitasking is somewhat of a misnomer. You can only give your full concentration to one task at a time. Trying to do two things at the same time is not the best practice. Confucius said, "The man who chases two rabbits catches neither." This is good advice.

- **Take a break.** Taking a break allows your mind to relax and refresh. Keeping your nose to the proverbial grindstone can be counterproductive to your efficiency. Working long periods without taking a break can create brain fog.

- **Have an estimating sequence.** An estimator should have a systematic sequence for preparing estimates. The use of standardized estimating procedures is essential for speed, accuracy, and consistency. Consistent procedures will produce consistent results. Here are some benefits estimators can expect from using an estimating sequence:

- Increased confidence in their work.
- Increased speed and greater estimating departmental production
- Increased organization
- Increased estimating accuracy
- Reduced estimating omissions
- Confidence during the bid summarization

This sequence checklist will greatly minimize mistakes.

Owning mistakes is necessary for learning to identify and correct them. Mistakes must be corrected sooner, rather than later. Major mistakes as well as minor mistakes have a culminating effect on the estimate. Identify the mistake, minimize the impact, and improve your processes/practices for prevention in future estimates.

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Don Kiper is an independent electrical estimating trainer and consultant based in Niagara Falls, N.Y. He can be reached at don@electricalestimating101.com.



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Project Gain or Fade

Why lack of visibility to the realities on the job site impacts profitability

By Heather Moore, Ph.D. and Jennifer O. Daneshgari, J.D., MCA, Inc.

You have many jobs of varying sizes. If we ventured a guess, we'd say that rarely do these jobs deliver the profit that was identified in the estimate. And if they do, the portion of the job where you made the profit was likely not where you expected to get it. How do we know this? Based on 30 years of studying the construction industry and data on millions of hours of construction projects, almost no project turns out how it was bid. The root cause is a lack of visibility to the realities on the job site.

Take a look at **Fig. 1**. MCA, Inc.'s data shows that while the estimates planned for a profit range of 12% to 24%, at the end of the job, the range was actually -12% to 42%. It's difficult to comprehend this because the team believes and intends to be observing, discussing, and attempting to monitor the job throughout its life cycle. But the numbers don't lie.

Ask yourself these questions:

- How often have you and your team watched the accounting job cost report and tracked the burn rate on the job?
- How often do you see job profit projections "holding steady" month after month?
- How much attention do you put into your schedule of values to ensure you're working to avoid financing the job?
- How often do you review under and overbilling?
- How often do you have work in progress meetings to discuss the status of the job?

You spend all this time with your team, reviewing the numbers, but you still end up with an outcome you don't expect. So, what are you missing?

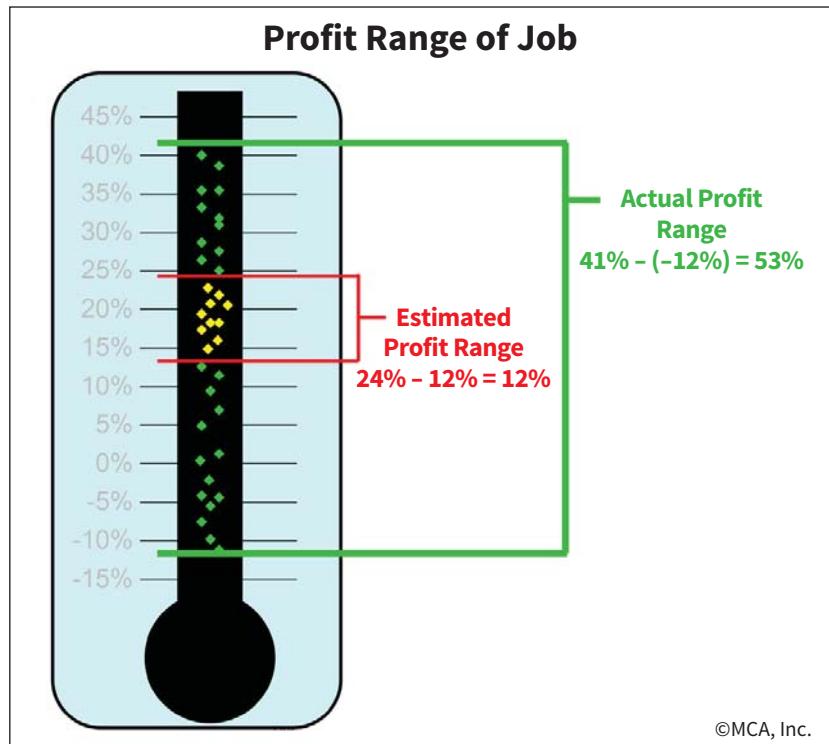


Fig. 1. Estimated versus actual range of profit for jobs.

IDENTIFYING THE VARIATION

Companies have various methods of tracking costs and profits. There are signs that things aren't as stable as you'd like. You meet weekly, reviewing the status of the job by looking at the costs and the billings. It all looks under control, but then something changes at the end. The discussions throughout the job could include some of the following items:

- Depending on your method of tracking, you may hear that the percent complete of the job matches the percent labor spend through most of the job — until the end.

- If the labor is over budget, you may hear that "we're waiting on approved change orders."

- When you're close to substantial completion, you'll hear that "we're almost done," but then that last 5% takes a LONG time to get to 100%.

- You're in the project management/work in progress meetings, asking or answering questions about projected profitability on the job and you hear, "We're on track. There are no changes to report. Everything is going fine."

MCA's data in **Fig. 2** (on page 14) shows that the real costs on the project — if labor and job productivity are



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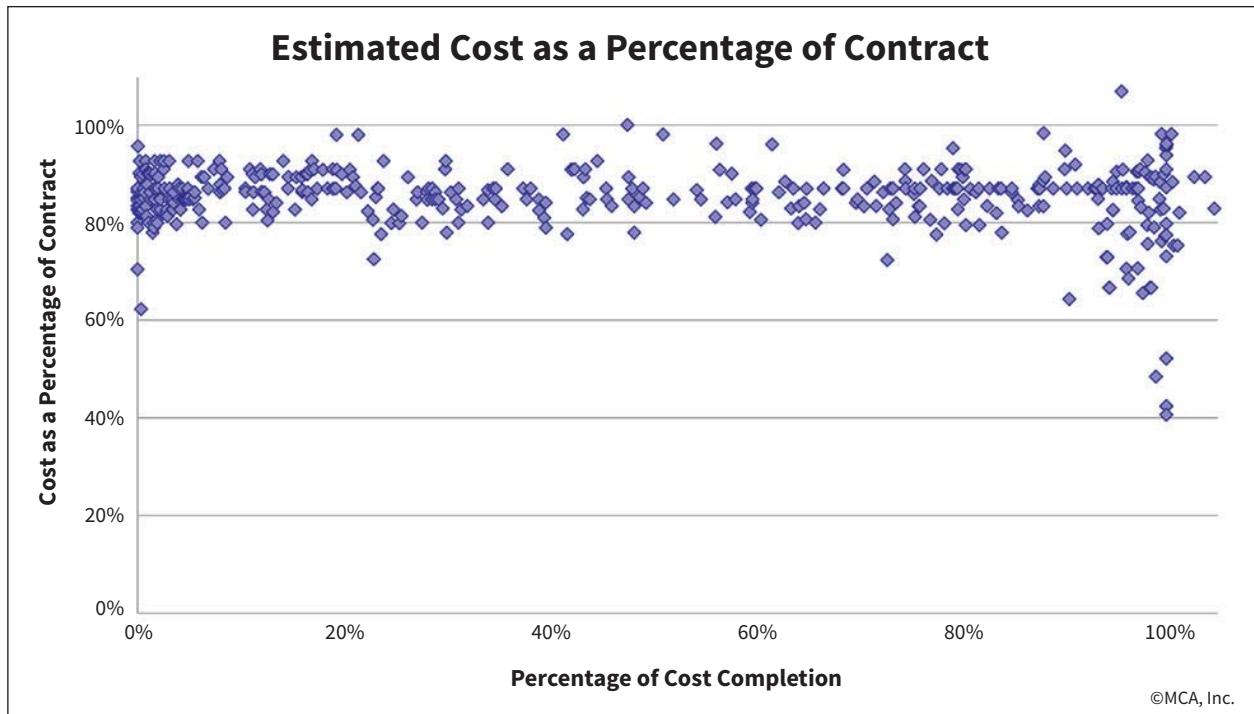


Fig. 2. If labor and job productivity are not tracked, the real costs on the project will likely show up when the job is close to 95% complete.

not tracked – will likely show up when the job is close to 95% complete. And then what? You have that last (long) 5%

The old saying is as true today as when it was first said: “What gets measured gets done.”

to finish, and there aren't a lot of knobs to turn to recover if you're behind — or even explain why you're ahead.

HOW CAN YOU HELP THE SITUATION?

The old saying is as true today as when it was first said: “What gets measured gets done.” It is also true that only what is visible gets measured. This creates a reference point/yardstick to measure performance against. This takes real-time data between estimating, the field, and accounting to triangulate to ensure that the answers you're getting in those meetings are grounded in data. Figure

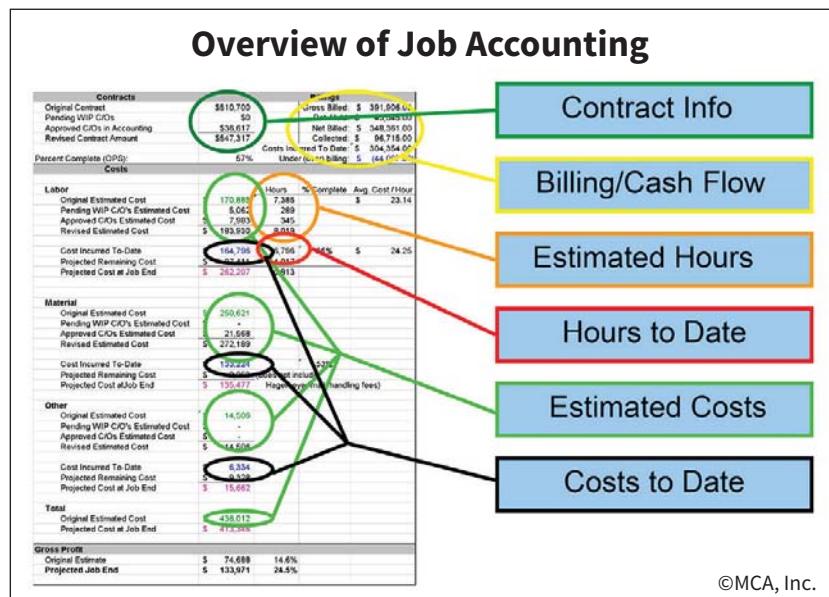


Fig. 3. The link between estimating, accounting, and the field.

3 is an example of a report that links money, manpower, and material from the field, accounting, and estimating. The best way to predict profitability is to control the job during the job. The key to this is to measure productivity instead of production. Refer to ASTM E2691-20, *Standard Practice for Job Productivity*

Measurement, which was originally published in 2008 and republished in 2012. The questions you should ask are:

- Do the hours/labor/cost codes planned for the job match how the field sees/will build the job?
- Are the cost codes being managed weekly to check for under/overruns



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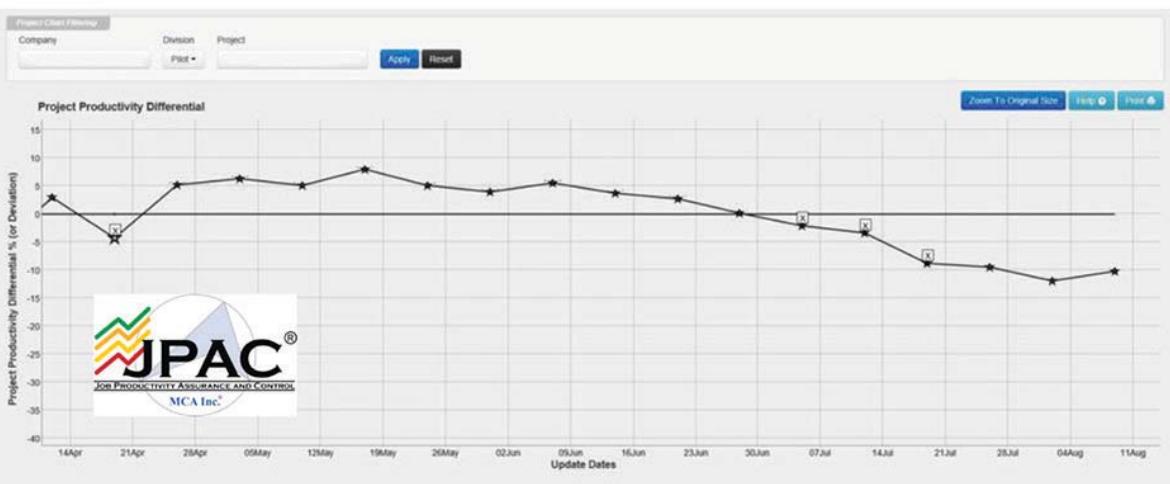
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With 125 shared years of industry expertise, Universal Douglas is a trusted name in lighting fixture, retrofit, and integrated controls solutions. Unlike most, we complement our innovative LED portfolio with a line of traditional products for the most comprehensive service possible.

Predicting Job Profitability in Advance



From May 17th to August 2nd, the productivity dropped from 7.99% to -11.91%, decreasing a total of 19.9%, resulting in a projected job and labor cost increase of 11.89%, and translating to approximately \$78,415 in additional cost.

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Fig. 4. How using application of ASTM E2691-20 can show prediction of job profitability in advance.

(versus one large bucket of labor)?

- How much work was planned for today versus how much was completed? If the completion didn't meet the plan, why not, and what are you doing to help that?
- What got in the team's way of completing their work?

PUTTING IT ALL TOGETHER

Figure 4 shows a real-life example of a team using all of the points listed above (accounting cost reviews and project management percent complete projections) and following the recommendations in the ASTM E2691-20 Standard. Using the standard and labor productivity (versus production), the signals that the labor was not productive and the profitability of this job was at risk were present as early as March 2019 (when the job started up and the estimate/planned work had a difference). Then in May, the tool showed downward productivity. Since this was a five-month job, this early notification was quite significant — and likely could've helped job profitability if acted upon. The ending accounting/company reports confirmed what the tool using ASTM Standard E2691-20 had been displaying.

So, let's focus on how you can use this process. First, create your reference points:

- Track costs in your accounting/project management/work-in-progress meetings, but recognize you need a link to an independent reference point related to the completion of work.
- Don't go by gut feel for percent complete on the job. Watch this plan frequently. Take job walks, review with your team what they see in the field, and help them see things they may be missing.

• Get the field workers to document the work they see on the job. Write it down with a daily plan. Don't focus on what was completed by the end of the day, but on what you scheduled. Then note what got in your way, according to the article "The Secret to Short-Interval Scheduling." For more information, view this article online at <https://bit.ly/3LQV5wy>.

• If they're spending time mobilizing/demobilizing for other trades or general contractor requests, document it and the time you're losing.

• If they're spending time moving material, consider breaking down the work to tasks you can have different people (or vendors) help with to keep

your most valuable and skilled labor doing what they do best — installing. For more information on this concept, read the article "Real Ways to Reduce Material Handling Costs" at <https://bit.ly/3raZuTm>.

• Figure out anything that can be taken off the job site and completed in a pre-fab shop to help with safety and speed of installation, according to the article "Putting Prefab into Perspective." Read more on this concept at <https://bit.ly/3KhPRcZ>.

If you focus on data and linking estimating, accounting, and field information through an application applying ASTM E2691-20's *Standard Practice for Job Productivity Measurement*, you will not be surprised in the last 95% of the job. You'll be able to effectively predict your profits to accurately plan for the future. **EC&M**

Dr. Heather Moore is the Co-Chair of ASTM Building Economics Subcommittee E06-81 and the vice president of operations at MCA, Inc., Grand Blanc, Mich. She can be reached at hmoore@mca.net. Jennifer Daneshgari is vice president of financial services and operations at MCA, Inc. She can be reached at jennifer@mca.net.

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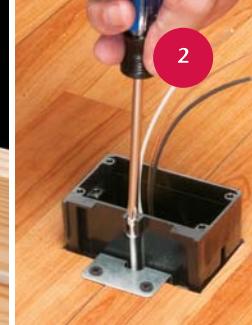
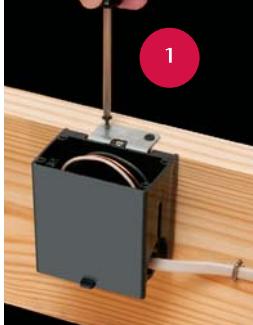
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BRASS

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FINISHED
FLOOR
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FLBAF101BL
BLACK

FLBAFR101NL
Nickel-plated
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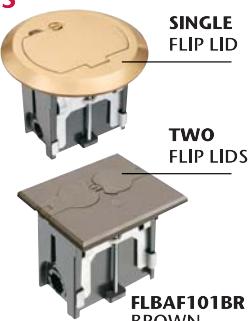
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What Makes a Desirable Home Electrical System?

How to make customers happy while ensuring code compliance

By Gerald Talbot, Mister Sparky

Houses are being built quickly every day. It seems like they are going up overnight! It makes you wonder if builders are planting a "house" seed that produces immediate results. The truth is that home builders have gotten pretty adept at putting the puzzle pieces together and delivering a code-compliant house in a timely fashion.

Houses today have to meet more codes than ever before, and, from an electrical standpoint, it could be a nightmare if you don't keep up with all the changes. As electrical contractors, we know better than anyone exactly what the electrical codes are. If you don't, your local inspector will surely let you know. But what the codes deem necessary and what your clients want can be somewhat different.

This begs the question, "What do clients want in an effective electrical system?" Here are some ideas from our recent experience:

WHAT DO ADULTS WANT FROM THEIR HOME ELECTRICAL SYSTEM?

We are seeing a rise in installation requests for smart home automation, video doorbells, USB chargers, EV chargers, and panel metering devices.

- **Video doorbells.** Having video capability at the front door is more important now than ever. These doorbells allow you to see the front steps of your home along with two-way communication with your visitor. From a safety standpoint, video doorbells can provide peace of mind knowing who is on your steps.

- **USB outlets.** Who doesn't need more places to charge their phone or



Gerald Talbot

device faster? It is no longer a nice thing to have but a necessity. Plus, these outlets can charge a device faster than with an adapter. They can also serve as a place to plug in a lamp or TV in addition to a smartphone or tablet.

- **EV charging stations.** With rising gas prices and green initiatives, people are investing in electric vehicles (EVs) and home charging stations. Many houses will need a further inspection to make sure the service and panel are large enough to carry the load for an EV. Check with your local permit office for any code updates that may need to be implemented if you have to change the service.

- **Home automation.** Smart switches and outlets make great additions to an electrical system. Not only

are these devices convenient, but they can also save you money by allowing you to manage your energy consumption by turning lights off remotely or controlling the temperature while out of the home.

- **Panel metering devices.** Panel metering devices can link to your phone and bring clarity on what exactly your house is pulling in terms of wattage. This could help you save money if you cut out the excess and make adjustments to your usage, too.

WHAT DO KIDS NEED FROM AN ELECTRICAL SYSTEM?

- **Tamper-resistant outlets.** Make sure to offer tamper-resistant (TR) outlets when working in existing houses. It's a nice upgrade to offer clients with small children.

- **Night lights.** Night lights in stairs and hallways can make children feel safer going to the restroom or making a run to mom and dad's room when they are afraid of something. It may seem silly to us, but to children, it's a real thing! Plus, there are cool night lights that you can simply fit into an existing outlet box.

These are just some ideas of what you can add to an electrical system to better serve your client and give them a house they can be proud to come home to.

EC&M

Talbot is a licensed, master electrician in Georgia, where he was born and raised. He has been in the industry for 22 years and is currently the operations manager for Mister Sparky Atlanta, where he manages a team of technicians. In his spare time, he plays with his kids, volunteers, and enjoys flipping houses. He can be reached at gerald.talbot@mistersparky.com.

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MCI-A Steel & Aluminum	.440 to .550	.480 to .550	.480 to .550	12/4
AC90, ACG90		12/3, 12/4 10/2	.480 to .550	10/2
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How to Get the Best Rebates for Horticultural Lighting

The number of utilities offering rebates for this market has nearly tripled since 2020.

By Randy Young, BriteSwitch



Courtesy of BriteSwitch

Horticulture lighting can be used alone or can supplement natural light for increased growing opportunities.

It seems almost comical that humans have spent hundreds of years trying to find a replacement for a seemingly endless resource: the sun. But humankind is not often happy with the status quo; they want things bigger, faster, and better. For example, they want to grow plants in places that aren't typically hospitable to them, so they turned to electric lighting to grow plants indoors or supplement available sunlight.

Artificial light has always been expensive; the average energy cost made it unprofitable to use plant lights or horticulture lights in many applications. However, the technology has evolved over the years. Today, horticulture lighting can be found in many different applications, including greenhouses, vertical farms, and tobacco production, along with growing flowers, cannabis, and even components to make plant-based vaccines. It's a vast market that is growing rapidly due to technological and societal changes.

BriteSwitch, a firm specializing in capturing local, utility, state, and federal rebates/incentives for business, explains advancements in horticultural lighting and how to take advantage of rebates in this market.

LED ADVANCEMENTS CREATE NEW OPPORTUNITIES

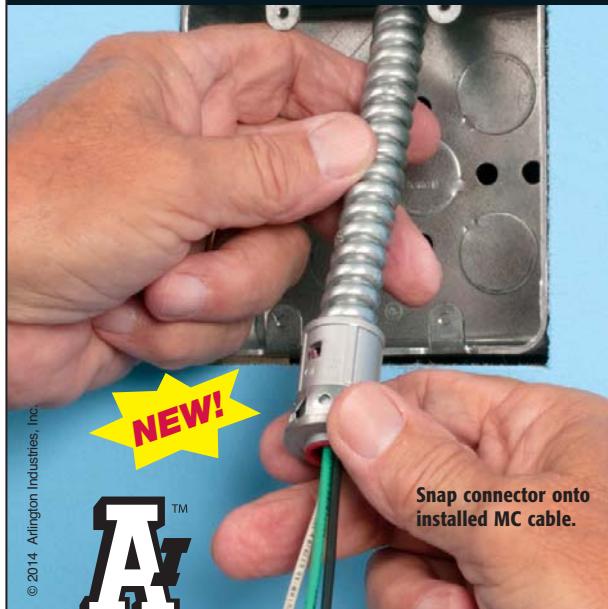
Like they did with traditional lighting, LEDs came along and revolutionized grow lights. With 20% to 40% less energy usage than conventional HID grow lights, they provided a huge opportunity to cut operating costs for growers. The reduced wattage also meant less waste heat, which was hugely beneficial to indoor growing operations.

Not only were these LED horticulture lights cheaper to run, but they also provided an opportunity to increase the production and quality of the product. When growing plants indoors, the color of the light is important. The sun offers full-spectrum lighting (all wavelengths). As humans, we perceive these different wavelengths as colors (e.g., a 400-nm wavelength looks violet to us, while 700 nm looks red). Plants, on the other hand, interpret the wavelengths in a completely different way. The wavelengths can stimulate different processes in the plant. For example, red light triggers germination and stem growth, while blue can promote root development and transition to flowering. By fine-tuning which wavelengths hit

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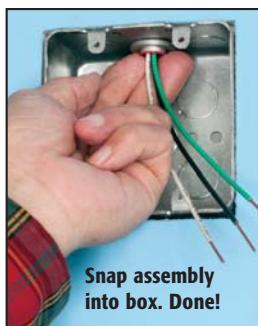
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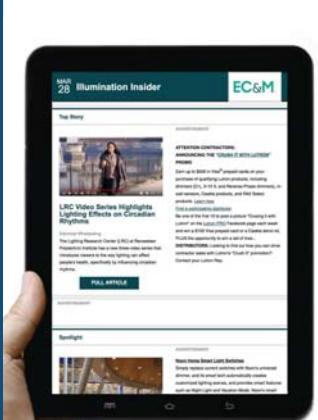
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the plant, its development and production can be optimized.

DLC HORTICULTURE LIST HELPS WEED OUT UNDERPERFORMING LUMINAIRES

In October 2019, the DesignLights Consortium (DLC) created a new standard and qualified product list (QPL), specifically for horticulture lighting. Over the years, the DLC has been the de facto standard that utilities use to ensure customers install high-quality lighting when applying for incentives. The DLC worked closely with manufacturers on the technical specifications for this list, considering the unique aspects of this type of lighting.

Since its debut, the DLC Horticulture List has grown rapidly. In September 2020, there were only 125 products on the list. Just a little over a year later, there are now more than 500 eligible luminaires.

Having a new category specifically for horticulture lighting gave rebate programs more confidence to provide incentives for these types of lighting. As a result, the number of rebates has increased substantially since the list's inception.

REBATES AND HORTICULTURE LIGHTING

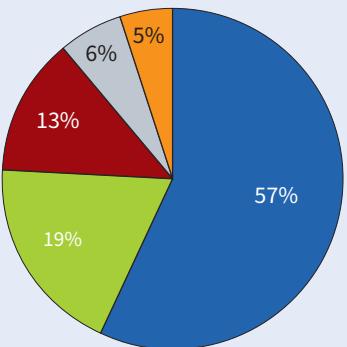
LED horticultural lighting has a huge potential for energy savings. According to a U.S. Department of Energy report, if all horticulture lighting installations switched to LED, they could reduce the sector's annual energy consumption by 40%, resulting in cost savings of roughly \$240 million. This opportunity makes it the perfect segment for commercial rebate programs to target with energy efficiency incentives.

Horticulture rebates were off to a relatively slow start, but with the introduction of the DLC Horticulture QPL and the evolution of the technology, they have grown. In fact, the number of utilities offering rebates for LED horticulture lighting has nearly tripled since 2020.

DIFFERENT HORTICULTURAL REBATE APPROACHES

About two-thirds of the rebates for horticulture lighting are custom rebates

How Horticulture Rebates Are Structured



Rebate Per:

█ kWh Saved	█ Watt Saved
█ Fixture	█ kW Saved
█ Other	

*Source: BriteSwitch RebatePro Nov. 2021
Courtesy of BriteSwitch*

or based on energy savings. That's a big difference from traditional LED luminaires, where most rebates are prescriptive, or a set dollar amount per luminaire. As real-world data comes in and utilities fully understand the new technology, programs are expected to transition to easier-to-understand prescriptive incentives.

HORTICULTURE REBATE AMOUNTS

How much of a rebate a horticulture lighting project will see varies a lot based on the geographical area. The average custom rebate is about \$0.13 per kilowatt-hour saved, but it's quite a large range from \$0.02 to \$0.40.

For prescriptive rebates, the average incentive is \$130 per luminaire, although that can range from \$10 to \$325 depending on the specific luminaire type and area.

NEW CONSTRUCTION PROJECTS CAN QUALIFY AS WELL

A substantial amount of horticulture lights is also being installed in new construction projects. They present a challenge for the rebate programs because, unlike retrofit projects, they

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FB900 Fan: 70 lbs, Fixture: 200 lbs



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LIGHTING & CONTROL

don't have a baseline energy usage for savings calculations. Most new construction rebate programs for general illumination are based on energy savings compared to the local electrical code's lighting power density (LPD). For horticulture lighting, this really doesn't apply. These lights aren't being used for general illumination, so the typical watts per square foot analysis is essentially meaningless. Because of this, each program may calculate the rebate a little differently.

HOW TO GET REBATES FOR HORTICULTURAL LIGHTING

With more than 150 horticulture lighting rebate programs available in North America, there's a good chance most projects would qualify for an incentive. Here are some tips to make sure you can get rebates for your horticulture lighting project.

1. Use DLC horticulture-listed products.

Most rebate programs

require that the LED is on the DLC list to get a rebate. It's not enough that the spec sheet or website has a DLC logo; the specific model you're using must be on the current DLC website. When searching the site, make sure to select "Horticulture Lighting" as the QPL list; these fixtures don't appear on the more commonly used general lighting list.

2. Make sure to get rebate pre-approval.

For many rebate programs, pre-approval is an essential part of the process that many people forget to consider. It usually takes about three to four weeks to get pre-approval, although it can take as long as eight to 10 weeks in some areas. Make sure you know the pre-approval requirements, and follow the steps of your local program. In some cases, a project must be pre-approved before even a PO is signed.

3. Check program funding levels.

Programs can run out of funding or change incentive levels at a moment's notice. While some utilities

have funding meters on their website, a majority do not — and the only way to know for sure is to call them. This step is especially important for large projects because rebate programs often have limited funds; a large horticulture project can wipe out a smaller rebate program entirely.

4. Verify the specific application is allowed.

Not all horticulture applications are eligible for rebates. Due to conflicting state and federal regulations, some programs explicitly deny rebates for cannabis-related horticulture lighting. Also, the project needs to have a commercial account with the electric company; residential horticulture lighting rebates are virtually non-existent.

EC&M

Randy Young is the operations manager at BriteSwitch, a company that specializes in finding and capturing rebates for businesses. He can be reached at randy.young@briteswitch.com.



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BUG ZAPPERS

COVID-19 spurred demand and budgets for disinfection technologies in classrooms, offices, and other public spaces. That's creating opportunities for ultraviolet lighting, which could get an additional boost from new standards.

By the time you read this, the World Health Organization (WHO) might have officially declared COVID-19 endemic. Or maybe yet another variant has emerged to keep the pandemic going. Either way, one thing is certain: COVID has triggered a long-term change in how and why schools, hospitals, businesses, and other organizations disinfect their buildings and the air inside. Those changes create

opportunities for the electrical industry, starting with disinfection lighting.

"The COVID-19 pandemic has dramatically spurred awareness and is defining a 'new normal' focused on indoor air quality and indoor health," says Travis Jones, vice president and general manager at Pittsburgh-based Wesco International. "As we move forward, there are other air and surface quality hazards — such as mold, influenza, E-coli, and salmonella — that still cause millions of occupants to suffer."

Disinfection lighting covers a variety of technologies and use cases, including ultraviolet germicidal irradiation (UVGI), which is used to disinfect the air or surfaces such as desktops. Water also is a big market, says Mike Krames, president of Arkesso, a consultancy specializing in LED technologies. Like lighting for illumination, UVGI is available in incandescent and solid-state versions. The research analyst firm IHS predicts that the germicidal LED (GLED) segment alone will be worth over \$5 billion by 2024. Just to put that into perspective: In 2019 (before the pandemic), it forecast just \$150 million over the same period.

BROAD-SPECTRUM BUSINESS CASE

That hockey stick growth is even more impressive in light of how long UVGI has languished as a niche play. Since the 1950s, it's been used mainly to neutralize tuberculosis (TB) — an application that's become the foundation for Centers for Disease Control and Prevention (CDC) and National Institute for Occupational Safety and Health (NIOSH) guidance for the design, installation, testing, and safe operation of "upper-room" UVGI systems. Read more at <https://bit.ly/36TH2Yb>.

Also known as "upper air," these systems have luminaires installed close to the ceiling, where the light can zap viruses as they're circulated up by the HVAC system. This location also keeps the UV light directed horizontally rather than being projected down on the room's occupants, thus helping to alleviate concerns about damage to their skin and eyes — more about that aspect in a moment.



Electric UV lamps are often used in industrial, commercial, and industrial settings for sterilization and disinfection purposes.

Although COVID has put a spotlight on UV, its long-term business case could revolve around its ability to neutralize multiple types of pathogens. For example, a company might view the cost of equipment, installation, and electricity as being far outweighed by savings such as increased productivity and reduced sick time because the UV system would zap common cold viruses and other bugs, too.

"Upper-room UVGI systems can be used to control SARS-CoV-2 as a useful ventilation tool to consider in reducing the spread of infectious pathogens," the CDC says. "Influenza viruses are more susceptible to UV energy than the bacteria that causes TB. Thus, any upper-room UVGI system installed to help during the COVID-19 pandemic will also be useful against seasonal flu, if it is properly maintained."

For more information from the CDC on the various prevention strategies that can be employed in a space as well as how upper UVGI systems actually work, see **Fig. 1** and **Fig. 2** on page 28.

When it comes to surface disinfection, there also could be savings if the lighting reduces the need for manual cleaning and harsh chemicals. One example is antimicrobial lighting, which uses LED but at different wavelengths than UV. Chatham Brewing in Chatham, N.Y., uses antimicrobial luminaires in the ceiling and walls to kill mold around its tanks. During the day, they emit a white antimicrobial light. At night, when the space isn't in use, they switch to a violet enhanced antimicrobial light.

Before they were installed, an employee did a deep, thorough chemical cleaning every two months. That's been reduced to no more than twice a year.

"Given that they are LED, they are actually more efficient than the lights they replaced, and with the savings in cleaning chemicals, there are cost savings," says Chatham Co-Founder Tom Crowell. "The payback for the equipment and installation will be longer term, but increasingly the cleanliness of the brewery and reducing chemical usage make it worth it. We did inquire about the lights and any potential risk to the eye, both for employees and patrons, as the lights are visible from the taproom. We were assured that there is no risk."

Even so, UV and non-UV lighting won't eliminate manual cleaning and chemicals, such as floors shadowed by desks.

Ultraviolet light disinfection is often used in health care settings, such as in this HVAC system in a hospital to treat the air.

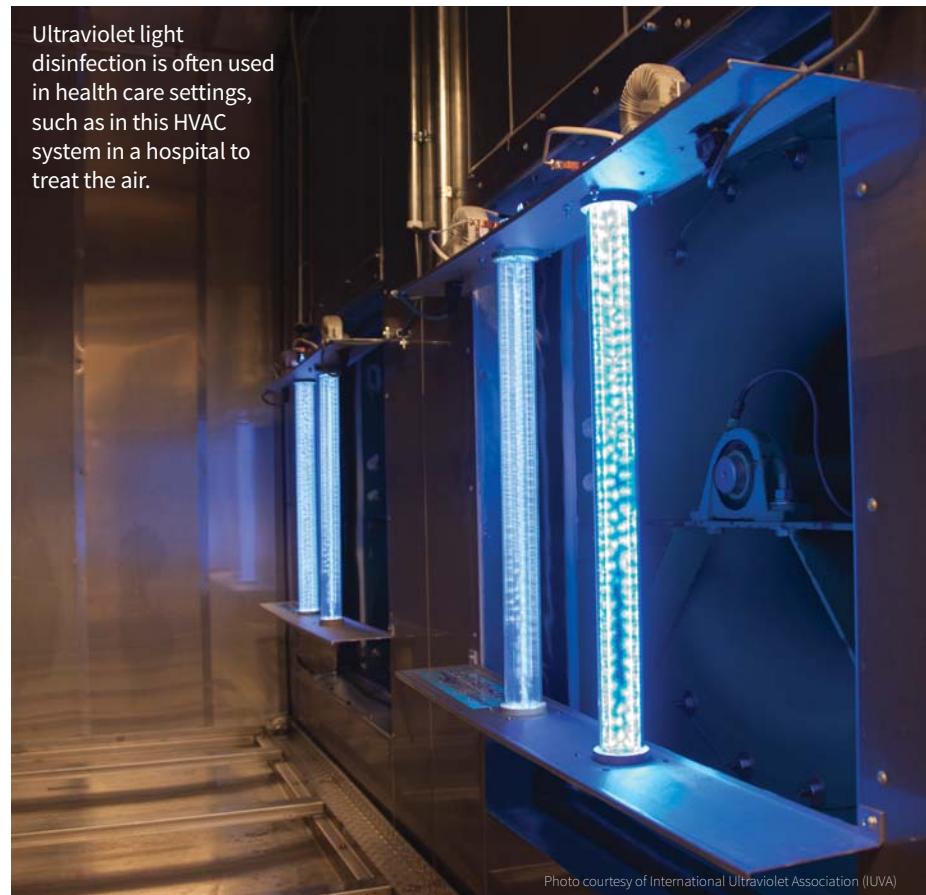


Photo courtesy of International Ultraviolet Association (IUA)

A New York City Metro Transit Authority subway car is bathed in germ-killing ultraviolet light emitted from portable and pole-based fixtures.



Photo courtesy of New York City Metro Transit Authority

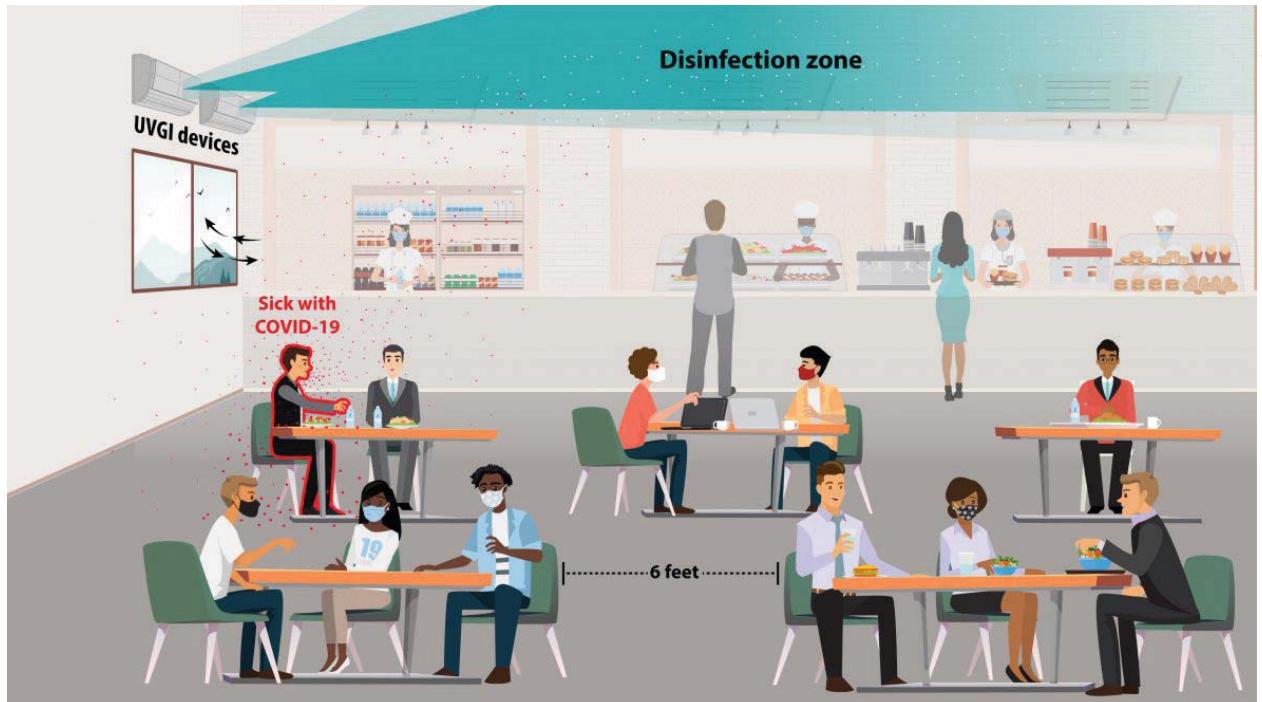


Image courtesy of the CDC

Fig. 1. Ultraviolet germicidal irradiation, or UVGI, is the use of ultraviolet (UV) energy to inactivate viral, bacterial, and fungal organisms. This illustration demonstrates how the system employs various prevention strategies to reduce infection.

“Surface disinfection technologies do not replace the need for chemical cleaning in hospitals,” says Jennifer Brons, research program director for the Light and Health Research Center at the Mount Sinai Icahn School of Medicine in New York City. “If a surface is soiled, UV cannot penetrate down to the surface. UV is a line-of-sight technology. When it comes to surface disinfection, these technologies are an added layer of protection against increasingly antibiotic-resistant organisms, not a replacement.”

Some demanding applications, such as health care facilities, could have three layers of protection: an upper-air UV system for aerosolized pathogens, a

“direct-view” UV system for surfaces, and periodic manual cleaning with chemicals. In those cases, the two UV layers’ value is based partly on their ability to reduce the time and money spent on the manual layer.

C THE LIGHT

When most people hear “UV,” they think of sunlight... and sunburns and skin cancer. That perception is noteworthy because it affects the market for UVGI lighting. For example, a school board, teachers union, and parents might be concerned that a proposed classroom UVGI upper air system will hurt students’ and teachers’ eyes and skin. That

would put the UVGI upper air system at a competitive disadvantage compared to HVAC-based alternatives, such as high-efficiency particulate absorbing (HEPA) filters. The company suggesting UVGI — such as a lighting designer or electrical contractor — could overcome those concerns by explaining the principle of how an upper-air system works.

“It’s shining into the air above where people are, or shining it only inside the ductwork,” says Troy Cowan, coordinator of the Healthcare Working Group at the International UV Association (IUVA), based in Chevy Chase, Md. “That’s how you avoid overexposing anybody in the room.”

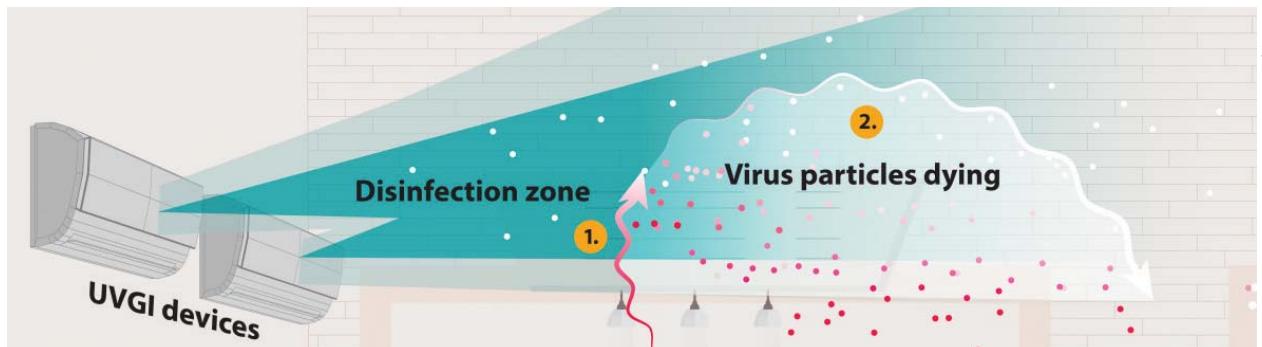


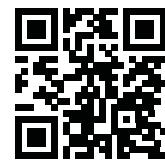
Image courtesy of the CDC

Fig. 2. In an upper room UVGI system, air passes through the disinfection zone from air flow through HVAC system, fans, and/or open windows. The airborne pathogens are inactivated once they receive an appropriate amount of UV energy. The particles remain in the air, but they are no longer infectious.

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Another factor is the UV system's wavelength. Sunscreen is designed to protect against UV-A and UV-B rays, whose wavelengths in the 280 to 400 nanometer (nm) range are more damaging to the skin. UVGI systems are UV-C, which is in the 100 to 280 nm range.

"UV-C penetrates only the superficial layers of the skin and eye, with the shortest wavelengths hardly penetrating at all to living cells (epidermis), so only a very mild, transitory sunburn occurs from accidental over-exposure of skin areas," notes the Illuminating Engineering Society (IES) on its website. "Even though GUV lamps can pose a theoretical delayed hazard, incidental UV exposures in the workplace would not significantly increase one's lifetime risk for cataract or skin cancer when compared to daily exposure to the UV radiant energy in sunlight."

UVGI disrupts viruses' DNA and RNA.

"You're messing with the reproductive system of the bad bugs, making them reproductively sterile, if you will," Cowan says. "Once they're sterile, they can't cause an infection. And since UVGI attacks the bugs' reproductive system, the chances of there ever being a super bug coming out of the mix is almost [nil]."

"Far" UV-C lighting operates around 222 nm.

"Far UV" or 'far UV-C' are wavelengths shorter than 254 nm, the Hg line," Krames says. "The definition is somewhat vague but lately we have been saying < 240 nm for far UV. There's a lot of interest in far UV-C. The threshold exposure elements climbed dramatically, especially with the newest proposed ones."

STANDARDS

Standards are another potential market driver. In June 2020, the IUVA and the IES began work on American National Standards Institute (ANSI) standards for measuring and characterizing UV-C device output. These will help enable apples-to-apples comparisons between different vendors' products, including models using LED, low-pressure mercury, xenon, and other technologies. They also will help determine how much UV light is needed to neutralize each type of pathogen.

In March 2022, ANSI certified ANSI/IES/IUVA LM-92-22, *Approved Method: Optical and Electrical Measurement of Ultraviolet LEDs*. Meanwhile, ANSI/IES LM-91 (C303)-2022, IES (Guide to) *Approved Method: Application Distance Specific Radiometry*, also had been approved but not yet published at press time.

UV LED efficiency also is steadily increasing. UV-C LEDs are being used in all kinds of applications to disinfect water, surfaces, and air, says Frank Harder, CRO at Bolb, a Livermore, Calif.-based company.

MARKET SHARE

For electrical contractors, the potential UVGI business opportunities range from simply installing equipment based on another company's design to helping clients select a UVGI solution and designing/installing the equipment.

"A typical room with 500 square feet of floor space will generally require two to three UV fixtures," the CDC says.

Some types of UVGI lighting are portable, such as handheld wands and devices mounted on roving robots. They aren't something that electrical contractors would sell or install, but they're still worth noting as a competitor in some applications. Perhaps the biggest competitor is HVAC-based systems, such as HEPA filters and in-duct UV lights that sterilize the passing air.

"COVID-19 incidence was 39% lower in schools that improved ventilation," says a May 2021 Centers for Disease Control (CDC) report. "Ventilation strategies associated with lower school incidence included methods to dilute airborne particles alone by opening windows, opening doors, or using fans (35% lower incidence), or in combination with methods to filter airborne particles with HEPA filtration with or without purification with UVGI (48% lower incidence)."

How UV stacks up against alternatives is important for understanding the market opportunity and developing a market strategy to sell against those alternatives. For example, HVAC systems usually cycle on and off, partly to save electricity. If a UVGI system is in the duct, that means it's disinfecting only some of the time, and won't refresh an entire room's air fast enough to kill the majority of pathogens circulating in a space.

“COVID-19 incidence was 39% lower in schools that improved ventilation.”

—CDC Report, May 2021

"One option is to leave the fan and the UVGI unit on all the time. Another is to install upper-air UVGI, to disinfect the air up next to the ceiling," Cowan says. "If you just look at what goes through the filter duct, you're maybe getting only a 10% air exchange at any one time versus broadcasting it all the time [with] UV disinfection. Upper air is more efficient because you're treating a lot more air at once when you have the ceiling height to accommodate it. Otherwise, I'd go with UVGI in the ductwork. Either way, UVGI helps disinfect the air, reducing the risk of inhaling infectious 'bugs.'"

Even so, some applications might require the aforementioned multi-layer approach.

"What we've come to learn is that UV-C is a viable solution to air disinfection, but it comes with some challenges," says Wesco's Jones. "For example, it may not adequately clean surfaces in occupied spaces, or it requires a significant amount of energy in unoccupied spaces. The unoccupied space solutions — typically portable solutions that radiate UV-C over some time — are usable for general disinfection in certain types of spaces."

"However, these only work line of sight. Surfaces between the source and target area block any UV-C light. This is not viable where there are short changes in occupancy (such as in schools) during the school day. As soon as a pathogen enters the space, this solution provides no disinfection until the next time the solution is used. In that time, pathogens may cross-contaminate unprotected spaces."

But this scenario also creates a potential major opportunity for far-UV solutions.

"This problem would be knocked out if UVGI were eventually allowed to be used continuously in an area, which may be possible with far UV," Krames says.

EC&M

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

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Courtesy of Lutron Electronics

A Contractor's Guide TO LUMINAIRE LEVEL LIGHTING CONTROLS

How to use LLLCs to save time, add value, and future-proof jobs.

Over the last 20 years, LEDs have made lighting more efficient, smarter, and versatile. Luminaire level lighting controls (LLLCs) are helping to integrate these benefits into individual LED luminaires and redefine the way we think about lighting control in offices, classrooms, conference rooms, and more. While wired, fixture-level control has been possible for more than a decade, wireless technology puts flexible, adjustable, smart control well within reach for most projects from a budgetary and scheduling standpoint.

WHAT DO WE MEAN BY LLLCS?

From an industry standpoint, LLLCs are wireless lighting control devices integrated directly into a luminaire, typically by the manufacturer. Equipped with this device, the luminaire can be individually controlled (or digitally grouped) to create lighting zones that meet the customer's specific needs.

Some manufacturers' LLLC devices include occupancy sensors and daylight sensors that can either be built into the luminaire by the manufacturer or provided as part of a retrofit kit to update existing lighting systems in field installations. Using these technologies, sensor data can be used to tailor system setup

to better reflect user patterns, manage energy use, and make the most of natural daylight in a space.

SIMPLE DESIGN, WIRING, AND INSTALLATION

For the contractor, using a digital solution — LLLC devices or digital drivers — simplifies the wiring and installation of controls and luminaires. Power wiring can be run independently of control wiring, which maximizes flexibility for the customer. Luminaire zoning can be determined at any time, even after the installation is complete. It can be just as easily adjusted from an app or dashboard with no new wiring. In addition, LLLCs do not require a control wire to be run to the luminaire, which is necessary for wired applications. This can save time and further reduce the amount of material required on the job.

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8413	1-1/4"	1.000	1.460	.870	1.370	2-3, 2-4, 1-3, 1-4, 1/0-3, 1/0-4, 2/0-3, 2/0-4, 3/0-3	
8414	1-1/2"	1.360	1.770	1.250	1.590	2/0-4, 3/0-3, 3/0-4, 4/0-3, 4/0-4, 250-3, 250-4	
8415	2"	1.700	2.200	1.550	2.050	250-4, 300-4, 350-3, 350-4, 500-3	
8416	2-1/2"	2.100	2.700	1.950	2.400	500-3, 500-4, 600-3, 600-4, 750-3	
8417	3"	2.500	3.300	2.350	3.000	600-4, 750-3, 750-4	
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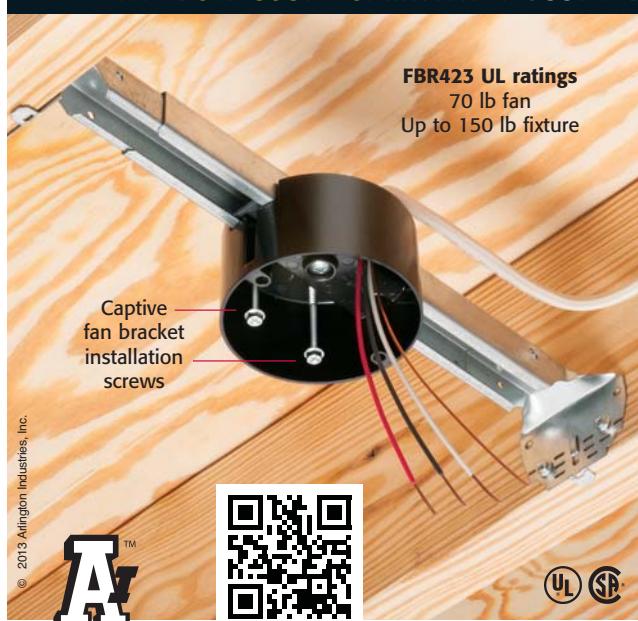
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When a project uses wired, 0-10V drivers, contractors need to know exactly how the luminaire will be zoned before the job is installed. This is important because the power and control wire must be zoned the same way. If the lighting needs to be rezoned, the project faces rewiring and additional costs. Complex space layouts with a large number of zones can make it especially difficult to wire the luminaires correctly and make troubleshooting even more challenging. The result is a system with very little flexibility. With LLLCs, wiring mistakes are minimized, and zoning decisions can be made after the luminaires are installed.

When the LLLC devices incorporate sensor options — occupancy and/or daylight sensors — the luminaires can provide data to support advanced energy savings and other business decisions while simplifying installation. When you are using traditional, wired zone-control systems, occupancy sensors and/or daylight sensors may have to be installed for code compliance or to meet the client's performance needs.

In comparison, when using a pre-installed LLLC that incorporates the sensors, you do not need additional, independent sensors. LLLCs eliminate extra steps and system complexity. There is also no extra time required for installing sensors, no need to associate those additional devices in the system, and less room for error.

Since these devices are pre-installed in the luminaire, driver compatibility is resolved before the luminaire is shipped. And as long as the LLLC works with the specified control system, you don't have to worry about compatibility between the LLLC and the driver. Contractors can be confident the system can be installed and setup easily with limited callbacks.

This is a clear win for the contractor, who can bid the job more accurately and add value for their customers. But it is also a significant advantage to the building owner, occupant, and facilities team. By reducing wiring and expanding set-up options, as part of a digital lighting control solution, LLLCs can save time, lower operating cost, and deliver a more future-proof install. As electrical contractors face ongoing (or worsening)



LLLCs are wireless lighting control devices integrated directly into a lighting fixture, typically by the luminaire manufacturer.

labor shortages, LLLCs contribute to simpler installations, reduced callbacks, and can increase the number of jobs a contractor can handle.

HOW ARE LLLCS COMMONLY CONFIGURED?

Since LLLC devices provide individual luminaire control and offer digital programming, there are a range of ways in which luminaires — or luminaire groups — can be controlled. Moreover, LLLC models have varying levels of sensing capability.

LLLC models are available with or without integral sensors and can be mixed and matched within a system. The advantage is that the customer only pays for the technology they need in the space and the contractor can have greater control over the bid. For example, an open office space with copious daylight may benefit from daylighting capabilities, but a conference room may be more functional with uniform lighting and not require the daylight sensor.

Energy codes likely still require an occupancy sensor that can either be included as part of the LLLC or be offered as a separate wireless sensor added to the bill of materials. These wireless sensors make it possible for the contractor to optimize the budget by ensuring the desired lighting system performance while minimizing extras that are not required by the customer. Regardless, the luminaires can be grouped in any configuration and easily regrouped if space use changes. LLLCs are important tools in the contractor's

toolkit — part of a larger system that provides a wide range of flexible control options.

FLEXIBILITY OVER TIME

To deliver flexible, future-proof lighting control, it is important to design and deploy the right solution in the right space. For example, an LLLC-based solution may be ideal for the open-office areas in a space, while adjacent conference rooms can be best-served with more traditional zone control. The key is to have the right options (and flexible systems) to provide the desired control in each space. With an app-based control system, the contractor can make programming changes right from an app without even having to be in the space. Settings can be adjusted, lighting can be rezoned, or luminaires can be easily adjusted for a special event right from an app on a phone or tablet.

As part of a wireless control system, LLLCs will continue to simplify lighting control installation — contractors do not need to have all the project details defined before they start the job and can still be confident the customer has a system that meets their needs. The opportunity for enhanced lighting performance is a significant differentiator for the design-build contractor, who now enjoys a broader design palette and greater freedom to design lighting that meets the individual needs of every job. In a design-build scenario, the contractor must have confidence in the solution since the design often continues to develop as the project progresses. LLLCs can provide that confidence. As long as the LLLC works with the chosen control system, the job is off to the right start.

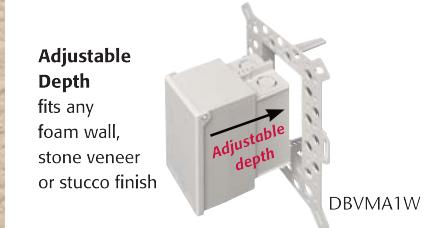
EC&M

Craig Casey is a building science leader at Lutron. Well-known in the lighting industry, he conducts applied research on energy and the human benefits of lighting and daylighting controls. He has presented multiple times at the Illuminating Engineering Society (IES)'s Annual Conference and LightFair. Craig sits on the Daylight Metrics Committee of the IES. He received the IES Presidential Award for chairing the 2015 Conference Steering Committee. Craig holds Bachelor and Master of Architectural Engineering degrees from Penn State and is currently pursuing his PhD.



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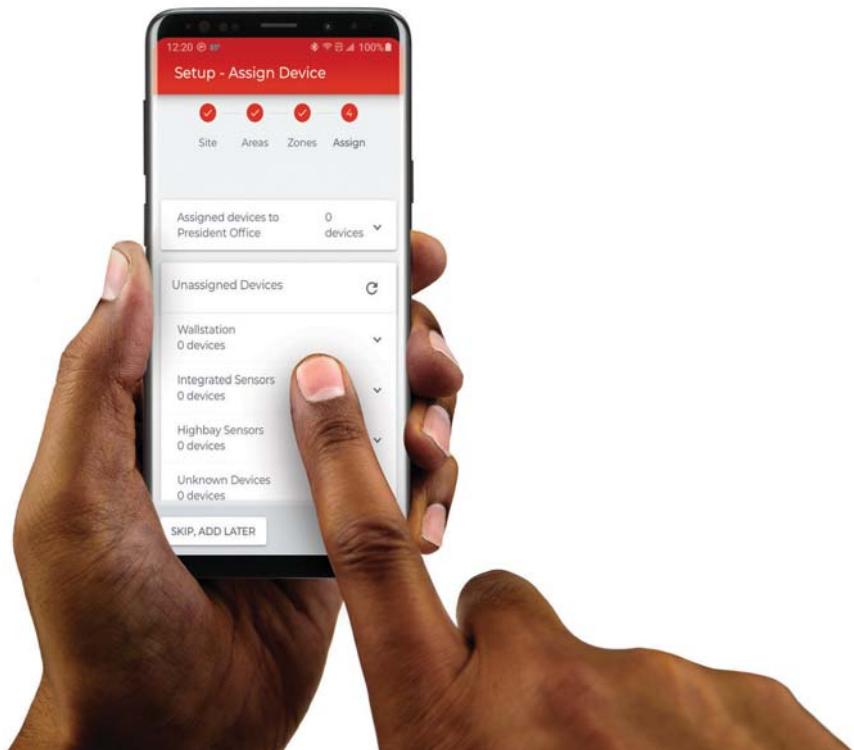


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How Lighting Helps to Prepare for the Future Integration of IoT Sensors

While most lighting control systems aim to provide energy savings — on top of the savings of today's LED technology — and to address local codes, some control systems have now been deployed for a completely different purpose.



By Martin Mercier, Cooper Lighting Solutions

Lighting accounts for an average of 35% of the total energy in a building and upgrading to LEDs can provide more than 50% in energy savings. If you add a control system, this can provide an additional 25% in savings, bringing significant value to your bottom line.

Typical lighting control systems allow you to control a building's lighting — from adjusting light levels to providing a more comfortable and productive environment to turning the lights off and on based on occupancy. Advanced lighting control systems go beyond just controlling the lights by allowing the gathering of data, bringing 10 to 100 times more value to the end-user.

DATA PROVIDES VALUE

Data is defined as "pieces of information, usually formatted and stored in a way that is concordant with a specific purpose." In the context of lighting, we are talking

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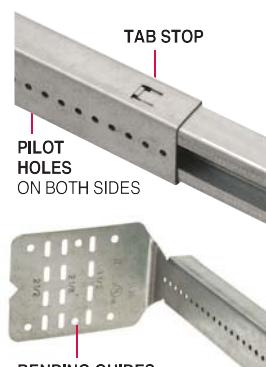
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SL1B24 KIT	SL24 SLIDERBAR, SINGLE GANG Plastic Box
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Patent pending



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about the data collected around the areas surrounding the luminaires, which is communicated to a local or remote server, then analyzed and shared with other systems, providing useful insights for the customer.

About a decade and a half ago, manufacturers realized LEDs could be controlled without a significant impact on the lamp life or the ambient lighting comfort. LEDs could provide energy savings and be controlled for specific tasks and activities. The easiest and most efficient well-known solution to achieve this is with occupancy sensors and daylight sensors. But what if we can get such data for an entire floor, building, or campus of buildings? This might be data that can tell us how often a room is entered or how many cars are currently on a parking garage floor. How many customers went into the store today, and what portion of the parking lot is used at night? And is anyone still in the local park when it's closed? This valuable data can be collected, analyzed, and communicated to learn much more about a site.

This is what happened when lighting manufacturers started networking/connecting the lights to accurately control or group luminaire behaviors based on installing single/multiple sensors within the fixtures. A decade ago, lighting manufacturers introduced luminaires with radio devices (such as the Zigbee local wireless network or 4G cellular communication) to control luminaires remotely. Lighting software started analyzing occupancy information and created useful information, beyond just lighting control.

Since lighting is everywhere, when grouped under a network, it can then be used as a conduit from end-users to devices for valuable information. Asset tracking, contact tracing, and wayfinding are a few examples of how advanced lighting control systems are being used beyond controlling the lights. As an example, a building's HVAC, fire alarm, and lighting system can use the same signal to turn off air intake and turn on all lights when the fire alarm is activated. The benefit of such information/signals gets even more valuable when shared with other manufacturers.

For example, you can share control of a room's temperature using lighting control wall stations, or a demand response



signal can be set up from the local electric utility to dim lights. This type of system will not only provide additional energy savings, but more importantly in some locations, it also satisfies a requirement to be code compliant. Such an ecosystem provides manufacturers' and industries' IoT products a backbone for advanced data and information at the heart of IoT. Air quality, structure vibration, and space utilization heatmaps are some examples of IoT applications.

EVALUATING THE VALUE OF DATA

How can you evaluate the true value of the data? There aren't many cases or projects showing the true value of such an ecosystem. For example, what is the true value of having lights fully turned on when the fire alarm is on? Or how many more customers made their way to the store with a wayfinding system? With that being said, we do know of some well-proven cases.

One example is asset tracking of hospital equipment, such as IV pumps. Hospitals are relatively large facilities and have a significant amount of mobile equipment in use daily. This equipment needs to be found, cleaned, and maintained. You might be wondering how they keep track of it. In most cases, they don't. Many times, to support their daily operation, they buy or rent more equipment. It is estimated that IV pumps are only utilized at 35% or less — even with the extra supply. This scarcity of equipment creates a vicious cycle to the point

that a nursing staff member may hide equipment to serve their patient better, often resulting in equipment "getting lost or forgotten."

With a real-time locating system (RTLS), critical equipment is "tagged" with an asset ID, which allows it to be located in the hospital from sensors embedded in a luminaire. This information is sent through the lighting control network to a server and then shared with a third-party system, such as a BioMed equipment maintenance software. The equipment's cleaning circle, maintenance, and distribution between the hospital department and floors are optimized. With an RTLS and data on the asset and its location, it is estimated that IV pump utilization could be improved up to 75%. Solely from asset tracking, hospitals could save more than \$500,000 per year, resulting in a less than a year return on investment (ROI).

LEVERAGING YOUR CURRENT NETWORK

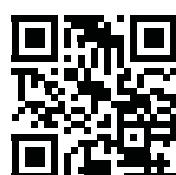
What is the next step for the lighting industry to help customers leverage their lighting networks? We need to "open" our lighting infrastructure and network to other manufacturers. There are so many new fields of expertise that one manufacturer can't support them all. To provide a sustainable solution, we need to offer guidance on the mechanical, electrical, and communication equipment to be used with luminaires. There are several initiatives underway to help accelerate and simplify sensor

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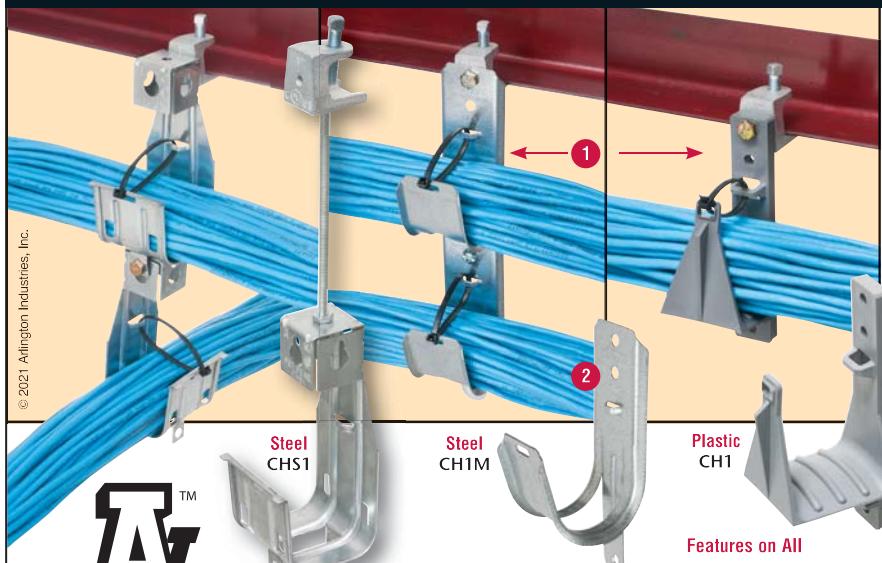
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- Listed for air handling spaces
- **Parallel or perpendicular stackability** for vertical support of multiple cable tiers
- Easy attachment to various supports, beam clamps and strut

Features on All

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



Patented

Product info aifittings.com/landing/Cable-Hooks

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integration and communication for sensor manufacturers.

One example is an indoor and outdoor luminaire sensor interface standardization and certification (D4i). According to the DALI Alliance, D4i (an extension of the DALI-2 certification program) is the DALI standard for intelligent, IoT-ready luminaires. D4i LED drivers have a mandatory set of features related to power-supply requirements and smart-data capabilities. Smart D4i luminaires are ideal platforms for the IoT, capable of gathering information from onboard D4i sensors and providing data for performance monitoring, asset management, predictive maintenance, and many other tasks.

LOOKING TO THE FUTURE

For customers looking to improve their operations with new smart devices, leveraging their lighting infrastructure is often the easiest path. An upgradable infrastructure helps specifiers and customers prepare the site for future technologies. It will help the installer

to test and replace products when they present signs of underperformance.

In addition, upgradable and scalable lighting products have recently been launched by reputable manufacturers and should become part of standard project requirements. Specifiers should consider these options if their customer is interested in network and IoT solutions but are not quite ready to make the jump today. These future-ready luminaires, for which sensors and controllers can be upgraded later, are the new 0V to 10V dimmable LED driver of 10 years ago. They'll simplify a customer's future steps into using data to improve their city/facility/building efficiently and their costs effectively.

Since these systems are relatively new, a good understanding of D4i is required when working on specifying a solution for a new project. Self-education and open discussion with manufacturers will help you fully understand the best D4i solution and to prevent issues when deployed. Every project is different, so it can also be a learning experience for the

manufacturer, who may need to adapt the system to an unforeseen specific application. This same open discussion should take place for in-field installation. Before the system technician visit, the installer needs to make sure the wiring, lighting connectivity, and network connectivity are in place.

Again, I encourage everyone to become educated on the topic before getting involved in this type of project. Once the opportunity to deploy such an ecosystem arises, create a functional mock-up with the customer and involved manufacturers. Most unforeseen challenges can be detected at a smaller scale and resolved before installation, significantly lowering cost and the time invested by specifiers, contractors, and manufacturers.

EC&M

Martin Mercier, P.Eng., is strategic marketing manager for IoT and connected systems for Cooper Lighting Solutions, a division of Signify, based in Peachtree City, Ga. He can be reached at martin.mercier@cooperlighting.com.

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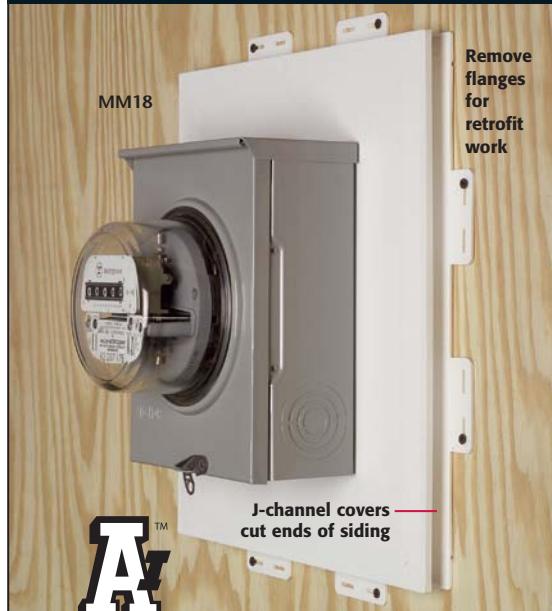


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MM10 7" X 10" MM23 17-5/8" X 23"

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Catalog Number	Cable Ranges (Armor Diameter)
LTMC50	.415" - .565"
LTMC507	.550" - .730" goes into 1/2" KO
LTMC75	.725" - .890" goes into 3/4" KO



Dynamic Lighting Provides Designers Future Adaptability

Ever-changing office configurations require flexible lighting options.



Photo courtesy of Axis Lighting

Architects and lighting professionals are designing open space work environments with flexible and scalable lighting systems.

By Howard Yaphe, Axis Lighting

ighting designers today have moved away from using drop ceilings in offices because they don't allow for design freedom, plus they make the space feel smaller. Instead, they're opting for open ceilings that permit design creativity, flexibility, and the perception of a larger space. These open ceilings, coupled with the need for flexible office space configurations, present an opportunity for innovative and dynamic lighting systems.

OFFICE DESIGN TRENDS

The growing trend in office designs is to accommodate ever-changing and future-proofing configurations – whether a person is working alone at a desk, in a small pod in a lounge area, with a group in a conference room, rejuvenating at the coffee bar, or taking a break in the exercise room. Present and future offices must be transformative

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Covers also sold separately.



FLB5331MB
Single gang
steel box kit w brass cover



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Plugs
stay inside
recessed
cover



FLBC4560DNL

Slotted in-use cover



FLBC4500

Easy to install
in concrete box



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

Fast installation, *inside the can* reduces trip hazards caused by plugs sticking out of the box. They look great and you get power and low voltage in the *same box*.

Assembled. Comes with matching in-use slotted cover and cover blank for unused boxes in **brass** or **nickel-plated brass**...

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FLBC4560DNL
Nickel-plated



FLBC4560DBR
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...and **plastic** in **FIVE** colors.

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Caramel

FLBC4560DBL
Black

FLBC4560DLA
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Product info aifittings.com/landing/inbox-cover-kits/

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and flexible to address these diverse work environments. This theory is supported by a study conducted by Knoll, "The Case for a Thriving Workplace," which provides compelling evidence that workforce performance and well-being considerations are largely driving the form and use of the future workplace. Based on the responses, Knoll also concluded that "further supporting flexibility, the average percentage of unassigned workspaces will more than double..." Read the full report at <https://bit.ly/3wA660P>.

If businesses expect to attract and retain a productive and engaged workforce, they will need to rethink the future of the office to emphasize flexibility. To provide a truly inclusive experience when redesigning a space, the future office will need to cater to all types of workers. The traditional, functional office space will shift to a workspace designed around social interaction, collaboration, and relationship building. A greater emphasis will be placed on technology and spaces that encourage face-to-face interaction as the future of work evolves.

Architects across the world are tackling the question of the post-pandemic office space as well. For example, in an article in *Surface Magazine*, "The Future of Work Might Look Like This," five architectural firms envision a paradigm shift toward a more resilient and flexible office space hub in place of permanent, large open-air office spaces. Read the full article at <https://bit.ly/3Lh3XeA>.

WHY LIGHTING IS IMPORTANT

In partnership with Cornell University, Delos, and the Innovative Workplace Institute, the American Society of Interior Designers (ASID) researched the impact of innovative workplace design on behavior and performance, how spatial design supports organizational goals, and the impact of design on human, organizational, and environmental sustainability. According to the article, "Bad Mood in the Workplace? Try Changing the Lights," written by Jeff Pocheban and featured in *Inc.* magazine, the study showed that 68% of employees were dissatisfied with the lighting situation in their offices. Read the full article at <https://bit.ly/3IL9mJu>.

Given that workers spend about one-third of their day in the office, inadequate lighting has a detrimental effect on employees by causing eye strain, poor spirits, lackluster energy levels, and low productivity. Cortisol levels drop significantly under artificial or poor lighting conditions, which means people may be more stressed and have less ability to stabilize energy levels. To combat these realities, thoughtful lighting design can support organizational priorities, such as employee health, productivity, and financial return. By incorporating multiple innovative features, like flexible lighting, the design can positively affect the health and well-being of employees while boosting resource efficiency.

ADAPTABLE AND INNOVATIVE LIGHTING

Since lighting is essential in every built environment, lighting designs must be adaptable to office reconfigurations and future changes in site layout. Dynamic lighting not only supports resilience, flexibility, and well-being, but it also provides a future-proof solution to deal with changes. Flexible designs — and lighting — necessitate the increased mobility of people and facilities.

Today more than ever, a successful workplace needs to be resilient — it has to be flexible and nimble enough to handle anticipated and unanticipated change, able to support employee well-being, and poised to continue to add value over time. Read "How Flexible Lighting Helps Define the Resilient Workspace" by Matt Ott in *Work Design Magazine* for more information at <https://bit.ly/3tKQLZC>.

Businesses must incorporate new office design strategies and embrace the new workplace dynamic to achieve future-proof solutions. Complementing these new office design strategies is dynamic lighting, which addresses the unexpected and offers designers a solution for creating flexible spaces that are better prepared for whatever changes and challenges lie ahead.

EC&M

Howard Yaphe, CEO Axis Lighting, has more than 35 years of experience in the lighting industry and may be reached at HowardY@axisllighting.com.

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

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- Complies with 2020 NEC, 314.20 for set back boxes
- (4) screws attach box securely to joist in new work
- **2-Hour Fire Rating** *Listed for fans up to 70 lbs; fixtures up to 100 lbs*

Product info aifittings.com/landing/fba426

- 1 Cutaway: Box set back in double drywall
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ADJUSTABLE BRACKET • EASY INSTALLATION IN EXISTING CEILING

FAN/FIXTURE BOX

HIGHER WEIGHT RATINGS

EASY TO INSTALL
1-2-3!



1
REMOVE BOX
from bar.
Insert in opening.

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

The 20.0 cu. inch FBR4200R installs *between* rafters with 16" to 24" on-center spacing, holding a fan or fixture securely in place. It's easy...

REMOVE BOX from bar.

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

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

FBR4200R
Patented

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

Product info aifittings.com/landing/fbr4200

2
EMBED
BAR
in joists.



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LEDucation Lights Up the Big Apple

More than 4,000 lighting pros attended LEDucation in New York last month.

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

LEDucation 2022, held March 15-16 at the New York Hilton in midtown Manhattan, got universally high marks from the exhibitors and attendees that *EC&M* visited at the show. Many lighting folks at the event said they were “Zoomed-out” and quite happy to finally be meeting with customers face-to-face.

With more than 4,000 registrants for the event and close to 400 booths, the show floor was buzzing, particularly on the first day. LEDucation has a different format than LightFair in that the majority of exhibitors were set up in 6-foot tabletop booths, instead of LightFair’s often larger and occasionally extravagant booths. Some companies did have multiple tabletops, and, in many cases, New York area lighting reps had all of their vendors in the same aisle.

Randy Reid, executive director for the National Lighting Bureau (NLB), said vendors like to use the smaller booth format to focus on a carefully curated group of products. Reid reported in his *Edison Lighting Report* that more than 2,400 attendees were at the show on Day 1. While the show draws primarily from the New York metropolitan area’s lighting community, exhibitors said they saw lighting designers and other lighting pros from other East Coast markets at the show as well.

LEDucation also featured more than 20 conference sessions that attendees could take part in for CEU credit. One of the LEDucation sessions on lighting control offered tips for building owners and tenants on how they can link their lighting controls systems to a building’s HVAC, security, and automation systems for more sophisticated control and maximum energy savings. In the seminar,



Randy Reid, executive director for the NLB (left), presents an NLB Citation Award to WAC Lighting's Daniel Moklas.

“Evaluating Lighting Control Sequence of Operations for High-Performing Buildings,” Acuity’s John McBride and Mark Lane said users want lighting control that’s simple, easy to access, and capable of producing major energy savings. Lane said another customer benefit of linking these building systems is cutting down on the number of separate maintenance contracts for HVAC, lighting systems, and other systems.

Several lighting manufacturers won awards at LEDucation from the National Lighting Bureau, which presented its second annual Art & Science of Lighting Awards on March 16. Mary Beth Gotti, chair of the NLB, and Randy Reid presented the awards. The purpose of the program is to give recognition to outstanding products that advance the categories listed below.

The judges on NLB’s juror panel were Jim Benya, Design Services, Inc.; Jean Paul Freyssinier, Rensselaer Polytechnic

Institute; Terry McGowan, Lighting Ideas, Inc.; Jim Yorkey, retired Lutron executive; Cary Mendelsohn, Imperial Lighting Maintenance Co.; and Howard Lewis, Spectro Lume.

The Science of Lighting Award — Seoul Semiconductor’s Sunlike. The NLB judges gave Sunlike the award for being a lighting product that demonstrates exceptional technical innovation and significantly improves how effectively and efficiently high-quality lighting can be specified and installed, or introduces new applications to high-quality lighting opportunities.

The Art of Lighting Award — OCL Architectural Lighting’s Petals. The company’s new Petals product won the award for its aesthetic appeal and the quality of lighting it provides, based on its innovative use of lighting technology, materials or sculptural forms.

The Art and Science of Lighting Award — Fluxwerx’s Portal. This product met the criteria for both the Art and Science of Lighting categories.

NLB’s jurors also awarded seven Special Citations and four Honorable Mentions. The products winning Special Citations in NLB’s 2022 Art & Science of Lighting Awards competition were Leotek’s Comfort View; Hess America’s Bishop Bollard; Lumenpulse’s Lumenblade; Artemide’s Alphabet of Light; Edison Price Lighting’s Infinity; WAC Lighting’s Strut System; and PureEdge Lighting’s TruTrack. Winning Honorable Mentions for the 2022 NLB awards were Coelux’s HT25; Impact Architectural Lighting’s tiki.aura; RAB Lighting’s L34; and Vode Lighting’s Zip Three Pendant with dynamic white.

LEDucation 2023 will be held March 7-8, 2023 at the New York Hilton. **EC&M**

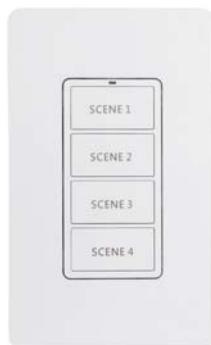
Focus on Lighting and Controls

Configurable Power Supplies

The LCM4000HV series of configurable power supplies features hot-swap functionality. Rated for up to 4,000W and operating with efficiencies of up to 95%, the single-phase AC-DC high voltage power modules (combined with the new LCM12K 19-in. 1U rackmount shelf) create a centralized current source for medium- to large-scale LED lighting installations. The modules are fully compliant with DesignLights Consortium (DLC) Technical Requirements for Horticultural Lighting (Version 2.1) and can be used with the 19-in. 1U rackmount shelf to deliver power up to 12kW with hot plug replacement. The modules provide a flicker-free current source from 0A to 16A at an output voltage range between 100 and 300VDC. Input voltage options are 187VAC to 364VAC and 311VAC to 528VAC. Input and output voltages are configurable via a Modbus interface, allowing the power supply to be optimized to the specific requirements of the target application.



Advanced Energy



Wireless Wall Dimmers and Scene Switches

The WWD2 series of wall dimmers and scene switches comes in either 2-button format for easy dimming or 4-button scene switches for programmed light adjustment. These specification-grade switches are slim, have a decorator style, and come with a screwless faceplate for a clean aesthetic. They are also available in two form factors: one for in-wall mounting into junction boxes that can be ganged together, or a slim surface-mount option that can be adhered to any surface. The WWD2 series wall switches can be managed in the Daintree EZ Connect platform, or they can be used in Daintree Networked.

Daintree

LED Floodlight

The color & wattage selectable LED floodlight offers precise security and general area illumination. The floodlight allows facilities the flexibility of switching between three temperatures (3,000K, 4,000K, and 5,000K) at the time of installation and four wattages (49W, 56W, 63W, and 70W and 6,650 lm, 7,600 lm, 8,550 lm, and 9,500 lm, respectively) to ensure proper lighting. According to the company, the floodlight delivers 135 lm/W with an 80 CRI. It has a 150° beam angle and accepts a 120VAC to 347VAC power supply. Additionally, the unit is IP65 rated for wet applications and has a durable, textured architectural bronze powder coat finish with a high-impact acrylic lens for long-term performance. It comes with a standard knuckle joint; plus, a yoke mount is available. Finally, the product is cUL, RoHS, and UL certified to comply with North American safety standards and will perform in temperatures ranging from -40°F to 131°F.



EarthTronics



Cylinder Light

The CR2 is a small diameter cylinder fixture intended for usage over a wide variety of applications. It's available in a wall mount, which, according to the company, is ADA compliant when used with an integral driver. It is available with a wide array of beam patterns and lumen outputs, allowing for use in 8-ft to 20-ft ceiling heights. Optical systems range from extra narrow spot (12°) to extra wide flood (60°) along with a wall wash optic and are all field interchangeable. CCTs range from 2,200K through 4,000K, at 2-step MacAdam Ellipse, and CRIs up to 90. Lumen packages from 500 lm to 2000 lm are available. Bezels are available in a variety of anodized finishes and decorative knurling options — and all come with an interior low dazzle anti-glare matte black finish.

Spectrum Lighting

GALVANIZED STEEL

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CABLE SUPPORT

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

Nail or screw on **CUS6**Foldline
(centerline)

Locking tab

Nail or screw to stud
through these holesBend right side
of strap in and
over cable*Holds up to four MC cables
centered on a 2x4!*

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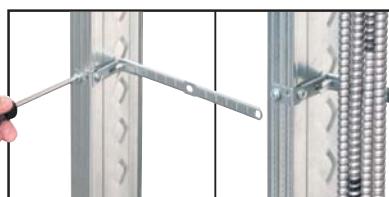
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- Complies with 2020 NEC, article 300.4(D)

**CUS6 holds FOUR** metal cables...or **SIX** NM cablesProduct info aifittings.com/landing/cus6/THE **SPACER**™

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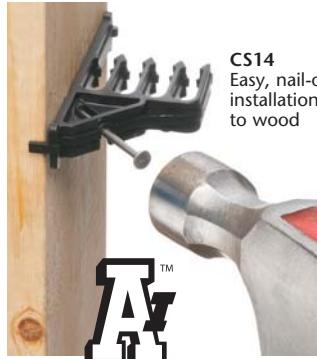
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for easy
centering
on 2x4CS14, CS14SC
hold up to eight
14/2 cables**The SPACER**™, Arlington's versatile cable spacer holds up to eight individual cables centered on a 2x4.Quick, easy
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Just nail or
screw **The SPACER**
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- Positions, fastens, routes power or datacom cable
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Screw-on CS14SC

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installation
to wood

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

FB442

13.4
cu. inch

- For 1/2" or 5/8" drywall
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- Locator posts assure proper
positioning of fan/fixture
bracket
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NEW PRODUCT SHOWCASE

Wireless Lighting Control System

The SmartLoop wireless lighting control system is a full solution of wireless load controllers, low-bay and high-bay sensors, and a simple keypad with an intuitive app. According to the company, SmartLoop is designed for simplicity. It allows users to set up a lighting system quickly and program their workspace in minutes. The product offers security by using Bluetooth mesh-based technology and is simple enough for single-room management, while it can also utilize individual fixture controls to establish multiple scenes and lighting zones. SmartLoop allows users to quickly change settings to adjust scenes, modify motion sensor settings, or turn on or off daylighting (if desired). Controllers can come factory-installed with an integrated sensor on select luminaires, or controllers can be added into any circuit to control that zone.



Keystone Technologies



Lighting Control Unit

The Dialog lighting control unit (WLC-4150-SC) has received the UL 2900-1 Standard for Software Cybersecurity Network Connectable Products designation from the global safety science organization. The product features a large touchscreen for changing system settings. It is an updated component to the company's Dialog System, a digital, centralized, and programmable lighting control system for entire floors, buildings, and large multi-building applications.

Universal Douglas

LED Temporary Work Light

The Appleton TL LED temporary work light family allows bright, energy-efficient 360° illumination. The company has expanded the line to include 60W (200W HID equivalent – 7,200 lm), 100W (400W HID equivalent – 12,000 lm), or 150W (600W HID equivalent – 18,000 lm) TL models. According to the company, the product consumes only 25% of the power consumed by a high-intensity discharge (HID) temporary fixture or incandescent stringer light. Heat is dissipated through heat sinks, along with openings on the bottom and top of the unit. The lights start and restart instantly, eliminating the risk of leaving an area in the dark for several minutes. They feature a L70 rated operating life of 54,000 hr.



Emerson



Portable Utility Light

The Utility Bucket LED light is designed with three lighting options to light up the surrounding work area during overhead work. The product is also portable and can be used across various job sites. The cordless LED light illuminates both the inside of the utility bucket and the outside working area and features a clamp function that locks to either the straight wall or corner of a utility bucket for optimal positioning. The product rotates 300° horizontally and 180° vertically for maximum exposure. It has flood, spot, and flood-spot settings to provide a variety of lighting options up to 2,500 lm. A second light in the mounting handle illuminates the inside of the bucket to find tools fast. The product is IP56 rated and powered by DeWALT 20V lithium-ion batteries. The product kit includes two 4Ah batteries and a charger.

Klein Tools

ONE-PIECE. SAVES TIME – LOOKS GREAT!

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LOW PROFILE, EXTRA DUTY COVER • **TWO STYLES** for 1-1/2" and *Foam Wall Systems*DBVMA1C
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ADJUSTABLE Depth

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

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

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



DBVME1W

Built-in FIXED FLANGE

Fits ANY foam board
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for protection of
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which require
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weatherproof-in-
use cover for all
outdoor 15 or 20
AMP receptacles.

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

DBVME1W
white cover

Patented/Additional patents pending

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LOW PROFILE • 4" DIAMETER

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SCONCE BOX

FOR SHALLOW WALL CAVITIES OR OBSTRUCTIONS



Install
the fixture
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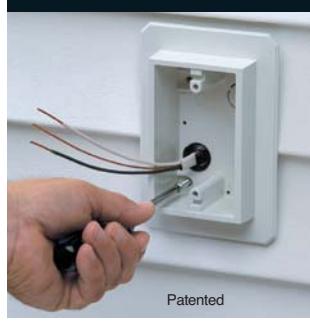
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NEW PRODUCT SHOWCASE



Touchless Switch

Designed for any environment where hands might get dirty, messy, or full, the radiant Wave Switch provides an easy, sleek option for cleaner control in both commercial and residential applications. The switches are available in both 15A and 20A ratings. Users can avoid touching the switch directly and turn the lights (or even small-motored appliances like garbage disposals) on and off with just a wave of the hand. The Wave Switch installs easily in place of any standard light switch and can be used in both single-pole and 3-way applications. It also features an internal sensor that can be adjusted to detect the wave motion anywhere from 1 in. to 6 in. from the device to best fit a specific user's needs or preferences.

Legrand

Hardhat Light

The EOS 360 is a hardhat-mounted headlamp that offers be-seen lighting in addition to traditional task lighting. Linemen will be highly visible due to a durable, rubberized band fitted with LEDs and reflective strips that encircle their hardhat. Having the reflective band coupled with a solid on LED strap on the headband, which can also strobe, aids in the visibility of the worker. The EOS is a 165-lm, 3-mode headlamp (high, low, safety strobe) that allows the worker to illuminate their work area in addition to being seen in all directions with the band. The band and the headlamp can work together or independently of each other.

Princeton Tec



Portable Explosion-Proof Lights

The XP970LED and XP980LED are beacon explosion-proof LED lights that are designed to replace existing portable hazardous location lights. The lights are equipped with an LED panel that is slim and lightweight, and they are approved by cULus and certified for Class I, Division 1, Groups B, C, and D and Class II, Division 1, Groups E, F, and G. According to the company, the XP970LED boasts a bright 5,660 lm (only using 40W and weighing 17 lb), while the XP980LED boasts 24,000 lm, using 160W and weighing 35 lb.

Lind Equipment

Lighting Control System

The RadioRA 3 line of wall controls features both a light bar design and IoT connectivity, an all-in-one processor powered by PoE, and simpler PC programming software and app-based editing features. The RadioRA 3 system includes new SUNNATA RF keypads, dimmers, and switches that feature the light bar design and come in a new, wider range of contemporary colors to enhance any décor. A soft glow makes the controls easy to find in the dark, and the dimmer's capacitive touch technology allows clients to set the lighting with a touch or swipe of the light bar. IoT connectivity gives homeowners control of their lighting through the company's app, voice assistant, remote, or wall control. The new SUNNATA RF dimmer features PRO LED+ technology for dimming of LED, halogen, incandescent, MLV, and ELV lighting. The product's processor is powered by PoE so pros can place it centrally in the home (without the need for a nearby power outlet) to optimize the system's RF network connectivity. It allows clients to connect up to 200 devices featuring Lutron's proprietary ClearConnect RF technology.

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Obtaining
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FN102FX
Two-gang
40.5 cu in
vapor box



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

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2-hour Fire Rating

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FN101FX
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FN102FX
Two gang

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ONE piece
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TWO piece
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NEW PRODUCT SHOWCASE

Adjustable Disc Light

The Brio 5CCT disc light is part of the adjustable CCT series that allows LED products to be precisely set at a wide range of color temperatures to optimize lighting environments while reducing inventory for commercial and residential applications. The Brio 5CCT disc light is a 5-in-1 luminaire that delivers up to 900-lm output performance and is available in 4-in. and 6-in. remodel trim sizes. Brio 5CCT comes with a hardwire junction box, remote driver, and spring-loaded mounting clips, allowing for installation in tight spaces. It is 5% to 100% dimmable with most TRIAC, CL, and ELV dimmers and delivers a 120° beam angle. Wattage varies from 9W for the 4-in. unit to 12W for the 6-in. unit. Additionally, the product can be set at 2,700K, 3,000K, 3,500K, 4,000K and 5,000K, each featuring a high 90+ CRI for visual acuity. Finally, the Brio features 120VAC voltage, a cETLus Listing for wet locations, and an IC rating.

American Lighting



LED Strip

Trace Vertical and Horizontal flexible (SMD) LED strips offer zero voltage drop for precise color consistency in straight and curved interior/exterior applications. This LED strip creates direct or indirect continuous illumination with three different fixture styles (horizontal tunable white, vertical tunable white, and vertical RGB+W). The strips are available in low, standard, and high output lumen intensities in 2,400K, 2,700K, 3,000K, 3,500K, 4,000K, 5,000K, green, blue, red, and amber with a CRI greater than 80, according to the company. The vertical strip delivers 87 lm/ft, 174 lm per ft, and 261 lm/ft for low, standard, and high output intensities, while consuming only 4.5W/ft. It has a 115.8° beam angle. The horizontal strip also offers 48 lm/W, 96 lm/W, and 144 lm/W for low, standard, and high output intensities, while consuming only 4.5W per ft. It has a 124.4° beam angle.

Tivoli

Disinfection Lighting

The Certolux MSU-DFX luminaire features 365DisInFx™ UVA technology designed to promote cleaner surgical suites. The new surgical luminaire with DFX technology has the added benefit of 365-nm UVA light. This technology provides a controlled amount of UVA light to reduce the bacteria on surfaces. The use of this low-energy invisible light near the visible spectrum is suitable for 24-hr human exposure. It offers symmetric or asymmetric distributions when located above the surgical table perimeter. It is certified dust-tight and water-resistant to IP65 for frequent rigorous cleaning practices. MSU is Mil-Std-461G certified and designed for recessed mounting in surgical ceiling systems and grid and flanged installations. The UVA light is invisible to the human eye and does not change the CCT or CRI of the luminaire.

Leviton



LED Commercial Downlights

The EVERLINE CDL series of LED commercial downlights offers flexible recessed lighting options for commercial buildings. Available in three sizes — 6 in., 8 in., and 9.5 in. — the units deliver long-lasting performance with a sleek appearance. The CDL downlights are designed for office reception areas, corridors, lobbies, conference rooms, and private offices. Each size comes with three different selectable light output options and selectable Correlated Color Temperature (CCT) options of 3,000K, 3,500K, or 4,000K. The luminaires are also dimmable, offering 0V to 10V LED dim control with dimming to 5%.

Universal Douglas Lighting Americas

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

Keeping Pools and Spas Safe – Part 1 of 2

Are you familiar with the requirements for permanently installed pools?

By Mike Holt, NEC Consultant

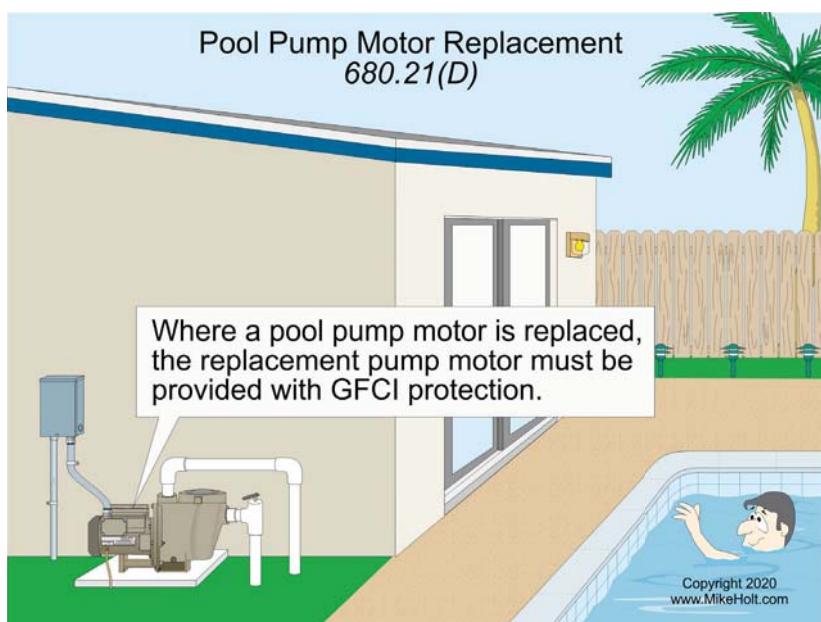


Fig. 1. Any replacement pool pump motor must be provided with GFCI protection.

The requirements in Art. 680 apply to the installation of electrical wiring and equipment for swimming pools, spas, hot tubs, fountains, hydro-massage bathtubs, and electrically powered pool lifts.

Article 680 is divided into eight parts. Each of the last seven is dedicated to a different application. For example, Part II covers permanently installed swimming pools, and Part VII covers hydromassage bathtubs.

EQUIPMENT BONDING AND GROUNDING

Electrical equipment must be bonded per Part V of Art. 250 and connected

to the equipment grounding conductor (EGC) per Parts VI and VII of Art. 250 [Sec. 680.6].

Terminals used for bonding and equipment grounding must be identified as suitable for use in wet and corrosive environments [Sec. 680.7]. Field-installed terminals in damp, wet, and corrosive environments must be copper, copper alloy, or stainless steel and be listed for direct burial use.

OVERHEAD CONDUCTOR CLEARANCE

Overhead conductors must meet the clearance from the maximum water level requirements contained in Table 680.9(A) [Sec. 680.9].

Permanently installed pools, spas, hot tubs, fountains, diving structures, observation stands, towers, or platforms cannot be placed within the clearances contained in Table 680.9(A).

Swimming and wading pools, diving structures, observation stands, towers, or platforms must not be installed where the maximum water level of the pool(s) and the top of the diving structures, observation stands, towers, or platforms will be less than 10 ft below communications, radio, and television coaxial cables.

UNDERGROUND WIRING

Underground wiring within 5 ft horizontally from the inside wall of the pool must be one of the wiring methods enumerated in Sec. 680.11(A)(1) through (7), such as intermediate metal conduit (IMC), and the minimum depths in Sec. 300.5 apply [Sec. 680.11(C)].

EQUIPMENT ROOMS AND PITS

Rooms or pits for the equipment for permanently installed pools, storable pools, spas, hot tubs, or fountain equipment must have drainage that prevents water accumulation during normal operation or filter maintenance [Sec. 680.12]. Equipment must be suitable for the corrosive environment per Sec. 300.6.

MAINTENANCE DISCONNECTING MEANS

A maintenance disconnect is required for pools, storable pools, spas, hot tubs, or fountain equipment other than lighting [Sec. 680.13]. The disconnect must be readily accessible, within sight, and at least 5 ft from the pools, storable pools,

spas, hot tubs, or fountain equipment unless separated from the open water by a permanently installed barrier. This horizontal distance is measured from the water's edge along the shortest path required to reach the disconnect.

Everything we cover after this point pertains to permanently installed pools (Part II).

MOTORS

The wiring to a pool-associated motor must comply with Sec. 680.21(A)(1) unless modified by (A)(2) or (A)(3). For example, branch-circuit wiring methods for pool-associated motors in corrosive locations must be rigid metal conduit (RMC), IMC, rigid polyvinyl chloride conduit (PVC), reinforced thermosetting resin conduit (RTRC) [Sec. 680.14], or Type MC cable listed for the location.

Also:

- The wiring methods must contain an insulated copper EGC sized per Sec. 250.122, but not smaller than 12 AWG.
- Liquidtight flexible metal and liquidtight flexible nonmetallic conduit are permitted.
- GFCI protection is required for all pool motors rated 60A or less, whether connected by receptacle or by direct connection.
- Any replacement pool pump motor must be provided with GFCI protection (Fig. 1 on page 56).

Exception: Listed low-voltage motors not requiring grounding, with ratings not exceeding the low-voltage contact limit supplied by transformers or power supplies that comply with Sec. 680.23(A)(2), may be installed without GFCI protection.

RECEPTACLES

These must comply with Sec. 680.22(A) (1) through (6). For example:

- At least one 15A or 20A, 125V receptacle must be installed on a general-purpose branch circuit.
- Receptacles for permanently installed pool motors, or other loads directly related to the circulation system, must be at least 6 ft from the inside walls of the pool and have GFCI protection [Sec. 680.22(A)(2)].
- Receptacles for loads not directly related to the circulation system must be at least 6 ft from the inside walls

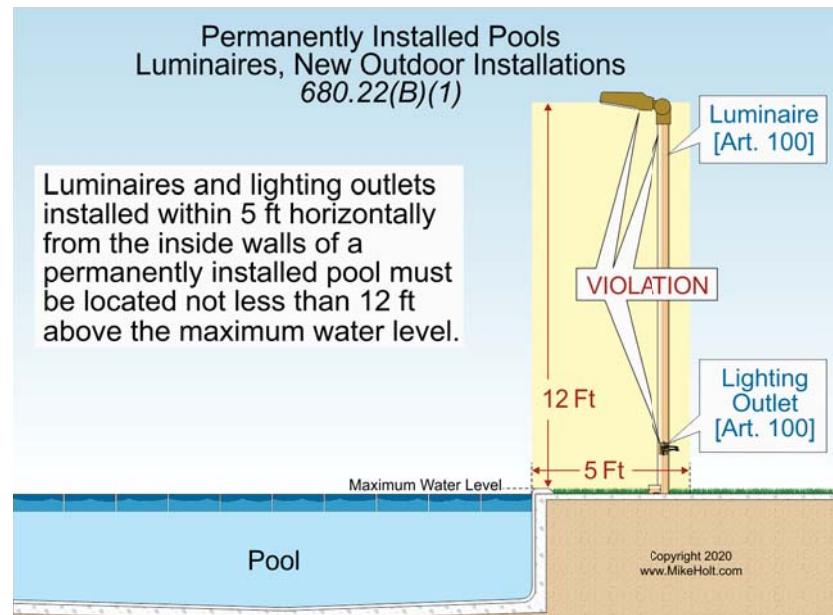


Fig. 2. Luminaires and lighting outlets installed at least 5 ft horizontally from the inside walls of a permanently installed pool must be at least 12 ft above the maximum water level.

of a permanently installed pool [Sec. 680.22(A)(3)].

- A pool equipment room must contain at least one GFCI-protected 15A or 20A, 125V receptacle. Receptacles within the pool equipment room must be GFCI protected. [Sec. 680.22(A)(5)].

LUMINAIRES, LIGHTING OUTLETS, AND CEILING-SUSPENDED FANS

These must comply with Sec. 680.22(B) (1) through (8). For example:

- Luminaires and lighting outlets installed at least 5 ft horizontally from the inside walls of a permanently installed pool must be at least 12 ft above the maximum water level [Sec. 680.22(B)(1)], as shown in Fig. 2.
- Existing lighting outlets within 5 ft horizontally from the inside walls of a permanently installed pool must be at least 5 ft above the surface of the maximum water level, rigidly attached to the existing structure, and GFCI protected [Sec. 680.22(B)(3)].
- When determining the dimensions for luminaires, the distance to be measured is the shortest path an imaginary cord connected to the luminaire
- will follow without piercing a floor, wall, ceiling, doorway with a hinged or sliding door, window opening, or other effective permanent barriers [Sec. 680.22(B)(8)].

UNDERWATER POOL LUMINAIRES

These must comply with Sec. 680.23(A) through (F). For example:

- Transformers and power supplies for underwater pool luminaires must be listed, labeled, and identified for swimming pool use [Sec. 680.23(A)(2)].
- Underwater wall-mounted luminaires must be installed so the top of the luminaire lens is at least 18 in. below the normal water level [Sec. 680.23(A)(5)].
- A nonmetallic raceway run to the forming shell of a wet-niche luminaire must contain an 8 AWG insulated (solid or stranded) copper conductor that terminates to the forming shell [Sec. 680.23(B)(2)(b)].
- The location of the forming shell and length of flexible cord for wet-niche pool luminaires must allow personnel to place the luminaire on the deck or other dry location for maintenance [Sec. 680.23(B)(6)].

EQUIPOTENTIAL BONDING

The pool parts listed in Sec. 680.26(B) (1) through (B)(7) must be bonded together with a solid insulated or bare copper conductor not smaller than 8 AWG using a listed pressure connector, terminal bar, or other listed means per Sec. 250.8(A), as shown in Fig. 3 on page 58.

These pool parts are:

1. Conductive pool shells
2. Perimeter surfaces
3. Metallic components
4. Underwater lighting
5. Metal fittings
6. Electrical equipment
7. Fixed metal parts

Pool shells need not be constructed with unencapsulated structural reinforcing steel to be considered conductive. Cast-in-place concrete, pneumatically applied or sprayed concrete, and concrete block with painted or plastered coatings are considered conductive materials due to water permeability and porosity. Vinyl liners and fiberglass composite shells are considered non-conductive materials.

The bonding requirements for some of these, such as perimeter surfaces, are highly detailed. The gist of the detailed requirements is that you create a bonding path of sufficient size and reliability to ensure there's no difference in potential between conductive parts. For example, consider these details for perimeter surfaces (these are new with the 2020 revision):

- (1) The copper ring is constructed of 8 AWG bare solid copper or larger.
- (2) The copper ring conductor follows the contour of the perimeter surface.
- (3) Only listed splicing devices or exothermic welding are used.
- (4) The copper ring conductor is placed between 18 in. and 24 in. from the inside walls of the pool.
- (5) The copper ring conductor is secured within or under the perimeter surface 4 in. to 6 in. below the subgrade.

Where a double-insulated water pump motor is installed, provide a solid 8 AWG copper conductor of sufficient length to make a bonding connection to a replacement motor from the swimming pool equipotential bonding means to an accessible point

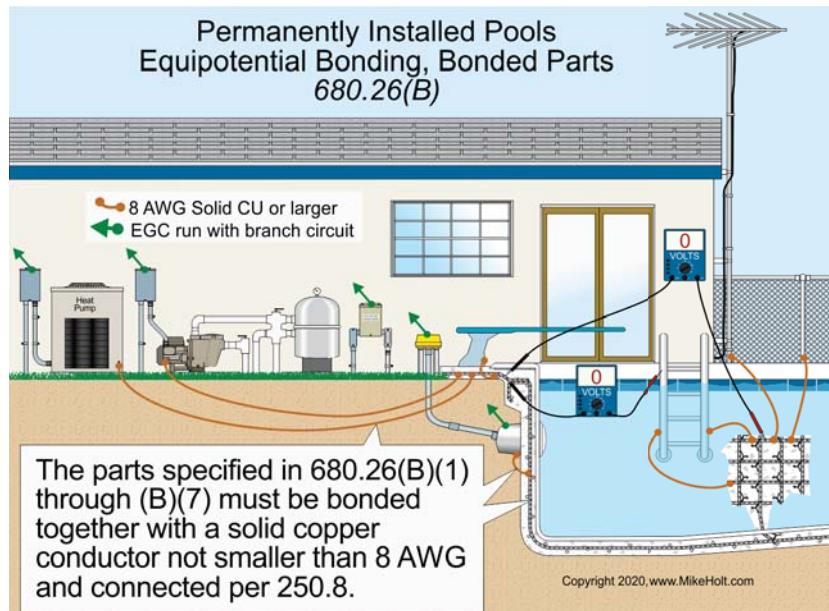


Fig. 3. The pool parts listed in Sec. 680.26(B)(1) through (B)(7) must be bonded together with a solid insulated or bare copper conductor not smaller than 8 AWG using a listed pressure connector, terminal bar, or other listed means per Sec. 250.8(A).

in the vicinity of the pool pump motor [680.26(B)(6)(a)].

Where there is no connection between the swimming pool equipotential bonding means and the equipment

Pool shells need
not be constructed
with unencapsulated
structural
reinforcing steel
to be considered
conductive.

grounding system for the premises, connect this bonding conductor to the EGC of the motor circuit.

Fixed metal parts such as metal-sheathed cables and raceways, metal piping, metal awnings, metal fences, and metal door and window frames located within 5 ft horizontally [Sec. 680.26(B)(7), Exception No. 2] and

12 ft vertically [Sec. 680.26(B)(7), Exception No. 3] from the inside wall of the pool, must be connected to the swimming pool equipotential bonding means [Sec. 680.26(B)(7)].

But you don't have to bond parts that are separated from the pool by a permanent barrier that prevents contact by a person or those that are separated by a distance greater than 5 ft horizontally from the inside walls of the pool.

SAFELY INSTALLING PERMANENT POOLS

While most of the requirements for permanently installed pools focus on keeping electricity separated from water and people, many of the requirements address eliminating differences of potential (voltage) between metallic objects. This is done by bonding all metal parts in the vicinity of a swimming pool. This is where errors often occur, but you can catch those errors by visually tracing out the bonding path and drawing it on paper as you go.

EC&M

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

Stumped by the Code?

By Mike Holt, NEC Consultant

All questions and answers are based on the 2020 NEC.

Q. What does the NEC require as the minimum size of branch-circuit conductors for a single motor compressor for air conditioning or refrigeration equipment?

A. Branch-circuit conductors to a single motor compressor for air-conditioning and refrigeration equipment must have an ampacity not less than the greater of [Sec. 440.32]

(1) 125% of the motor-compressor rated-load current.

(2) 125% of the branch-circuit selection current.

Branch-circuit conductors for a single motor compressor must have short-circuit and ground-fault protection sized between 175% and 225% of the rated-load current [440.22(A)].

Let's look at an example scenario to show you how this works.

What size conductor and overcurrent device are required for an 18A motor compressor for air-conditioning equipment (See **Figure**)?

Solution:

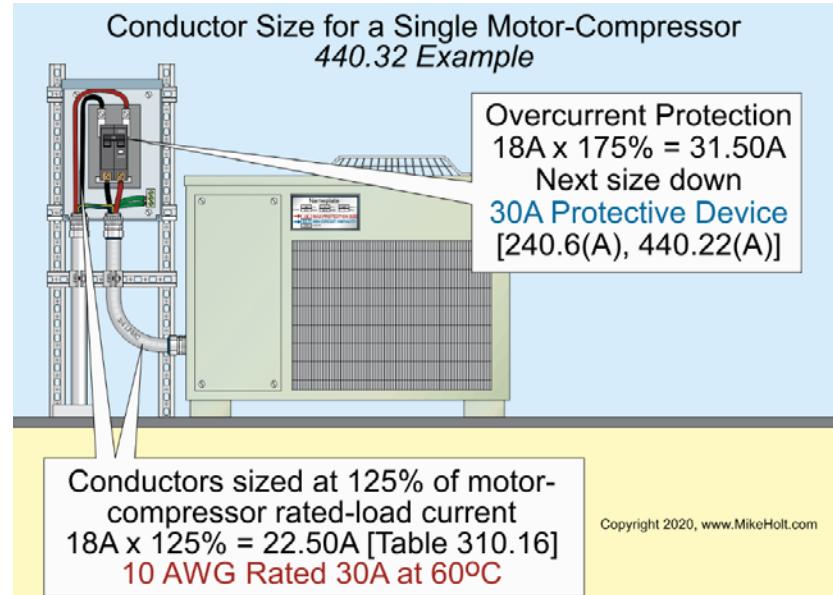
Step 1: First, determine the branch-circuit conductor [Sec. 440.32 and Table 310.16].

Branch-circuit conductors for a single motor compressor must have short-circuit and ground-fault protection sized between 175% and 225% of the rated-load current.

Branch-Circuit Conductor = $18A \times 125\% = 22.50A$

Use a 10 AWG conductor rated 30A at 60°C [Sec. 110.14(C)(1)(a)(2) and Table 310.16].

Step 2: Next, determine the branch-circuit overcurrent protection [Sec. 240.6(A) and Sec. 440.22(A)].



Branch-Circuit Conductor = $18A \times 125\% = 22.50A$. Use a 10 AWG conductor rated 30A at 60°C.

Branch-Circuit Over Current Protection = $18A \times 175\% = 31.50A$

Use the next size down, which is 30A. If the 30A short-circuit and the ground-fault protective device cannot carry the starting current, then the protective device can be sized up to 225% of the equipment load current rating.

- The branch circuit selection current is not required to be marked on the nameplate unless the internal overload equipment permits continuous operation at a current that exceeds 156% of the rated load current. The minimum circuit ampacity that is found on the equipment nameplate is 125% of the rated load current and the conductor selection can be made directly from that value as shown on the nameplate.

Q. What is the Code requirement for the listing of stationary generators?

A. Stationary generators rated 600V and less must be listed [Sec. 445.6].

Exception: One-of-a-kind or custom-manufactured generators are permitted to be field labeled by a field evaluation body.

EC&M

Branch-Circuit Over Current Protection = $18A \times 225\% = 40.50A$

Use the next size down, which is 40A.

Author's notes:

- A 30A or 40A overcurrent device can protect a 12 AWG conductor for an air-conditioning circuit. See Sec. 240.4(G) for details.

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Sizing Up the Equipment Grounding Conductor

Making sense of Sec. 250.122(B)

By Russ LeBlanc, NEC Consultant

Based on the 2020 NEC.

Section 250.122(B) is possibly the most peculiar requirement in the Code. It can be difficult to understand or explain, and it's virtually impossible to enforce. Let's try to make sense of what it says.

If ungrounded conductors are increased in size for any reason other than for ambient temperature correction or more than three current-carrying conductors, any wire-type equipment grounding conductors (EGCs) installed shall be increased in size proportionately to the increase in circular mil area of the ungrounded circuit conductors. On the surface, this may seem easy enough, but it really does not make sense sometimes either. Here are a few examples of how this requirement can sometimes cause confusion.

A 40A circuit with a 10 AWG EGC and 8 AWG THWN circuit conductors is perfectly Code-compliant. But, that same 10 AWG EGC on a 30A circuit with 8 AWG THWN circuit conductors could be a violation. Yup, that's correct!

Using that same 10 AWG EGC on a lower-rated circuit breaker is literally a violation if those 8 AWG circuit conductors were increased from 10 AWG by design. That really doesn't seem to make sense to me.

Okay, let's try again. A 125A circuit with a 6 AWG EGC and 1 AWG circuit conductors is perfectly Code-compliant. But, that same 6 AWG EGC could be a violation on a 110A circuit with 1 AWG circuit conductors. Is the 110A circuit breaker somehow more dangerous than the 125A breaker? I don't think so, but that same 6 AWG EGC on a lower-rated circuit breaker is literally a violation if those



1 AWG circuit conductors were increased from 2 AWG. And yet, according to Table 250.122, a 6 AWG EGC would be perfectly fine on a 200A circuit too. I'm having a difficult time reconciling this in my brain.

Let's review. A 6 AWG EGC is permitted for a 200A circuit, but it could be a violation on a 175A, 150A, 125A, or 110A circuit. But it's not always a violation on a 175A, 150A, 125A, or 110A circuit. Is your head spinning yet? Mine is.

Thankfully, an exception was added to Sec. 250.122(B) allowing the EGC to be sized by a qualified person, if it provides an effective ground-fault current path. I'm thinking a 6 AWG EGC that would otherwise be perfectly fine for a 200A circuit would be perfectly fine on any circuit rated lower than 200A too. But you may want to have a discussion with your AHJ about whether they see it the same way. **EC&M**

Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

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

WACKY ANTENNA WIRING



Jon Turpin, Turpin Electric, Inc., Cambridge City, Ind., was kind enough to share this photo with us. Here's what he had to say: "Russ, I came across this 'multi-tasked' receptacle while looking over a home for sale by a local realtor. It appears the previous homeowner wanted his TV antenna cable very close to the 120V power source. I was amazed to find the receptacle live!" I'm amazed too, Jon. I'm not so sure this method of wiring was a suitable method as recognized by Sec. 110.8. Section 110.3(B) requires equipment to be installed and used in accordance with its listing or labeling instructions. Drilling out a receptacle so an antenna cable can be shoved through the hole certainly does not comply with any instructions included in the listing or labeling for this duplex receptacle. The damage done to this receptacle makes me question the safety and integrity of this installation. Section 110.12(B) prohibits damaged parts that adversely affect the safe operation or mechanical strength of the equipment. This installation needs a do-over!"

KOOKY PANELBOARD LOCATION

This photo was sent in by Chuck Cole. He says, "I found this in a hunting cabin in New Jersey. It had open holes in the panel (guess they ran out of duct tape for the upper opening). No support on the MC cable within 12 in. (top). The toilet was within the clearance. The top breaker looked to be over 6 ft, 7 in. The best part is, I was standing in the shower when I took the photo." There are lots of violations to cite here. The lack of clear working space violates Sec. 110.26(A). Circuit breakers are required to be readily accessible as specified in Sec. 240.24(A). That same Section of the Code generally does not permit the operating handle of a circuit breaker, when in its highest position, to be more than 6 ft, 7 in. above the floor. I'm not sure if this hunting cabin would qualify as a dwelling unit, but, if so, Sec. 240.24(E) would prohibit these overcurrent devices from being in the bathroom. The missing knockout seal is a violation of Sec. 110.12(A). Unused openings must be closed in a manner that provides protection substantially equivalent to the wall of the enclosure. Duct tape certainly would not suffice for this purpose. Improperly supported MC cables violate Sec. 330.30(B).



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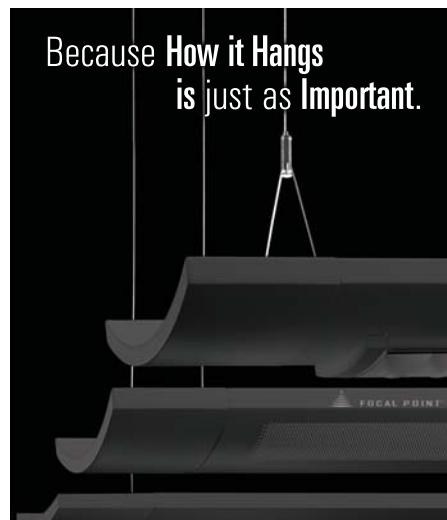
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MARKETPLACE

AEMC® Instruments has a NEW Volume 21 Master Catalog!

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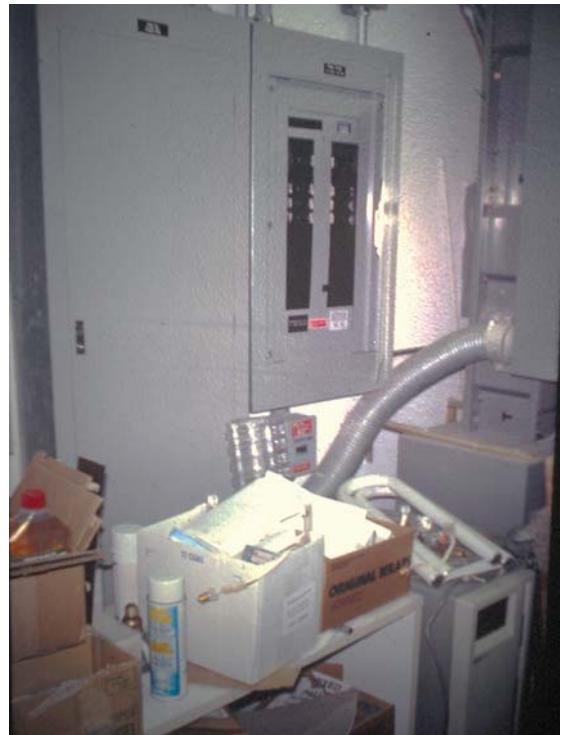
By Russ LeBlanc, NEC Consultant

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

Hint: A stockpile of violations

— 'TELL THEM WHAT THEY'VE WON...' —

Using the 2020 NEC, correctly identify the Code violation(s) in this month's photo — in 200 words or less — and you could win an Arlington Industries 18" Slider Bar and plastic box for mounting between studs with non-standard spacing. E-mail your response, including your name and mailing address, to russ@russleblanc.net, and Russ will select three winners (excluding manufacturers and prior winners) at random from the correct submissions. Note that submissions without an address will not be eligible to win.



FEBRUARY WINNER



Our winners this month were George Bottinor of Park Ridge, N.J.; Eric Wissenbach of Dade City, Fla.; and Junior Latocha of Anchorage, Alaska. They all knew these drip loops and overhead service conductor were mounted too low. Section 230.9(B) requires vertical clearances for final spans of service conductors above platforms or surfaces permitting personal contact to be maintained in accordance with Sec. 230.24(B). Section 230.24(B)(1) requires a minimum clearance of 10 ft above this porch to be provided for overhead service conductors and the lowest point of the drip loops. These drip loops are located only slightly above the height of the door. A typical door height would be 80 in. to 82 in. That equates to less than 7 ft, which means these wires are probably only 8.5 ft above this porch. Having service conductors too low could result in a person making accidental contact with them, greatly increasing the risk of shock.

BETTER IDEAS

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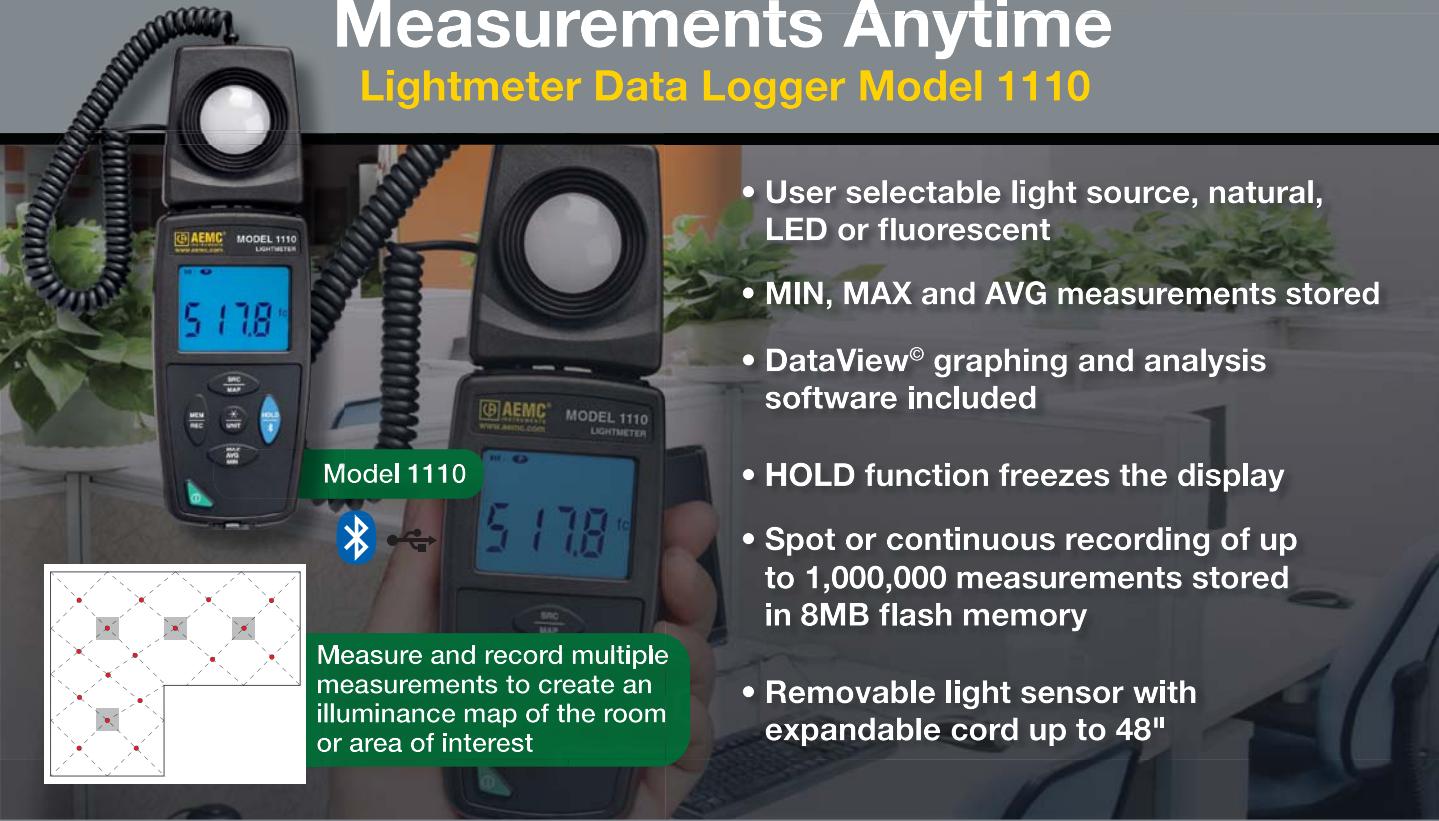
ENTER to WIN...

SLIDER BAR™ mounts plastic (or metal) boxes between studs with non-standard spacing



Measure and Record Multiple Lighting Measurements Anytime

Lightmeter Data Logger Model 1110



The image shows the AEMC Model 1110 Lightmeter Data Logger. It features a digital display showing '5178 lx' and a keypad with buttons for 'REC', 'MAX', 'MIN', 'AVG', 'HOLD', 'UNIT', 'MEM', and 'DATA'. A removable light sensor with a 48" cord is connected via a black cable. A hand is holding the sensor, and a small inset shows a grid of measurement points. A green callout box contains the text: 'Measure and record multiple measurements to create an illuminance map of the room or area of interest'. To the right of the device, a list of features is provided:

- User selectable light source, natural, LED or fluorescent
- MIN, MAX and AVG measurements stored
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- Spot or continuous recording of up to 1,000,000 measurements stored in 8MB flash memory
- Removable light sensor with expandable cord up to 48"

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