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Promise Vs. Practice: Are **Lighting Controls** Closing the Gap?

How electrical contractors are harnessing the power of increased capability and functionality in lighting controls

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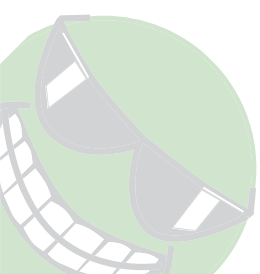
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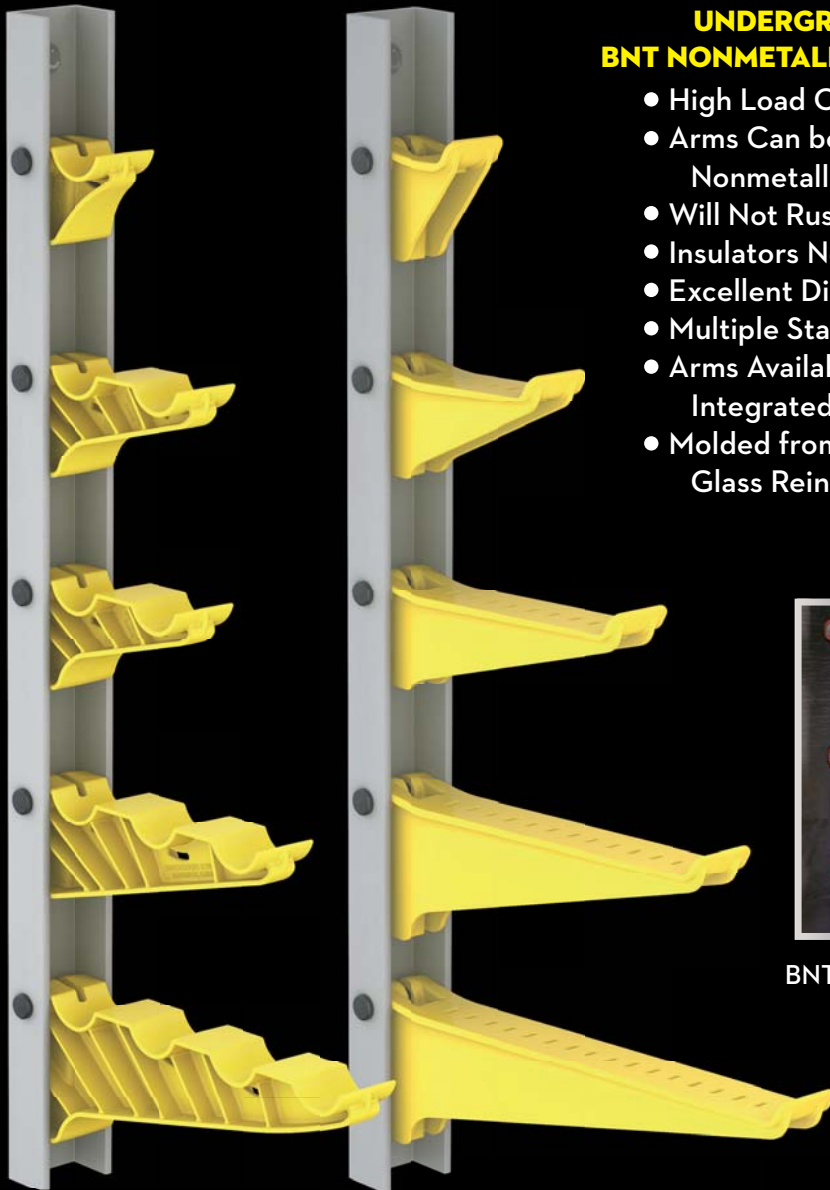
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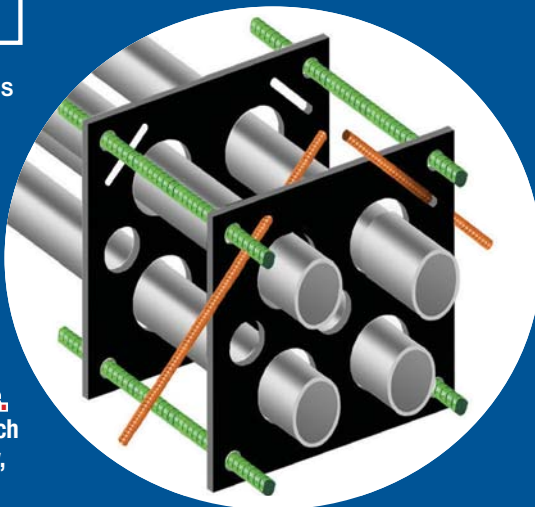
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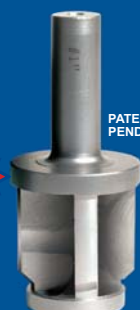
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Tracking Trends in Lighting & Control

By Ellen Parson, Editor-in-Chief



As we do every April, this issue is dedicated predominantly to the latest trends in lighting & control. Although lighting is a hot topic for a wide range of *EC&M* readers working in different vertical markets and applications each and every month, with LightFair 2023 coming up at the end of May, it seemed only fitting to offer a little extra lighting content this month.

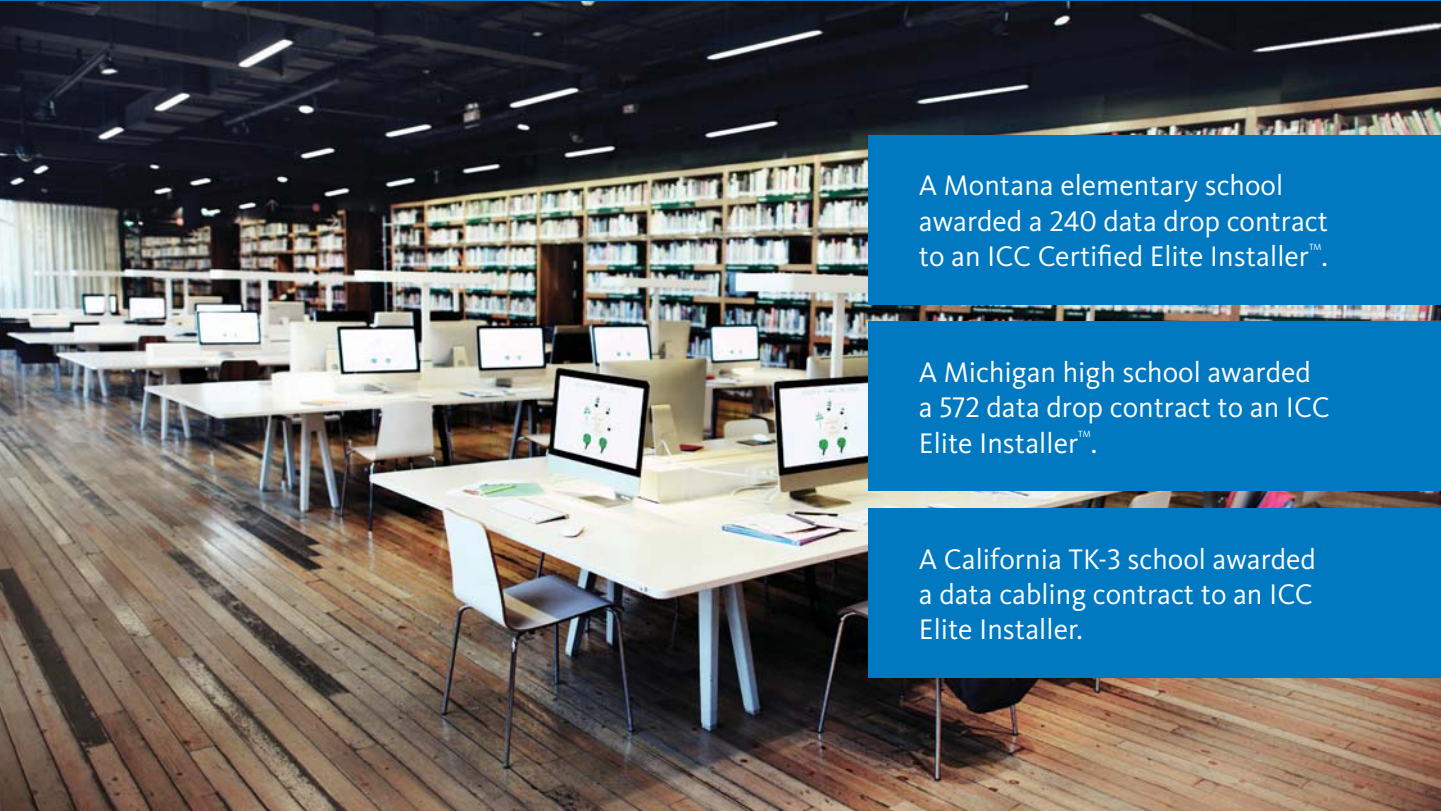
As has been the case for many years, there's been a lot going on in the lighting industry, especially when it comes to mergers and acquisitions. Here are just a few examples. Signify recently acquired Minnesota-based Intelligent Lighting Controls, Inc. (ILC), a maker of wired control systems, in March of this year. In January 2022, Orion Lighting announced the acquisition of Stay-Lite Lighting. In 2021, GE Current closed its acquisition of Hubbell Inc.'s commercial and industrial lighting business in February. And Legrand acquired Canadian commercial lighting controls manufacturer Encelium in December. For an excellent synopsis on the latest mergers and acquisitions in the lighting & control space as well as new business opportunities/technologies that are reshaping the market, read Jim Lucy's recent column on lighting megatrends at <https://bit.ly/3UgrwtZ>. Editor-in-Chief of *Electrical Wholesaling* and *Electrical Marketing*, sister publications to *EC&M*, Jim is a veteran journalist who has been covering the electrical industry for more than 30 years. His unique perspective on the historical progression of the lighting market and what trends will have the greatest impact on our market is definitely worth a read. In this issue, we have assembled a great lineup of articles that address different aspects of lighting & control:

- At the start of 2023, 78% of the United States had a commercial lighting rebate program available. For more details on how these different programs and rebates shake out, flip to page 20 for the latest trends from Randy Young at BriteSwitch.
- The cover story, written by Ruth Taylor, project manager on the Advanced Lighting Team at the Pacific Northwest National Laboratory, offers an inside look at the latest trends in lighting controls as well as how electrical contractors can benefit from the increased functionality of these devices. Turn to page 28 to learn how designers/installers are closing the gap between the technology's promise and practice upon installation.
- For buildings under 50,000 square feet, which comprise 90% of U.S. commercial buildings according to the U.S. Energy Information Administration, more than half (about three million buildings) have no lighting control strategies beyond a simple on-off switch. In the piece starting on page 34, Jason Jeunette, technical manager for building integration and controls at the DesignLights Consortium, takes a specific look at how to make networked lighting controls more affordable and useful in these smaller spaces.
- Next, Michael Jouaneh of Lutron Electronics offers expert insight on what changes are likely in store for lighting and controls this year as they relate to energy code requirements. Don't miss this energy codes state on the union, starting on page 38.
- Our coverage wouldn't be complete without *EC&M*'s new product showcase, focusing on the latest lighting and controls introduced to market, starting on page 44.
- Finally, don't miss this online exclusive: a new e-book on "Everything You Need to Know About Luminaire Level Lighting Controls." You can download this PDF for free on the members-only section of our website at <https://bit.ly/3nXFAw6>.

That's a lot of lighting content to consume, but it's definitely worth your time and effort. Happy reading, and don't forget to stop by *EC&M*'s booth (#1565) at LightFair in May. Our editorial team would love to chat with you about all things lighting.

Ellen Parson

Are You Profitable Installing School Cabling Projects?

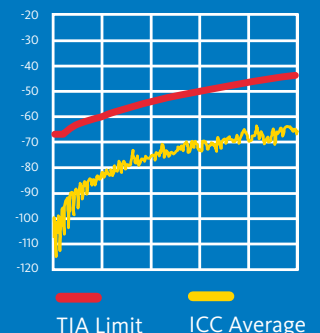


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Tracking the Hottest Housing Markets

Even though single-family construction will likely have an off year in 2023, you will still see a surprising amount of construction in some hot markets.

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

Where's the single-family housing market headed in 2023? The answer depends on your local market. The business climate for the residential construction market varies drastically on a metro-by-metro basis because of building lot availability and local building, water, or environmental regulations, and the underlying demand for starter homes, larger single-family homes, apartments or condos, and senior living developments. Macroeconomic factors such as the ongoing population shift to the Sunbelt, the surge in Baby Boomer retirements, and remote officing are also huge factors. And don't forget that home buyers are getting hit with the highest mortgage rates they have seen in the last few years coupled with the shortage of available entry-level homes in many markets.

Construction economists agree that the construction of single-family homes and multi-family condos or apartments will decline from 2022 before regaining traction in 2024. A post by the National Association of Home Builders (NAHB) at www.nahb.org said, "The housing recession that began in 2022 will bleed into 2023 as elevated inflation and mortgage rates, coupled with stubbornly high building material construction costs, continue to take a toll on the housing industry and are expected to push the overall economy into a mild recession this year. However, the second half of 2023 could lead to a turning point for housing and the economy."

During a press briefing at the 2023 International Builders' Show, Robert

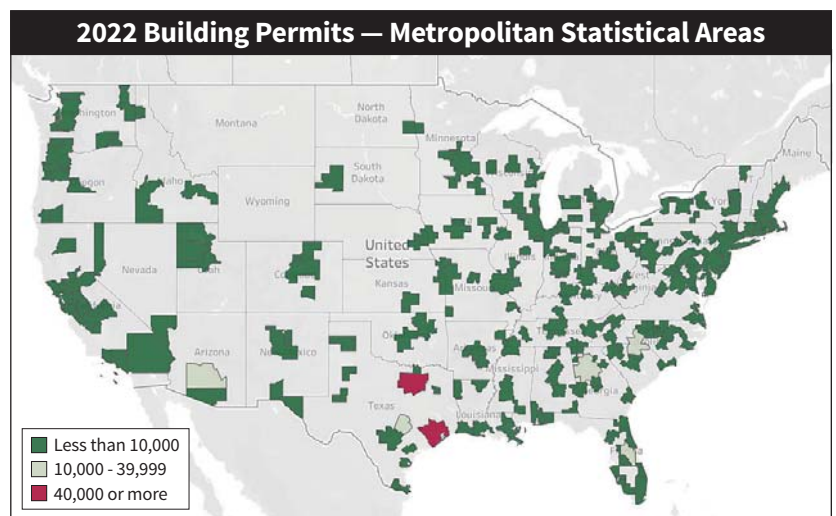


Fig. 1. The Houston and Dallas metros saw the most single-market permit activity by a wide margin in 2022. Homebuilders in these two markets pulled a combined total of more than 90,000 permits last year, according to U.S. Census Bureau preliminary annual data.

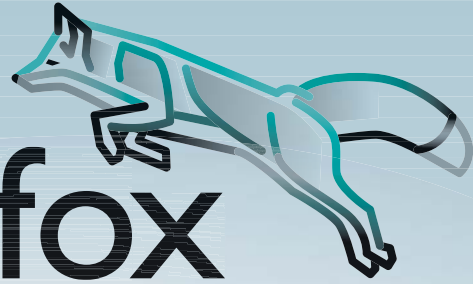
Dietz, NAHB's chief economist said, "With interest rates projected to normalize in the second half of 2023 as the Federal Reserve taps the brakes in its fight against inflation, the pace of single-family construction will bottom out in the first half of 2023 and begin to improve in the latter part of the year. This forward momentum will lead to a calendar year gain for single-family starts in 2024."

Now that the preliminary year-end building permit data for 2022 is in from the U.S. Census Bureau, we can get a good sense of which market areas will see the most home construction this year (Fig. 1). Because single-family building permits typically lead housing starts

by several months, they are a dependable leading indicator of future building activity. And despite the general feeling amongst construction economists that housing starts will slide again this year before bouncing back in 2024, some local markets should see a surprising amount of housing construction in 2023. Let's explore the key trends that will shape the residential construction market's business climate in 2023.

Homebuilders will get some relief from price increases for key construction products, but the pricing picture will remain mixed in 2023. The good news for homebuilders is that lumber and plywood prices are down 30.8%

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2022's 25 Largest Markets for Single-Family Building Permits

Rank	Metropolitan Statistical Area (MSA)	Single-Family (SF) Permits	SF Year-Over-Year (YOY) # Change	SF YOY % Change	Housing Hotness Index	2021 Population Estimate	# Population Change	Net Migration 2021	New Residents per Day
1	Houston-The Woodlands-Sugar Land, TX	47,633	(5,086)	(10)	9.6	7,206,841	69,094	31,921	189
2	Dallas-Fort Worth-Arlington, TX	43,409	(8,587)	(17)	10.1	7,759,615	97,290	62,921	267
3	Phoenix-Mesa-Chandler, AZ	26,828	(7,519)	(22)	10.2	4,946,145	78,220	70,097	214
4	Atlanta-Sandy Springs-Alpharetta, GA	26,382	(5,178)	(16)	6.4	6,144,050	42,904	25,049	118
5	Austin-Round Rock-Georgetown, TX	20,289	(4,197)	(17)	24.0	2,117,000	64,000	40,000	175
6	Charlotte-Concord-Gastonia, NC-SC	18,987	(1,843)	(9)	11.2	2,701,046	31,381	26,652	86
7	Orlando-Kissimmee-Sanford, FL	16,194	(1,601)	(9)	11.4	2,691,925	14,238	9,939	39
8	Nashville-Davidson-Murfreesboro-Franklin, TN	15,189	(2,233)	(13)	16.0	2,012,476	17,133	13,234	47
9	Jacksonville, FL	14,368	(2,168)	(13)	13.9	1,637,666	26,278	25,857	72
10	New York-Newark-Jersey City, NY-NJ-PA	12,495	(452)	(3)	2.9	19,768,458	(327,955)	(361,774)	(899)
11	Raleigh-Cary, NC	12,494	(1,733)	(12)	14.9	1,448,411	28,186	23,279	77
12	Riverside-San Bernardino-Ontario, CA	12,199	237	2	3.4	4,653,105	47,601	33,986	130
13	Washington-Arlington-Alexandria, DC-VA-MD-WV	11,652	(2,077)	(15)	4.3	6,356,434	(29,280)	(54,211)	(80)
14	Myrtle Beach-Conway-North Myrtle Beach, SC-NC	11,550	496	4	24.0	509,794	18,212	21,921	50
15	North Port-Sarasota-Bradenton, FL	11,005	(1,101)	(9)	18.5	859,760	22,653	29,691	62
16	Los Angeles-Long Beach-Anaheim, CA	10,996	(94)	(1)	2.4	12,997,353	(175,913)	(199,539)	(482)
17	San Antonio-New Braunfels, TX	10,173	(3,772)	(27)	8.6	2,601,788	35,105	26,622	96
18	Denver-Aurora-Lakewood, CO	10,104	(3,009)	(23)	10.1	2,972,566	3,277	(5,448)	9
19	Cape Coral-Fort Myers, FL	9,259	(1,761)	(16)	17.0	787,976	23,297	26,813	64
20	Las Vegas-Henderson-Paradise, NV	9,205	(2,951)	(24)	7.1	2,292,476	19,090	15,395	52
21	Minneapolis-St. Paul-Bloomington, MN-WI	9,107	(2,627)	(22)	7.1	3,690,512	(1,909)	(12,629)	(5)
22	Lakeland-Winter Haven, FL	9,023	(1,568)	(15)	17.3	753,520	24,287	25,517	67
23	Indianapolis-Carmel-Anderson, IN	8,716	(1,443)	(14)	6.3	2,126,804	13,104	8,854	36
24	Chicago-Naperville-Elgin, IL-IN-WI	8,365	(1,706)	(17)	1.9	9,509,934	(91,671)	(102,613)	(251)
25	Sacramento-Roseville-Folsom, CA	8,132	(1,258)	(13)	5.2	2,411,428	12,077	8,325	33

Notes: Housing data from U.S. Census Bureau is 2022 preliminary total for Metropolitan Statistical Areas (MSAs); Housing Hotness Index is the number of single-family permits per 1,000 residents; net migration is the difference between residents moving into and out of an MSA.

The 25 metros shown in this table accounted for more than half of the single-family permits builders pulled in 2022, according to U.S. Census Bureau data.

year-over-year (YOY) in January, according to the U.S. Bureau of Labor Statistics' Producer Price Index (PPI). However, some other key product groups were still logging increases at press-time. Plastic construction products were up 7% YOY according to the PPI, while prices for building wire and cable were up 7.7%, and residential luminaires were up 5.9% YOY, according to *Electrical Marketing's* Electrical Price Index (EPI).

A handful of markets will once again see the bulk of the action. The homebuilding market is quite consolidated, with the majority of the activity in the Sunbelt or Intermountain states.

The 10 largest markets (see **Table** above) account for 33% of all single-family building permits, while the Top 25 metros account for more than half the permits. The Top 50 metros account for an estimated 70% of all activity.

Builders in the three Texas Metropolitan Statistical Areas (MSAs) ranked in the Top 10, pulling in a crazy number of combined permits — 111,331 single-family permits. The Houston-The Woodlands-Sugar Land, TX, MSA (47,633 permits) led the state's Big Three, followed by Dallas-Fort Worth, Arlington, TX, MSA (43,409 permits); and Austin-Round Rock-Georgetown,

TX, MSA (20,289 permits). Add in San Antonio-New Braunfels, TX, MSA (10,173 permits), and these four metros alone account for more than 121,000 single-family permits. These four Texas MSAs together had more single-family permits than any other entire state except for Florida, which had 133,750 single-family permits for 2022.

Despite the massive number of permits builders pulled in these markets last year, many of the top markets actually experienced some sizeable declines in permit activity. While the 10 largest markets saw builders pull at least 12,000 permits through December 2022, nine of

these MSAs saw YOY declines of at least 2,000 permits. It's interesting to note that the two market areas with YOY increases in single-family building permits of more than 1,000 were actually smaller or medium-sized markets — the San Jose-Sunnyvale-Santa Clara, CA, MSA (1,294 increase) with 3,694 single-family permits, and the Punta Gorda, FL, MSA (1,202 increase) with 4,637.

While many of the Sunbelt's larger MSAs logged some impressive permit totals last year, several smaller and medium-sized markets actually grew faster. You can use the Housing Hotness Index to compare large and small markets in terms of building activity. To level the playing field when comparing smaller market areas to the nation's largest MSAs, this index ranks metros based on the number of single-family permits per 1,000 residents. It's interesting to note that seven MSAs in Florida ranked in the Top 10 in the Housing Hotness Index — The Villages; Punta Gorda;

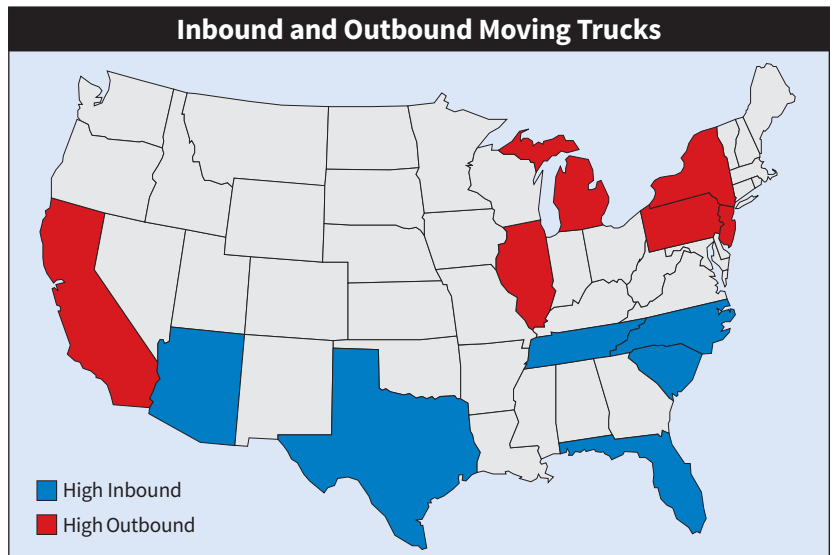


Fig. 2. North American Moving Services tracks inbound and outbound moving trucks. It recently published a report showing that Texas, Florida, Arizona, Colorado, the Carolinas, and Tennessee were the most popular destinations.

North Port-Sarasota-Bradenton; Lake-Myers; Naples-Marco Island; and Port
land-Winter Haven; Cape Coral-Fort St. Lucie. Rounding out the Top 10 in



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12124-50 shown installed to BCHS-12, MC cables connected to 1/2" K.O. s



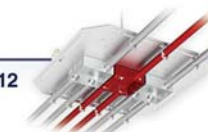
12124-50 shown fabricated to lighting relay panel, used as pull box



Shown fabricated with pre-wired lighting relay devices, ready-to-install



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the Housing Hotness Index were Austin-Round Rock-Georgetown, TX; Myrtle Beach-Conway-North Myrtle Beach, SC-NC; and Provo-Orem, UT.

Tracking inbound and outbound moving trucks/population growth offers a quick read on residential building activity. You can always get a pretty good idea of where the new housing construction will be happening by watching the markets with the highest increase in population. In fact, six of the metros with the biggest increases in population between 2020 and 2021 are also among the Top 10 in building permits.

Many of these same MSAs pop up in the North American Van Lines “Moving Migration Report,” which analyzes the cities with the most inbound and outbound moving trucks (Fig. 2 on page 11). The report said the top cities for in-bound migration in 2022 include: Raleigh, NC; Charleston, SC; Tampa, FL; Jacksonville, FL; Tucson, AZ; and Nashville, TN. On the flip side, the

report said since 2014, Illinois has been the top state for outbound moves and that other leading outbound states include New Jersey and Pennsylvania.

Another way of measuring a market’s population growth is to look at the number of new residents moving in each day. Six MSAs are attracting more than 100 new residents each day: Dallas-Fort Worth, Arlington, TX, MSA (267); Phoenix-Mesa-Chandler, AZ, MSA (214); Houston-The Woodlands-Sugar Land, TX, MSA (189); Austin-Round Rock-Georgetown, TX, MSA (175); Riverside-San Bernardino-Ontario, CA, MSA (130); and Atlanta-Sandy Springs-Alpharetta, GA, MSA (118). The folks moving into these high-growth markets tend to be from some of the nation’s larger metropolitan areas. The two markets that suffered the largest population losses, according to U.S. Census data, were the New York-Newark-Jersey City, NY-NJ-PA, MSA, which lost 327,955 residents in 2021 (899 per day); and

the Los Angeles-Long Beach-Anaheim, CA, MSA, which lost 175,913 residents (482 per day). The Chicago and San Francisco metro areas are also losing residents at an alarming rate.

Summary. Even if the single-family construction in your local market area doesn’t rank up there with the high flyers mentioned in this article, you can still track your local market with the same data sources. Become familiar with the U.S. Census Bureau’s Building Permit Survey data, available at www.census.gov/construction/bps/current.html, and the data and housing reports available for free from the National Association of Home Builders at www.nahb.org. Population data at the county, MSA, state, and national level are also available at www.census.gov. *Electrical Marketing* newsletter (www.electricalmarketing.com), *EC&M*’s sister publication, offers regular data updates on residential building activity, population growth, and employment trends as part of a \$99 annual subscription. **EC&M**



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The Danger of Making Assumptions When Estimating

Understand these 10 elements of estimating.

By Don Kiper, Electrical Estimating 101

The word “assume” means “to take for granted; suppose.” Most estimating departments are fast-paced environments, which requires the estimator to read many specifications in a short period of time. You may be tempted to review the project documents too casually, causing you to take some things for granted or make assumptions. However, you can minimize or eliminate assumptions if you have a good understanding of the following 10 items:

1 Scope of work — When bidding on a plan and spec project, typically the scope of work is provided in the specification. This specification section will provide the estimator with work to be performed by the contractor. Sometimes, a scope of work will be provided in Division 26 of the specification. This summary of the work can (and may) list work items that the contractor is responsible for. If there is no scope of work listed in the bidding documents, the wise contractor will write one that details the components included in his or her bid price.

2 Division 1 of the specifications — Some refer to this section as the “front end” of the specification. The bidding documents are found in this section and typically include the following: advertisement for bids, instructions to bidders, bid forms, and the agreement form or contract. Also in this section are the general conditions and supplemental conditions of the project. The general conditions set forth the rules by which the project is constructed and administered. The supplemental conditions deal with the project’s specific matters related



to the contract. Supplemental conditions may also modify items in the general conditions section.

3 Schedule — The project schedule may be indicated by one of two means. It can give the contractor a number of calendar days, such as 150 days or a fixed calendar date. Regardless of the means, the estimator must understand the schedule. This is vital in determining supervision, equipment rental costs, labor rates, and, most importantly, crew size.

4 Phasing — Some projects require portions to be completed in succession. The phasing drawings will usually indicate specific areas and the completion dates these areas must be

completed. Depending on the phasing requirements, the contractor may have to mobilize and demobilize several times over the course of the project.

5 Shutdowns — Renovation projects are known for having shutdowns. When the project requires an upgrade to the electrical service, this is typically done on the weekend and will require overtime. In an occupied facility, the circuitry may need to be fed from a new panel — this work typically will need to be done on off-hours to avoid interruptions to the owner.

6 Building construction — Not all buildings use the same wiring methods. For example, a high-rise condo structure with poured concrete

Check Your Symbols

FA SMOKE DETECTOR SYMBOLS



Here is an example demonstrating how engineers can use different symbols to convey the same thing. Above are four different symbols for a fire alarm smoke detector used by various engineers.

Review the symbol legend carefully for each project you estimate. Having to recount devices for various systems because “assumptions” were made will waste valuable estimating time. You can make another dollar, but you can never make another minute. So, place a high value on your time!

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walls is not estimated the same as a multi-residential housing project. In an industrial environment, areas with corrosive materials are estimated differently than areas that require explosion-proof equipment. Both material and labor costs are affected in these different areas. Understanding the building’s construction is vital.

7 Technical specifications: Divisions 26, 27, and 28 — Technical spec sections have three headings: 1) General; 2) Products; and 3) Execution. The product heading will typically list each product specified with acceptable manufacturers and catalog numbers. The execution heading will detail how the material is to be installed. One example would be conduit installation. For example, PVC conduit may not be permitted to be installed in the slab or underground, where on a previous project this means of installation was permissible. The estimator must completely understand these sections of the specification, paying careful attention to the execution heading.

8 Check scales on all drawings — It is not uncommon for drawings to have different scales. In rare cases, a drawing may have two areas shown, each with a different scale.

Quantifying materials on the wrong scale can be detrimental to the estimate’s accuracy.

9 Check match lines for overlapping items — Some projects require more than one drawing per floor. When this happens, the architect provides match lines. Sometimes, items are duplicated on two drawings.

10 Check column lines — This is very important in multi-level buildings. For example, the main electrical room may be in the basement, and a new panel is being installed on the 4th floor. The vertical length is typically easy to determine. But the horizontal length can be a challenge. This is easily accomplished by identifying column lines of the project. Assuming that the electrical room is directly below is risky, especially when estimating a large feeder.

Making too many assumptions is unwise. The fewer you make, the better. Just remember that estimating is more of a science and less of an art — so treat it as such.

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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@electralesimating101.com.

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What's Cooking in the Kitchen for the 2023 NEC?

Learn the new requirements for GFCI protection and electrical appliance cords.

By David Humphrey, County of Henrico, Va.



The 2023 NEC introduced changes meant to mitigate electrical hazards in kitchens.

The kitchen of a home is more than just a place to prepare food. It's a place for the family to gather and share meals, discuss and celebrate life events, and entertain family and friends. Second only to bathrooms, the kitchen is also the most dangerous room in the home. Some of the hazards found in kitchens are rather obvious, including knives, exposed elements on cooktops and ranges, tile floors that can be slippery when wet, and so forth. Other hazards are less obvious but can be just as (if not more) dangerous to family members and other guests in the kitchen. These are the electrical hazards that go unnoticed by most people.

NFPA 70 (NEC) Code-Making Panel 2 (CMP 2) has worked for many years to

address and reduce electrical hazards in kitchens. The group took a major step forward with the 2023 National Electrical Code (NEC). In this article, we will review the changes to the NEC designed to make the kitchen a much safer place.

ELECTRICAL APPLIANCE CORDS

Electrical appliance cords routed over the edge of the countertop to access a receptacle outlet installed below the countertop are one such hazard. Since the 1990 NEC, a receptacle outlet(s) has been required to serve each island or peninsular kitchen countertop over 12 in. wide in kitchen and dining areas. As there is generally no wall or backsplash on or in which to install a receptacle, permission to install a receptacle in the side wall of the peninsular or island countertop



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Receptacle outlets cannot be installed on the side of the cabinet, but they can be installed on the countertop surface.

base (and within 12 in. of the top) has been provided in Sec. 210.52(C)(3). There have been many objections to this permission for side mounting of receptacle outlets with fear that cords hanging over the countertop may be inadvertently pulled or snagged. Appliances — such as fryers and crock pots containing extremely hot liquids that may contact persons (including small children who may pull cords) — have been of concern to many. Until recently, these concerns have been mostly anecdotal.

A task group appointed by the Chair of CMP 2 charged with obtaining the number of documented injuries from pulling an appliance cord yielded startling results. As per the Consumer Product Safety Commission, nearly 10,000 hospital visits are estimated to have occurred from such events. This number included some fatalities. With the evidence no longer being primarily anecdotal, CMP 2 acted. Receptacles per Sec. 210.52(C) are no longer required to serve island and peninsular kitchen countertops. If a receptacle is to be installed to serve such tops, it may not be installed on the side of the cabinet base. A type of receptacle assembly commonly referred to as a pop-up or other type permitted to be installed in the countertop surface must be used, meaning our kitchens just got safer.

GFCI PROTECTION

Beginning with the 1987 NEC, ground-fault circuit-interrupter (GFCI) protection was introduced for dwelling unit kitchens. The initial requirement was for GFCI protection of countertop receptacles within 6 ft of a sink. The expansion of this life-saving protection has steadily progressed ever since.

Kitchens are electrically more complicated today than ever before. An original premise of GFCI protection for kitchen receptacles was to provide a level of protection from the use of electrically operated appliances and equipment near the kitchen sink. Dropping an appliance into the sink or contacting the sink while operating an appliance was the fear. Such an appliance that may be leaking dangerous levels of current could put the user

in great danger. Documented cases of electrocution while using such equipment supplied by non-GFCI outlets are abundant. Unfortunately, these cases of severe electrical shock injury and electrocution at non-GFCI-protected outlets are still occurring.

The progression of GFCI protection in kitchens has moved beyond concerns of just contacting the sink while operating an appliance. Large conductive surfaces of appliances that one may contact while operating an appliance, standing on a conductive tile floor, contacting another appliance, or any combination thereof pose at least an equal risk.

Accordingly, in the furtherance of making kitchens more electrically safe than ever before, Sec. 210.8(A)(6) requires all 125V through 250V single-phase receptacles up to 50A to be GFCI protected. No more measuring formulas or concerns with doors and types of doors — simply all the receptacles in the kitchen shall be GFCI protected. This is essentially the same rule we have had for commercial kitchens since the 2002 NEC. Additionally, GFCI protection shall be provided for the branch circuit or outlet supplying the appliances listed in Sec. 210.8(D). Large conductive surfaces for these appliances may pose a risk of electrical leakage current above the levels considered safe for human contact, and GFCI protection will serve to mitigate these risks.

CONCLUSION

This consistent progression of safety will undoubtedly make kitchens safer for us, our families, and anyone working in or visiting our homes. This progression may well lead to the point where kitchens are no longer the second most dangerous room in the home but electrically as safe as any other room in the dwelling.

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David Humphrey is certified as a 1&2 Family, General Electrical Inspector, Electrical Plans Examiner, and he holds a Virginia Master Electrician's certification. He currently serves as an electrical plan review engineer. He can be reached at hum@henrico.us.



Protection from hazards posed by non-GFCI-protected outlets has progressed with the 2023 NEC.



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Commercial Lighting Rebate Trends for 2023

The most significant change for rebate programs this year is in response to the Energy Independence and Security Act.

By Randy Young, BriteSwitch

Rebates have been a staple in the commercial lighting marketplace for decades, helping millions of customers transition to more efficient lighting at a reduced cost. Each year, these programs adjust their offerings, evolving to match the current market needs.

What are the latest trends in commercial lighting rebates for 2023? BriteSwitch, a firm specializing in capturing local, utility, state, and federal rebates/incentives for business, explores some of the key developments in this space and discusses how businesses can position themselves to take advantage of these trends.

OVER 3/4 OF THE UNITED STATES HAS A COMMERCIAL LIGHTING REBATE PROGRAM

At the start of 2023, 78% of the United States had a commercial lighting rebate program available. That's consistent with the past few years and just shy of the record of 79% we saw back in 2017.

Looking across the country, we haven't seen any dramatic change in areas discontinuing or starting new programs. As we've seen in the past, the most robust programs are still in the Northeast and Northwest, while states like Ohio, Kansas, and North Dakota offer no rebates.

It's interesting to see that the top 3 most populated states (California, Florida, and Texas) also have some of the lowest rebate potential. While all three states appear green in the **Map** on page 22, the programs there are so restrictive that they offer little value for most projects. For example, Florida Power & Light, the largest utility in Florida, limits the program to only a handful



© Artur Szczybylo | Dreamstime.com

of luminaire types. Also, their amounts are very low. For example, its high-bay rebate is 10% of the national average.

A BIG CHANGE FOR SCREW-IN/GENERAL SERVICE LAMPS

The most significant change for rebate programs in 2023 is in response to the Energy Independence and Security Act (EISA). Phase 2 of that legislation will go into full effect in July and will increase the minimum efficacy requirement of many general service lamps, like A19s and PARs, to 45 lm/W. That significantly changes the marketplace and has created two big changes with rebate programs.

With this upcoming change, programs are pushing hard to complete projects with these lamps in the first half of the year. Many of these programs are offering bonuses or increased dollar amounts in an effort to capture the savings while

they still can. In fact, with this increased push, the average rebate for a screw-in/incandescent replacement lamp shot up an impressive 71% from last year to \$7.66 per lamp (see **Table** on page 22). Projects at hotels, multi-family buildings, restaurants, and other businesses that often use these lights should plan their projects in the first half of this year while the higher funds are still available.

For the second half of the year, many programs have announced that they'll be discontinuing the rebates for general service lamps. It should be noted that EISA does not explicitly prohibit rebates for these products. However, it does mean that inefficient lighting will no longer be available for sale starting in July. Therefore, many programs question if customers still need to be motivated to make the switch.

Also, since the new baseline wattage will be much lower, the utility can claim

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less savings. For example, when measuring program effectiveness before EISA, a program could say a 60W A19 was replaced by an 11W LED, resulting in 49W savings. However, under the new guidelines, a 60W equivalent A19 (800 lm) would have to be at most 17.8W. So if a customer installs an 11W LED, the program can now only claim 6.8W savings.

REBATE AMOUNTS STAY RELATIVELY FLAT ACROSS ALL OTHER CATEGORIES

For most other lighting types, the 2023 incentive amounts have stayed relatively consistent year-over-year. It's the third year the rebates have remained stable, bucking the historical trend of a 10% to 20% decline each year. In 2021 and 2022, we attributed this stability to the pandemic and the need to get more projects. This year, the motivating factor is likely due to increased LED costs and inflation.

The product categories with the highest dollar amounts are typically the luminaires that offer the most energy savings, such as high-bay luminaires and pole lights (see **Figure** on right). These luminaires have historically had the highest rebates, and the 2023 amounts are on par with their record-high levels.

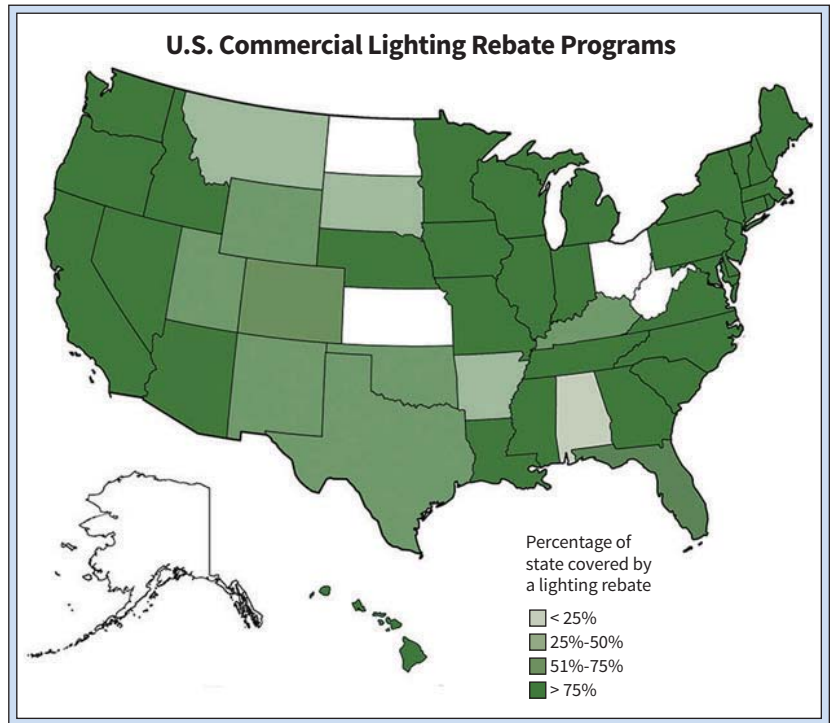
Rebates for lighting controls also remain consistent over the previous year. For basic controls, like wall and remote-mount occupancy sensors, the rebates still cover a good portion of the cost, making it a great add-on to most energy efficiency projects.

More advanced controls, like networked lighting controls (NLCs), have also stayed flat for 2023 in terms of geographic availability and dollar amount. This trend is surprising, since the rebates for this category saw a good amount of growth in 2022. Programs still seem to be struggling with how to explain the benefit of NLCs to customers in a quantifiable way.

PROGRAMS ARE GETTING HARDER TO USE

A concerning trend in rebate programs is that they are getting harder to use.

Over the years, many of the incentive programs have shifted to online portals in an effort to cut costs and streamline work on their end. Those portals are



2023 Average Rebate Amounts in North America

Type of LED Solution	2023	% Change vs. 2022
Replacement Bulbs (A19, PAR, MR)	\$8	71%
Linear Tube	\$4	1%
Pin-Based (CFL-NI Replacement)	\$6	-11%
Downlights	\$28	-2%
Troffers/Panels	\$34	1%
Retrofit Kits (1x4, 2x2, and 2x4)	\$38	10%
Accent/Track Lighting	\$50	-2%
Screw-in HID (Corncob)	\$58	4%
Outdoor Wall Mount	\$98	4%
Parking Garage Luminaires	\$101	4%
Outdoor Pole/Arm Mount	\$106	3%
High-Bay Luminaires	\$127	4%

Based on prescriptive and midstream rebates as reported in BriteSwitch RebatePro for Lighting in February 2023

usually poorly developed, full of glitches, and slow down the application process. The time spent per application increases significantly for the person entering the information. A simple pre-approval application with just one line item can easily take up to 20 minutes now, a significant change from the days of paper or PDF applications.

As programs “streamlined” their applications, they’ve also cut staff, and it’s increasingly hard to connect with

someone. When there is a problem with a project or an application, reaching someone typically involves calling a general call center where an assistant with no knowledge of lighting or the rebate program takes your contact information and passes it to the utility’s staff, who can take up to a week to get back to you.

These issues make the rebate process, which was already cumbersome, even worse. As a result, people looking to file rebates in 2023 need to focus on

Average Prescriptive Rebates in North America



allowing enough time to complete all the steps in the process and have a project management system in place for tracking each rebate application from start to finish.

2023 IS ANOTHER STRONG YEAR FOR COMMERCIAL LIGHTING REBATES

Overall, 2023 proves that commercial lighting rebate programs still have life left in them. While rebates may seem like old

news, they still are a valuable tool for making projects more affordable and improving the payback period of a project. With most of the country having a program, you should research the rebates available for each and every project you do. **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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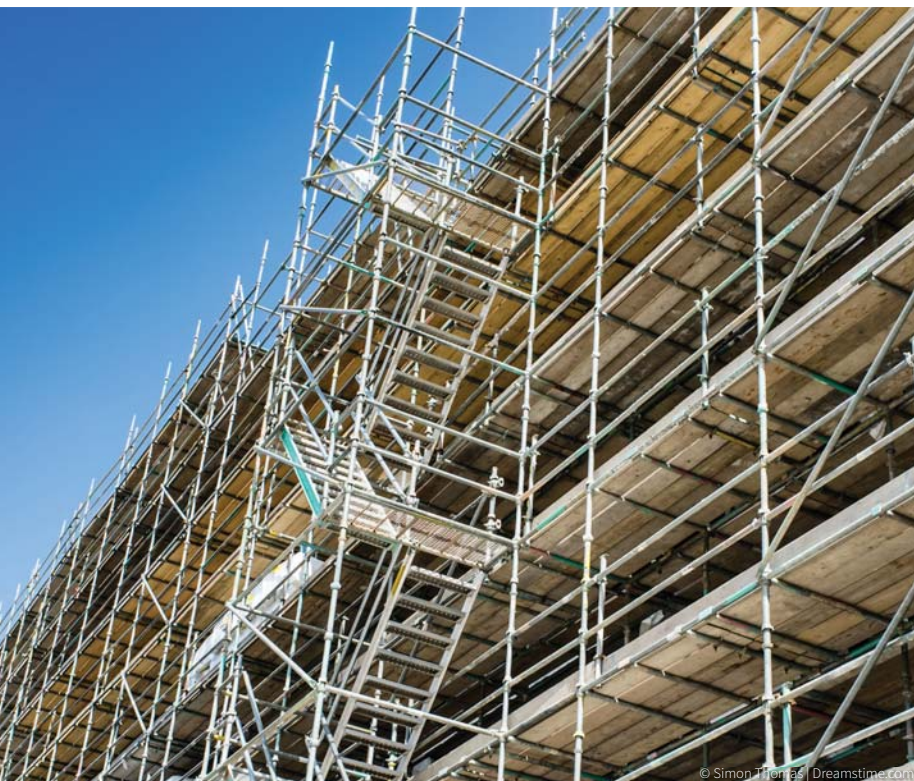
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How To Beat the Odds in the Game of Scaffolding Safety

You can help eliminate scaffolding danger in your organization, turning a gamble into a sure bet.

By Mark Lamendola, Electrical Consultant



unsecured scaffolding planks at a refinery expansion project in Louisiana. This scaffolding rose above the dome of a 210-ft cracking tower; thus, its top deck was a long way above the cement below. As the nephew slid down the dome toward the vertical tower wall, he got lucky and was able to grab a thermocouple well with his left hand. His work partner pulled him back onto the scaffolding, but the ordeal took considerable effort — and they almost failed.

We sure have come a long way on scaffolding safety since the 1970s. Right? Not according to the data collected from OSHA. Last year, scaffolding took the No. 4 spot for the number of violations. It wasn't an off year, either. Scaffolding also took the No. 4 spot the previous year. In fact, scaffolding ranked third in 2019, 2018, 2017, 2016, 2015, and 2014. It took first place in 2013 and third place the prior year (2012).

If you keep going back, you find the number of OSHA citations for scaffolding violations for any given year is at or near the top — and never lower than fourth place.

If you are a scaffold user (but not a scaffold erector), as Donald's nephew and those ironworkers were, you should understand that just because it's up doesn't mean it's safe.

Part of the problem is many companies let unqualified people erect scaffolding. One solution, especially on large sites, is to outsource scaffolding erection to a company that specializes in it. But when such companies have labor shortages, they may take qualification shortcuts or have other problems that result in unsafe scaffolding.

In 1977, five ironworkers fell to their deaths from improperly erected scaffolding on the construction site of a power plant in the Midwest. Donald, the site superintendent of the ironworkers, had been complaining about scaffolding deficiencies for several months. During one rather heated exchange, the general contractor's superintendent told Donald he was making a big deal out of minor discrepancies — after all, nobody has died in all this time (a bad excuse for ignoring safety).

Then the superintendent told Donald to “quit being such a crybaby.” Nobody who reports a safety problem is a crybaby. Adding to the irony, Donald was one of the Chosin Few — a Korean War hero of unquestionable courage. This case (based on a true story, although names have been changed for privacy) illustrates how ignorantly that label can be tossed at someone who voices concern for workplace safety.

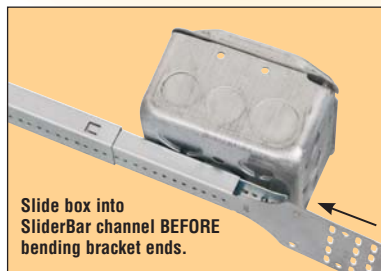
The day after those men died, Donald resigned. A few years later, Donald's nephew fell between two

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CONSTRUCTION

Even if you don't erect scaffolding, become familiar with the main rules. This will help you spot problems in how someone else is erecting the scaffolding, plus help you inspect it once it is erected. So, let's look at some of the rules these people are supposed to follow; then we'll look at how you can protect yourself whether they follow those rules or not. If you want to read the original OSHA text, it's in 29CFR1926 Subpart L (1926.450 through 1926.454) plus the five appendices that follow (A, B, C, D, and E). It is dense reading.

- **Only a “qualified person” can lawfully erect scaffolding.** The term “qualified person” gets a lot of abuse, often being redefined on the fly for the sake of expediency. In this context, it means that everyone erecting, adjusting, maintaining, and removing scaffolding has the specific training and experience to correctly perform those functions. If your company's insurer or the site policies require certification, make sure you have that before trying to erect whatever scaffolding that's present.

- **Have a solid foundation.** Use base plates, mud sills, or other adequate firm foundations on which to set supported scaffold legs, poles, posts, frames, and uprights.

- **Brace for non-impact.** Check the legs, poles, posts, frames, and uprights to ensure they are plumb. If they sway or could be displaced, add bracing.

- **Don't forget the tip.** What is the height to base width ratio (including outriggers) of your scaffolding? If it exceeds four to one, use guy cables or braces. Make sure you secure the cantilevered portions of platforms so they don't tip; you may need to block the cantilevered end.

- **Don't use narrow platforms.** Scaffold platforms and walkways must be at least 18 in. wide unless space doesn't allow it. If there's a space limitation, accommodate that in some way (e.g., erect a guardrail). This requirement does not apply to some types of scaffolds (such as roof bracket ones) that must be at least 12 in. wide.

- **No partial planking.** This just leaves a hole that someone can step

through. So, ensure each platform on each working level is fully planked or decked.

- **Secure to structures correctly.** If that scaffolding must be secured to the structure (often a requirement due to needing the extra stability), use the prescribed methods at the prescribed positions. In one case, a contractor bolted to the fascia of the building rather than to a structural component. Upon loading, the fascia was torn off, and the scaffolding nearly tipped over.

- **Heed overhead clearances.** Allow for the height and reach of workers on the scaffolding — not just the height of the highest deck.

INSPECTION

An inspection tag doesn't mean the scaffolding was correctly inspected. Donald encountered plenty of these. The scaffolding his nephew fell from bore such a tag. But don't ignore these tags; aside from meeting pro forma requirements, they can be helpful (we will get to that in a moment).

Always conduct a thorough inspection. Don't feel rushed to do this, and don't skip the steps.

- **Read the inspection tag.** This is not done to see if the scaffolding is safely erected. It's done to see how long it's been since someone allegedly inspected it. Each inspection tag is supposed to have an expiration date on it. If that date is not even on the tag, report the scaffolding as being uninspected and thus unusable — same if the date is present but now expired.

- **Ask about the installer(s).** Ascertain whether qualified persons installed this scaffolding you are about to trust your life to. That does not mean asking your boss, “Did a qualified person install this?” Get some proof. It may mean asking to see the qualification certificates of those who installed the scaffolding. Will that cause a major kerfuffle on the job? Only if there's not an attitude of safety first or if the boss is quick to toss out the “crybaby” slur.

- **Give it a quick look-over for problems.** Check each level that you can see from the ground to see whether the planks or decks look secure. Do any fasteners look loose? Is it set on a firm foundation? Does it look plumb, or is

it tilting? Don't try to fix any of these problems unless you are a “qualified person” for this particular scaffolding. Report any problems to your foreman, and use the scaffolding only after all those problems are resolved.

- **Ensure each deck is clear.** If there is junk (e.g., scrap wood or process waste) on a deck, remove it before using the scaffolding. If the scaffolding is outside and there is snow or ice on it, use a proper deicing method to eliminate the slipping hazard.

USE

The safety features of properly erected scaffolding can be defeated by improper use. Follow these tips.

- **Keep it clear.** For example, keep tools and small parts in buckets rather than strewn about.

- **Use the correct fall protection for the situation.** You can still fall, so have this as a backup.

- **Control loads.** When large items must be hoisted up to a level of scaffolding, ensure the hoisting process won't tip the scaffolding.

- **Don't supplement with make-shift platforms.** If the scaffolding won't quite reach, add another stage rather than stand on a box or other object.

LADDERS

If you use a ladder on a scaffold:

- Secure the scaffold against any lateral force from the ladder.

- Ensure all ladder legs are on the same platform or are isolated from unequal platform deflection.

- Secure the ladder legs, to prevent movement.

BEAT THE ODDS

It is well within the reach of any company to have zero violations for scaffolding requirements, instead of being average (mediocre) and letting this be among the company's top safety problems. But for that to happen, scaffolding safety must be a team effort. Now that you know your part, you can help your team beat the odds. **EC&M**

Mark Lamendola is an electrical consultant based in Merriam, Kan. He can be reached at mark@mindconnection.com.

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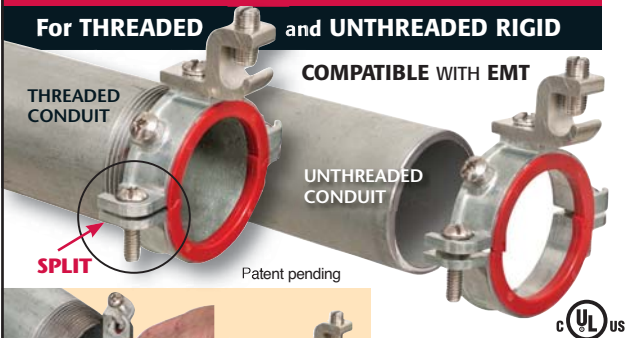
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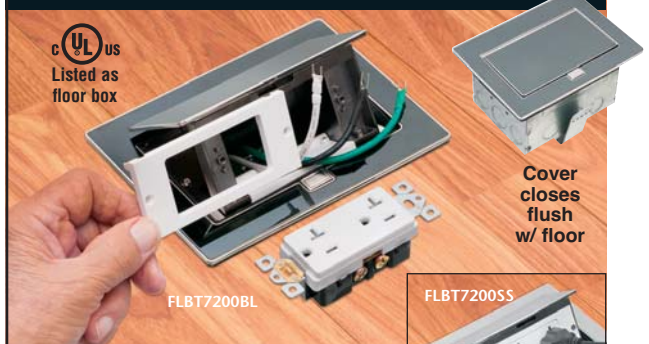
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Promise Vs. Practice: Are Lighting Controls Closing the Gap?

An inside look at the latest trends in lighting & controls — and how electrical contractors are harnessing the power of increased capability and functionality

When lighting controls moved past the simple switch, a gap began to grow between the technology's promise and practice. Controls promise energy savings, convenience, and tailored lighting effects. But the post-installation reality includes systems that don't function as intended, controls that have been disabled, and costs that significantly exceed expectations. What's more,

over the last decade, enhanced controls capabilities have increased system complexity, which has served to maintain the gap and (in some cases) widen it.

Most of us have experienced the struggle between what we want (more capabilities) and what we don't (more complexity). In the dynamic U.S. market, the capabilities/complexity tradeoff remains. But several developments look favorable for improvement. Most of the observations shared in this article relate to

projects with discretion or significant influence over the choice of a lighting control system. Whether you're responsible for electrical engineering and construction or working to a consultant's specifications, your choices and advice can improve the effectiveness of lighting controls in terms of cost, performance, and reliability.

UPGRADE, NOT REPLACE.

At Pacific Northwest National Laboratory, we have begun to see manufacturers



An electrician installs a networked sensor (with occupancy and light detection).

Photo courtesy of NIEEA



An installer reviews an online how-to video to aid a lighting installation.



An electrician installs AC-powered controls in an NGLS living lab

creating scalable systems (**Fig. 1** on page 30) rather than separate control products — each targeted to projects of a different scale (i.e., think room-based vs. networked). In general, a scalable system starts with a common platform and by adding components, such as a gateway, the system can grow in scale to handle an entire building and even a campus of buildings.

The potential benefits accrue to both owners and contractors. Controls that satisfy simpler requirements can be upgraded as requirements change without the need to replace the original installation. A scalable system permits rightsizing of the control system at the outset, which reduces the initial cost, complexity, and risk of failure. The knowledge and know-how that went into the first installation should give

the installing outfit a leg up in securing the upgrade.

A common platform brings consistent system architecture and terminology to a manufacturer's products. Designers and installers don't need to learn as many new arrangements and technical descriptions. Training is more efficient because installers and project managers do not need to master as many separate products and configurations. With familiar terminology as the system grows in scale, communication on the job is less likely to be misunderstood.

Scalable systems can be fundamentally more cost-efficient than a series of independent systems; you can build on them rather than replace them entirely. There's less material and labor waste as the installed components remain in use when the system is upgraded. There's also less "knowledge waste" in learning a new system architecture, installation process, and protocols. Of course, a scalable system does not necessarily mean a simple one. Today's lighting control systems continue to add capabilities. Usually, the more capable the system, the more costly, complex, and risky it becomes. The simplicity of a buildable system lies in its ability to be upgraded (rather than replaced) as project needs change.

THE INFORMATION YOU NEED

Industry practice is changing, particularly for controls documentation.

Familiar wiring and riser diagrams have long guided installers in the installation and connection of lighting control devices. But where is the information you need to set up the system after installation? A Sequence of Operation (SOO), a common practice in the setup of HVAC and other mechanical controls, has now been applied to lighting controls, as shown in **Fig. 2** on page 30.

Previous practice left many ambiguities and gaps in information: Controls might not perform as intended, and there was no documentation to guide the fix. The SOO can serve as a roadmap for setting up a control system. In a well-written SOO, you can find the specific settings for each function in each control device. The SOO provides a format for collecting such information as time-out periods for occupancy sensors, light levels for dimmers and different scenes, set points for daylight harvesting, and scheduled lighting change.

Large projects typically engage a commissioning agent for setup. For smaller projects, setup may be a designer's responsibility or service provided by the control's seller or manufacturer. Sometimes, setup falls to the installer — or simply falls through the cracks. Here's where the SOO can save time and money.

The Illuminating Engineering Society has published *LP 16 Documenting Controls Narratives and Sequences of*

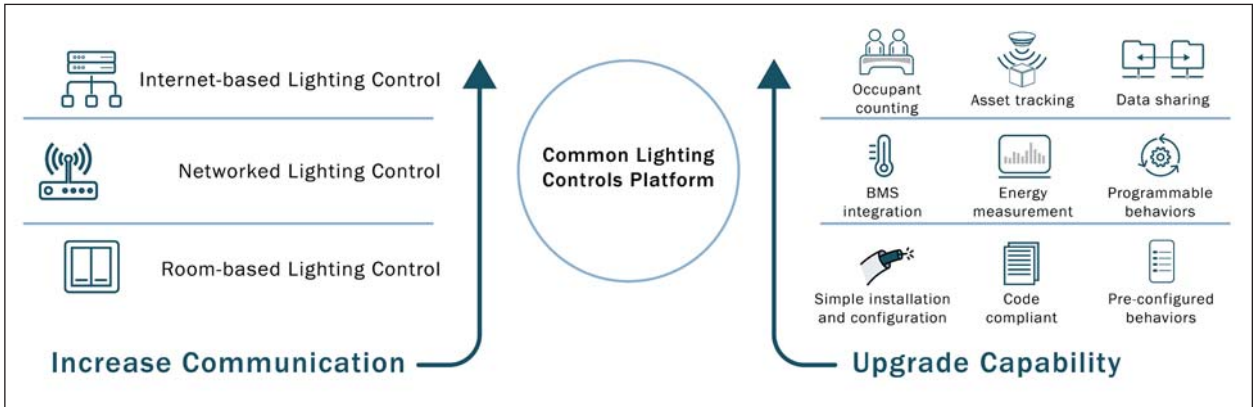


Fig. 1. A scalable system starts with a common platform. By adding components, the system can grow in scale to handle an entire building and even a campus of buildings.

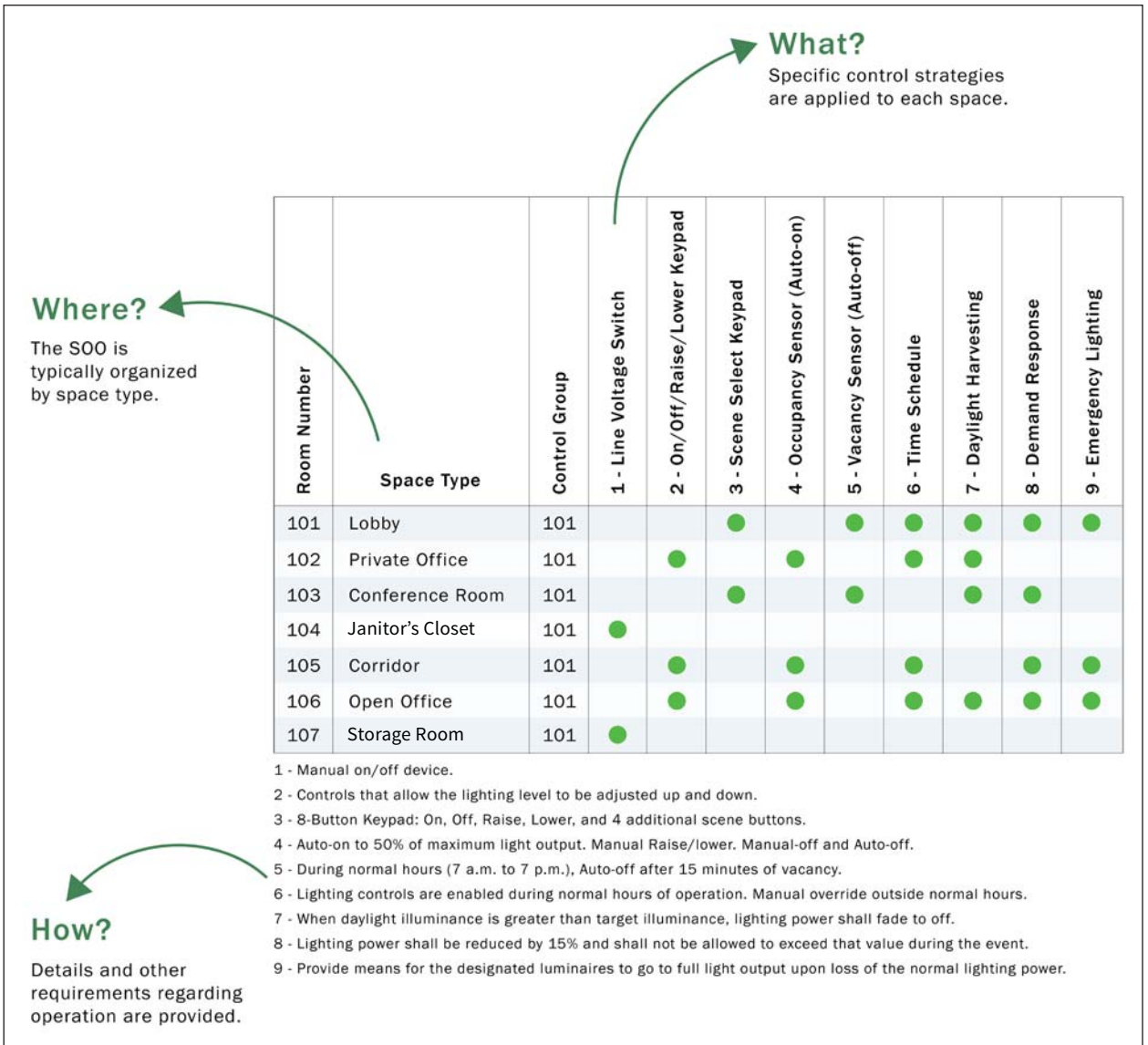
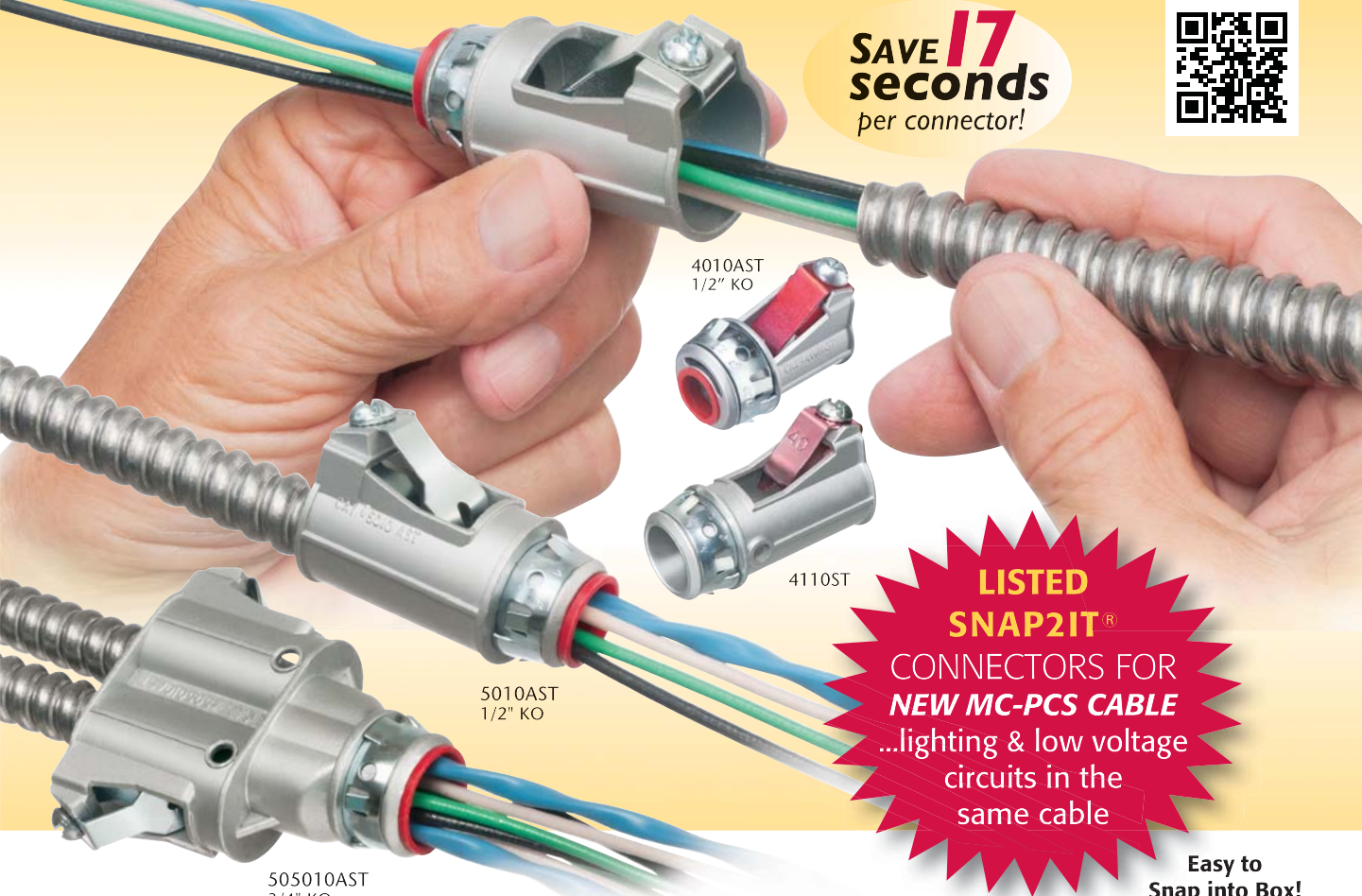


Fig. 2. A Sequence of Operation (SOO) can serve as a roadmap for setting up a control system.

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Operations. Among its many important features, LP 16 shows how the various controls documents work together and offers examples of different formats and methods for creating a clear and complete SOO. Several examples apply to projects where lighting controls are engineered within the electrical contractor's scope.

ALL-AROUND SUPPORT

Just as the number and capabilities of lighting control systems have grown, so has the availability of information, training, and support. Installers can use their smartphones to download apps with installation and setup instructions. Installers can also watch videos showing how it should be done. The best setup guides are built into the app itself.

Manufacturers provide training on their own products, of course, but organizations like the Lighting Controls Association (LCA) offer generic training. The LCA catalog currently includes 33 separate classes available online, ranging from 100-level courses, such as *Occupancy and Vacancy Sensors*, to the more advanced *Luminaire Level Lighting Controls* and *Lighting Control Protocols*.

You can also attend seminars dedicated to lighting controls at trade shows and conferences around the country. In addition, you can draw local support from the increasing number of controls specialists in lighting sales agencies, especially those that have proved most effective. In other words, there is no shortage of resources to help close the gap between promise and practice.

CAPABILITIES FIRST

Why are systems installed with low-priority features that complicate the system and add cost and risk? Perhaps customers fear missing out on a feature that might be of use later. With their practical knowledge and experience, electrical firms are well-positioned to help customers assess the value trade-off as more capabilities add cost and risk.

New tools make it easier to focus system capabilities and rightsize the system. After years of observing the selection and installation of lighting systems, PNNL has developed materials to assist in system selection, beginning

with objectives (Fig. 3). In addition, the DesignLights Consortium recently updated its Qualified Products List of networked lighting controls. The QPL features a searchable database with filters for various capabilities.

Looking at system capabilities before purchasing products familiar to you — with their known feature sets — helps to rightsize the system. With a capabilities-first approach guiding the choices, it becomes easier to choose among the favored brands and suppliers that best fit your business approach. Rightsizing becomes routine.

For most projects, “code compliance at least cost” provides the starting point for system design or selection: just a few capabilities, including occupancy control, scheduling, daylight response, bi-level, or dimming. Of course, the details vary by code jurisdiction. For many customers, the control system can start and end with the code requirements.

For others, additional energy-oriented capabilities, such as high-end trim or energy reporting, can offer an attractive return on investment. Perhaps scene controls or tunable white lighting will enhance the appeal or productivity of high-profile areas. And some customers believe that advanced sensors and analytics promise productivity gains in the facility.

Much of the challenge with system selection lies in the intangibles of products and suppliers: reliability, familiarity, and responsiveness. Most businesses deal with a favored brand or outfit because experience says that it saves time and money. On the other hand, sticking to a favored brand can limit important options and information. Moreover, it may diminish competition, raising costs.

Searching the DLC Qualified Products List and thinking “capabilities first,” as discussed above, can now provide the information to focus system selection on those systems with the optimal range of features.

IT'S WITHIN REACH

Although the gap between promise and practice may never disappear entirely, I now see it narrowing, thanks to these developments — all of which bode well for the bottom lines of both electrical firms and customers as well as others



Fig. 3. Typical objectives for a lighting controls installation.

in the industry. Scalable systems can increase flexibility and reduce wasted equipment and training. Improved documentation can avoid many costly problems in system configuration. Rightsizing can lower cost, complexity, and risk of failure. Taking a capabilities-first approach can help find the favored brand best suited to the project.

But it won't happen by itself. To enjoy the promise of profits from lighting controls, electrical professionals must build a technically knowledgeable workforce and adopt new practices. In this sense, you are another key to closing the lighting controls gap. **EC&M**

Ruth Taylor serves as a project manager on the Advanced Lighting Team at the Pacific Northwest National Laboratory where she leads projects including Next Generation Lighting Systems (NGLS), a nationally recognized program that encourages technical innovation and promotes excellence in the design of energy-efficient LED luminaires and connected lighting systems. Feel free to share your experience with lighting controls with her at Ruth.taylor@pnnl.gov.



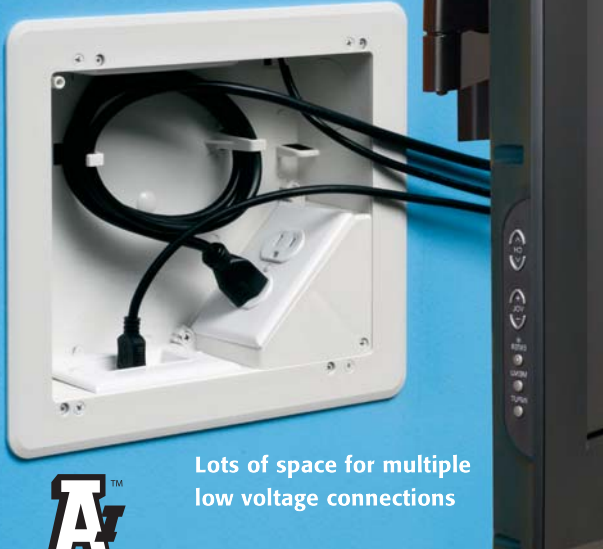
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Photo 1. According to DLC research, installing networked lighting controls (NLCs) in conjunction with LEDs can make them up to 70% more efficient — a benefit in the smaller building sector that has yet to be enjoyed to its full potential.

Implementing Lighting Controls in Smaller Buildings

How electrical contractors can make networked lighting controls more affordable, attractive, and useful for smaller facilities

By Jason Jeunette, [DesignLights Consortium](#)

A revolution in illumination was underway a decade or so ago, as companies, universities, and retailers began swapping out energy-wasting fluorescent and incandescent lamps for super-efficient light-emitting diode (LED)-based luminaires and lamps. Using about 75% less electricity and lasting up to 25 times longer than their incandescent counterparts, LEDs quickly grew in popularity. Today, they now dominate the commercial and industrial lighting market.

As first-generation LEDs reach the end of their useful lives, there's a rare

opportunity to significantly boost the energy efficiency of commercial lighting systems by pairing the installation of new LEDs with networked lighting controls (NLCs).

A recent study published by the DesignLights Consortium (DLC) and Northwest Energy Efficiency Alliance found that installing NLCs and LEDs together yields dramatic increases in energy efficiency — making LED luminaires up to 70% more efficient in some building types and averaging 47% across eight categories of facilities (**Photo 1**). Since LED luminaires installed today may last another decade, new LED products should be dimmable and combined

with controls from the outset to avoid sacrificing the increased energy savings and occupant comfort, security, and well-being enabled by advanced controls.

For reasons ranging from upfront costs to unfamiliarity with the technology, however, connected lighting comprises less than 1% of all luminaires in the United States, according to the Department of Energy (DOE) — and uptake is notably lacking in the smaller building sector. For buildings under 50,000 square feet, which comprise 90% of U.S. commercial buildings according to the U.S. Energy Information Administration, more than half (about three million buildings) have no lighting



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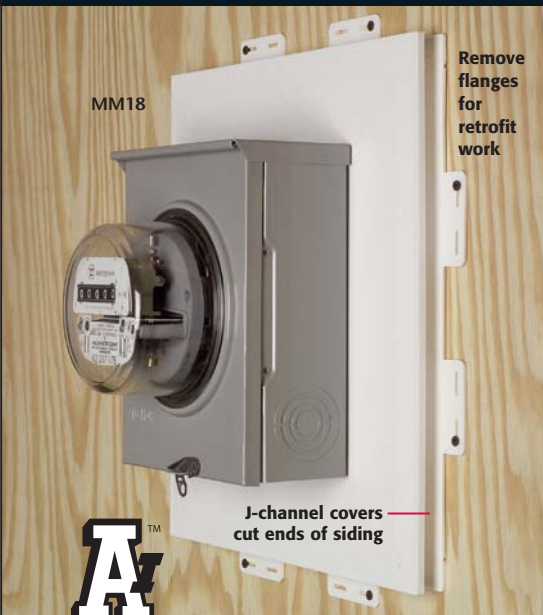
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control strategies beyond a simple on-off switch (**Photo 2** on page 36).

The DOE is seeking to change this narrative for commercial buildings of all sizes. Through controlled, connected lighting, the agency estimates the United States could avoid about one quad of electricity consumption (approximately equal to one-fifth of the country's commercial sector energy use) and save more than \$10 billion in annual energy costs by 2035 when just under a third of installed luminaires in commercial buildings are expected to have network connectivity.

In addition to expanded energy savings, combining NLCs with LED luminaires unleashes an array of non-energy benefits that, in some cases, eclipse the value of energy savings alone. A DLC study published in January 2023 found that considering the net value of an NLC's non-energy benefits, such as longer equipment life-cycles and safety and security gains, could provide an additional 30% value to a building owner.

Despite these benefits and incentives offered by more than 50 electric utilities across the country, lighting decision-makers haven't sufficiently warmed to NLC technology, especially in the small- to medium-sized building sector.

How to improve this situation was a main topic of discussion at a DLC meeting in Boston last May attended by electric utility officials, energy efficiency professionals, lighting manufacturers/distributors, researchers, and other industry representatives. To attract more small building lighting decision-makers to the technology, one theme prevailed: Lower the barrier of entry, and keep it simple.

That message resonated with the DLC, a non-profit organization that collaborates with utilities, energy efficiency programs, manufacturers, lighting designers, building owners, and government entities to create rigorous lighting performance criteria that keep pace with technology. Over the past several months, the DLC has been developing a new program geared toward supporting the implementation of lighting control strategies in buildings under 50,000 square feet served by the retrofit market. Out for stakeholder comment this spring, the proposed policy aims to answer questions, provide resources, and



Photo 2. According to the U.S. Energy Information Administration, approximately 3 million commercial buildings in the United States, many of which are smaller buildings under 50,000 square feet, have no lighting and control strategies beyond a simple on-off switch.

open lines of communication needed for smaller facilities to reap the energy and non-energy benefits of NLCs.

The crux of the new offering is the creation of tools containing all the information needed for energy efficiency incentive programs to evaluate retrofit projects and for installers to order materials and install/program a lighting control system. The proposed tools will feature a project intake form that includes all details about a lighting control retrofit project, including room-by-room details and an energy savings calculator. Project leaders will be able to choose how deep they want to go with energy savings, ranging from meeting the local energy code to significantly exceeding it. These preferences will inform a materials list (more sensors, for example, in a more aggressive scenario) and a sequence of operations provided for the project.

Specific features aimed at smoothing the way for small building NLC installations include generating individual forms listing the luminaires and sequence of operations for each room in a project, which would simplify a foreman's assignment of work to project installers. The tool will also generate material lists that project leaders can

give lighting distributors. Material lists will include verification that products being installed are on the DLC Qualified Products Lists relied upon by scores of energy efficiency incentive programs, thereby streamlining the rebate process. In addition, the program will generate leave-behind sheets for building owners/occupants, helping them understand the work that's been done and how it may impact their future work environment.

The DLC is conducting pilot projects to ensure that this end product includes everything needed to maximize its usefulness and effectiveness for installers and incentive programs. Additional lighting control projects interested in piloting the DLC's tools during this process are encouraged to email this author.

An array of technology and cost issues currently discourage most small- to medium-sized building decision-makers from embracing the transformative benefits of NLCs. We're confident this new program, rolled out during 2023, will usher in the changes needed to shift that paradigm. **EC&M**

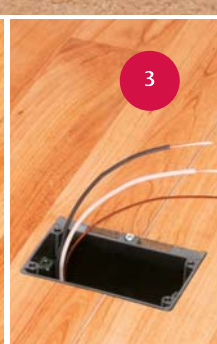
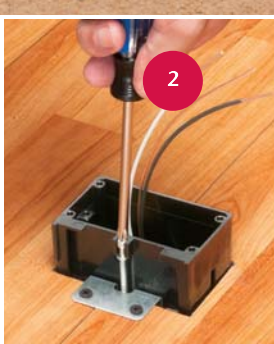
Jason Jeunnette is the DesignLights Consortium's technical manager for building integration and controls. He can be reached at jjeunnette@designlights.org.

FLOOR BOX KITS

FLUSH-TO-THE-FLOOR RECEPTACLE INSTALLATIONS THE EASY WAY!



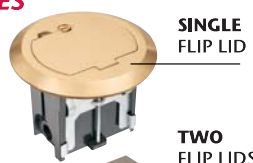
ADJUSTS TO
FINISHED
FLOOR
HEIGHT



Designed for New or Retrofit work, Arlington's UL LISTED ADJUSTABLE FLOOR BOXES fit varying floor heights up to 2".

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

- **Gasketed covers with ONE or TWO FLIP LIDS** prevent water intrusion and protect the box when not in use
- **Non-Metallic Covers** Black, brown, light almond and **Metal Covers** in brass and nickel-plated brass.



Arlington[®]

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Wireless occupancy/vacancy sensors ensure lights are off when a space is vacant. They install in minutes to help optimize energy savings and simplify code compliance.

Energy Codes

State of the Union

What changes are likely in store for lighting and controls this year as they relate to energy code requirements

By Michael Jouaneh, Lutron

National building codes govern residential and commercial construction requirements to protect against substandard living and working conditions. Energy codes are a subset of building codes, designed to promote energy efficiency in construction. There are four major energy codes in North America: ASHRAE 90.1, IECC, Title 24 Part 6, and NECB.

Most U.S. states and jurisdictions use the International Energy Conservation Code (IECC) model energy code as the basis for their local or state energy code — the majority of the rest follow the ASHRAE 90.1 Standard. Of the jurisdictions that use these codes, most simply adopt the IECC or 90.1 without modifications. ASHRAE 90.1 covers commercial buildings and residential structures four stories and higher. IECC and Title 24 Part 6 cover commercial buildings and all residential buildings. Title 24 Part 6 is exclusive to California, while most provinces in Canada use the National Energy Code for Buildings (NECB) as the basis for their local energy code.

CODE UPDATES

Codes are updated frequently (typically every three years) as new technologies, products, and strategies lead to greater opportunities for energy efficiency. According to the

NO TOOLS! • EASY CABLE INSERTION

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SNAP²IT[®] 90° CONNECTORS

WITH and WITHOUT INSULATED THROAT



SAVE 1 MINUTE
per connector

...over 90°
2-screw MC connectors!



AT THE SAME COST PER CONNECTOR!

4010900AST

38900AST

40900ST

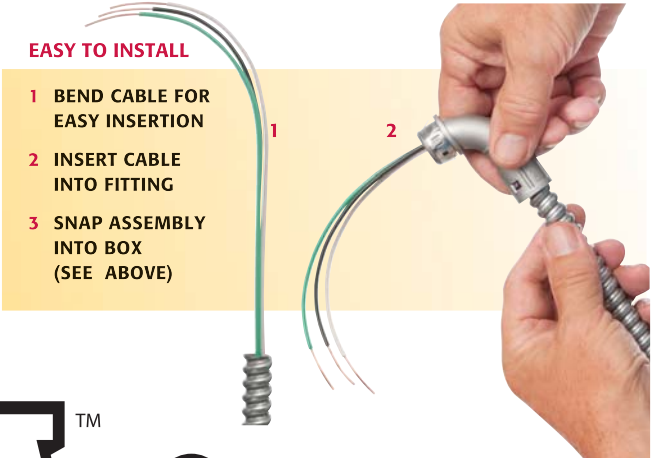
- Easy snap-in cable installation...SAVES A MINUTE each over 2-screw 90° styles
- Handles widest range & variety of cables: 14/2 to 10/2 AC, MC, HCF, MC continuous corrugated aluminum cable, MCI-A cables (steel and aluminum), AC90 and ACG90
- Fast, super-secure installation...No pullout
- Easy to remove from box...reusable

90° SNAP2IT[®] CABLE RANGES

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

EASY TO INSTALL

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



with and without insulated throat



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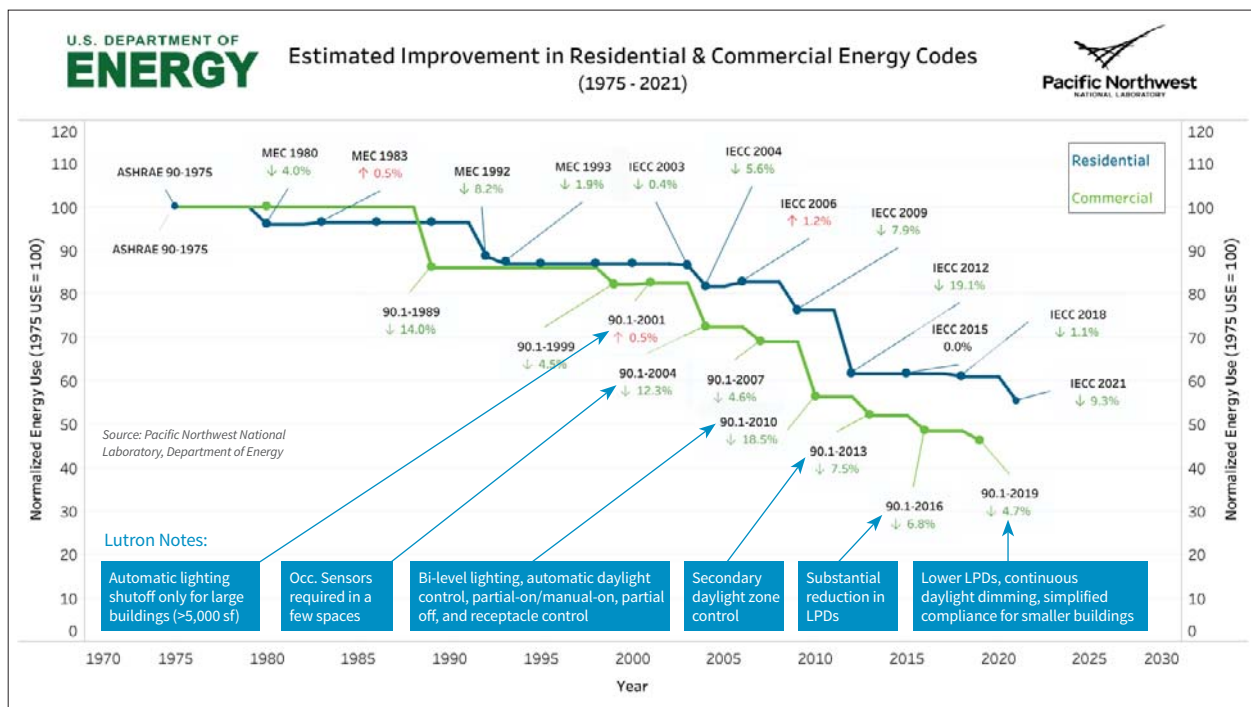


Figure. This graphic outlines the estimated national average energy use reduction in model energy codes from 1975 to the present. Green down arrows indicates a more efficient code while red up arrows indicate lost efficiency from code to code. The data presented in this graph is based on total building energy use. Blue notes were added by Lutron to show key lighting and lighting control requirements that contributed to the increased energy efficiency.

Department of Energy (DOE), a building designed to the minimum requirement of ASHRAE 90.1-2022 will be about 5% more energy efficient than one designed to 90.1-2016 (see the **Figure** above).

The **Table** (right) highlights the most current, published versions of each energy code. There is a lag between when a new version is published and when it is adopted by the states or local jurisdictions. For instance, many states are still moving to IECC 2021; some are still using IECC 2015 and moving to IECC 2018. Local jurisdictions (e.g., New York, N.Y. and Seattle, Wash.) can modify the state energy code to be more progressive and energy efficient than the state requires.

Title 24 is typically seen as the most progressive energy code in terms of promoting energy efficiency and often acts as a bellwether of where other codes might go. Title 24 has changes in 2023; some of the biggest in the commercial lighting arena include:

- Demand-responsive lighting — Buildings using more than 4,000W of total lighting power in spaces that

Energy Code	Latest Version
IECC	2021
ASHRAE 90.1	2022
Title 24 Part 6	2022 (effective for construction permits submitted on or after Jan 1, 2023)
NECB	2020

Table. A listing of the most recent published versions of four key energy codes.

have more than 0.5W/ft² must have a demand-responsive lighting control system that can reduce lighting load by at least 15% when their utility sends a demand response signal.

- Open office lighting — In zones of 600 ft² or less, lighting must be partially off (or fully off) when the zone is vacant.

FUTURE CODE REQUIREMENTS

What's on the horizon? Here are some of the likely future provisions to anticipate as well. Consult your local code for current requirements.

For lighting:

1. More codes are likely to follow Title 24's lead, adding requirements for demand-responsive lighting.

2. More automatic, daylight responsive control in spaces with windows and/or skylights as the wattage threshold before the automatic daylight control is required will be lowered (e.g., 90.1-2022 lowered the wattage threshold to 75W [from 150W] of lighting power in all daylight zones in a space before daylight responsive control is required).

3. Continuous daylight dimming will likely be mandated for spaces that must use daylight-responsive control. Previously, projects could comply with stepped daylight switching, which was disruptive to occupants and saved less energy than continuous daylight dimming.

4. Dimmers will likely be required for certain spaces.



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Made in USA

CABLE WAY™

CABLE SUPPORT SYSTEM FOR NEW WORK OR RETROFIT

Listed as
Cable Runway
Support System



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

System components get the job done quickly and easily.

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

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

Angles and Tees make turning corners a breeze.

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

FLAT SURFACE
SUPPORT BRACKET
T23F



WALL MOUNT
SUPPORT BRACKET
T23W



SUPPORT BRACKET
T23H OPEN



T23H CLOSED



Product info
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GALVANIZED STEEL

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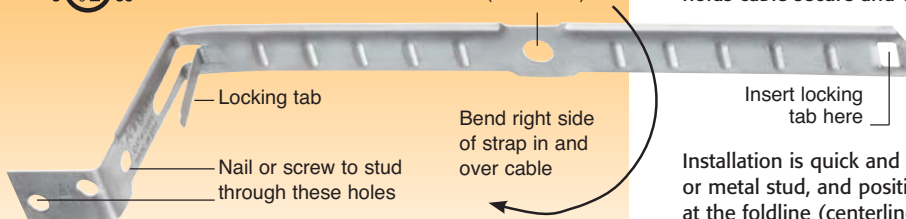
CABLE SUPPORT

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



Nail or screw on **CUS6**

Foldline
(centerline)



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

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

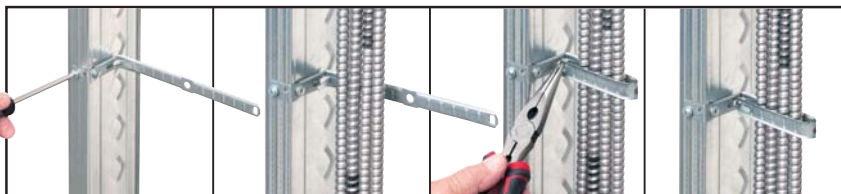
Installation is quick and easy. Nail or screw **CUS6** to a wood or metal stud, and position the cables. Next bend the strap at the foldline (centerline). Fold the strap over the cables and insert the locking tab in the opening as shown to hold them securely in place.

- Complies with 2020 NEC, article 300.4(D)

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



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

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Product info aifittings.com/landing/cus6/





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EC&M[®]



Electrical contractors who install residential, commercial, and industrial lighting and control systems must keep up with changing energy code requirements, such as Title 24.

When you look at energy code trends, expect a continued focus on lighting control. Since LEDs are already so efficient, it is getting harder to reduce lighting power allowances without negatively affecting the occupant's visual acuity. As a result, enhanced lighting control requirements may be needed instead of lower lighting power. Outside of lighting updates, future code changes will likely incorporate renewable energy and electric vehicle charging/parking requirements as well as requirements for buildings to accommodate energy storage (space for batteries).

We also expect changes to required additional energy efficiency measures that go beyond mandatory requirements. These will likely manifest as a point-based requirement for all projects. For instance, projects will have to achieve a certain number of additional energy efficiency measures to get the required number of points for their climate zone. This is in 90.1-2022 and likely will be in IECC 2024. Rather than dictate a specific

strategy, projects will have a list of above-code energy efficiency measures to choose from and they must achieve some of them to meet the requirement.

- For lighting, there will likely be credits (points) for high-end trim of lighting, more occupancy sensor control, and lower lighting power allowances.
- Outside of lighting, there will likely be energy credits for automated window shading, increased HVAC efficiency, and building envelope performance. **EC&M**

Michael Jouaneh is the manager of sustainability and energy standards for Lutron. He chairs the commercial Power, Lighting, and Renewables subcommittee for the 2024 International Energy Conservation Code (IECC). He is a vice chair of the ASHRAE 189.1 Standard for High-Performance Green Buildings committee. He is active with many standards-development organizations, including the California Energy Commission, National Electrical Manufacturers Association, and Illuminating Engineering Society.

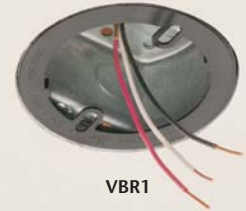
PREVENT AIR INFILTRATION

AROUND STEEL AND PLASTIC BOXES

NEW
Multi-Gang
and Round



Round or Octagonal ceiling boxes



VBR1

Single and Multi gang boxes



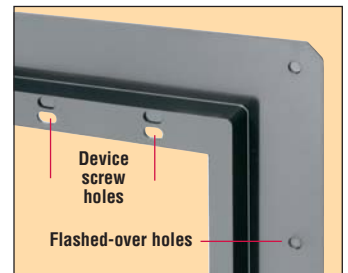
VB2

For help
Obtaining
ENERGY STAR
rating

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

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

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



Arlington[®]



VB1



VB2



VB3

for single-gang round or octagonal boxes



VBR1

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Focus on Lighting & Control

Fixture Mount Sensors

The company has expanded its integrated in-fixture control offerings with its smart fixture mount sensors (FMSs) for high-bay applications. These in-fixture controls are engineered to install directly into high-bay and low-bay luminaires to provide an integrated occupancy sensing, dimming, daylight harvesting, and scheduling solution to meet energy code requirements. The IP 66-rated sensors are available in two mounting options (internal, external, or end-mount) and are designed for use with switching or 0V-10V dimming drivers. Both internal and external mount options are available in 120VAC-277VAC and universal 120VAC-347VAC for single-pole applications and 208VAC-480VAC for 2-pole applications. The sensors use PIR detection and advanced optics to provide field-of-view. All smart fixture mount sensors come with a low-mid bay lens for mounting heights ranging from 8 ft to 20 ft, mid-high bay lens for mounting heights from 20 ft to 40 ft, and aisleway masks for both lenses.

Leviton



Linear System

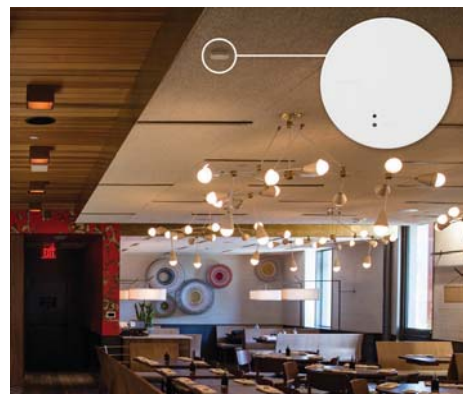
The linear lighting system (LLS) is a universal system for all linear applications. With the product, customers can create the design they want for cove, perimeter, recessed, surface, or suspended applications, with multi-color tuning and a variety of field-adjustable capabilities. The system's flexibility in the field is made possible through continuous illuminated expansion modules that telescope to fit custom lengths down to 1 in. and require no field cutting of aluminum. And with options for standard 90°, custom fixed angles, or adjustable corners up to 330°, installers can adapt the product on-site to create squares, rectangles, and custom shapes. Inside and outside corners are also fully lit for uniform continuous light. The LLS features a frosted acrylic diffuser, offering high light transmission of over 85% — available as either regress or snap-on flush mount, delivering up to 750 lm/ft. There is uniform illumination throughout the entire system for consistent light levels and zero dark spots.

LAMAR LED

Wireless Processor

The Athena wireless processor is sized for smaller spaces while also scalable for use in larger projects. With the Athena wireless processor, the company's Athena systems do not require panels and work with a wide range of both wireless and wired devices. The single-device processor combines all the Athena cloud-connected benefits and features, allowing system software, controls, shades, and drivers to communicate wirelessly to the Athena system. Each wireless processor can easily marry third-party luminaires in the same application, layering in any control strategy — occupancy, vacancy, and daylight sensors, as well as touchscreens, keypads, and Pico wireless remotes all in a single control package. In addition to being equipped with all the benefits of the Athena cloud-connected system, the small, wireless processor is unobtrusive and supports a minimalist aesthetic.

Lutron





STEEL BOX WITH BRASS COVER

LISTED
SINGLE GANG

FLOOR BOX KITS

CONVENIENT, FLUSH-TO-THE-FLOOR RECEPTACLE INSTALLATION



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



FLB5331MB
Single gang Kit
w brass cover

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

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

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

Covers also sold separately.



FLB5331MB
Single gang
steel box kit w brass cover



for NEW or existing floors



Product info aifittings.com/landing/flb5331-flb5551-kits

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IN BOX® RECESSED COVER KITS

INSTALLS INSIDE 4.5" CONCRETE BOXES



Plugs stay inside recessed cover



FLBC4560DNL



Slotted in-use cover



FLBC4500

FLOOR BOX FOR NEW CONCRETE



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

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

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

FLBC4560DMB
Brass

FLBC4560DNL
Nickel-plated

Cover blank
Slotted cover

FLBC4560DBR
Brown

...and plastic in FIVE colors.

FLBC4560DGY
Gray

FLBC4560DCA
Caramel

FLBC4560DBL
Black

FLBC4560DLA
Light almond



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

NEW PRODUCT SHOWCASE

Downlights

The X series is a collection of modular 2-in. downlights and 3-in. cylinders with field-changeable trims, modules, and optics. The modules are offered in fixed and adjustable (360° rotation and 35° tilt) and pair with a universal housing, offering a small footprint without sacrificing light output. Lumen outputs range from 750 lm to 1500 lm — comparable performance to 3- and 4-in. downlights in ceilings up to 10 ft, according to the company. The tool-less, field-interchangeable optics include 15°, 25°, 40°, and 60° linear spread distributions. Color temperatures range from 2,700K to 4,000K and include warm dim and tunable white with a 93+ CRI.

DMF Lighting



Track Heads

The company has expanded its MAX track series with a miniature 1,000 lm addition. MAX Mini has all the same features as other MAX track heads and include Cree COB LED technology with TIR optics that can be specified in three beam angles. Constructed of extruded/machined aluminum, the heat-sink and integrated driver housing provide a sleek and modern look, designed to complement any space. These heads are available in dedicated color temperatures (2,700K, 3,000K, 3,500K, or 4,000K) and in two finishes (black or white).

Nora Lighting

Area Luminaire

OpticSwap makes switching optics tool free: Undo two clasps, change out the optic lens, and relatch the clasps. The luminaire retains its weather-resistant IP 65 rating after the lens swap. XFit area luminaires with OpticSwap stocking specials include everything in a single box: luminaire, three optics (Type III, IV, and V), pre-installed mount, dusk-to-dawn photocell, 12V AUX tap for the company's SmartPort sensor, surge protection, and shorting cap. Each luminaire has a pre-installed lens and two alternates. In addition, the company's available SmartPort technology — screw-in motion sensors that can be easily field-installed with no wiring — means that XFit area lights with OpticSwap can take care of multiple needs.

Keystone Technologies



Luminaires

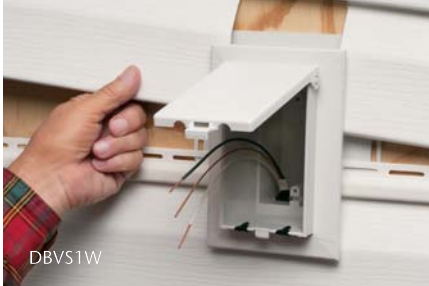
The Pacifica family of round-form luminaires offers sleek minimalist lines and is available in 18- and 24-in. post top luminaires as well as a 12-in. bollard and an arm mount for the larger model. Luminaires and bollards come in five standard and two premium finishes as well as RAL colors. The 12-in. bollard is designed to deliver more than 3,600 lm for walkways and building approaches. Producing up to 17,000 lm, the 18-in. post top unit provides a proportioned appearance at pedestrian scale to optimize sidewalk and pathway illumination. The large 24-in. post-top and pole-mounted luminaires are available from 41W to 221W with lumen packages ranging up to 29,000 lm. All of the luminaires are dark sky friendly and carry a BUG rating of UO.

U.S. Architectural Lighting



IN BOX[®] RECESSED BOX

EXTRA-DUTY, LOW PROFILE COVER



DBVS1W



for New & Existing Vinyl Siding

DBVS1C



for New Brick in brown, white

DHB1BRC



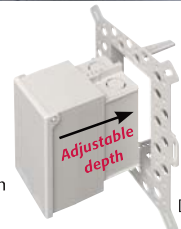
ONE PIECE
FAST, EASY
INSTALLATION
LISTED



for Retrofit Flat Surfaces including brick

DBVR1C

Adjustable Depth fits any foam wall, stone veneer or stucco finish



DBVMA1W



Fixed Flange for 1-1/2" wall systems

DBVME1W



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

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

Cost savings. Time savings. UL Listing. Great Looks. Get it all in Arlington's one-piece IN BOX!

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



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



Arlington[®]

Metal Conduits

Do you know the rules for installing the four types of metal conduit listed in the NEC?

By Mike Holt, NEC Consultant

The NEC Articles covering conduit start with Art. 342 and end with Art. 356. The first four conduits are the metal ones:

- Intermediate metal conduit (IMC) [Art. 342].
- Rigid metal conduit (RMC) [Art. 344] (Fig. 1).
- Flexible metal conduit (Type FMC) [Art. 348].
- Liquidtight flexible metal conduit (Type LFMC) [Art. 350].

INTERMEDIATE AND RIGID

You can use IMC and RMC in all atmospheric conditions and occupancies [Sec. 342.10, Sec. 344.10]. RMC, commonly called “rigid,” has long been the most common raceway for protecting conductors from physical damage. IMC is also used for this purpose.

IMC is a circular metal raceway with the same outside diameter as RMC. IMC has a wall thickness less than that of RMC, so it has more space for conductors. IMC is lighter and less expensive than RMC and is approved for the same applications. The steel alloy used for IMC makes it stronger than RMC even though the walls are thinner.

Where practicable, avoid putting metal raceway in contact with dissimilar metals; galvanic action corrodes the metal [Sec. 342.14, Sec. 344.14].

The minimum trade size is ½-in. for both IMC and RMC. The maximum is trade size 4 for IMC and trade size 6 for RMC [Sec. 342.20, Sec. 344.20].

For complete systems, the number of conductors cannot exceed the percentage fill in Chapter 9, Table 1. Raceways must be large enough to permit the installation and removal of conductors without damaging the insulation [Sec. 342.22 and Sec. 344.22].



Fig. 1. Rigid metal conduit requirements can be found in NEC Art. 344.

Conduit bends can't have kinks [Sec. 342.24, Sec. 344.24]. To comply, use a bender per the manufacturer's instructions. The total bends (including offsets) between pull points cannot exceed 360° [Sec. 342.26, Sec. 344.26].

The rules for securing IMC and RMC are the same [Sec. 342.30, Sec. 344.30]. For example:

- Fasten within 3 ft of each outlet box, junction box, cabinet, conduit body, or other conduit termination.
- Support the raceway at intervals not exceeding 10 ft.
- Straight runs with threaded couplings can be supported per the distances in Table 344.30(B)(2).
- Exposed vertical risers for fixed equipment can be supported at intervals not exceeding 20 ft if the conduit is made up with threaded couplings, firmly supported, and securely fastened

at the top and bottom of the riser. And if no other means of support is available.

Threadless couplings and connectors must be made up tight to maintain an effective ground-fault current path to safely conduct fault current per Sec. 250.4(A)(5), Sec. 250.96(A), and Sec. 300.10 [Sec. 342.42(A), Sec. 344.42(A)]. If buried in masonry or concrete, threadless fittings must be of the concrete-tight type. Fittings installed in wet locations must be listed for use in wet locations to prevent moisture or water from entering or accumulating within the enclosure per Sec. 314.15.

Don't use running threads for the connection of couplings (they are permitted at other locations) [Sec. 342.42(B), Sec. 344.42(B)].

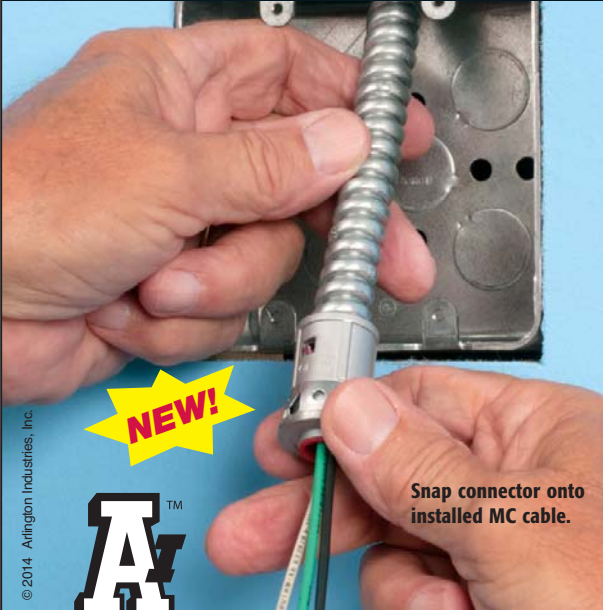
To protect conductors from abrasion, install a metal or plastic bushing on conduit termination threads (regardless of



NO TOOLS • EASY SNAP-IN INSTALLATION • SAVES TIME!

SNAP2IT® CONNECTORS

FOR RETROFIT INSTALLATIONS



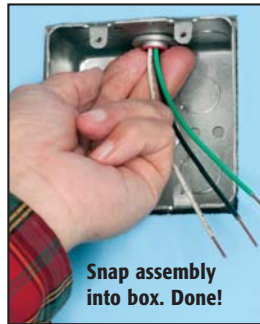
NEW!

Snap connector onto installed MC cable.

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



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



Snap assembly into box. Done!

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

40RAST



38RAST

Patented

Product info aifittings.com/landing/38rast-40rast/



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NON-METALLIC

Made in USA

FIXTURE BOXES for Siding

EASY INSTALLATION

**BOTH
INSTALL
BEFORE
OR AFTER
SIDING**

Arlington's **8141F** and **8081F** boxes deliver the fastest, easiest way to install light fixtures and receptacles on siding. *Good looks. Smooth vertical mounting!*

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

ONE piece
8141F
Fixture Box

TWO piece
8081F
Electrical Box

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Fig. 2. FMC is primarily used where equipment moves or vibrates, although it's not permitted in wet locations.

conductor size) unless the box, fitting, or enclosure already provides this protection [Sec. 342.46, Sec. 344.46].

FLEXIBLE AND LIQUIDTIGHT FLEXIBLE METAL CONDUIT

FMC, commonly called “flex” or “Greenfield” (after its inventor), is an interlocked metal strip type of raceway. It is used primarily where flexibility is necessary or where equipment moves or vibrates. To ensure the longevity of FMC and LMFC, run these in a smooth arc rather than a tight bend or (at the other extreme) a nearly straight run.

LMFC is commonly called “liquid-tight.” It is similar in construction to FMC, but has an outer liquidtight thermoplastic covering. LMFC has the same primary purpose as FMC, but (when used with LMFC fittings and connectors) also provides protection from liquids and from some corrosive effects.

As you might guess, the requirements for FMC and LMFC are similar. One unsurprising difference is you cannot use FMC in wet locations [Sec. 348.10(12)(1)], but that is exactly where you'd use LMFC [Sec. 350.12] (**Fig. 2**).

The one usage restriction on LMFC is you can't use it where subject to physical damage. By contrast, FMC has that restriction and five more (besides wet

locations). For example, you also can't use FMC [Sec. 348.12] in hoistways other than as permitted by 620.21(A)(1), or in battery storage rooms.

FMC and LMFC can be used in exposed or concealed locations [Sec. 348.10, 350.10], but four locations for LMFC are enumerated [Sec. 350.10]. For example, you can use LMFC if flexibility or protection from machine oils, liquids, vapors, or solids is required.

The maximum trade size is 4 for both FMC and LMFC [Sec. 348.20(B), Sec. 350.20(B)]. You can't use FMC or LMFC smaller than ½ in. [Sec. 348.20(A), Sec. 350.20(A)], but you can go as low as ⅜ in. for these applications [Sec. 348.20(A) and Sec. 350.20(A) Exception]:

- (1) For enclosing motor leads.
- (2) Not exceeding 6 ft in length.
 - a. For utilization equipment.
 - b. As part of a listed assembly.
 - c. For luminaire tap connections per Sec. 410.117(C).

The number of conductors in FMC or LMFC can't exceed the percentage fill in Chapter 9, Table 1 [Sec. 348.22, Sec. 350.22]. Raceways must be large enough to permit the installation and removal of conductors without damaging the insulation.

Cables can be installed in FMC or LMFC if the total area of cables does not

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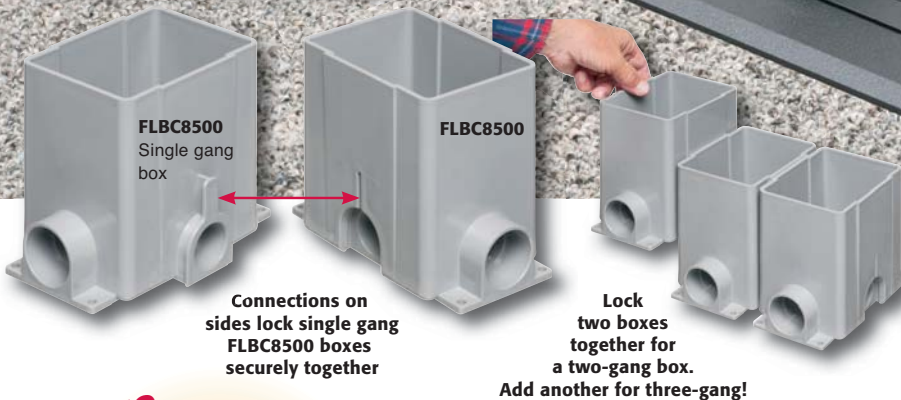
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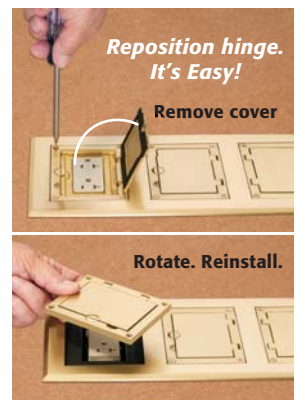
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FLBC8520BL Black
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FLBC8520CA Caramel
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FLBC8530GY Gray
FLBC8530CA Caramel
FLBC8530LA Lt Almond

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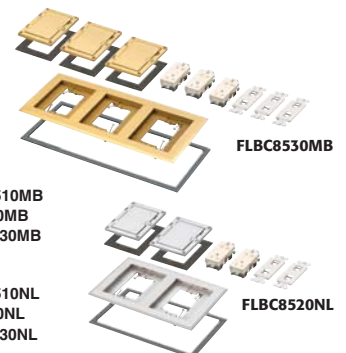
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Three-gang FLBC8530NL



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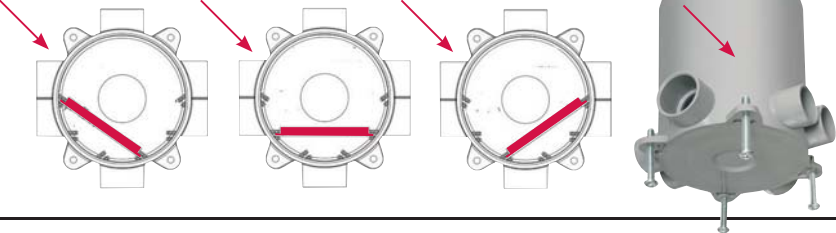
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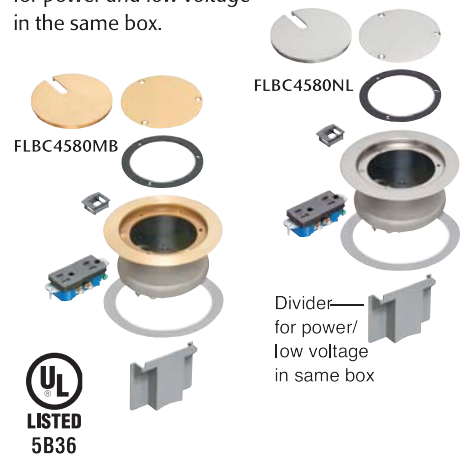
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Patent pending



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exceed the allowable percentage fill in Chapter 9, Table 1 and there's no conflict with the respective cable Article(s).

When bending, ensure the conduit will not be damaged and its internal diameter will not be effectively reduced. The radius of the curve of the inner edge of any field bend cannot be less than shown in Chapter 9, Table 2, using the column "Other Bends" [Sec. 348.24, Sec. 350.24]. The total bends (including offsets) between pull points can't exceed 360° for these flexible conduits [Sec. 348.26, Sec. 350.26].

The cut ends of FMC and LFMC must be trimmed to remove the rough edges [Sec. 348.28, Sec. 350.28], but for FMC this is not necessary if fittings are threaded into the convolutions [Sec. 348.28].

FMC and LFMC must be securely fastened by an approved means within 1 ft of termination and at intervals not exceeding 4½ ft [Sec. 348.30(A), Sec. 350.30(A)].

Exception No. 1: They don't have to be securely fastened or supported where fished between access points through concealed spaces and supporting is impractical.

Exception No. 2: If flexibility is necessary after installation, unsecured lengths from the last point where the raceway is securely fastened can't exceed:

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

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

New with the 2023 NEC is additional text following the four exceptions for LFMC: "For the purposes of these exceptions, listed LFMC fittings are permitted as a means of securement and support." This sentence means using LFMC fittings for securing and supporting applies only to installations made using one of the four exceptions. It does not give permission to use these fittings to secure and support LFMC in all applications.

FMC or LFMC installed horizontally in bored or punched holes in wood or metal framing members, or notches in

wooden members, at intervals not more than 4½ ft is considered supported. But the raceway must be secured within 1 ft of terminations [Sec. 348.30(B) and Sec. 350.30(B)].

EQUIPMENT GROUNDING CONDUCTORS

You can use IMC and RMC as equipment grounding conductors (EGCs) [342.60, 344.60] with no additional requirements. IMC and RMC are excellent EGCs, because the conduit radius greatly exceeds the radius of any conductor you can run inside it (important for high frequency current, which travels in the "skin"). Ensure all connections are mechanically sound and electrically continuous.

There are three EGC rules that apply to FMC or LFMC:

1. If flexibility is necessary (to minimize the transmission of vibration from equipment or because the equipment requires movement) after installation, an EGC of the wire type must be installed with the circuit conductors per Sec. 250.118(5) [Sec. 348.60, Sec. 350.60].

2. If flexibility is not necessary after installation and vibration is not a concern, the metal armor of FMC or LFMC can serve as an EGC if the circuit conductors contained in the raceway are protected by an overcurrent protective device rated 20A or less, and the combined length of the raceway in the same ground-fault return path does not exceed 6 ft [Sec. 250.118(5)].

3. You can install equipment bonding jumpers inside or outside the conduit. If outside, a jumper can't be longer than 6 ft and must be routed with the conduit per Sec. 250.102(E)(2).

PRO TIP

Go beyond mere Code compliance, and pay attention to the aesthetics of the installation. For example, parallel runs of IMC on the same wall should be the same distance apart. Small details of workmanship send a big message about work quality.

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		Min	Max	Min	Max		
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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	
8418	3-1/2"	3.300	3.600	3.031	3.500	750-3, 750-4, 1000-4	

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

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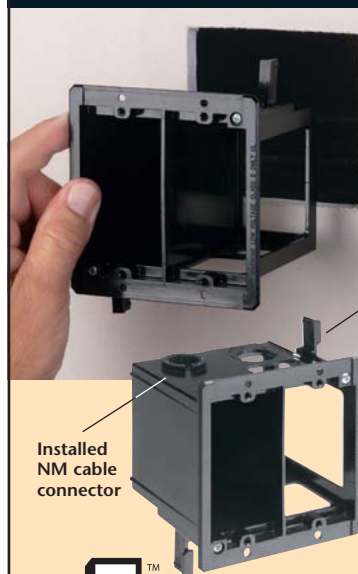


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Stumped by the Code?

By Mike Holt, NEC Consultant

All questions and answers are based on the 2023 NEC.

Q. Does the NEC permit splices, taps, and feed-through conductors in panelboards?

A. Yes, Sec. 312.8(A) permits splices, taps, and feed-through conductors in panelboards.

The wiring space within cabinets for panelboards can be used for conductors feeding through, spliced, or tapped where all the conditions of (1), (2), and (3) are met:

(1) The area of all conductors at any cross section does not exceed 40% of the cross-sectional area of that space (**Fig. 1**).

(2) The area of all conductors, splices, and taps installed at any cross section does not exceed 75% of the cross-sectional area of that space (**Fig. 2**).

Author's Comment: The 40% and 75% requirements apply to all conductors, splices, and taps within the cross-sectional area, not just conductors, splice(s), or tap(s) being added.

(3) The bending space for conductors 4 AWG and larger complies with Sec. 314.28(A)(2).

(4) Where conductors feed through the cabinet, a permanently affixed warning label sufficiently durable to withstand the environment involved — and complying with Sec. 110.21(B) — must be applied on the cabinet to identify the location of the disconnect for the feed-through conductors.

Q. What are the NEC requirements related to cabinets for panelboards associated with repairing gaps in noncombustible surfaces?

A. The requirements related to cabinets for panelboards associated with repairing gaps in noncombustible surfaces are found in Sec. 312.4. Recessed cabinets for panelboards and cutout boxes in

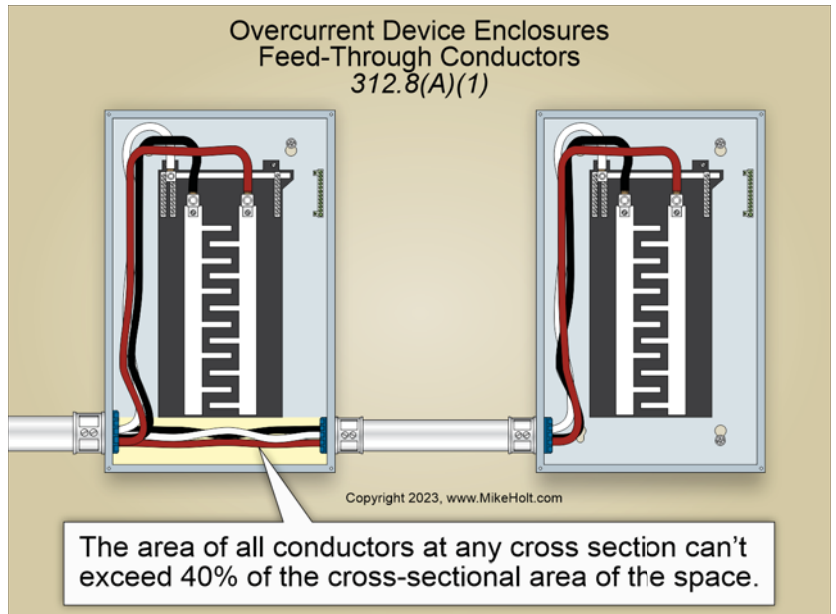


Fig. 1. The wiring space within cabinets for panelboards can be used for feed-through conductors as long as the space they take up doesn't exceed cross-sectional area limitations.



Fig. 2. Splices and taps can be placed in the wiring space within panelboard cabinets as long as the space they take up doesn't exceed cross-sectional area limitations.

noncombustible surfaces (plaster, dry-wall, or plasterboard) must not have a gap of more than 1/8 in. around any edge of the cabinet.

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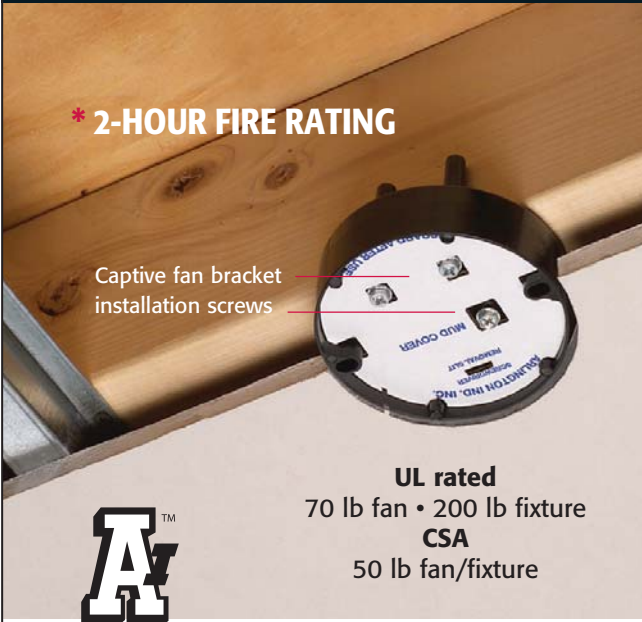


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- 1 Cutaway: Box set back in double drywall
- 2 After ceiling's installed, (if necessary) use the depth adjustment screw to position box flush with ceiling.



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Kitchen Countertop Conundrum

Getting to the bottom of where to install receptacle outlets on the walls at countertop surfaces.

By Russ LeBlanc, NEC Consultant



When it comes to installing receptacle outlets on the walls at countertop surfaces, there seem to be conflicting Code rules. The wall spaces at fixed cabinets having countertops or similar work surfaces, such as the countertops in the kitchen shown in the photo, are not excluded from the wall spaces specified in Sec. 210.52(A)(2). This means that the wall spaces at these cabinets are required to have receptacle outlets installed to satisfy the requirements of Sec. 210.52(A).

At first glance, this may not appear to be a big deal, since there are receptacle outlets installed here to serve the countertop spaces as required by Sec. 210.52(C). However, this is when the conflict arises. Section 210.52(A)(4) specifically states that the “receptacles installed for countertop and similar work surfaces as specified in 210.52(C)

shall not be considered as the receptacle outlets required by 210.52(A).” Section 210.52(C) then reiterates this by stating these receptacle outlets “shall not be considered as the receptacle outlets required by 210.52(A).”

So, where should installers put the receptacle outlets needed to satisfy Sec. 210.52(A) requirements? Section 210.52(A)(3) permits receptacle outlets in or on floors to serve as wall space receptacle outlets if located within 18 in. of the wall. This really won’t work because most base cabinets are deeper than 18 in. Section 210.50(A) permits receptacles on cord pendants, but this would be impractical because the cords would interfere with opening and closing the cabinet doors — and I don’t think many homeowners would like the look of cord pendants hanging in their beautiful kitchens. Installing receptacle outlets

in the cabinets would not be an option either, since Sec. 210.52(3) states that receptacles in cabinets will not be considered “required” receptacle outlets.

What’s an installer to do to solve this conundrum? One simple Code solution would be to delete Sec. 210.52(A)(4) in its entirety and revise Sec. 210.52(C) to permit countertop receptacle outlets to also serve as wall space receptacle outlets too. This makes practical sense, and I actually tend to doubt these requirements are being followed or enforced as specifically written anyways. I believe that installers and inspectors are probably accepting the countertop receptacle outlets as the required wall space receptacle outlets too. I recommend installers have a discussion with their AHJ to discuss a practical way to satisfy the requirements for wall space receptacle outlets and countertop receptacle outlets.



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Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

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

NO ROOM FOR ERROR

Section 440.14 was revised in the 2023 NEC to address installations such as these. The disconnects for each one of these air conditioning units were installed directly behind the unit, leaving almost no room for service personnel to safely work on them. This is now an unquestionable violation of Sec. 440.14. The disconnecting means must meet the working space requirements of Sec. 110.26(A). This means there must be at least 3 ft of depth, 30 in. of width, and 6½ ft of working space height in front of each disconnect to provide personnel some space to troubleshoot, examine, adjust, service, or otherwise maintain this equipment while it is energized. This revision is a great step in promoting a safer working environment. In previous editions of the Code, the requirements of Sec. 110.26(A) may not have always been applied uniformly to air conditioning disconnects. Some installers and inspectors were not requiring the Sec. 110.26(A) working space for disconnects that did not contain overcurrent devices such as fuses or circuit breakers. With the new wording in Sec. 440.14, the type of disconnect installed no longer matters. Hopefully, this revised wording will be easier for installers and inspectors to understand and apply.



BIRD IS THE WORD!



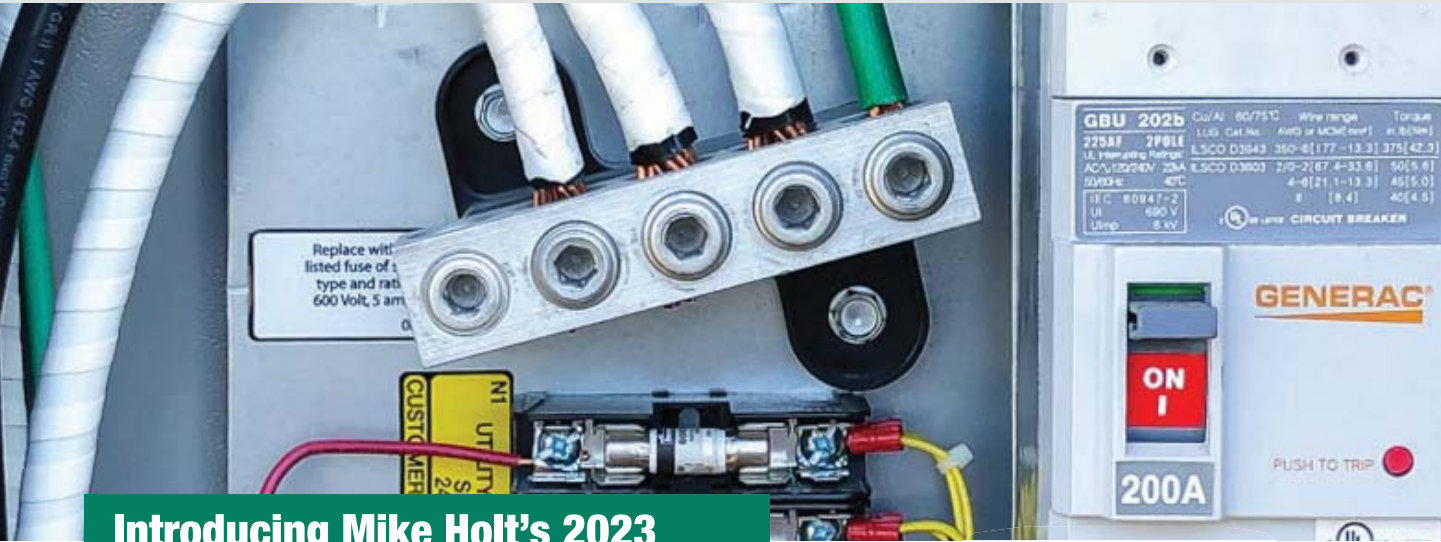
While there may not be any specific Code rules about preventing birds from nesting in a weatherhead, there are plenty of other applicable rules we could discuss. Section 230.54(A) requires service raceways to be equipped with a service head at the point of connection

to overhead service conductors or service drop conductors. The service head (or weatherhead) must be listed for use in wet locations. With the insulator popped out of this weatherhead, rain and snow are much more likely to enter and run down the inside of this raceway

and potentially cause damage to equipment connected to it. Section 230.54(C) requires the service head to be located above the point of attachment of the overhead service conductors or service-drop conductors. This service head is below the point of attachment, and the exception would not be applicable here, as there is no practical reason to have this raceway stop where it did. One other concern is the cracked insulation on the conductors where they exit the service head. Water can now seep into those cracks and flow underneath the conductor insulation as if it was a hose. This can lead to serious damage at the terminals where these conductors are connected. Section 310.10(D) requires insulated conductors exposed to sunlight to be listed as sunlight resistant or covered with a sleeve or tape that is sunlight resistant.



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What's Wrong Here?

By Russ LeBlanc, NEC Consultant

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

Hint: Wet location worries



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

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

FEBRUARY WINNERS

Our winners this month were Kenney Olivey with Franklin Electric in Greensboro, N.C.; Paul Duemmel, an *EC&M* reader from Grove City, Ohio; and Jim Linder, a facilities management consultant from Gem Lake, Minn. They all knew these plumbing pipes violated the requirements in NEC Sec. 110.26(A).

As we have seen in so many of the photos we have published in this column, there seems to be this never-ending battle for that space in front of electrical equipment. Plumbers want it, HVAC installers desire it,



and every other tradesman craves it, too. However, electricians really need it, and nobody wants to give up that space. The battle continues! Section 110.26(A) requires working space to

comply with the dimensions of Sec. 110.26(A)(1)-(4). The working space is to be maintained for electrical equipment likely to be serviced, adjusted, or otherwise maintained while energized. Another all-to-common violation is the dedicated space requirements in Sec. 110.26(E). The space directly above and below service equipment, switchboards, switchgear, panelboards, and motor control centers are considered dedicated spaces as specified in Sec. 110.26(E). Systems foreign to the electrical system are not permitted in this dedicated space.

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LED HIGH BAY LIGHT FH7



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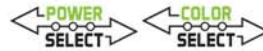
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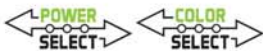


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