

EC&M®

THE TOP 50

*We rank this year's top players
in electrical contracting.
Read more on **pg. 16***

IN THIS ISSUE

**2022's 50 Largest Electrical
Distributors** *pg. 8*

**How to Get the Best Use
Out of a Circuit Tracer** *pg. 14*

**Planning for the Future
of Electric Vehicles** *pg. 48*

**How Well Do You Understand
the CAT Rating System?** *pg. 58*

**Tool Time: New Product
Showcase** *pg. 66*

**Temporary Vs. Permanent
Installations** *pg. 70*

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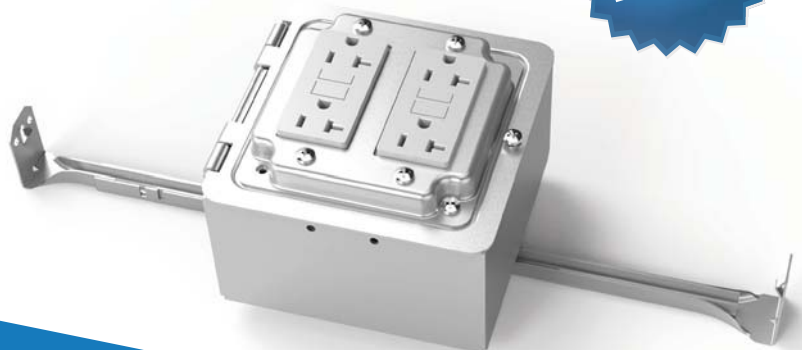
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CONTENTS

COVER STORY

16 Big Year on Paper

This year's Top 50 electrical contractors pulled in an unprecedented revenue gain in 2021 as a collective group, but that masked intense pressure exerted by rising inflation, snarled supply chains, and continued labor supply challenges.



Photo courtesy of E-J Electric

16

OTHER FEATURES

48 Planning for the Future of Electric Vehicles

Essential elements every electrical designer and installer must understand to ensure readiness as the buildout of the national EV charging infrastructure takes shape



48

58 Understanding the CAT Rating System

Selecting the right meter for the job



66

NATIONAL ELECTRICAL CODE

70 Code Basics

Temporary installations

74 Code Quandaries

Stumped by the Code?

76 Illustrated Catastrophes

More Code catastrophes

80 What's Wrong Here?

Can you spot the Code violations?



76



80

EC&M

September 2022 • Volume 121 • Number 9



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DEPARTMENTS

6 Industry Viewpoint

8 Market Watch

2022's 50 largest electrical distributors

14 Basic Training

Circuit tracing best practices

64 Product News

66 New Product Showcase

Focus on tools

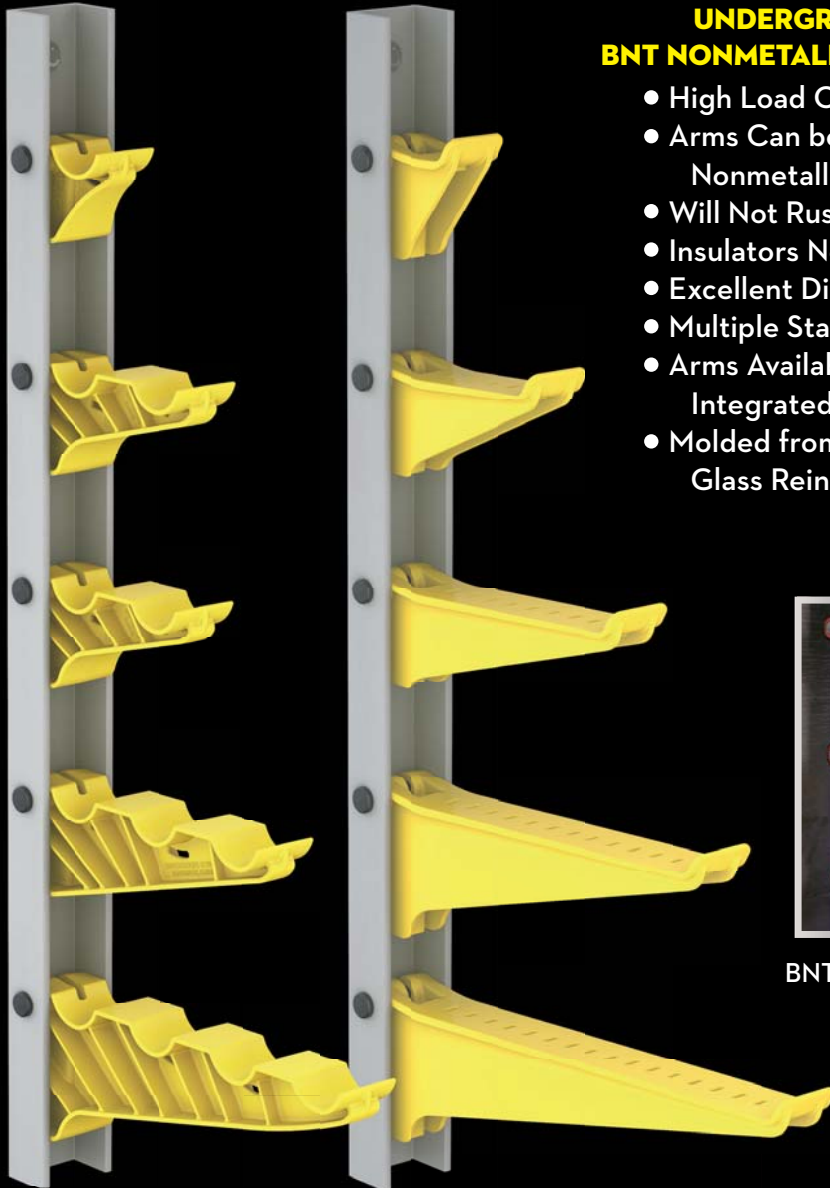
78 Classified

79 Ad Index

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Podcast ▶ In this episode, Editor-in-Chief Ellen Parson sits down with three Top 40 executives. ecmweb.com/21248907



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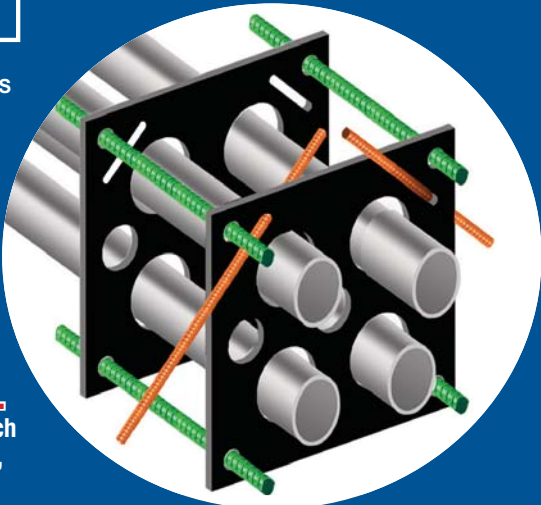
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Riding the Recovery Wave

By Ellen Parson, Editor-in-Chief



Every September, *EC&M* reveals the highly anticipated results of its annual Top 50 Electrical Contractors survey, a benchmark our readers look forward to because it serves as a historical gauge to measure business conditions in the industry. For the last couple of years, as electrical contracting companies have fought their way to survive (and some even figuring out how to thrive) during the pandemic, the economic outlook has been cautiously optimistic at best. In 2020, respondents consistently dropped buzzwords like “trying times” and “unprecedented challenges” to describe the business landscape. One even admitted his firm’s biggest challenge was “learning what the new normal will look like.” In 2021, that mindset shifted slightly to more of a “hang tough” mentality. After studying the 2022 survey results, there’s still one unanswered question in my mind: Is this what the new normal actually looks like? According to this year’s data, Top 50 companies don’t see eye to eye on that point. Nearly half (49%) indicated it would be at least the end of 2022 before “business as usual” comes back. However, as of June when the survey went out, 37% maintained it was already “back to normal.” Collectively, 91% anticipate a revenue shortfall of no more than 10% due to the lingering effects of the pandemic. What’s causing this disconnect? I suspect it’s a matter of how deeply they’ve been affected by factors like rising inflation, supply chain delays, and labor shortages.

Last year in this column, I discussed how a return to normalcy would depend on many circumstances, most of which were outside contractors’ control, including how and when the federal infrastructure bill would pan out, what the new vaccine mandate would mean for contractors doing business with the federal government, and how inflation would affect the market. Fast forward to today — to say a lot has happened is an understatement. The Infrastructure Investment and Jobs Act was signed into law in November 2021 (<https://bit.ly/3B2m8Bo>). This piece of legislation is poised to filter \$1.2 trillion into the market over the next five years (<https://bit.ly/3QIJH8k>), including funds earmarked for the buildout of a national electric vehicle charging station infrastructure, updates to the grid, broadband, and more. Despite this development, 66% of respondents expect no more than a 5% revenue increase in new project revenue tied to these federal funds. Although it initially appeared the government would enforce Executive Order 14042, which required all parties contracting with the federal government to enforce COVID-19 vaccine mandates on their employees, as of early September, the government announced it would no longer take action to implement or enforce this requirement (<https://bit.ly/3d46IVn>). And as for inflation, considering the fact that it hit a 40-year high in June 2022, there are definitely still a lot of unknowns. Although there was a modest slowdown in inflation numbers in July and August — and some analysts believe passage of the Inflation Reduction Act will help — it is yet to be seen how the economy will respond to the Federal Reserve’s key interest rate hikes in an effort to curb inflation.

Despite these obstacles, *EC&M*’s 2022 Top 50 Electrical Contractors pulled in an unprecedented revenue gain (based on numbers from 2021) of more than \$40 billion, up 20% from the \$34 billion posted the previous year and marking the biggest year-over-year jump in at least 15 years. This growth is even more impressive when you consider all of the challenges they overcame to reach this milestone. Survey results revealed factors having the most negative impact on business growth were by far “difficulty finding and retaining quality employees” followed closely by “supply chain problems.” “Delays with material delivery and logistics” also emerged as their greatest obstacle to finishing jobs on time and within budget. They also felt the pain of material price hikes, especially for wire and cable and distribution equipment. Not surprisingly, the ongoing skilled labor shortage continues to be a thorn in electrical contractors’ sides — 81% of Top 50 companies indicated they were experiencing worker shortages in 2022 with “electrician,” “journeyman,” and “electrical foreman” identified as the most difficult positions to fill. Read the full 2022 Top 50 Electrical Contractors special report, written by veteran freelance writer Tom Zind (starting on page 16), for more details on how this year’s top electrical contractors are securing their success in an unpredictable business climate. Last year, I closed this column with this opinion: “I believe the electrical industry’s resilience will continue to shine through even under the most difficult of circumstances. So I believe we’re bound for a rebound.” Based on this year’s revenue performance, I’d say that prediction was right on. This year, I’m reluctant to speculate on what’s to come. As we move forward, I do feel strongly about one thing. Electrical contractors have proven to be an exceptionally resilient group. They’ve done it before; they’ll do it again — even in the face of some of the most difficult circumstances. Until next year.

Ellen Parson

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2022's 50 Largest Electrical Distributors

The largest electrical distributors see opportunities for growth in 2022 despite one of the most challenging economic environments the electrical market has seen in years.

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

After successfully navigating through most of 2021's COVID-induced challenges, the largest electrical distributors in North America are now struggling to overcome historic product price increases, supply chain snafus, and labor shortages in the field (and at their own companies).

From what *Electrical Wholesaling* magazine's editors saw in the survey responses for their annual listing of the largest electrical distributors in the United States and Canada, distributors don't expect long lead times and big-time price increases to subside until 2023. While product availability for many electrical products has improved in recent months, lead times for switchgear and some types of distribution equipment can easily be six months or more, and products loaded with semiconductors (such as industrial controls and LED lighting systems) are still prone to stock-outs.

However, the nation's largest electrical distributors are confident they can overcome these challenges (see **Rankings Table** on page 10). Over the past two years, they found that they could not only adapt to COVID-19 restrictions out in the field and hybrid work strategies at their own businesses, but also grow market share by investing in their businesses and focusing on service basics.

GRABBING MORE MARKET SHARE DESPITE SOME TRICKY ECONOMIC CONDITIONS

Richard Booth, Electrical Division manager for Coburn Supply, Beaumont,



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Texas, anticipates a 20% increase in his company's 2022 revenues. Booth said Coburn's growth over the past year can be attributed to "price increases, increased market share, having inventory when other distributors didn't, and not shutting down during COVID-19, which earned us many new customers in 2020."

Thomas Nelson, corporate communications director, Border States, Fargo, N.D., said inflation had some impact on its 2021 revenue growth, but the company also "identified a number of areas of the business where we grew market share and expanded our share of wallet with key customers." In 2022, he says Border States is experiencing double-digit growth in all key market segments

and that supply chain constraints have been the primary reason any of the segments have lagged.

Julie Kingsley, controller, Electrical Equipment Co., Raleigh, N.C., sees plenty of large projects underway or on the drawing board in her company's market area, including textile plant expansion, utility upgrades, and new facilities in the auto tire, aggregate, and cement plant niches. She said in her response that Electrical Equipment Co.'s bookings outpaced sales because of supply chain issues — and that this trend also holds for 2022. "Calendar year 2021 sales trended approximately 12% higher than 2020 with increases in OEM and MRO spend," she said. "OEM sales and orders accelerated



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MARKET WATCH

50 LARGEST ELECTRICAL DISTRIBUTORS IN NORTH AMERICA

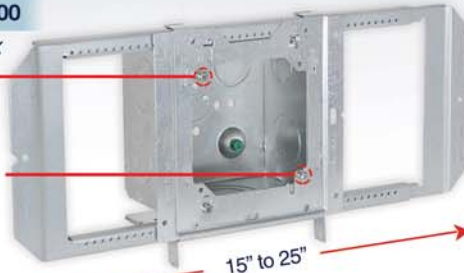
Rank	Company Name	Town/City	State/ Province	2021 Revenue (\$)	Employees	Locations	Senior Executive
1	Wesco International Inc.	Pittsburgh	PA	15,905,053,000*	14,000*	632*	John J. Engel
2	Sonepar North America	Charleston	SC	11,001,900,000	NA	500*	Robert Taylor
3	Graybar Electric Co.	St. Louis	MO	8,800,000,000*	8,800*	300*	Kathleen Mazzarella
4	Consolidated Electrical Distributors (CED)	Irving	TX	NA	NA	700	Kurt Lasher
5	Rexel Holdings (Rexel USA)	Dallas	TX	5,800,013,000*	7,364*	569*	Brad Paulsen
6	Border States	Fargo	ND	2,850,000,000	2,568	101	David White
7	City Electric Supply	Dallas	TX	NA	4,259*	620*	Thomas Hartland Mackie
8	McNaughton McKay Electric Co.	Madison Heights	MI	NA	1,500	53	Donald Slominski Jr.
9	Elliott Electric Supply	Nacogdoches	TX	1,501,000,000	2,400	168	Bill Elliott
10	Crescent Electric Supply Co.	East Dubuque	IL	NA	1,800	140	Scott Teerlinck
11	Mayer Electric Supply Co.##	Birmingham	AL	1,300,000,000	NA	68	Nancy Collat Goedecke
12	U.S. Electrical Services	Middletown	CT	NA	2,000	150	Randy Eddy
13	W.W. Grainger Inc.	Lake Forest	IL	NA	24,200**	348*	Donald Macpherson
14	Kendall Electric Inc.	Portage	MI	NA	1,250	72	John Harman
15	OmniCable (DFH)	West Chester	PA	NA	550	22	Greg Lampert
16	Van Meter Inc.	Cedar Rapids	IA	678,746,000	785	25	Lura McBride
17	Main Electric Supply Co.	Santa Ana	CA	NA	458	14	Scott Germann
18	Turtle & Hughes Inc.	Linden	NJ	572,000,000	600	14	Jayne Millard
19	Dealers Electrical Supply	Waco	TX	NA	632	55	Scott Bracey
20	State Electric Supply Co.	Huntington	WV	NA	650	40	John Spoor
21	Gresco Utility Supply Inc.	Forsyth	GA	490,000,000	230	7	Steve Gramling
22	Scott Electric	Greensburg	PA	NA	610	15	Larry Shirey
23	Wholesale Electric Supply	Texarkana	TX	NA	592	61	Buddy McCulloch
24	Kirby Risk Electrical Supply	Lafayette	IN	NA	535	39	James K. Risk, III
25	Winsupply Inc.	Dayton	OH	NA	NA	75	Richard Schwartz
26	Summit Electric Supply	Albuquerque	NM	NA	559	24	Ed Gerber
27	LoneStar Electric Supply	Houston	TX	405,000,000	309	6	Jeff Metzler
28	Wholesale Electric Supply of Houston	Houston	TX	NA	479	12	Greg Hall
29	Colonial Electrical Supply	King of Prussia	PA	NA	NA	17	Steve Bellwoar
30	Gexpro Services (Lawson Products)	Irving	TX	NA	660	14	Bob Connors
31	Shepherd Electric Supply	Baltimore	MD	349,140,531	311	5	Stuart Vogel
32	Werner Electric Supply Co.	Appleton	WI	NA	455	11	Craig Wiedemeier
33	Echo Group Inc.	Council Bluffs	IA	NA	400	21	Mitch Lane
34	TEC Manufacturing & Distribution Services (Texas Electric Cooperatives)	Georgetown	TX	332,000,000	101	28	Johnny Andrews
35	IEWC	New Berlin	WI	NA	458	8	Mike Veum
36	Gerrie Electric Wholesale Ltd.	Burlington	ON	NA	NA	24	Elaine Gerrie
37	Edges Electrical Group	San Jose	CA	NA	340	12	Chester C. Lehmann III
38	Madison Electric Co.	Warren	MI	NA	NA	7	Brett Schneider
39	Franklin Empire	Mount-Royal	QU	NA	546	23	B. Backman & C. Back- man
40	United Electric Supply	Wilmington	DE	NA	NA	21	George Vorwick
41	Fastenal	Winona	MN	258,468,700*	20,507**	1,649*	Daniel Florness
42	Agilix Solutions	St. Louis	MO	NA	375	13	Mike Stanfill
43	Schaedler Yesco Distribution Inc.	Harrisburg	PA	255,567,116	360	23	Greg Schaedler
44	Standard Electric Co.	Saginaw	MI	NA	300	30	Bill Gray
45	Loeb Electric	Columbus	OH	NA	300	5	Charles Loeb
46	Granite City Electric	Quincy	MA	NA	NA	29	Steve Helle
47	Rural Electric Supply Cooperative (RESCO)	Middleton	WI	238,000,000	73	7	Matt Brandrup
48	PEPCO	Eastlake	OH	230,000,000	175	10	Joe Borkey
49	Villa Lighting Supply	St. Louis	MO	222,500,000	115	2	Jack Villa
50	Dominion Electric Supply	Arlington	VA	NA	NA	11	Steven Krooth

* North America ** Global # Acquired in 2022 ## Acquired in 2021



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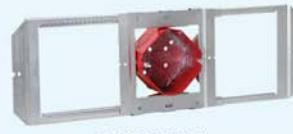
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for Wall Studs & Hard Lid **NEW!**



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throughout the year. Industrial capital spend was limited, but it was a mirror of 2020 results. Utility spend and specifically solar grew in 2021.”

Loeb Electric, Columbus, Ohio, is one of the distributors looking forward to the groundbreaking of Intel’s multi-billion semiconductor manufacturing facility near Columbus. Brandy Seich, Loeb Electric’s senior director of marketing, said data centers, medical center expansion, and other large commercial projects contributed to the company’s 2021 revenues and that Loeb expects a

Larry Swink, president of Jackson Electric Supply, Jacksonville, Fla., says his company has gone from a privately owned, unknown start-up in 2013 to \$54 million in 2021 revenues. He estimates that Jackson Electric Supply is now No. 2 in its local market with a national footprint selling lighting and gear to national retailers/global logistics companies. “Jackson exceeded projections for 2021 and grew from \$25 million to \$54 million year-over-year,” he wrote in his response. “Key investments in new salespeople and an increase in business with existing

DeRosa is forecasting a 20% increase in revenues for 2022, partly from a new General Services Administration (GSA) contract to supply goods to the federal government via the GSA Advantage program. The contract took more than a year to complete. “We already are seeing orders from the USDA, Navy, and other agencies within the federal government,” he said in his survey response.

Warshauer Electric Supply Co., Tinton Falls, N.J., opened a state-of-the-art electrical training facility called “Warshauer Trade” and established a

While few Top 150 respondents have seen federal dollars from Biden’s Infrastructure Investment and Jobs Act for electrical grid modernization flowing freely, utility specialists are still seeing growth.

15% increase in 2022 revenues due in part to “continued positioning as a service leader for our entire customer base.”

No stranger to double-digit annual revenue growth, Jeff Metzler, CEO of Houston’s Lonestar Electric Supply, is expecting 25% growth this year because of inflation and market share. Matt Brnik, executive VP of Schaedler YESCO Distribution Services, Harrisburg, Pa., said his company gained more market share in the construction and commercial markets. The company made major investments in its logistical capabilities, adding 40,000 sq ft to an existing central distribution center; purchasing a larger facility in the Allentown, Pa., market; and purchasing a warehouse in the Pittsburgh metropolitan area to convert into a CDC. Schaedler YESCO is also seeing increased revenues from the branches in Pittston, Pa., and Johnson City, N.Y., which it purchased from Rexel in 2020.

Dean Stier, marketing director of IEWC, New Berlin, Wis., was also very bullish on his company’s growth prospects. “We have much to celebrate,” he said in his response. “A record 2021, a strong start to 2022, our expansion into the telecom market via our recent acquisitions of Cablcon and Jupiter Communications, and our continued expansion of our OEM business in the EMEA (Europe, Middle East, and Africa) and APAC (Asia-Pacific) markets.”

customers combined help the Jackson team reach new levels in 2021, and we are positioned for continued growth in 2022.”

While few Top 150 respondents have seen federal dollars from Biden’s Infrastructure Investments and Jobs Act for electrical grid modernization flowing freely, utility specialists are still seeing growth. Steve Gramling, president/CEO of Gresco Utility Supply, Forsyth, Ga., said fiber-to-home projects added to the company’s 2021 revenue growth, and Rusty Batch, CEO, Tri-State Utility Products Inc., Marietta, Ga., said grid modernization projects are underway in the Southeast.

Several distributors saw growth in 2021 because of concerted efforts to stock up inventories. John Eggleton, Kirby Risk Corp., Lafayette, Ind., said in his response that his company saw sales increase in 2021 due to “less COVID-19 restrictions, increased on-site access vs. competition, pent-up demand, and strong inventory position.” The company also has a new customer relationship management (CRM) and digital transformation strategy, he said.

NEW BUSINESS VENTURES

James DeRosa, general manager for YESCO Electrical Supply Inc., Columbi-ana, Ohio, said the company had a good year because of having products on hand from “enhanced purchasing in 2020.”

Green Energy Division that focuses on all green technologies and energy-saving initiatives. Joe Borkey, president of PEPCO, Eastlake, Ohio, said the company’s new “Audit and Efficiency” effort reviews all processes, procedures, operations, etc., and has led to “paradigm shifts in pricing and service models.” PEPCO also opened locations in Latrobe and Palmyra, Pa.

MERGER MANIA IN THE DISTRIBUTOR WORLD

Mergers and acquisitions have had a huge impact on *EW*’s annual ranking of the industry’s largest distributors. In fact, over the past two years, no less than 18 distributors formerly ranked on the listing have been acquired. There’s no reason not to expect that this wave of M&A activity won’t continue. The 50 largest electrical distributors in *EW*’s ranking have been the most active acquirers, and their acquisitions over the past few years have helped them grab huge chunks of market share. In 2021, the Top 50 accounted for an estimated \$76 billion in combined total sales (63% of the electrical wholesaling industry’s total) and ran at least 6,500 branches. If you want to find out if any of the local distributors in your market are in *EW*’s complete ranking of the 150 largest electrical distributors, go to www.ewweb.com/data-training/top-150. **EC&M**

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Circuit Tracing Best Practices

Tips for getting the best use out of a circuit tracer

By J.C. Tiller, Greenlee

Every electrician has been there: You open a panel, and nothing is marked — or the markings are so outdated, you don't have confidence in their accuracy. In some cases, you might be able to shut off the main breaker and use trial and error to troubleshoot. But what about those times when a total loss of power isn't an option? Health care facilities, hospitals, and data centers are just a few businesses where power shutdowns simply aren't acceptable.

Tracing circuits and locating breakers is the ultimate test of an electrician's patience. You not only need the right tools for tracing, but you also need to trust that those tools will deliver accurate and reliable reads. Using circuit tracing equipment properly and fully understanding what it can do will give you the confidence needed to locate electrical paths throughout a facility when circuit groupings are unclear or some panels can't be found. Here's the process we suggest for getting the most out of your circuit tracers.

GET THE RIGHT TOOL FOR THE JOB

Every circuit tracer has a specific voltage rating, so make sure you know the voltage limit for the brand and model you are using. When using any circuit tracer, it is important to review the instruction manual before operation. There are different features packed into these tools to provide you with the ability to trace circuits, locate breakers, or detect faults in the line, so make sure to become familiar with the features and use instructions first.

Understanding category ratings is also important. You will want to make sure you select tools that meet the International Electrotechnical Commission (IEC) standards for electrical test and measurement equipment to assure the device will help protect you from the risks of shock caused by transient high-voltage spikes in electrical distribution systems. The IEC has established a standard for test and measurement equipment overvoltage protection capacities. These established overvoltage protections can be further divided into categories. Wherever you need overvoltage protection, you should choose at least the minimum category rating appropriate to the type of work you expect to be doing. Categories include:

- **Measurement Category I (CAT I)** — is for measurements performed on low-voltage circuits not directly connected to main circuit breakers.
- **Measurement Category II (CAT II)** — is for measurements performed on fixed or non-fixed local level power devices like household lighting, appliances, or office



Photo courtesy of Greenlee

If an outlet is not available, use alligator clips on your test leads to connect to the conductors.

equipment. Category II equipment may also be used in Category I applications.

- **Measurement Category III (CAT III)** — is for measurements performed at the distribution level on equipment like primary feeders or branch circuits. These circuits are usually separated from Category IV (whether utility service or other high-voltage sources) by a minimum of one level of transformer isolation. Category III may also be used in Category II and Category I applications.

- **Measurement Category IV (CAT IV)** — is for measurements performed at the primary or utility supply level. Category IV may also be used in Category III, Category II, and Category I applications.

Another important consideration is the radial asymmetry (signal sensing) ability of the receiver when tracing live lines. Most circuit tracers receive signals using a single axis sensor, which can make tracing hidden wires more challenging if they are not run in a vertical or horizontal direction — or if there are multiple devices along the wire run. Models are available that use two-axis sensing, omnidirectional sensing, or a rotating user interface (screen). This makes tracing hidden wires easier and also allows the receiver itself to be held in a vertical or horizontal orientation.

SET UP THE TRANSMITTER

This setup is dependent on what you're looking for. If you are tracing conduit, data cable, or coaxial cables, use alligator clips to make a connection, while making sure you have a good ground. If possible, ground the far end of the conductor for better results. For most live breakers or tracing of GFCI-protected circuits, you will simply plug the transmitter into the outlet in question. You can still use proper leads if an outlet is not available.

POWER UP THE RECEIVER

Before powering up, if possible, remove any gloves you're wearing. The hand and body act as a ground plane for the receiver, so this will improve the sensitivity. Confirm that the receiver is picking up a signal from the transmitter. Different units will confirm this signal in different ways.

SELECT YOUR MODE

Most tracer units have both a "search" and "breaker" mode; using both modes can help you pinpoint the line you're looking for. Use "search" to begin your trace because this mode can detect a wider signal range. Then switch to "breaker" mode for a more precise reading. The receiver will block out weaker signals, allowing you to observe small changes in signal strength. This will help you pinpoint the correct breaker, trace circuits

of objects that are very close to the receiver, and determine the exact locations of a break or short in a conductor.

SCAN THE PANEL AND BREAKERS

Once you are on the panel and ready to find the proper breaker, a best practice is to scan the panel and breakers. Start by running the receiver in a counterclockwise manner around the outside board of the panel, then up and down the panel cover. This will locate the correct panel when there are several to choose from.

Pro Tip: Panel trim can distort the signal when locating breakers on the outside corners of the panel. If you think that you are not receiving consistent readings, remove the trim, if possible.

Next, scan each row of breakers from top to bottom. Once you have what you believe to be the correct breaker, make a small counterclockwise rotation around it versus the breakers next to it. The signal strength will confirm you've located the proper breaker for your line.

Circuit tracers are an incredibly useful tool for electricians — helping them trace with confidence. Proper use will help assure that users locate and trace the correct line every time, no matter the situation.

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J.C. Tiller is the North Texas territory manager for Greenlee, a part of Emerson's Professional Tools portfolio. He can be reached at JC.Tiller@Emerson.com.

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BIG YEAR ON PAPER

This year's Top 50 electrical contractors pulled in an unprecedented revenue gain in 2021 as a collective group, but that masked intense pressure exerted by rising inflation, snarled supply chains, and continued labor supply challenges.

It's unlikely that 2021 and its swirling economic winds will be remembered as a home-run year for American industry. But one sector tore the cover off the ball — accounting-wise at least.

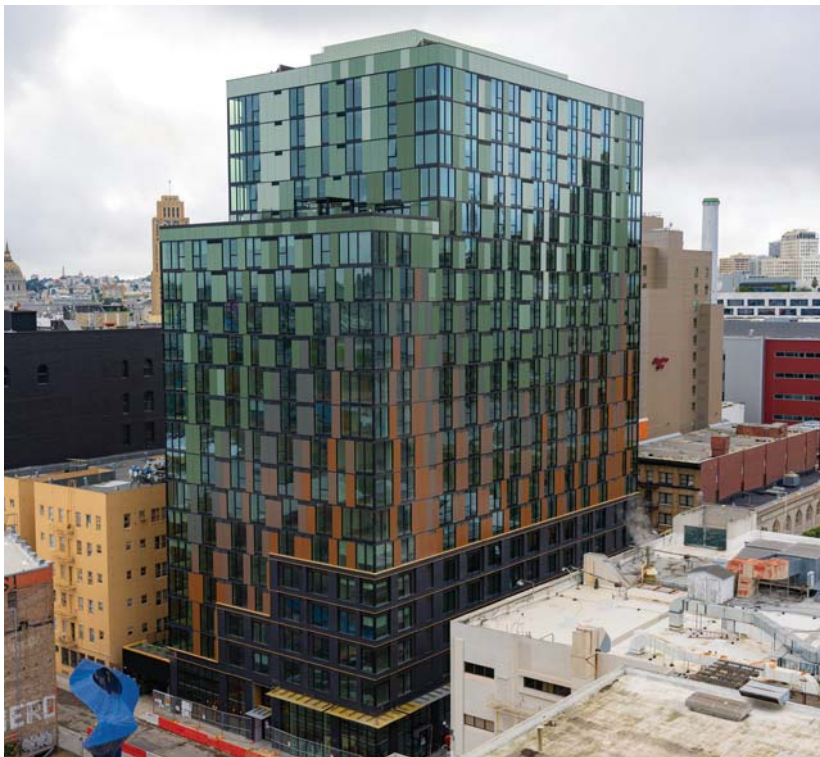
Even as the economy struggled to regain its footing in the wake of the COVID-19 pandemic and inflation, supply chain snarls and labor shortages, companies comprising the 2022 installment of *EC&M's* Top 50 Electrical Contractors reported combined record

revenues of almost \$40 billion for the year (see **Rankings Table** on page 18), a 20% gain over the \$34.1 billion amassed in 2020 by the 2021 Top 50 (see **Historical Trends Chart** on page 20). That eye-popping gain may be partly due to the timing of revenue bookings for firms and even the inflation spike, but its sheer magnitude — easily the biggest year-over-year jump in at least 15 years — suggests that, despite speed bumps, electrical contractors as a group have been busier than ever the last two

years — from the start of the pandemic, through its depths, and beyond.

Whether or not the revenue figure is an accurate barometer of industry health, contractors completing *EC&M's* annual survey of business conditions and trends did indicate that 2021 was at least a better business year than 2020. The overall business climate (**Fig. 1** on page 22) was judged strong by 63%, a big rebound from the 37% of 2021's Top 50 that rated 2020 as strong. Additionally, 43% said they exceeded their revenue goals for the year (**Fig. 2** on page 22) — well up from the 24% last year who said goals were exceeded the prior year. Only nine companies reported 2021 revenues lower than the year before. Companies' bottom lines, however, didn't fare better, generally. Only 10 of 41 firms responding said

Photo courtesy of Cupertino Electric



The George, by Brookfield Properties, is a 302-unit high-rise apartment in the heart of San Francisco. As the electrical contractor, Cupertino Electric installed the electrical and low-voltage systems.



Photo courtesy of Miller Electric

Miller Electric began construction to completely renovate the Vystar Credit Union in 2018 in Jacksonville, Fla., and completed the project in 2021.



Photo courtesy of Guarantee Electrical

One Cardinal Way, a high-rise (at center) outside of Busch Stadium in St. Louis, was recently built with \$10.3-million worth of electrical contracting input from hometown-based Guarantee Electrical Co. The company provided all electrical and low-voltage infrastructure, consisting of three electrical services, a 750kVA back-up generator, three bus duct risers, smart energy-efficient lighting, and power/data to all residential and common spaces.

Photo courtesy of FTI



FTI provided all of the electrical systems as well as critical systems at the Eurofins Food Integrity and Innovation Lab project located in Madison, Wis.

they adjusted their bids for greater profits in 2021 (Fig. 3 on page 22), up from eight of 45 responding last year about their 2020 experience.

Looking back, several Top 50 contractors said 2021 (the calendar year that the 2022 survey is based on) was a period of rebound and reset that brought



Photo courtesy of E-J Electric

E-J Electric performed the electrical work on One Vanderbilt, a 1,401-ft tower that redefines the Manhattan skyline in the heart of East Midtown.

THE TOP 50 ELECTRICAL CONTRACTORS

Ranking		Company	Headquarters	2021 Sales	% change (2020-2021)
2022	2021				
1	1	Quanta Services	Houston	\$9,010,000,000	15.91%
2	NL	MasTec*	Coral Gables, Fla.	\$3,930,000,000	NA
3	2	MYR Group, Inc.	Henderson, Colo.	\$2,499,000,000	11.07%
4	3	Rosendin Electric	San Jose, Calif.	\$2,400,000,000	16.62%
5	4	MDU Construction Services Group, Inc.	Bismarck, N.D.	\$1,751,678,492	0.49%
6	5	Cupertino Electric, Inc.	San Jose, Calif.	\$1,625,000,000	16.89%
7	7	IES Holdings, Inc.	Houston	\$1,418,000,000	31.00%
8	8	M.C. Dean	Tysons, Va.	\$1,251,545,761	21.61%
9	9	ArchKey Solutions	St. Louis	\$1,091,670,000	15.28%
10	11	Power Design, Inc.	St. Petersburg, Fla.	\$840,000,000	10.89%
11	16	MMR Group, Inc.	Baton Rouge, La.	\$768,000,000	26.32%
12	10	Helix Electric, Inc.	San Diego	\$741,500,000	-3.51%
13	12	Faith Technologies, Inc. (FTI)	Menasha, Wis.	\$717,616,355	2.99%
14	14	Cache Valley Electric Co.	Logan, Utah	\$662,300,000	-0.74%
15	15	E-J Electric Installation Co.	Long Island City, N.Y.	\$641,000,000	-1.64%
16	19	Hunt Electric Corp.	Bloomington, Minn.	\$590,000,000	34.09%
17	17	Facility Solutions Group (FSG)	Austin, Texas	\$546,000,000	9.29%
18	21	Miller Electric Co.	Jacksonville, Fla.	\$494,000,295	23.76%
19	24	Hatzel & Buehler, Inc.	Wilmington, Del.	\$493,642,464	31.88%
20	23	The Newtron Group, LLC	Baton Rouge, La.	\$486,000,000	25.58%
21	18	Five Star Electric Corp.	Ozone Park, N.Y.	\$477,100,000	6.44%
22	27	Motor City Electric Co.	Detroit	\$454,498,586	33.13%
23	22	Wayne J. Griffin Electric, Inc.	Holliston, Mass.	\$453,853,000	14.60%
24	20	Redwood Electric Group, Inc.	Santa Clara, Calif.	\$450,000,000	12.50%
25	NL	RES (Renewable Energy Systems)	Broomfield, Colo.	\$433,794,064	NA
26	29	Gaylor Electric	Indianapolis	\$401,000,000	18.02%
27	31	Rogers Electric	Alpharetta, Ga.	\$400,000,000	26.98%
28	NL	EC Company (dba EC Electric)	Portland, Ore.	\$352,500,000	NA
29	25	O'Connell Electric Co., Inc.	Victor, N.Y.	\$348,000,000	-4.40%
30	36	Cleveland Electric Co.	Atlanta	\$339,272,000	41.90%
31	30	VECA Electric & Technologies	Seattle	\$331,000,000	-0.84%
32	33	J.F. Electric	Edwardsville, Ill.	\$308,500,000	12.39%
33	35	Wachter, Inc.	Lenexa, Kan.	\$305,164,419	17.02%
34	NL	CEC	Irving, Texas	\$298,000,000	NA
35	32	Fisk Electric Co.	Houston	\$284,000,000	2.90%
36	NL	Inglett & Stubbs, LLC	Atlanta	\$261,697,000	NA
37	42	Tri City Electric Company of Iowa	Davenport, Iowa	\$259,818,479	29.69%
38	26	Walker Engineering, Inc.	Irving, Texas	\$254,000,000	-27.51%
39	39	Encore Electric	Lakewood, Colo.	\$240,000,000	11.37%
40	37	Interstates, Inc.	Sioux Center, Iowa	\$233,340,449	0.11%
41	NL	Newkirk Electric Associates, Inc.	Muskegon, Mich.	\$222,525,248	NA
42	49	Commonwealth Electric Company of the Midwest	Lincoln, Neb.	\$219,100,000	21.72%
43	43	ERMCO, Inc.	Indianapolis	\$212,000,000	\$6
44	NL	Sargent Electric Company	Pittsburgh	\$207,000,000	NA
45	NL	Van Ert Electric Company, Inc.	Wausau, Wis.	\$206,904,683	NA
46	40	Guarantee Electrical Co.	St. Louis	\$203,000,000	-1.55%
47	41	JMEG, LLC	Farmer's Branch, Texas	\$202,600,000	0.01%
48	48	Amteck, LLC	Lexington, Ky.	\$193,600,000	\$6
49	46	Decker Electric Co., Inc.	San Francisco	\$190,000,000	-0.40%
50	45	Lake Erie Electric Companies	Westlake, Ohio	\$189,600,000	-3.71%

* MasTec acquired Henkels & McCoy Group (which was #6 on last year's list) in December 2021.

NL-not listed. This company did not appear in last year's Top 50 listing.

NA-not available. EC&M did not have access to the electrical and datacom sales figure for 2021.

Combined revenue for the 2022 Top 50 Electrical Contractors (based on 2021 numbers) exceeded \$40 billion.



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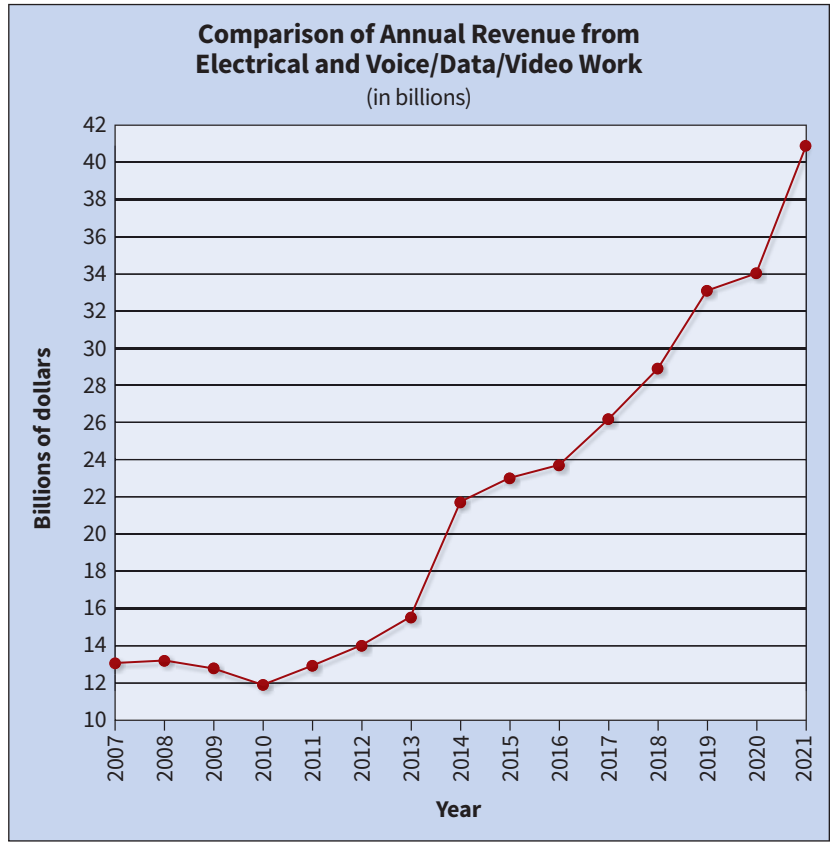
a surprising amount of success. Others described it as another challenging year.

Tom Schott, president and CEO of Cupertino Electric, Inc., (No. 6) San Jose, Calif., says the company's 17% revenue gain was possible because it had multiple avenues for pursuing business.

"We've mostly recovered from the impact of the pandemic," he says. "Our diversified approach to markets we serve — and our national presence — means we were able to rebound quickly and has allowed us to realize real growth and opportunity. Some of our markets were hit harder than others, but our diversified strategy allowed us to weather the storm."

Commonwealth Electric Company of the Midwest (No. 42), Lincoln, Neb., saw its revenues climb 22% in the wake of a disruptive 2020.

"When COVID hit, we saw some significant reaction, mostly in project delays that caused about a 38% drop in some areas like service work and man hours, but that lasted about three months," says Michael Price, chief executive officer. "But our revenues were back up in 2021, due in part to our geographic distribution across the Midwest and South that gives us good risk mitigation."



Despite the lingering effects of the pandemic in 2021, Top 50 companies still managed to exceed last year's revenue total as a collective group, boosted by large numbers from a few key players.



Photo courtesy of MDU Construction Services Group

Capital Electric Construction Company is the prime electrical contractor on the design-build project at Kansas City International Airport. The LEED Gold project scope includes 164,000A/480V redundant services, lighting, lighting control, signage, cellular DAS, and airfield lighting systems. Capital Electric Construction is part of MDU Construction Services Group, Inc.

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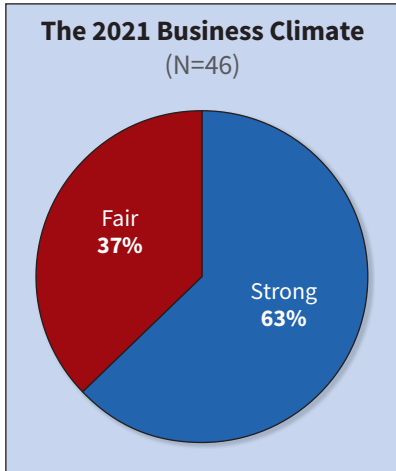


Fig. 1. While the majority of Top 50 respondents (53%) characterized their business climate as “fair” in last year’s survey, the tables changed this year — with 63% of respondents deeming the business climate as “strong” and no companies labeling it as “weak.”

Joel Van Egdome, chief financial officer at Interstates, Inc. (No. 40), Sioux Center, Iowa, says the company’s strong backlog got it through the initial stages of COVID-19 in 2020, but that relative weakness later set in, causing revenue to come in flat for 2021.

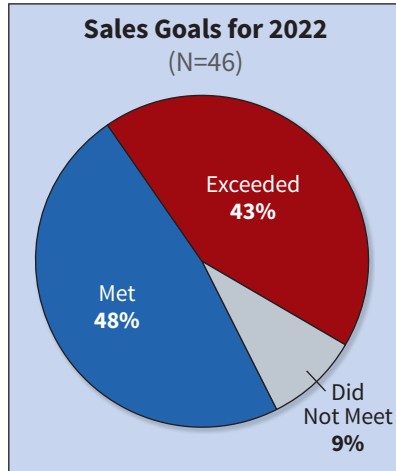


Fig. 2. The number of Top 50 companies that “did not meet” revenue expectations in 2020 rose 19 percentage points from previous year. This year, that number dropped back down to 9%. The number of companies “exceeding” their sales goals also rose 19 percentage points from last year, coming in at 43% this year.

“We thought business would ramp up in the second half last year, but it didn’t happen,” he says. “So, we saw basically no growth year over year. There was increasing competition from other contractors, and we did have to take some

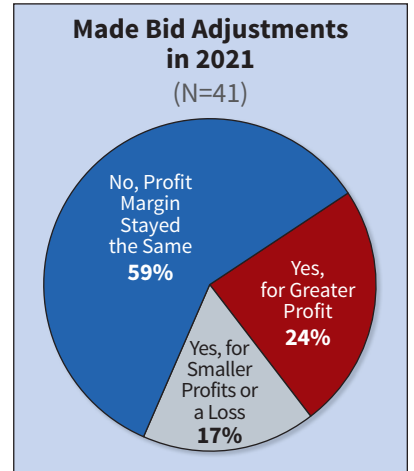


Fig. 3. Similar to last year, the majority of respondents (59% compared to 60% in 2020) expect profits to stay the same.

tighter-margin jobs to secure work — so gross profit was down too.”

INPUT INSANITY

While Top 50 revenues were up, and many firms judged the business climate strong in 2021, there was no shortage of headwinds. After bubbling up in late 2020, severe supply chain problems and material price spikes surfaced in

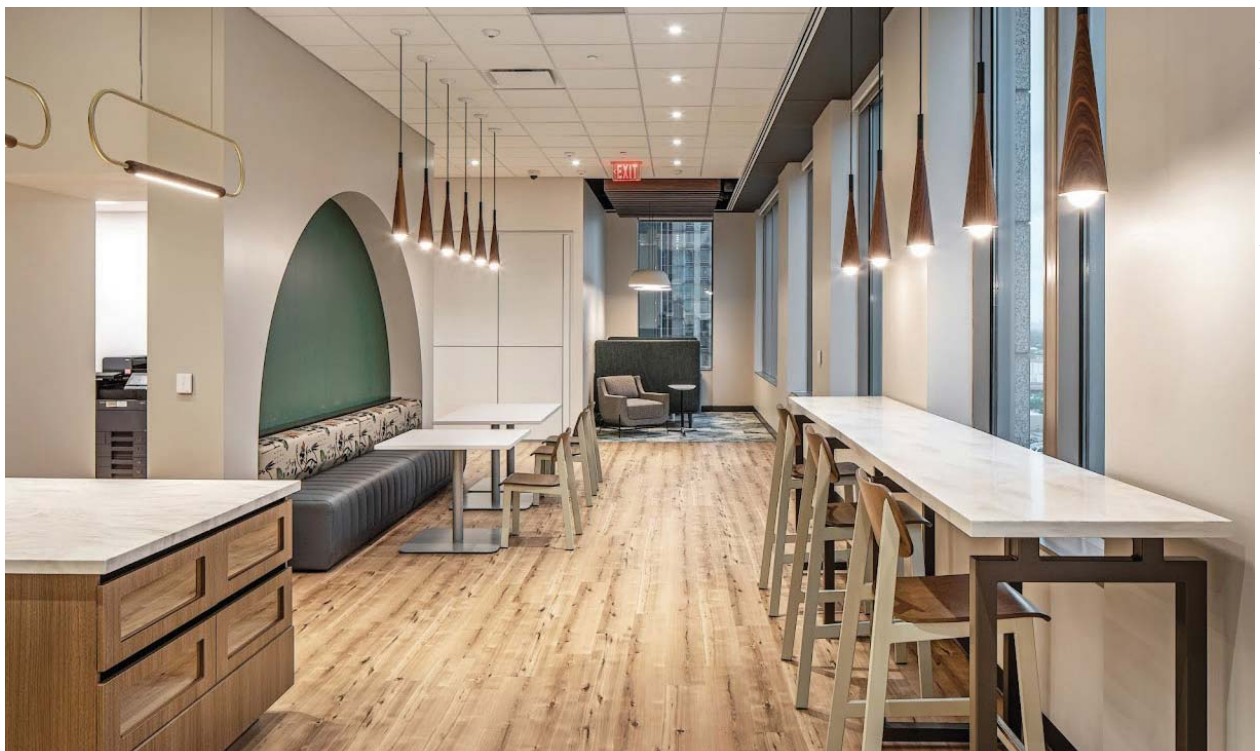


Photo courtesy of Commonwealth Electric

Renovations on the First National Bank of Omaha Tower began in November 2021 and will be completed in 2023. Commonwealth Electric Company of the Midwest performed a floor-by-floor renovation of this 45-story office building.

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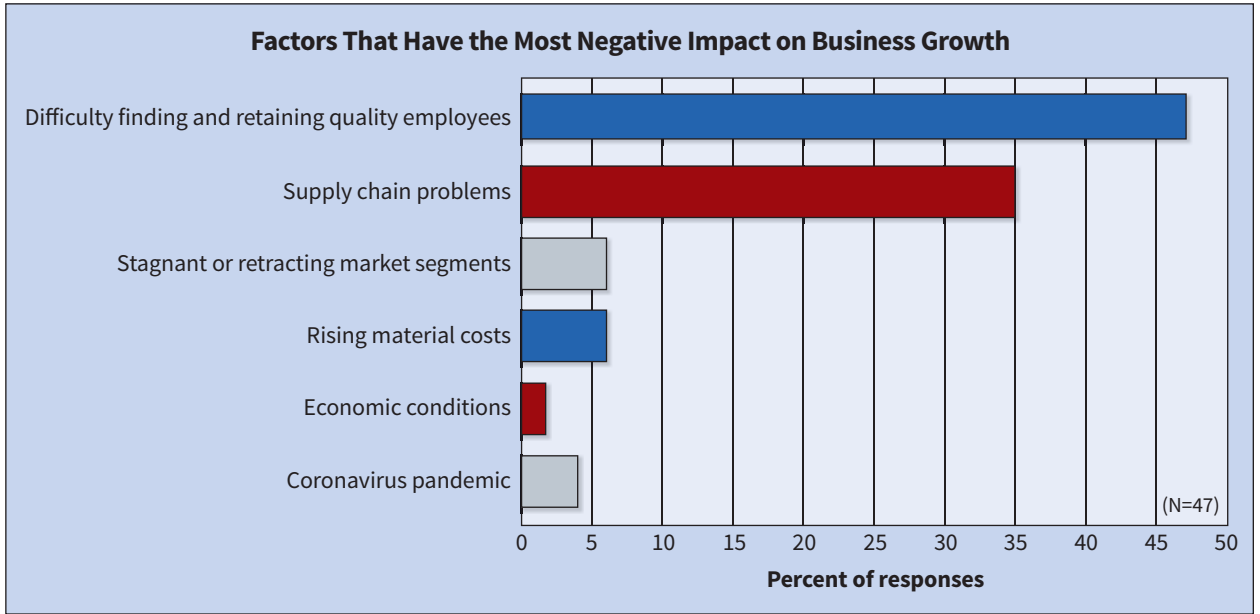


Fig. 4. Difficulty finding and retaining quality employees was the most obvious concern among Top 50 companies again this year followed closely by supply chain issues. If the survey (which went out in mid-June) was conducted now, it's likely rising inflation may have boosted the "economic conditions" response.

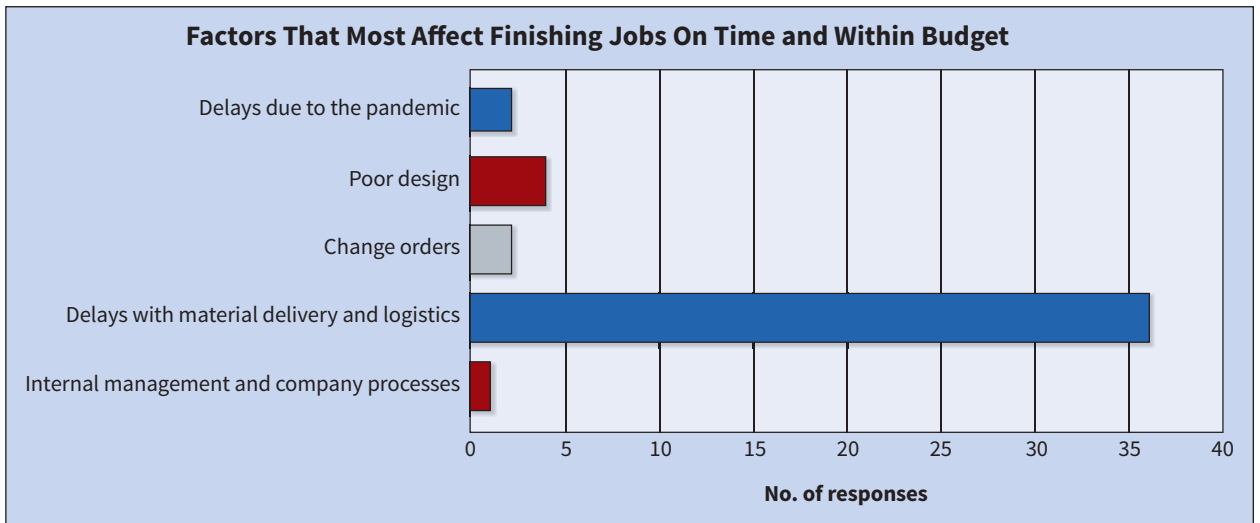


Fig. 5. Far and away, the most pressing issue on Top 50 company's minds (as it relates to their ability to get a job done on time and within budget) is delays with material delivery and logistics.

full force as 2021 progressed, complicating project starts, bidding, and scheduling. On top of that, contractors had to contend with the perennial problem of qualified worker shortages — one magnified by the combination of a surge in construction projects and heavy churn/disruption in the national labor force.

Both sets of problems were deemed major operational concerns by Top 50 contractors. Recruiting and retention of quality employees and supply chain problems ran away with the designation as

Greatest Short-Term Impact of the Pandemic	
Factor	Ranking
Supply chain issues (delays in equipment or material shortages)	1
Delayed projects	2
Canceled projects	3
Failure to meet budget due to decreased revenue	4
Laying off of employees	5
Reduce company benefits, such as 401K match, bonuses, annual salary increases	6

Fig 6. Last year, the No. 1 factor respondents felt had the greatest short-term impact on their companies was "delayed projects." Although still a popular response, "supply chain issues" surpassed it, moving into the top spot.



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Photo courtesy of Cache Valley Electric

Cache Valley Electric was an electrical construction trade partner for the new Utah State Correctional Facility — a 170-acre campus designed to incorporate the latest concepts in correctional facility operations.

factors exerting the most negative impact on business growth (Fig. 4 on page 24). Also, 36 of 43 firms identified delays with materials delivery and logistics as the single biggest factor affecting their ability to finish jobs on time and within budget (Fig. 5 on page 24). Respondents appear to lay the blame for supply chain problems on the pandemic and its strong link to supply and demand imbalances across the economy that have also helped ignite inflation. Supply chain issues got the most mentions (39) as a key short-term byproduct of the pandemic (Fig. 6 on page 24), up from 27 mentions last year, followed closely by delayed projects (32), down from 40 in 2021.

Nick Arb, vice president of market strategy for Guarantee Electrical Co. (No. 46), St. Louis, says unusually volatile materials pricing and widespread supply chain kinks were surprise headaches in 2021 that had to be dealt with creatively.

“That really stressed the importance of having good relations with suppliers and contract partners,” he says. “And it actually played to our strength as design-build contractors because getting in on a project up-front allows owners to procure long lead-time products earlier and mitigate supply chain risks, rather than

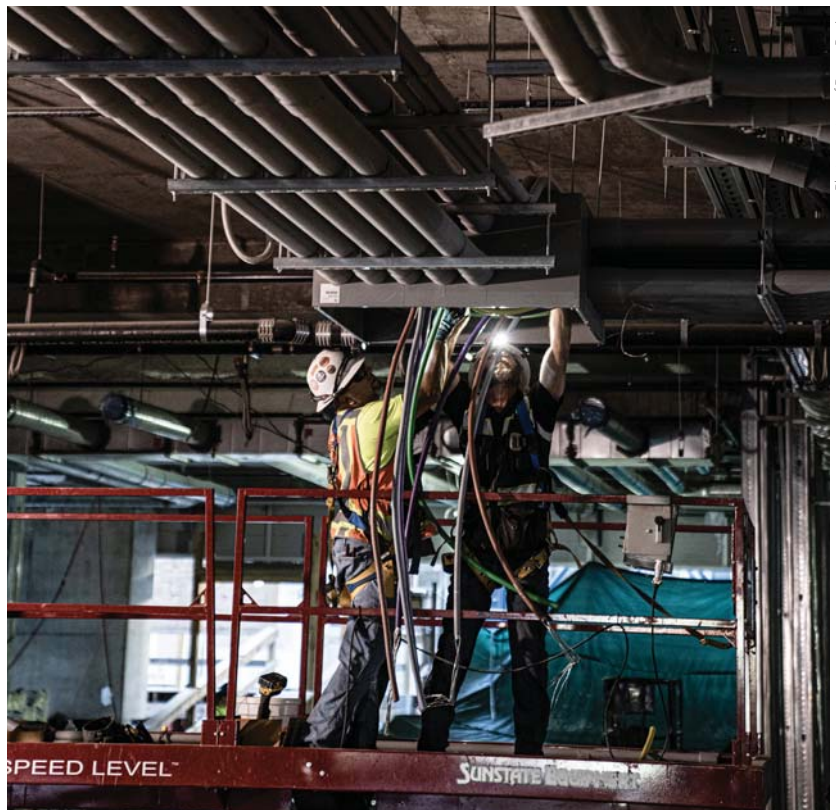


Photo courtesy of Power Design

Soon to be the largest tower in Austin, Texas, this mixed-use high-rise totals 2,193,000 sq ft and features 66 floors and 349 units. Power Design delivered design assist on electrical, as well as construction on fire alarm and DAS, which includes 40 miles of wiring and 6,000 ft of bus duct.



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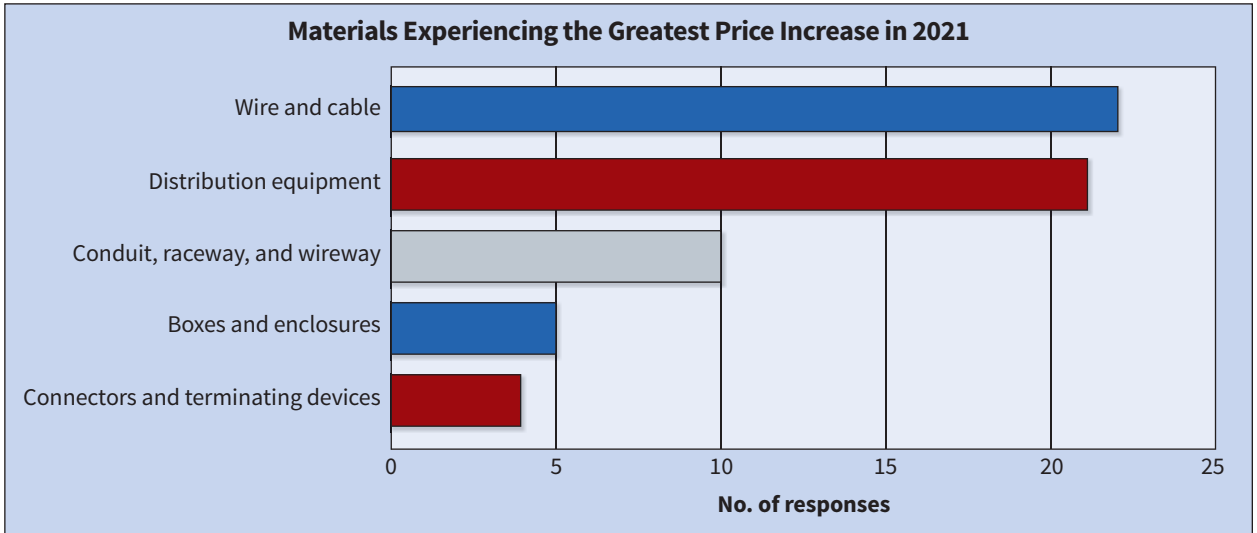


Fig. 7. Unlike last year, in which “wire and cable” ran away with the top spot as the material type experiencing the greatest increase in price, “distribution equipment” came in a very close second this year.

waiting for designs to be complete and then placing orders.”

Contractors also described a 2021 environment where a lack of visibility on costs for materials and labor ate into profits and prompted more careful consideration of project opportunities. Schott said Cupertino’s margins remain “under pressure” from inflation, supply problems, and labor shortages and have made it “extremely important that we make sure we’re choosing the right projects and using discretion.” Atlanta-based Inglett & Stubbs (No. 36) saw its revenues rise but struggled to assemble a stable and reliable workforce from a more demanding labor pool and navigate a difficult materials market.

“With input costs growing, we had to tackle that by managing our margins more closely and pricing more aggressively in some cases,” says Gael Perlot, vice president. “We saw more projects going to the guaranteed maximum pricing format, so we had to add to our staffing on the accounting side.”

Nearly all companies surveyed indicated they faced materials pricing challenges in 2021. Materials cited as showing the biggest price spikes were wire and cable and distribution equipment (Fig. 7), the latter ranking far higher in mentions than in the 2021 survey. A plurality of respondents (48%) put the cost increase for the material they said had gone up the most (Fig. 8) in the 15% to 29% range.

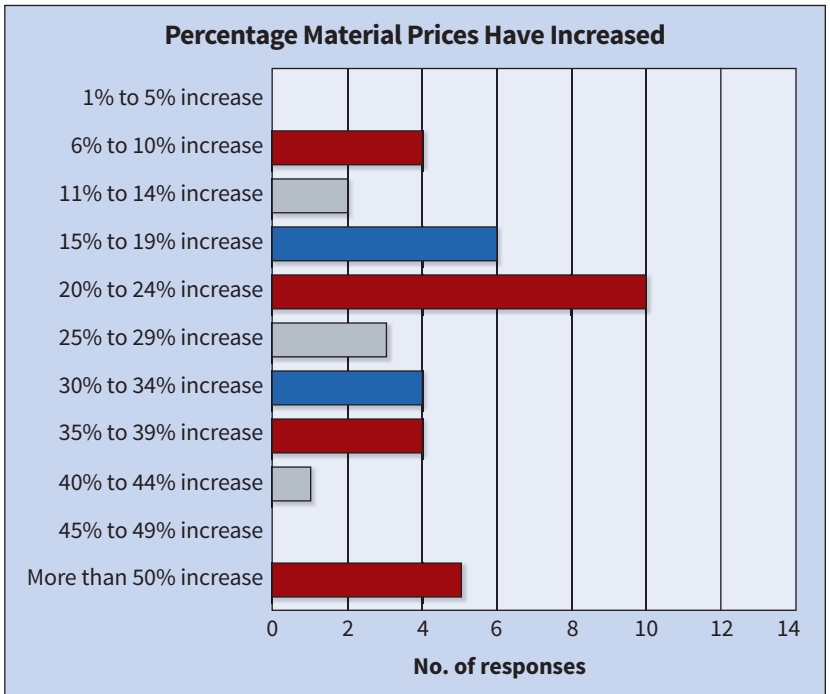


Fig. 8. Last year, nearly 30% of respondents anticipated a 50% or more price hike for construction materials. However, this year projections were more spread out with the greatest number of respondents expecting a 20% to 24% increase.

THE HOT STAY HOT

Those spiraling costs, combined with pricier labor and rising interest rates, made construction more expensive in 2021. That iced some projects, but many others moved ahead regardless, benefitting electrical contractors. For those properly positioned (able to take advantage of economically well-situated

markets capable of absorbing higher construction costs), 2021 was a year to restore revenue streams and pad backlog.

Once again, the action for electrical contractors seemed centered in data centers/mission critical and health care, two markets that close to half of those surveyed included in their list of hot-test markets for 2021 (Table 1 on page

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30). Both markets have been No. 1 or No. 2 on the hottest list for the last several years, while manufacturing placed third for the second consecutive year. As for cold markets (**Table 2**), retail, private office, and hospitality topped the list, closely mirroring last year's ranking and offering further evidence of COVID-19's lingering chilling effect on construction demand in possibly pandemic-scarred sectors.

"The office market has cooled down drastically, and hospitality too," says Anthony Mann, CEO of E-J Electric Installation Co. (No. 15), headquartered in Long Island City, N.Y. "But the warehouse side of retail has been hot — the big distribution centers. And health care, which responded to COVID, is now getting back into a lot of its longer-term projects and driving forward on those. We also see some more opportunities coming in renewable energy and transit and airport work"

Commonwealth Electric, Price says, saw decision makers in some markets finally "flinch" at construction costs, but rode the still-cresting wave in data center and health care work and filled gaps with a pickup in electrical components of growing street projects.

"No one is building office space, and retail is still slow, though we've had

Hottest Market Sectors for 2021
Data Center/Mission Critical
Health Care
Manufacturing
Transportation (tie)
Power (tie)

Table 1. For the sixth year in a row, data center/mission critical construction and health care held their places as the top two markets bringing in the greatest dollar volume of projects in 2021. Manufacturing and transportation also retained their spots. The power market, however, made its debut on the hot list this year.

Coldest Market Sectors for 2021
Retail
Private Office
Hospitality
Sports/Recreation
Education/Institution

Table 2. Given the ongoing effects of the pandemic, it's no surprise that certain markets fared better than others. On the list last year in the fourth spot, retail rose to the top spot, according to this year's responses. The other "cool" markets were all on this list last year; they just shuffled spots.

strong years before in that," he says. "The strong highlight today is mission critical projects. Data center construction seems to be recession-proof."

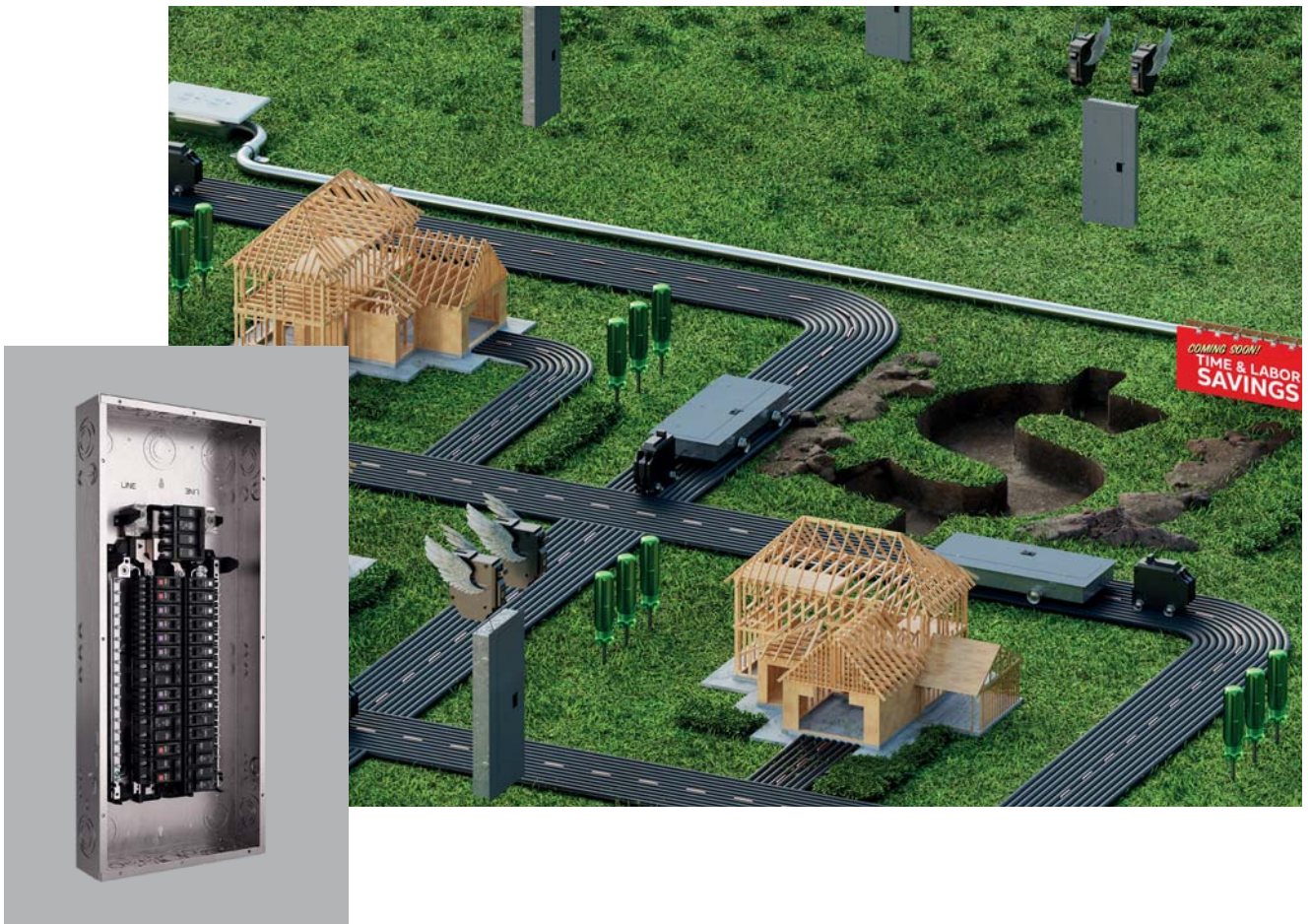
More government work is on Guarantee Electrical's radar as a possible

bulwark against a construction recession. Arb says that work has grown partly because more of its long-time general contractor partners are securing government contracts. More of that work is coalescing in Colorado — Air



Photo courtesy of Harlan Electric

Line workers for the Harlan Electric Company, a subsidiary of MYR Group, Inc., worked closely with Amtrak personnel to construct a 2.5-mile, 115kV circuit running parallel to Amtrak's Springfield (MRS) line southwest of Hartford, Conn. Completed in September 2021, the scope of work on this project included 47 steel structures, eight foundations, 39 caissons, and two transition structures.



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The new Western Spirit Transmission line route originates from the Pajarito Substation in Bernalillo County and ends at the Clines Corner Switchyard in Santa Fe County in New Mexico. Collectively, all four wind farms form the largest single-phase renewable power project in the country, generating electrical power for nearly 600,000 homes.

Force base projects and a NORAD facility recently – prompting the 2021 acquisition of Berwick Electrical in Colorado Springs.

“A larger percentage of our backlog is in federal work; it now stands at about 30%,” he says. “It’s an emerging market for us, while we stay strong in areas like water, health care, and distribution and logistics facilities.”

Looking ahead, the stage could be set for some electrical contractors to seize new and expanded market opportunities by way of the massive infrastructure improvement bill passed by Congress in 2021. Funding transportation, power and water systems, electric vehicles, broadband, and climate change mitigation to the tune of \$1.2 trillion, the act will require the participation of many classes of contractors. For now at least, many Top 50 firms aren’t counting on a big payday from the legislation. Just 7% (Fig. 9) expect to see a significant positive impact on their business, and two-thirds see 2022 revenues tied to the spending amounting to 5% or less (Fig. 10). Contractors best positioned to gain might be those with electric vehicle charging infrastructure, road

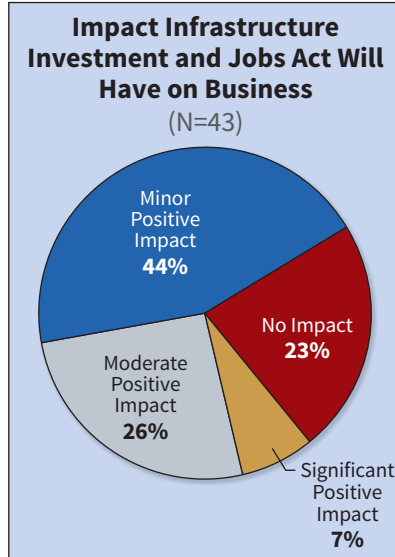


Fig. 9. Not many companies believe the infrastructure plan will have a significant impact on their business; however, 70% anticipate a minor to moderate impact. Almost a quarter of respondents also do not expect any impact on their business from the increased federal spending on infrastructure projects over the next five years.

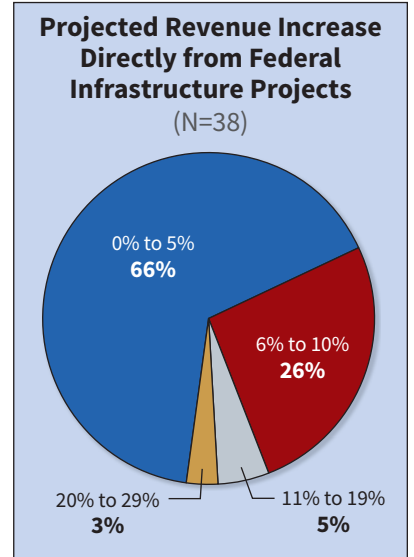


Fig. 10. Almost two-thirds of survey respondents (66%) anticipate no more than a 5% revenue increase in new project revenue tied to federal infrastructure funds. No firms expect to experience a 30% or more boost in project activity from the recent legislation.

Sectors Expected to Experience Biggest Boost from Federal Infrastructure Funds	
Factor	Ranking
Electric vehicle (EV) charging infrastructure	1
Roads and bridges	2
Electric grid updates	3
Renewables (solar and wind)	4
Water/wastewater	5
Broadband/telecom	6 (tie)
Rail, buses, airports, shipping ports	6 (tie)

Fig. 11. Top 50 companies identified several sectors they felt would enjoy the biggest increase in new project activity in 2022 from federal infrastructure dollars. EV charging projects topped the list, followed closely by roads and bridges, electric grid updates, and renewables.

and bridge, and electric grid expertise (Fig. 11) — the three sectors contractors expect to get the biggest boost from the spending.

When it does come, much of that work will likely flow to market specialists, but Schott says established companies with strong performance track records like Cupertino could be positioned to expand their portfolios via the funding push. The company, he says, has slowly leveraged its size, scale,

and ability to execute to push into the public infrastructure market, where markets like water treatment and transportation are ripe for upgrades. That “separates us, and we’ve been positioning ourselves to do more of that work for the last few years.”

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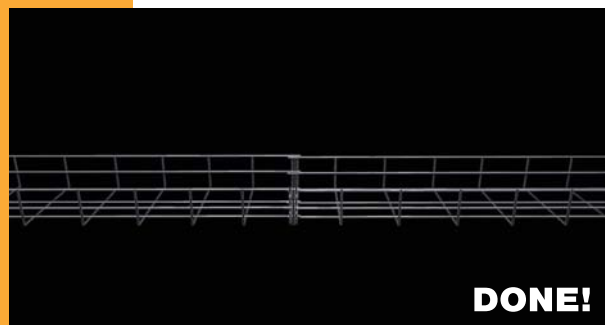
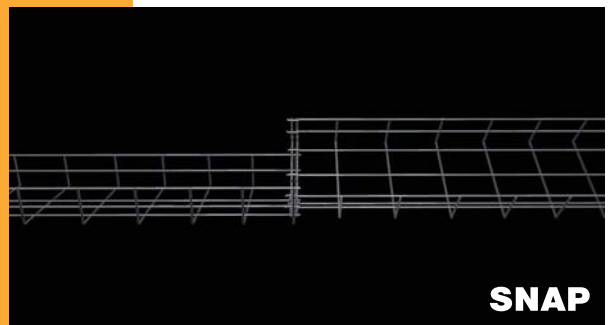
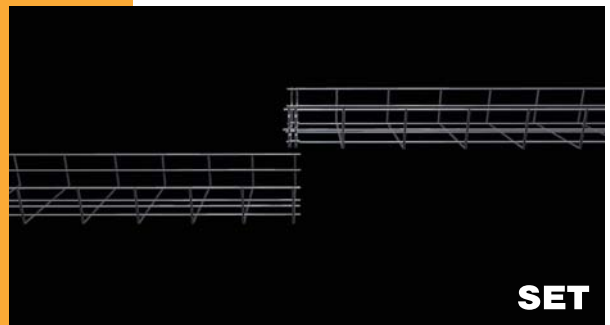
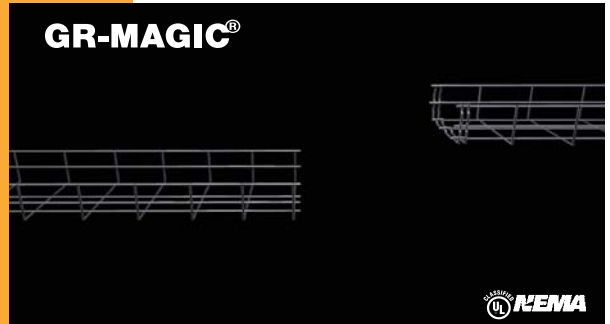
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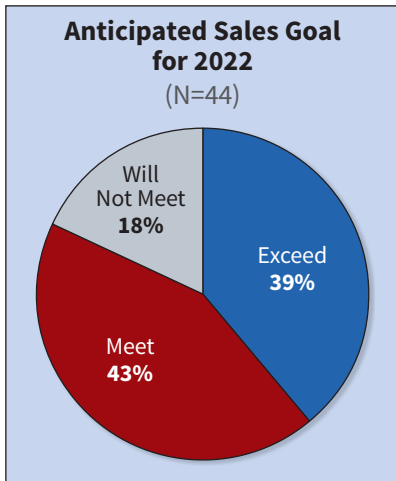


Fig. 12. Although the number of Top 50 companies wanting to make revenue projections for 2022 decreased from last year's survey, those who did answer this question indicated that most respondents expect to meet (43%) or exceed (39%) their sales goals for 2022.

horizon — leading electrical contractors surveyed in late spring largely saw a stronger 2022 taking shape. The percentage anticipating current-year electrical revenue gains over the prior year (Fig. 12) increased slightly from last year, with almost 40% believing they would exceed goals. Almost half expect a revenue increase, similar to last year, with the majority expecting healthy 11%-plus increases (Fig. 13).

Meanwhile, the impact of the pandemic on business seems to be steadily fading. Fewer expect pandemic-related revenue declines greater than 10% in 2022; 91%, however, see lingering effects of up to 10% on revenues (Fig. 14), roughly in line with last year's results. Still, half the companies surveyed seem to say business is not back to pre-pandemic normal just yet, but that "business as usual" will resume early next year. Many (42%) surveyed last year said business was back to normal in late spring 2021. This year, 37% said it was already back to normal (Fig. 15 on page 36), suggesting that some may have been premature in their assessments.

The big sensibility shift, though, was on the profits front. Perhaps anticipating greater visibility on costs, 37% said they'd adjust bids for higher profits in 2022 (Fig. 16 on page 36), up from 16% of last year's Top 50 who said they saw a chance for higher profits coming in 2021.

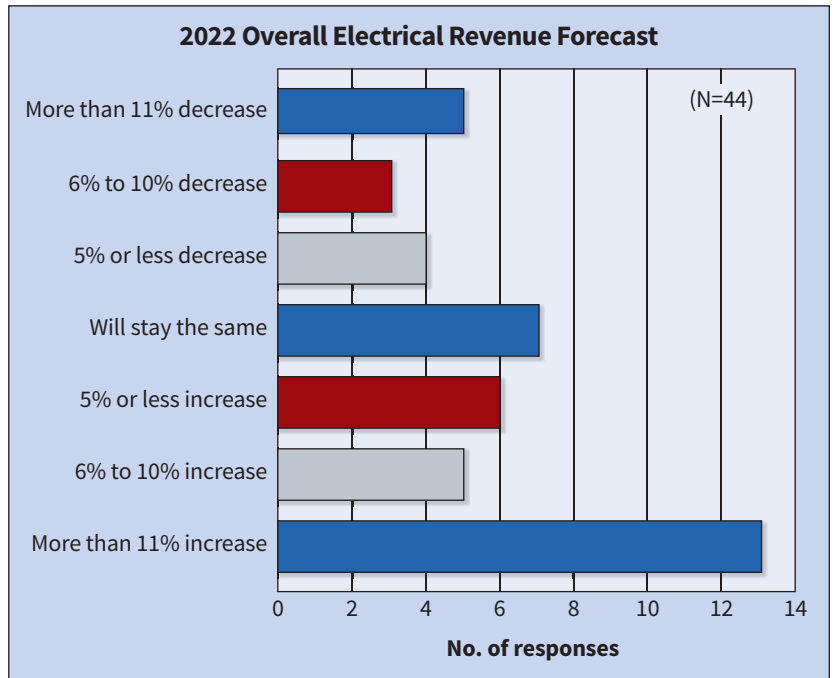


Fig. 13. Last year, 72% of respondents expected their company's revenue to either stay the same or increase. This year, that number remained consistent with a little more than 70% expecting the same or greater revenues.

Margins have taken a hit in early 2022 at Gaylor Electric, Inc. (No. 26), Indianapolis, but President and CEO Chuck Goodrich sees a better second half if stabilizing materials costs allow the firm to bid more confidently.

"We've seen tremendous margin erosion based on the contracts we had in place," he says. "Inflation has killed us, but the good news is that now these higher costs are in contracts so our margins should increase from where we are now."

The company's volume of business seems to be growing as well. From January through June, Goodrich says, backlog goals were exceeded. In July, however, they fell by 6%.

"I'm concerned we could be slowing, but it won't affect us for 2022 revenues," he says. "Next year could be flat."

The economic backdrop also has the attention of Frank Musolino, CEO at Power Design, Inc. (No. 10), St. Petersburg, Fla., but the design-build firm's concentration, expertise, and relationships in the growing multi-family residential sector is a bulwark against an uncertain market outlook. Despite rising construction costs, demand for multi-family and mixed-use residential/commercial construction looks strong and sustainable, he says, provided

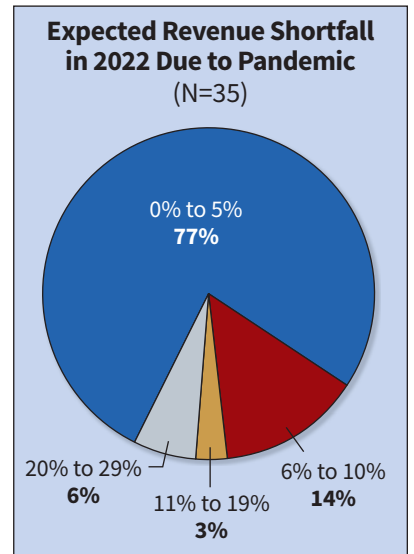


Fig. 14. Last year, 84% of Top 50 companies expected a revenue shortfall of no more than 10% as a result of the pandemic. This year, that number grew to 91%.

the economy stays out of anything but a shallow recession that could lead to higher unemployment.

"The rub will be over the next year," he says. "Can the market continue to bear these rising costs and interest rates? But our backlog is the largest in our history and carries us out two



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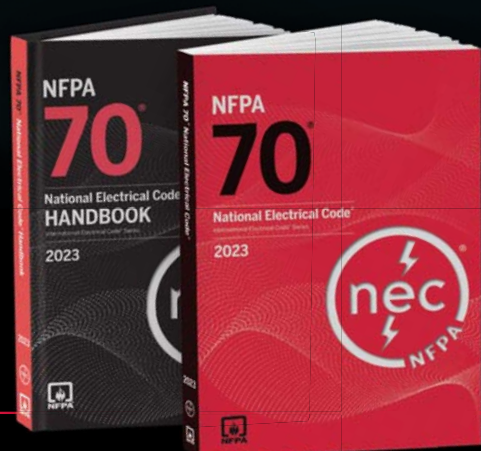
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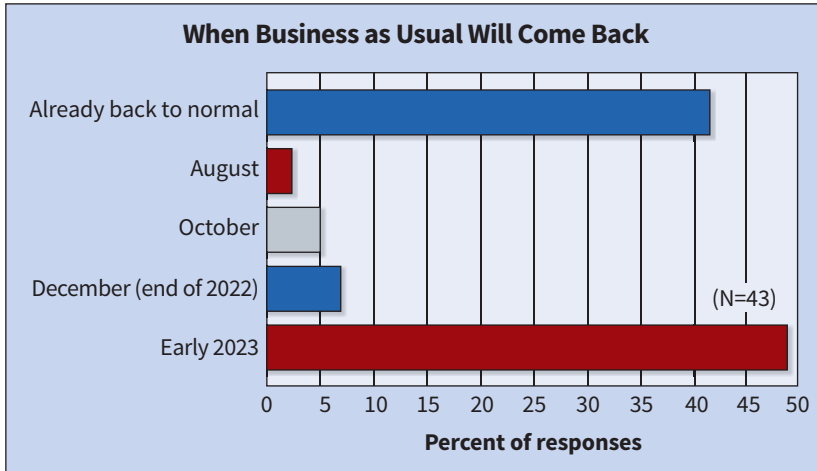


Fig. 15. Last year, the greatest number of respondents (44%) believed the industry wouldn't be back to business as usual, given the circumstances surrounding the pandemic, until early 2022. This year, slightly more (49%) expect it to be end of the year before this happens. On the other hand, 37% felt it was already back to normal.

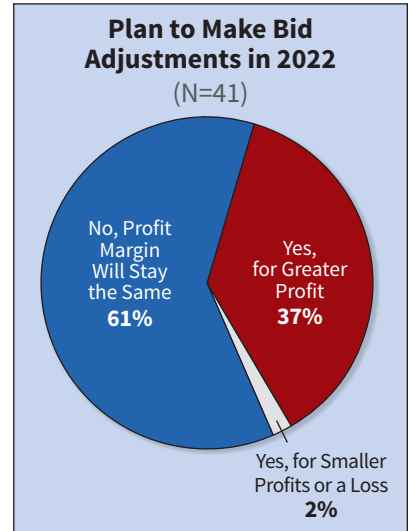


Fig. 16. The number of Top 50 companies expecting profit margins to increase rose 21 percentage points — from 16% last year to 37% this year. Last year, only seven companies projected an increase in profits.

years with bigger and longer projects. The idea now is to grab work while it's good, and make sure we're capitalizing on this boom."

E-J Electric's 2022 business is benefitting from project starts put off during the pandemic and a surge in project awards in late 2021 but is also seeing some owners "holding back because material costs are up 30%," says Mann. The uncertainty is giving the company and its potential clients time to plan and reassess.

"We're sitting down with clients to look into the future, help them project their needs, and get into the queue on materials," he says. "Some health-care clients are bringing us in earlier on because they're aware of lead-time issues and the need to get engineering done faster."

NEW MANPOWER WRINKLE

That will take skilled and professional labor, of course, a commodity that could continue to come at a premium in the current economy. Workers of all types might be in shorter supply due partly to a near unprecedented labor market upheaval, bad timing for an industry that has seen demand accelerate.

After labor demand plummeted due to the pandemic in 2020, most of the Top 50 reported staffing up in 2021 (Fig. 17 on page 38) and the number of firms saying they're short workers ticked up

Photo courtesy of FSG



In Denton, Texas, a prefabricated underground utility service rack was delivered to a hospital expansion project site on the day it was scheduled to be installed by FSG.

Photo courtesy of Interstates



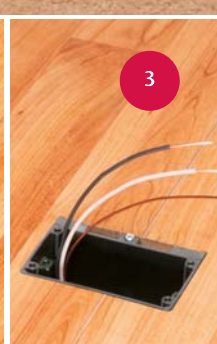
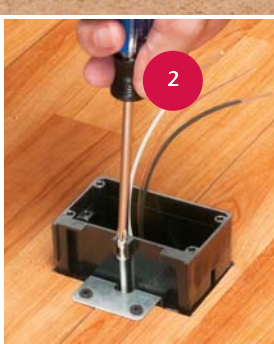
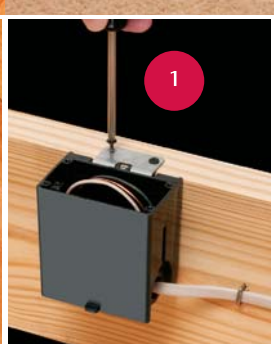
The Interstates team collaborated closely with the other project partners to preplan model conduit racks on the Ardent Mills Port Redwing Flour Mill in Gibsonton, Fla.. The model allowed the team to move some work into the early stages of the project, increase the installation rates, avoid clashes with other installations, and review the routing with the owner.

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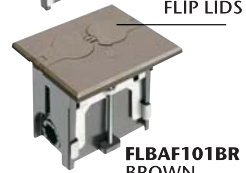
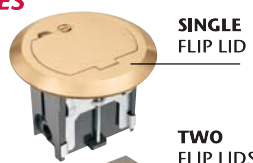
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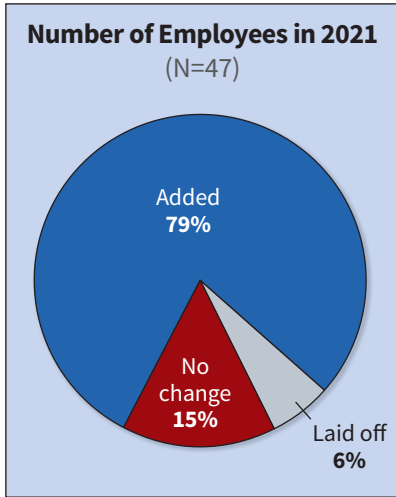


Fig. 17. Last year, the number of Top 50 companies adding, laying off or not changing headcount was evenly split. This year, there was a dramatic shift with 79% of companies adding employees as compared to 38% last year.

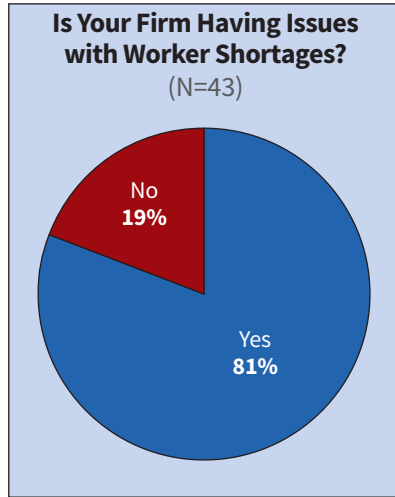


Fig. 18. Just like last year and many years before that, the vast majority of Top 50 companies (81%) indicated they were experiencing worker shortages.

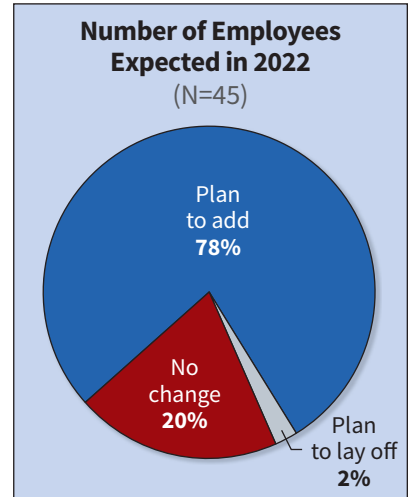


Fig. 19. Last year, only 2% of Top 50 companies expected to have to reduce headcount in 2021; this year's results mirrored that sentiment.

to 81% from 75% (**Fig. 18**). For 2022, just as in 2021, more than three-quarters of firms plan to add employees (**Fig. 19**). With nearly half of contractors saying labor sourcing and retention is their single biggest growth impediment, the tight labor market adds fuel to the fire, limiting the supply of qualified candidates for many positions. Top contractors, however, indicated their critical project-labor needs may have narrowed. Last year, many appeared to check multiple boxes on “most difficult positions to fill.” This year, it appears, most chose just one from a list of seven, with “electrician” taking the top spot from “electrical foreman” with 14 mentions (**Fig. 20**).

Cupertino's Schott says the labor squeeze is as tight as ever, covering front-line field electricians to back-office project managers and support staff. To combat the problem, the company has ramped up efforts to burnish its image as a progressive employer.

“In the war for talent, we've been investing in a formal ‘employer brand’ campaign to differentiate ourselves in the market — similar to how we'd formally invest in communicating our value to customers,” he says.

Interstates is also squeezed front to back on labor, not a big change from previous years but feeling the press of the so-called “Great Resignation” phenomenon that may be drawing

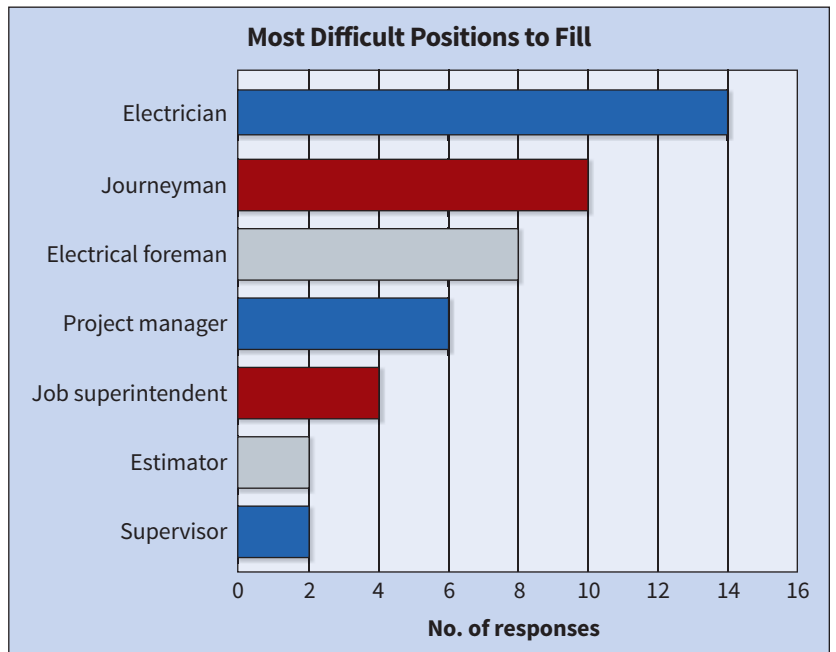


Fig. 20. “Electrical foreman,” which had retained the top spot for the last several years as the “most difficult position to fill,” was replaced this year by “electrician” followed by “journeyman.”

experienced people out of the labor pool, Van Egdome says.

“With turnover seemingly higher than it's been, that adds to the challenges of both retaining and attracting new talent,” he says.

Gaylor Electric is attacking its “quality” labor pipeline deficit partly on two novel fronts: carefully crafted high school partnerships to identify and groom students for its apprenticeship

programs and repurposing retiring employees to serve as teachers and mentors for young craft employees.

“We're reaching out to high schoolers, trying to find 16- to 18-year-olds we can turn into electricians,” Goodrich says.

A tool contractors might employ to ease the recruitment challenge for some jobs is hybrid work arrangements. Accelerated during the pandemic, remote and remote/on-site blend

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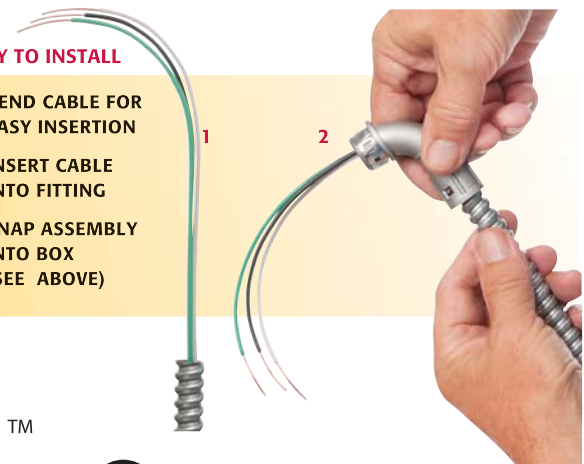
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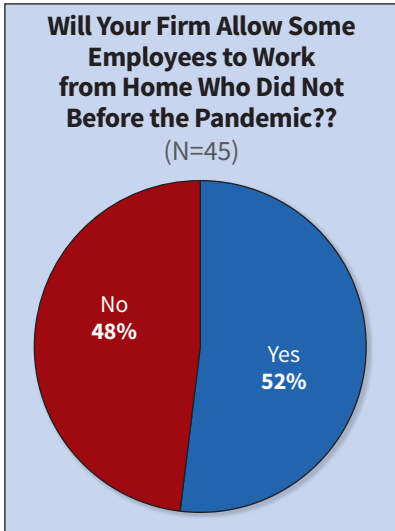


Fig. 21. When asked if their companies would allow employees who used to work in the office pre-pandemic to continue working from home part- or full-time going forward, last year the majority of Top 50 firms (58%) said no. This year, that shifted slightly with 48% saying no and 52% answering affirmatively.

structures could become workplace fixtures after technologies allowing online collaboration and sharing proved highly capable. Offering job candidates such flexible work options could be a way for contractors to expand their geographic search maps and lure talent reluctant to pull up stakes or be latched to an office.

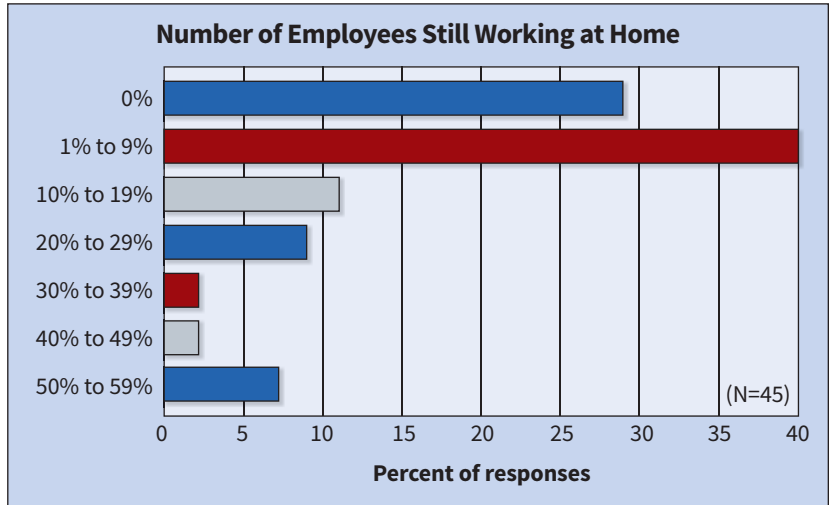


Fig. 22. At the time this survey closed (early July 2022), nearly 70% of Top 50 respondents had less than 9% of its workforce working from home who were not previously doing so.

Greatest Long-Term Impact of the Pandemic	
Factor	Ranking
Conduct more meetings virtually that were previously held in person	1
Use technology to gain a competitive advantage, such as increased use of artificial intelligence, augmented reality, and virtual reality tools	2
Put an increased focus on employee health and safety	3
Allow more employees to work from home part- or full-time	4
Revise HR policies to include more sick leave, additional mental health resources, and wellness program	5
Decrease typical employees' travel schedule	6

Fig. 23. Again this year, the No. 1 factor respondents believe will have the greatest long-term impact on their companies going forward as a result of the pandemic is the trend to continue conducting more meetings virtually followed closely by using technology to gain a competitive advantage.



Photo courtesy of Motor City Electric

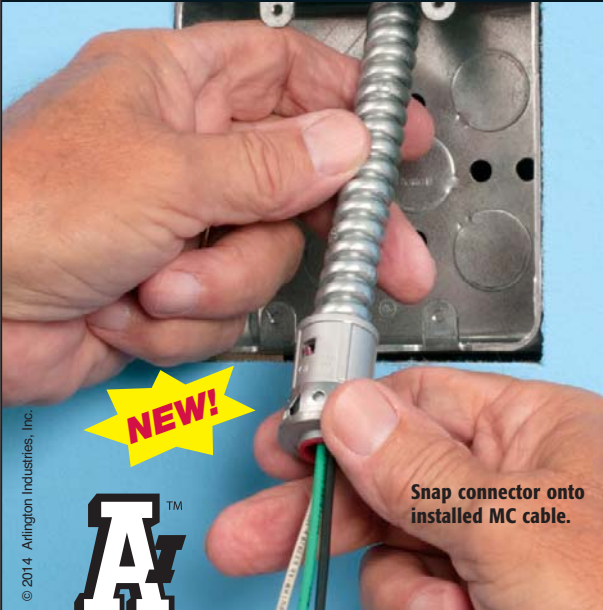
Motor City Electric Co. (MCE) was the electrical contractor for the Amazon Fulfillment Center in Pontiac, Mich., where the Silverdome previously resided. The substantial completion date of the project was June of 2021, with the remainder of the project being wrapped up this past March.



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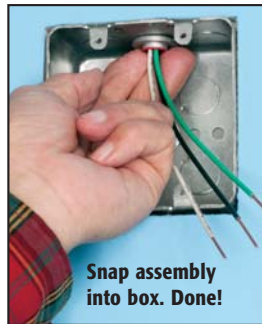


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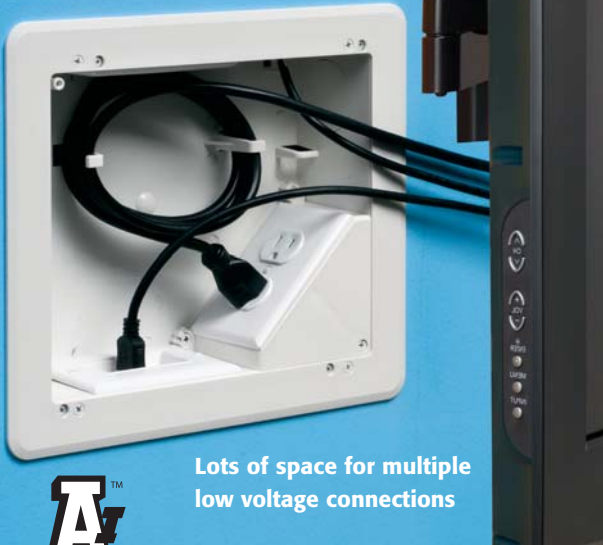
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Mounts to stud in NEW work



Secure installation in RETROFIT

includes box, trim plate, duplex receptacle, line voltage box, wall plates, cable entry device, knockout plugs



cUL US

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Product info aifittings.com/landing/TVBU810

Contractors don't seem to be on the same page when it comes to the feasibility of those arrangements. In a slight shift from last year, Top 50 contractors, by a narrow margin, say they're permitting some former office-based employees who shifted to working from home fully or partially during the pandemic to continue doing so (Fig. 21 on page 40). But those who are permitting it are being selective. About 70% offer the perk to less than 19% of their workforce (Fig. 22 on page 40).

At Power Design, Musolino says, only a few full-time positions are remote but more flexibility has been put into employee schedules.

"We do feel that an office presence is important, but we're trying to balance that as we can," he says. "Construction is really a people-based industry, and if you don't have strong relations with the team you're working with, morale can do down. So face-to-face is important."

TECHNOLOGY'S LURE

Unrelenting labor challenges find more contractors, Interstates included, turning to technology to mitigate the effects of manpower and talent shortages. Van Egdom says the company is exploring more deeply IT tools, including generative design, robotic process automation, and technology-aided prefabrication processes that can improve efficiency in design and project execution management — hopeful they can

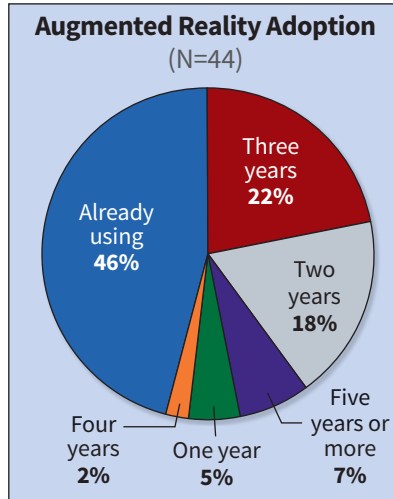


Fig. 24. Although the percentages changed slightly, the order in which respondents ranked the time frame for implementation of augmented reality technologies stayed the same. This year, 46% of Top 50 companies indicated they were "already using" augmented reality technology as a viable component in their electrical work.

supplement or supplant some labor over time.

"Technology and automation are definitely a component of the solution to the labor issue that we continue to invest in," he says. "Taking more work off site to a manufacturing environment is also an element of mitigating peak labor needs."

Technology's growing importance to contractors, extending from the design

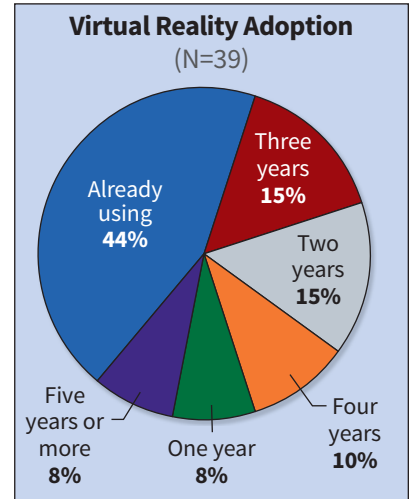


Fig. 25. Although it's taken some time to catch on, most Top 50 companies said this year that they are already using virtual reality technology or they plan to do so in the next two to three years.

and specification phase through training and down to the job site, is again evident. Becoming steadily more intertwined, technology's advance may have quickened during the pandemic.

Plans to use technology such as artificial intelligence and augmented and virtual reality tools (AR/VR) to boost competitiveness ranked a high second on a list of possible long-term byproducts of the pandemic (Fig. 23 on page 40). And the pace of AR/VR adoption appears to be picking up. Almost half say they're already

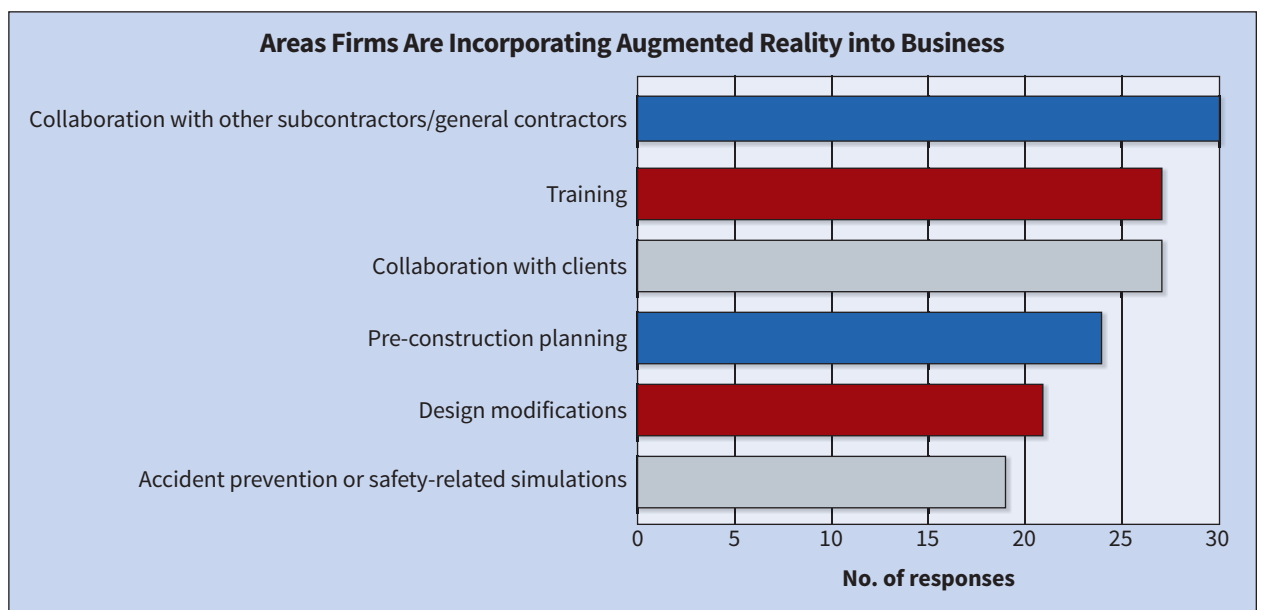


Fig. 26. These are the top six areas in which Top 50 respondents see their firms incorporating augmented reality technology into their business in the next few years. Collaboration and training are a driving force behind adoption of this technology.

ENCLOSURE BOXES

PROTECT DEVICES, POWER BACKUPS and MORE!



**FACTORY
INSTALLED
Hinged
Covers**

**NEW
6" depth**



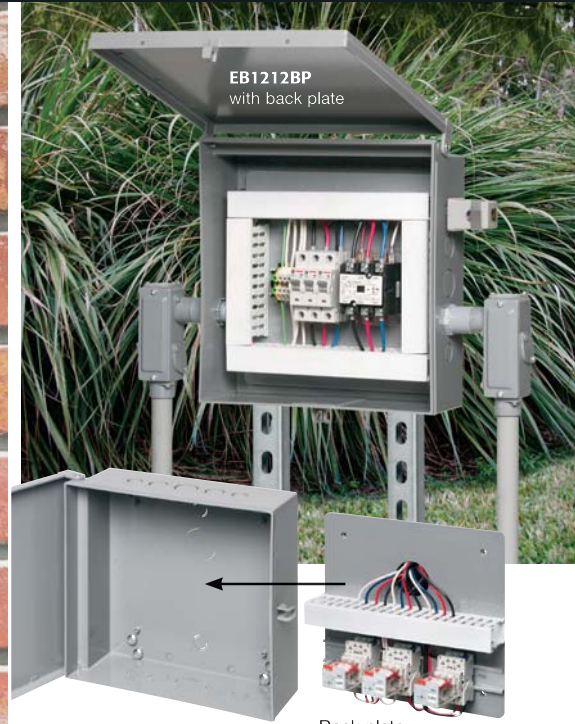
EB12126

EB12126BP
with back plate

- EXTRA-DEEP – MORE SPACE for components
- BACK PLATE for easy mounting, access



LOCKABLE



EB1212BP
with back plate

Back plate
with electronics mounted
(not included)

**All available with
or without Back Plate**

**Outdoor Rated
Meets NEMA 3R
with Hinge on TOP**



Gray
EB0708



Black
EB0708BL

SIDE hinge
for indoor use

**Never Lose Another Cover
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Shipped with factory-installed hinged covers, Arlington's non-metallic enclosure boxes meet NEMA 3R requirements for outdoor use when mounted with the hinge on top.

Perfect for protecting and securing power backups, security devices and other valuable equipment indoors or outside, our heavy-duty, UV rated boxes come with or without a back plate. Get easy access to components, even after the enclosure box is installed.

Gray and black, in a variety of convenient sizes, including the new 6" depth.

'Lockable' with a knockout for a cam lock (EBL1 sold separately) or a padlock latch.



Arlington®



EB1212
12" x 12" x 4"



EB1111
11" x 11" x 3.5"

GRAY Enclosure Boxes *Add suffix BL to order in Black

Cat #	UPC	Dimensions
EB0708	12672	7" x 8" x 3.5"
EB0708BP	23170	7" x 8" x 3.5" with Back Plate
EB1111	12670	11" x 11" x 3.5"
EB1111BP	23171	11" x 11" x 3.5" with Back Plate
EB1212	12671	12" x 12" x 4"
EB1212BP	23155	12" x 12" x 4" with Back Plate
EB12126	23172	12" x 12" x 6"
EB12126BP	23173	12" x 12" x 6" with Back Plate
EBL1	11400	Cam Lock

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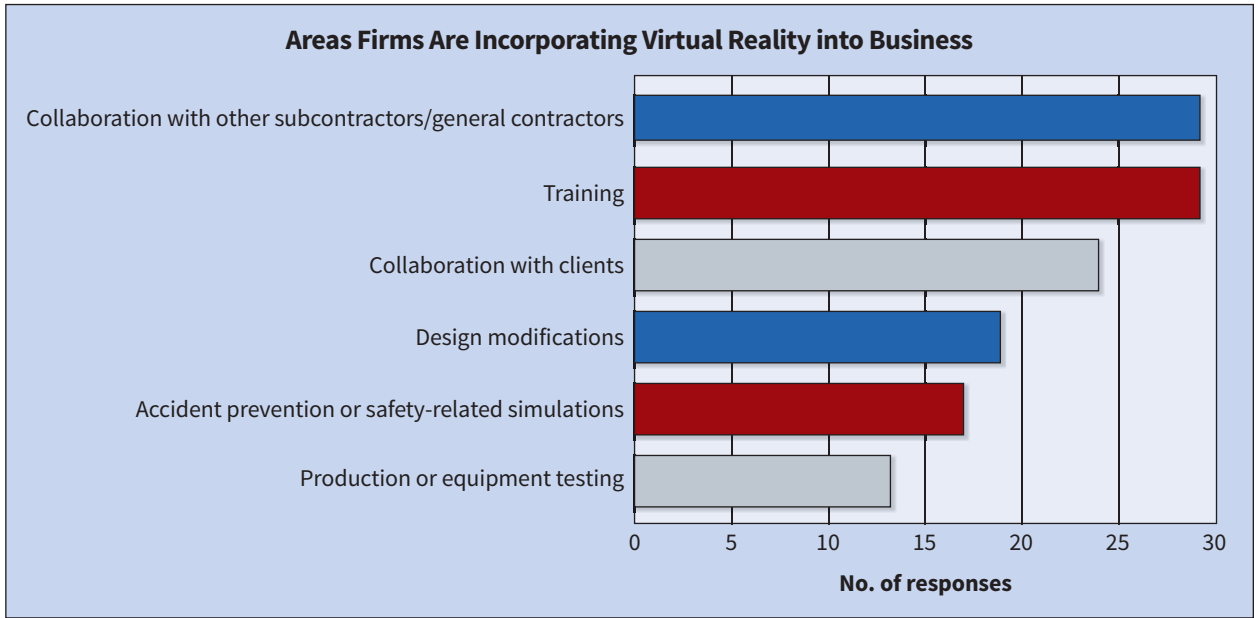


Fig. 27. These are the top six areas in which Top 50 respondents see their firms incorporating virtual reality technology into the business in the next few years. This year, responses were spread out fairly evenly across all of the categories than in past years. Based on the results, electrical contractors seem to be using this technology for multiple tasks.

using AR (Fig. 24), well up from 26% last year, while 44% say they're using VR (Fig. 25 on page 42), up 10 percentage points from last year. Primary applications for both technologies (Fig. 26 on page 42 and Fig. 27) seem to be coalescing around collaboration — with fellow contractors and clients alike — though others are popular, including training and safety enhancement, which may be gaining ground.

Inglett & Stubbs is still feeling its way through the AR and VR world, slowly embracing the tools as more projects incorporate them, and their potential benefits become clearer. Perlot is drawn to their seeming power to better unite design and construction phases, accurately monitor progress, and minimize costly problems that stem from miscommunication.

“We’ve been applying VR more, giving us some great conversations with owners about better understanding and visualizing what they want as they walk through and see what works and what doesn’t,” he says. “We’re still trying to figure out how to tackle AR, but it could be a good tool for communication between the field and the design team and doing quality checks on installations.”

The ability to bring ever more powerful IT tools into all phases of work continues to open new efficiency and performance horizons for contractors. In particular, the growing power of mobile

Topics Employees Need the Most Training On	
Topic	Ranking
Field apps and software	1
National Electrical Code	2
Building management/building automation systems	3 (tie)
Lighting and control technology	3 (tie)
Power over Ethernet (PoE) technology	5
Energy codes and standards	6 (tie)
Fire and life safety codes and standards	6 (tie)
Bonding and grounding theory	8

Fig. 28. Once again this year, “field apps and software” and the “NEC” overwhelmingly were listed as the most common topics Top 50 employees need training support on.

Type of Digital Tools Employees Use Most Regularly	
Tool	Ranking
Project management	1
Time management	2
Labor management	3
Tool management	4
Product specs and installation guidelines	5
Job costing/estimating	6
Codes/standards rules and regulations	7
Inventory tracking/management	8
Fleet management	9

Fig. 29. Again this year, Top 50 respondents overwhelmingly indicated their employees use project management tools more than any other type of digital program, followed closely by time management and labor management platforms.



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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



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INSTALLS INSIDE 4.5" CONCRETE BOXES



Plugs stay inside recessed cover



FLBC4560DNL



Slotted in-use cover



Easy to install in concrete box

FLBC4560

FLOOR BOX FOR NEW CONCRETE

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

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

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

FLBC4560DMB
Brass

FLBC4560DNL
Nickel-plated

Cover blank
Slotted cover

FLBC4560DBR
Brown

...and plastic in FIVE colors.

FLBC4560DGY
Gray

FLBC4560DCA
Caramel

FLBC4560DBL
Black

FLBC4560DLA
Light almond



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devices and the software they can utilize has continued to make field operations more nimble, informed, and capable in execution and oversight. Their importance is evident in the top ranking that “field apps and software” has on the list of topics contractors believe employees need the most training support on (Fig. 28 on page 44). That may be because they have so many regularly used functions vital to operations — from top-ranked project management, time management and tool management to job costing/estimating, codes and standards guidelines, and inventory tracking (Fig. 29 on page 44). And contractors point to a range of specific useful job-related information that employees are accessing on mobile devices, with product specifications and codes/standards requirements topping the list (Fig. 30).

That information, readily accessible in the field at all levels, is becoming essential as job sites grow more complex, demanding, and schedule-driven, says Commonwealth Electric’s Price.

“On-the-ground technology that can access information through the cloud gives us remarkable capabilities,”

Information Most Likely Accessed Via Mobile Devices on the Job	
Information	Ranking
Product specifications	1 (tie)
Codes and standards requirements	1 (tie)
Installation instructions	3
Product pricing information	4
Product availability	5

Fig. 30. Again this year, Top 50 respondents indicated their employees are accessing product specifications and codes and standards requirements most frequently in the field, followed closely by installation instructions.

he says, which are needed because, “as technological advances in construction have pushed construction schedule timelines from where they used to be, expectations have followed suit to the point where we have to do in a week some things that used to take a month.”

As central participants in almost any construction project, electrical contractors will need to take advantage of every technology-aided tool at their disposal to take full advantage of what looks like a full slate of opportunities stretching to the long horizon. Coming off an incredibly strong year of revenue

growth tainted by profit challenges, Top 50 companies face a near-term future that looks hazy at best due to the very mixed signals the broader economy is sending. By any measure, though, top contractors delivered at least a mild surprise in a 2021 buffeted by no shortage of economic headwinds and uncertainty. Can they deliver again in a year equally (if not more) economically perilous? Stay tuned. **EC&M**

Tom Zind is a freelance writer based in Lees Summit, Mo. He can be reached at tomzind@att.net.



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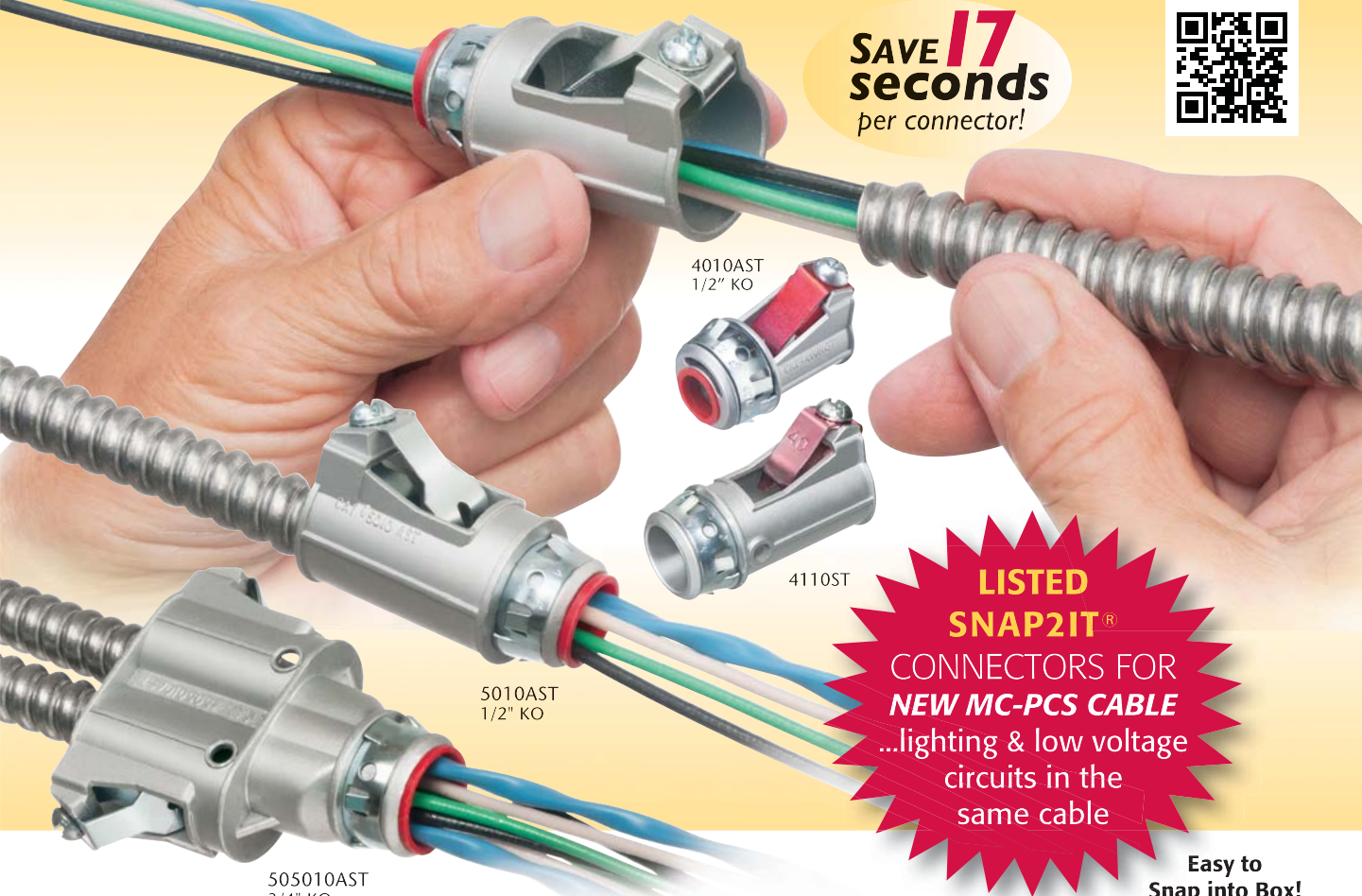
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- **Fast, secure snap-on installation**
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From cable Loosen screw on top. Remove connector from cable.
From box Slip screwdriver under notch in Snap-Tite[®] ring. Twist. Remove connector.



Arlington[®]

CATALOG NUMBER	DESCRIPTION	CABLE OUTSIDE DIA (OD)
4010AST	Snap in, 1/2" KO w insulated throat	.405 to .610
5010AST	Snap in, 1/2" KO w insulated throat	.580 to .780
505010AST	Duplex Snap in, 3/4" KO w insulated throat	(2) .590 to .820
4110ST	Snap in, 1/2" KO	.525 to .705
414110ST	Duplex Snap in, 1/2" KO	(2) .525 to .640
NEW! 4141107ST	Duplex Snap in, 3/4" KO	(2) .525 to .690

4141107ST

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Planning for the Future of Electric Vehicles

Essential elements every electrical designer and installer must understand to ensure readiness as the buildout of the national EV charging infrastructure takes shape



Photo 1. One of the major considerations for building out electric vehicle charging infrastructure is determining what level chargers will be needed. This decision will affect the design and cost.

By Daniel Colombini and Vinod Palal, Goldman Copeland

It's extraordinary how rapidly the future of electric vehicles is approaching. The pace has been growing so dramatically that it's hard to anticipate just how quickly the future will arrive. As a result, designers and installers of electric vehicle (EV) charging stations need to be prepared with plans for phased implementation at client sites that can be activated on short notice.

In November 2021, the Infrastructure Investment and Jobs Act (IIJA) earmarked \$7.5 billion to build out the first-ever national network of EV chargers in the United States. That investment supports the federal government's goal that half of all new vehicles sold in the United States will be zero-emissions vehicles (including electric or plug-in hybrids) by 2030. That goal reflects the fact that transportation generates the largest share of greenhouse gas emissions (27% in 2020).

In the wake of that announcement, "Tesla posted a record \$3.3 billion profit in the first three months of 2022, with sales of its vehicles up 81% from last year," according to a recent article in *Fortune* magazine. "Other carmakers with fledgling EV divisions also saw big sales boosts. Volkswagen Group saw a 65%



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CONNECTS, PROTECTS MULTIPLE PV1000 CABLES



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

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



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



1" NMPV1005

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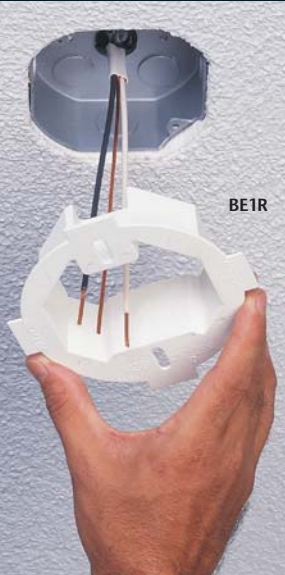
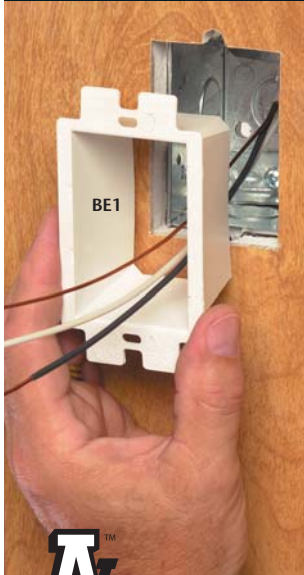
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BOX EXTENDERS

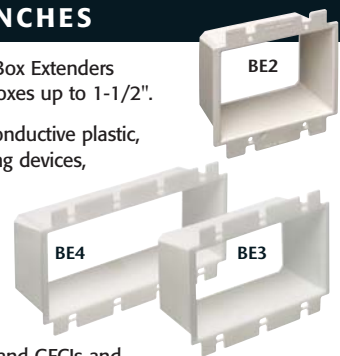
EXTENDS SET BACK BOXES UP TO 1-1/2 INCHES



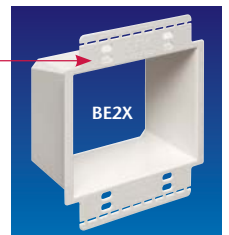
Arlington's **UL/CSA Listed** Box Extenders extend set back electrical boxes up to 1-1/2".

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

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



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



Product info <http://www.aifittings.com/landing/box-extendere/>

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SIDE A
Fits 6" round covers with a 3-1/2" screw hole pattern

SIDE B
Fits 6" round covers with a 3-3/8" screw hole pattern

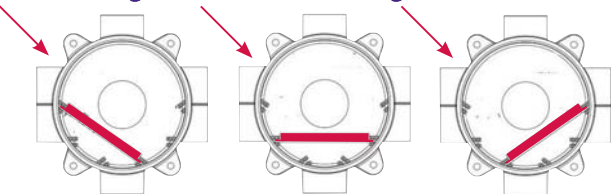
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REVERSIBLE
Leveling Ring

Arlington's FLOOR BOXES, COVER KITS, and accessories **FOR NEW CONCRETE** are the low cost, *convenient* way to install a receptacle flush with a new floor.

Made of heavy-duty plastic, our FLBC4502 4.5" non-metallic **concrete floor box** has more: SIX conduit hubs and FOUR plugs and THREE options for positioning the low voltage divider in the box.

The NEW FLBC4502LR leveling ring makes installing a cover easy on ANY 4.5" concrete box including our FLBC4500 and the new FLBC4502. *It's REVERSIBLE!* **Side A** fits any 6" round cover with a 3-1/2" screw hole pattern. **Side B** has a second set of holes that fits 6" covers with a 3-3/8" screw hole pattern.

THREE Options for Low Voltage Divider Positioning



Openings for optional screws to raise box so concrete flows beneath



ARLINGTON Cover KITS for FLBC4502, FLBC4500 boxes



Arlington offers a variety of **cover kits** for our concrete boxes: round with flip lids or threaded plugs in brass or nickel-plated brass. Metal trapdoor covers with three device options. *And in plastic, in six colors.*

Get a great-looking, time-saving receptacle installation *in new concrete* with floor box kits, covers and more – *from Arlington!*



PLASTIC SINGLE FLIP COVERS in 6 COLORS



Brass or Nickel-Plated Trapdoor, 3 DEVICE OPTIONS

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FOR 4.5" CONCRETE BOXES



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Cover Kits
with **ULTRA THIN**
Flanges
SAVE 20%

NEW!

FLBC4580MB
brass-plated covers
stamped steel flange



FLBC4580NL
nickel-plated covers
stamped steel flange

IN BOX® with Ultra-Thin Stamped Steel Flange



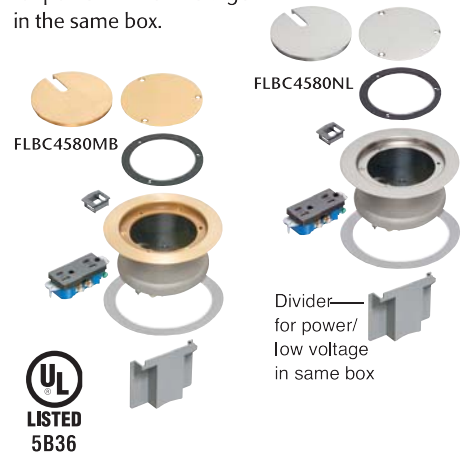
Arlington's NEW recessed **FLBC4580 IN BOX**® **Cover Kits** are the solution to installing a receptacle in a 4.5" concrete floor box, like our FLBC4500 or FLBC4502 boxes. They install *into* the box so they look great and reduce the trip hazard caused by protruding plugs.

Our UL Listed **FLBC4580 IN BOX** Cover Kits

COST 20% LESS than **SOLID brass and nickel-plated brass covers**. This new series has brass-plated or nickel-plated diecast zinc covers with plated-to-match **ULTRA-THIN, STAMPED STEEL FLANGES** for cost-saving, flush-to-the-floor installation.

Use the *blank* cover when not in use; substitute the *slotted* cover when cords are plugged in.

Easy to install, **IN BOX** Cover Kits have a divider for power and low voltage in the same box.



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PRODUCT INFO aifittings.com/landing/flbc4580

Patent pending

bump for all of its electric models, while sales of Mercedes EVs were up 37%.”

U.S. consumers seem to have climbed onboard in a big way. “There is a different kind of tipping point that we seem to have hit — an emotional or psychological tipping point among consumers,” said Venkat Srinivasan, director of the Center for Collaborative Energy Storage Science at the U.S. government’s Argonne National Laboratory in Chicago, according to Reuters. He said that “more and more people” would buy EVs “notwithstanding the cost of the battery and the vehicle.”

The EV industry is responding, too. In May, Hyundai announced plans to spend \$5.54 billion to build its first dedicated EV and battery manufacturing facilities in the United States.

Thirty-five million EVs are now expected on American roads by 2030. That means another 1.5 million charging ports will be needed, according to NBC News. Watch the video here: <https://nbcnews.to/3eHusPs>.

With this momentum building so rapidly, designers and installers of EV charging stations must be prepared for whatever pace emerges. Based on all of these factors, planning is needed for the staged implementation of facilities. That planning should have four elements to ensure readiness for whatever transpires.



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ELEMENT NO. 1: DETERMINE THE DETAILS.

First, consider the nature and needs of each existing property in the context of future EV use. What is the nature of the current parking? Does it serve commuting employees or a commercial fleet? How long is the typical commute or product delivery route? How many existing parking spaces are there? How close are those spaces to the electrical infrastructure?

What needs can be anticipated beyond a shift to EVs? Will drivers expect to charge their vehicles at work or home? How long will they need to charge them at work? What other charging station options are being planned nearby?

ELEMENT NO. 2: ASSESS THE EXTENT OF THE UPGRADE.

If substantial needs are identified, survey the infrastructure. This will likely require professional engineering assistance, but it will provide the basis for essential future planning.

The existing electrical infrastructure should be evaluated to determine what would be required to adapt it to meet the anticipated needs. Most properties have the existing capacity to serve a small percentage of parking spaces with EV charging. However, how much of an upgrade is needed?

The magnitude and cost of any upgrade to meet anticipated demand will depend on several factors: the capacity of the electrical service upgrade; the distance from existing electrical service to the sites where the chargers will be needed; whether digging trenches is required; and any local law requirements. In New York City, for instance, Local Law 130 requires that any parking garages or parking lots that make electrical modifications must include the electrical capacity needed to make at least 20% of the parking spaces suitable for EVs.

State codes will also affect the magnitude of any upgrade, and those codes may well need to be updated to reflect new and emerging conditions. At present, for instance, codes typically require that designs for EV chargers assume that the charger is drawing at 100% capacity all the time. As patterns of consumer use of EVs evolve, there may well be a need for state codes to be adapted to better reflect those patterns.

The likely need to update state codes may justify doing certain work sooner than later. Work performed before any updating is typically grandfathered into the new standards, so it may be best to perform that work while the existing codes are in place.

It’s also vital to consider how rapidly EVs need to be charged. Chargers on commercial properties would typically be Level 2 chargers that provide around 32 miles of range per hour of charging (Photo 1 on page 48). If there is a need for Level 3 (industrial) chargers, that will affect both the design and the cost, as generating the more rapid turnaround at Level 3 requires a higher voltage.

It should be noted that there is no reason to think that EVs are more of a fire hazard than fossil fuel-powered vehicles. There is, therefore, no regulatory need for extra fire protection.

ELEMENT NO. 3: CALCULATE THE COST.

Determine the estimated cost of any needed upgrade. The cost will be influenced by the size of the upgrade and by the siting of the chargers. Will they be scattered across the

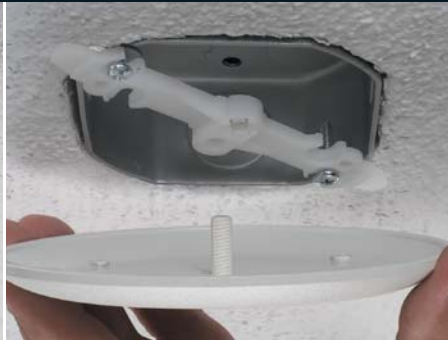


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NON-METALLIC BOX COVER

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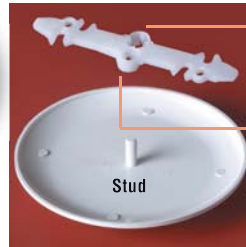


CP3540 Box Cover

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Our non-metallic, paintable **CP3540** Box Cover is the neatest way to cover unused fan/fixture boxes, pan boxes or poorly cut drywall.

Versatile bracket design with 'A' and 'B' openings for use on flat or uneven ceilings.



'A' for flat ceilings
Push stud into opening to seat cover

'B' for uneven or textured ceilings
Thread stud into opening until tight

Stud

- No visible screws on ceiling plate
- Fits 3.5", 4" round or octagonal boxes

Easy installation. Attach the bracket to the box with #8 or #10 screws. Back the screws out enough to slip the bracket on.



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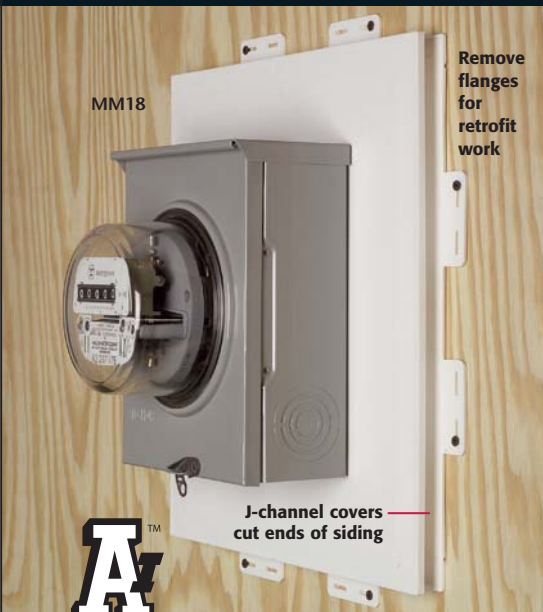
Product Info aifittings.com/landing/CP3540

ONE-PIECE • NON-METALLIC

Made in USA

METER MOUNTING BASE

INSTALLS ON SIDING – AND OTHER SURFACES



MM18

Remove flanges for retrofit work

J-channel covers cut ends of siding

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

UV rated, paintable plastic for long outdoor life.

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



MM23 → ← MM18

Gangable...for custom sizing



Mounting Bases

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



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

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MM7 info aifittings.com/landing/mm7
Other aifittings.com/landing/meter-mounting-bases



Photo 2. The Infrastructure Investment and Jobs Act includes \$7.5 billion to build out a national network of EV chargers. Some government and utility incentives can cover 50% or more of the cost, depending on the location and type of property.

property or centralized? Will they be spread horizontally or stacked vertically on floors of a multi-story garage? Will the chargers be incentivized by

providing prime locations? What structures are needed underneath the chargers to ensure that they cannot be toppled by an errant vehicle?

Fortunately, government and utility incentives can cover 50% or more of the cost, depending on the location and type of property (**Photo 2**). In New York City, for instance, incentives from the New York State Energy Research and Development Authority (NYSERDA) and local utility Con Edison are significant. Con Edison's rebate per EV charger port has been as much as \$11,200.

There may also be an opportunity for reimbursement for the upfront cost over time through a nominal surcharge beyond the energy consumption of each vehicle serviced. That will depend on the nature of the property and the consumer's willingness to bear that additional cost.

In assessing the cost of needed work, it's worth considering whether short-term modifications of existing infrastructure are the best approach in the long run. It may be more cost-effective to consider a fuller electrical infrastructure upgrade that offers more benefits over time.

simPRO

The only tool missing from your belt

Total business software for the trades

Work smarter, not harder. Join more than 200,000 trade businesses worldwide who trust simPRO to help them grow their business through streamlined workflow management software.

Call today for your custom demo.



simprogroup.com | (855) 338-6041



RAIN-TIGHT • CONCRETE-TIGHT FITTINGS FOR

Made in USA

PVC JACKETED MC CABLE

ONE FITTING FITS MULTIPLE CABLE SIZES



NEW DESIGN!

Save time and money with Arlington's *rain-tight, concrete-tight* fittings for PVC jacketed MC cable.

ONE fitting FITS MULTIPLE cable sizes!

LTMC50 ships ready to use on #10, #12 or #14 PVC jacketed MC cable. Try the NEW SIZES too... LTMC507 and LTMC75.

Because they fit more than one cable size, these fittings reduce inventory, saving the cost of stocking several *different* fittings.

**Ideal for Parking Decks,
High-rise Residential**



Catalog Number	Cable Ranges (Outer Cable Diameter)
LTMC50	.415" - .565"
LTMC507	.550" - .765" goes into 1/2" KO
LTMC75	.725" - .980" goes into 3/4" KO

Patented



1/2"
LTMC50
(components)

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

Product Info aifittings.com/landing/ltmc507-ltmc75/

LOWEST COST • L-SHAPED Made in USA

FAN/FIXTURE BOX

SECURE MOUNTING TO SINGLE, DOUBLE JOISTS



FB442
13.4
cu. inch



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

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

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



Patented
Product info
aifittings.com/landing/joist-mount-fan-fixture-box

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

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WEATHERPROOF Made in USA

OUTLET BOX

EASY TO INSTALL ON ANY SIDING TYPE



Our one-piece FS8091F outlet box is your best buy for a fast, easy device installation on siding.

- Works with all single-gang devices, including GFCIs
- Installs on any siding, before or after it's up



FS8091F

- For use where a weatherproof-in-use cover is not required – Accommodates a weatherproof-in-use cover for wet locations

Product info aifittings.com/catalog/siding-mounting-blocks/weatherproof-fs-outlet-box/FS8091F



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

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ELEMENT NO. 4: EXECUTE THE PLAN.

Anticipate and meet the need. Based on the considerations described, develop a staged plan for meeting expected demand: how many chargers and when?

The staged nature of that plan allows not only for adapting to emerging demand but for incorporating new technology that develops. A company called Ample is now building robotic stations that swap in a fully charged EV battery for San Francisco fleet vehicles and Uber drivers in 10 minutes. Each robotic station has a small footprint, equivalent to two parking spots, and, in the company's words, "An Ample station is 3 to 10 times cheaper than a fast-charging station. It's cheaper to build and cheaper to install."

This and other technology may become prominent in the time covered by the plan. As technological innovations continue, the staged plan can be updated accordingly.

The plan can then be activated so that the property is always one step ahead of demand and prepared to meet new developments. It will thus enable "future-proofing" along the way.

BIG PICTURE

While these four steps are designed for adapting existing properties to the anticipated demands of growing EV usage, they offer a lens that can be applied in considering the needs of new construction. In that case, there is an immediate question of how much capacity is incorporated from the outset. While one



© Michele Ursi | Dreamstime.com

would start with a significant initial capacity, there may still be a need to anticipate and accommodate future growth and innovation. That may yet require a staged approach.

With these four steps, designers and installers of EV infrastructure can ensure that properties are always ahead of the demand for EV chargers. **EC&M**

Daniel Colombini and Vinod Palal are principals at the New York City-based consulting engineering firm Goldman Copeland. For more information, visit <https://www.goldmancopeland.com/>.

THE GO-TO DAYLIGHT HARVESTING SOLUTION

ENERLITES

- ✓ Quick Installation
- ✓ Reduce Peak Electric Load
- ✓ Self-Contained, 0-10V Dimming



An ideal solution to meet CA Title 24 or ASHRAE 90.1 daylight harvesting needs, this closed-loop sensor detects the ambient light present and adjusts the brightness accordingly.

Allows your facility to conserve more energy, improve indoor ambiance, and boost productivity.



Follow the QR code to learn more.

www.enerlites.com





NON-METALLIC

Made in USA

THE SCOOP™

ENTRANCE PLATES, HOODS, DEVICES



NEW

Entry Device
w Brush
opening

CED135

(with wall plate,
order CED135WP)

Arlington's
TVBU505 TV BOX



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

Our newest **CABLE ENTRY DEVICES** come with *or without* a wall plate for efficient cable management.

HOODS for decorator-style wall plates, single and two-gang **PLATES** install facing in or out...and save time!

- Low voltage cable protection
- Best way to run cable



CED130
entry device
w slotted cover



CED1
facing OUT



CED1



CE1
facing
IN



CE2
facing
OUT

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

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

RECESSED FOR FLUSH-TO-THE-WALL MOUNTING OF LED, HI-DEF TVs

STEEL TV BOX™ KIT

COMBO BOXES FOR USE WITH METAL RACEWAYS

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

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

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

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



RETROFIT Mounting wing screws hold box in the wall

NEW!

1-GANG
TVBS503



© 2008-2020 Arlington Industries, Inc.

NEW WORK

Mounting screws hold box on stud

2-GANG
TVBS505



Patented



3-GANG
TVBS507



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Product Info aifittings.com/landing/recessed-tv-boxes

Understanding the CAT RATING SYSTEM

Selecting the right meter for the job

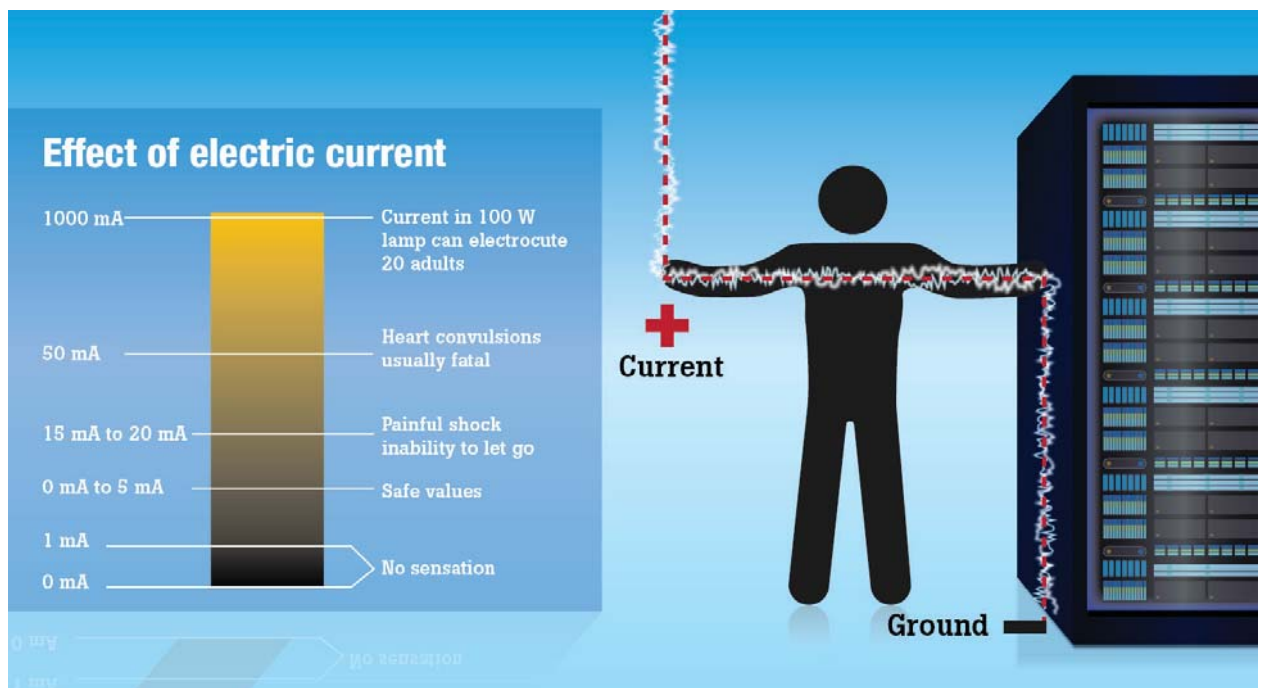


Fig. 1. Working with electricity always carries a risk. Know what those hazards are, and take the appropriate precautions before you begin taking any measurements.

By Sean Silvey, Fluke Corp.

In a recent in-house safety survey, 65% of industry respondents agreed that they use tools “properly rated” for the jobs they’re performing. But what about the other 35%? Electricity is not a power to play with. If tools are underrated for the job, they can damage equipment, cause arc flash, explode, or deliver deadly blows to the user (and potentially those in the vicinity), as demonstrated in **Fig. 1**. How do you know if you have the right meter for the job? Let’s examine this further.

A well-built meter will protect you against electrocution and arc explosion. It will carry a Category rating as well as third-party certification by an independent test laboratory. If the meter isn’t properly rated and certified, there is no way to tell if it offers the necessary protection against electrical transients that may lead to insulation breakdown or arc explosion.

The Switzerland-based International Electrotechnical Commission (IEC) 61010 establishes measurement categories (CAT) and voltage ratings for electrical

environments. The system establishes categories to provide guidance to help protect you from the increased risks of making live measurements when testing or troubleshooting the power system. With CAT environments II, III, and IV, the available fault current in these high-energy circuits can reach as much as 100kVA (see **Fig. 2** on page 60).

CAT RATING DESCRIPTIONS

A high CAT number refers to an electrical power system with higher power available and higher energy transients.

FOR FLUSH-TO-THE-WALL MOUNTING OF LED, HI-DEF TVs

PLASTIC TV BOX™

RECESSED POWER/LOW VOLTAGE COMBO BOXES



LISTED POWER/LOW VOLTAGE BOX

TVBU505 with CED130
CABLE ENTRY DEVICE



for **NEW WORK** or **RETROFIT**



CED130 with slotted cover
REVERSED for RECESSED LOOK



CED135 with brush cover



Arlington's **PLASTIC TV BOX™** – recessed combination power/low voltage boxes offer the secure, easy way to mount TVs flush against a wall.

The job looks great. Plugs and connectors stay inside these Listed boxes without extending past the wall. Available in 2-, 3- and 4-gang styles for retrofit or new work. Each offers power and/or low voltage in one or more of the other openings. There's a box to fit nearly any application!

And a cable entry device with slotted or brush cover to organize your low voltage cable bundle.

- **NEW WORK** Box screw-mounts to stud
- **RETROFIT** Mounting wing screws pull box against wall
- Non-metallic box with paintable white trim plate
- Optional covers available



CED135



4-GANG
TVB613



2-GANG TVBU505



3-GANG TVBU507



Arlington®

Made in USA

Patented. Other patents pending.

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

Product info <https://www.aifittings.com/landing/non-metallic-tv-boxes>

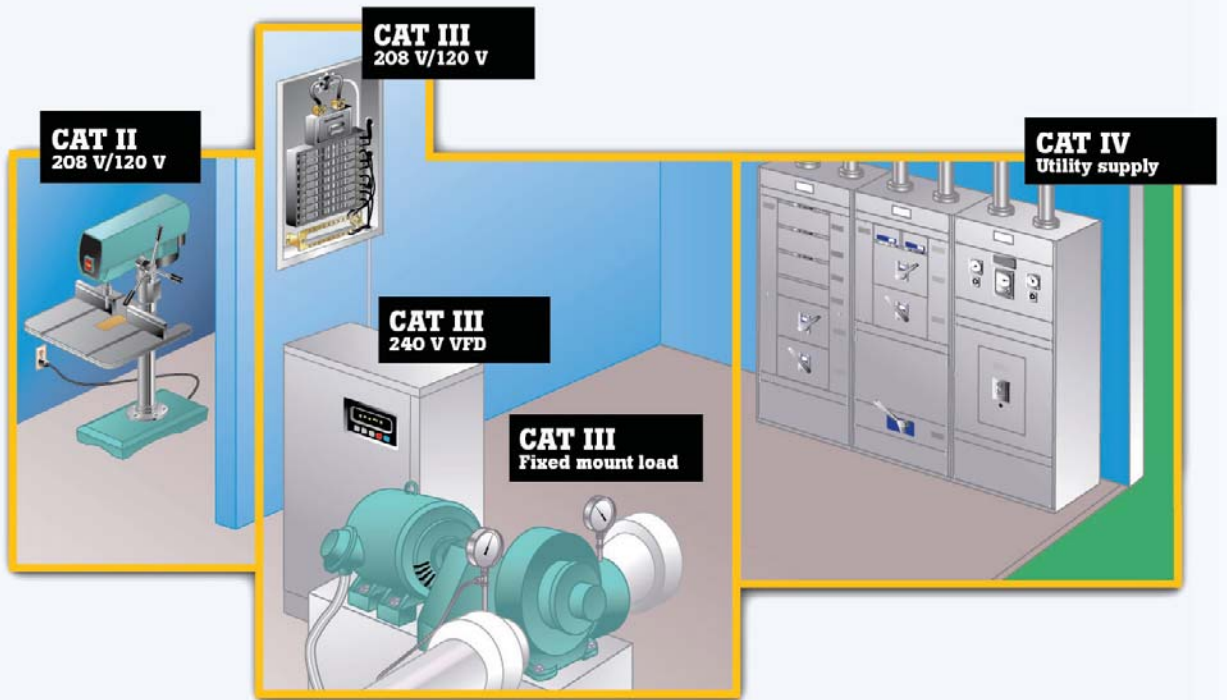


Fig. 2. Always choose a tool rated for the highest category you could potentially use it in, and select a voltage rating to match or exceed those situations.

Essentially, the higher the short-circuit fault current available, the higher the category. This is a key principle to understand when it comes to choosing and using test instruments. A test instrument designed to the CAT III standard can resist much higher energy transients than one designed to CAT II standards. Transients are dampened by system impedance as they travel from the point where they were generated.

CAT IV refers to the “origin of installation,” or where the connection is made to utility power or measurements on devices installed before the main fuse or circuit breaker in the building installation. Examples include electricity meters, primary overcurrent protection equipment, outside and service entrances, service drop from pole to building, the run between the meter and the panel, and overhead lines to detached buildings or underground lines to a well pump.

CAT III refers to 3-phase distribution including single-phase commercial lighting. Examples for this environment include measurements on distribution boards, circuit breakers, and wiring,

First Digit Level	Solid Object Size	Effective Against
0	50 mm or less	No protection
1	> 50 mm	Any large surface of the body
2	> 12.5 mm	Fingers or similar objects
3	> 2.5 mm	Tools, thick wires
4	> 1 mm	Granular objects. Most wires, screws, etc.
5	Dust protected	Not entirely prevented but must not interfere with satisfactory operation
6	Dust-tight	No ingress of dust. Dustproof.

Table 1. The first digit in the ingress protection code relates to protection from solid objects.

which include cables, bus bars, junction boxes, switches, and socket outlets in the fixed installation. Equipment in fixed installations may (such as solar plants) include switchgear and polyphase motors, bus and feeders in industrial plants, feeders and short branch circuits, distribution panel devices, lighting systems in larger buildings, and appliance outlets with short connections to the service entrance.

CAT II refers to single-phase receptacle-connected loads. This includes the

main circuits of household appliances, portable tools, and similar loads — outlets and long-branch circuits more than 10 m or 30 ft from a CAT III source, and outlets more than 20 m or 60 ft from a CAT IV source.

INGRESS PROTECTION CODE DESCRIPTIONS

Ingress protection (IP) codes are classifications associated with IEC 60529, a guideline that defines to what degree of protection mechanical casings and



ADJUSTABLE BRACKET • EASY INSTALLATION IN EXISTING CEILING

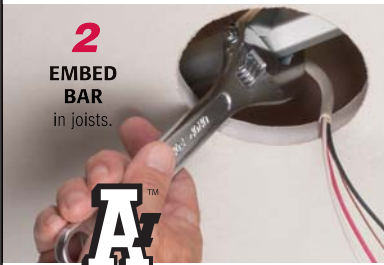
FAN/FIXTURE BOX

HIGHER WEIGHT RATINGS

EASY TO INSTALL 1-2-3!



1 REMOVE BOX from bar. Insert in opening.



2 EMBED BAR in joists.



3 REATTACH BOX to bar.

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

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

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

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



FBR4200R Patented



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



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

Product info aifittings.com/landing/fbrs4200r

ADJUSTABLE BRACKET • FOR NEW CONSTRUCTION

FAN/FIXTURE BOX

FLUSH CEILING INSTALLATIONS



Captive screws attach bracket ends to joists



Attach to joists, adjust box position

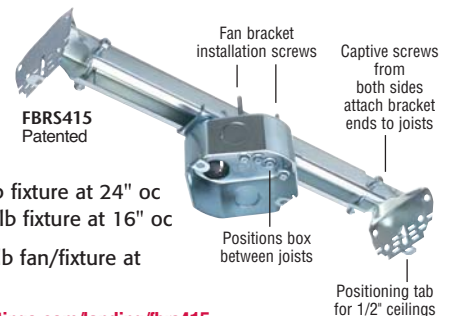
Arlington's heavy-duty, plated steel fan/fixture box has an adjustable bracket that mounts securely between joists spaced 16" to 24" o.c.



Flush ceiling installations

FBR415 is designed for ceilings up to 1-1/4" thick. For 1/2" ceilings, use the pre-bent positioning tab. For other ceiling thicknesses, bend along the appropriate score line.

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



FBR415 Patented

UL ratings

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

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

Product info aifittings.com/landing/fbrs415

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

Second Digit Level	Protected Against	Effective Against
0	Not protected	
1	Dripping water	Vertically falling water. No harmful effect.
2	Dripping water, 15° tilt	Vertically falling water. No harmful effect when the unit is tilted up to 15° from its normal position.
3	Spraying water	Water falling as a spray at up to 60°. No harmful effect
4	Splashing water	Water splashing from any direction. No harmful effect.
5	Water jets	Water projected by a nozzle from any direction. No harmful effect.
6	Powerful water jets	Water projected in powerful jets by a nozzle from any direction. No harmful effect.
7	Immersion up to 1 m	Immersion in water up to 1 m for 30 minutes. Waterproof to 1 m for 30 minutes.
8	Immersion beyond 1 m	Continuous immersion.

Table 2. The second digit in the ingress protection code relates to protection from water.



Photo 1. Check for appropriate CAT ratings, IP codes, and independent verification symbols to be sure the meter you select has been tested by an independent lab and is safe for your measurements.



Photo 2. A well-built meter will carry a category rating as well as third-party certification by an independent test laboratory.

electrical enclosures must protect the inner equipment against intrusion, dust, accidental contact, and water. These are especially useful in protecting users and equipment in volatile or harsh

environments and should be considered in addition to CAT ratings when selecting the right meter for the job.

The IP code is represented by two digits that, together, tell you what level

of resistance to dust and water your meter can withstand. It details what size of dust particles will be kept out and to what water depth your meter can be submerged and continue functioning.

The first digit relates to solids and the second to water (see **Table 1** on page 60 and **Table 2** above).

CERTIFICATIONS

Forensic investigations have determined that inferior test equipment — without a measurement category rating or with a rating that does not match the task — can sometimes explode if used improperly. Therefore, it is critical to make sure your meter (and other electrical testing tools) have been independently evaluated to survive voltage transients and certified to meet safety standards. Standardization bodies, such as the IEC and National Fire Protection Association (NFPA), are not responsible for enforcing their test tool safety standards. Any test instrument you use should be labeled to indicate it has been certified by at least one independent testing agency (see the **Photo 1** and **Photo 2** as examples). **EC&M**

Sean Silvey is a product application specialist with Fluke Corp. His focus is on application awareness, product education, and worker safety. Prior to joining Fluke, Sean was a field service manager in the HVAC industry for 15 years, training and supporting field service technicians as well as assisting customers in resolving HVAC issues. He can be reached at sean.silvey@fluke.com.



GALVANIZED STEEL

Made in USA



CABLE SUPPORT

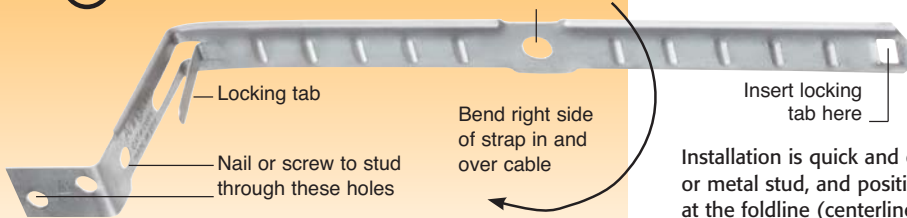
ECONOMICAL...HOLDS UP TO FOUR MC CABLES • EASY TO INSTALL



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.



Locking tab

Nail or screw to stud through these holes

Bend right side of strap in and over cable

Insert locking tab here

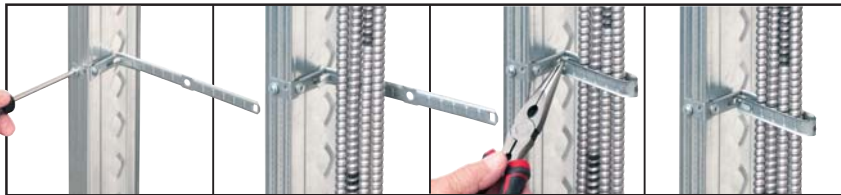
It's perfect for fastening and positioning *up to four* individual metal clad cables – or six NM cables on a 2x4.

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!



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



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

Product info aifittings.com/landing/cus6/

ADJUSTABLE • NON-METALLIC

Made in USA

IN/OUT™ BOX for Fans & Fixtures

EASY TO INSTALL... IN NEW CONSTRUCTION



FBA426
Adjustable Fan/Fixture
21.0 cu in Box

Bracket installation screws ship captive

Underside

Depth adjustment screw



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

- Pre-set for 1/2" ceiling...use depth adjustment screw *after the ceiling's in place* to position the box flush with the ceiling
- Complies with 2020 NEC, 314.20 for set back boxes
- (4) screws attach box securely to joist in new work
- **2-Hour Fire Rating** *Listed for fans up to 70 lbs; fixtures up to 100 lbs*



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

Product info aifittings.com/landing/fba426



Patented



HMI Cover

SolarShield HMI covers are durable and non-metallic, designed for use with all enclosure material types. They are designed for protecting HMI screens from UV and harsh environmental conditions, and, according to the company, they are the only non-metallic HMI covers with side shields. The product can be used in both outdoor and indoor applications. SolarShield HMI Covers fit standard 10 in. x 8 in. and smaller HMI screens. They maintain a NEMA 4X rating of enclosure and screen when paired with a NEMA 4X HMI device.

AttaBox



Distribution Cables

The Activate line of PowerPipe distribution cables is a new family of copper multipair and hybrid copper/fiber cables that provides a resilient Class 4 fault-managed power solution for distributed electronics requiring long distance runs. PowerPipe cables combine the convenience and safety of low-voltage cables with the power and distance capabilities of traditional AC distribution. According to the company, it delivers nearly 20 times the power of PoE, while using low-voltage pathways and wiring practices. And, like PoE, the single cable construction requires only one cable pull.

Remece Wire & Cable



LED Downlight

The H series is a recessed downlighting, whole-home solution. Combining a modular design — featuring a single, compact, field-adjustable LED light module — with reliable performance, the LED downlights offer field-selectable lumens, natural warm dim technology, quality construction, and contractor-friendly installation features. The LED module's field-selectable lumens switch allows three low-glare brightness levels (350 lm, 750 lm, or 950 lm) for various applications needs, including ceiling heights up to 12 ft.

DMF Lighting



Digital Reference Tool

The NFPA LiNK platform is a fully digitalized system meant to help contractors, engineers, fire/life safety practitioners, and other professionals collaborate with access to every NFPA code and standard on one screen. LiNK delivers NFPA codes and standards, expert commentary, visual aids, and supporting content on a user's favorite device, allowing work safety professionals to easily navigate and understand Code requirements based on real-life situations with reliable information at their fingertips.

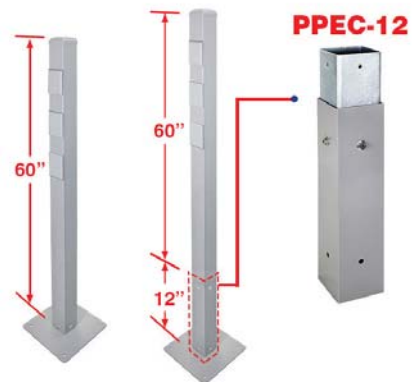
National Fire Protection Association



Energy and PQ Meter

The ST40 compact Din-rail mounted energy and power quality meter now offers a 0.333V input capable of being paired with any standard 0.333V CTs for sub-metering applications. Other features of the product include compact ANSI C12.20 0.2 energy metering Accuracy Class, power quality, including harmonic analysis and up to 512 samples/cycle waveform recording, extensive memory for storing load profiles, system events, and limit alarms, Modbus, BACnet/IP, or DNP3 protocol support, and RS485 or 10/100BaseT Ethernet communication.

Electro Industries/GaugeTech



Pedestal Post Extension

The PPEC-12 adds 12 in. of height to the rooftop pedestal post series (30-in. and 60-in. models). PPEC-12 is designed for rooftops that require layers of extended foam insulation between the base structure and the finished roof. Coupling is easy to install between the pedestal post base and stand components. In addition, multiple PPEC-12s can be stacked on top of each other, allowing for infinite extension of pedestal post height.

Orbit Industries



ONE-PIECE. SAVES TIME – LOOKS GREAT!

Made in USA

RECESSED IN BOX®

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



DBVMA1C
clear cover

ADJUSTABLE Depth



DBVMA1W

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

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

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

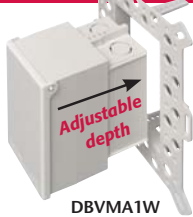


DBVME1W

Built-in FIXED FLANGE

© 2011-2015 Arlington Industries, Inc.

Fits ANY foam board on 2-3/4" to 5" wall or custom stucco finishes 1/4" to 2-1/2" thick.



DBVMA1W
white cover



Product Info aifittings.com/landing/db-series



800/233-4717 • www.aifittings.com



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



DBVME1W
white cover

Patented/Additional patents pending

LOW PROFILE • 4" DIAMETER

Made in USA

SCONCE BOX

FOR SHALLOW WALL CAVITIES OR OBSTRUCTIONS



Install the fixture where YOU want it!



(Pipe)

Arlington's Low Profile Sconce Box is perfect for retrofit installations with shallow wall cavities or obstructions in the wall.

This non-metallic box installs FAST in an existing 1/2" or 5/8" wall with a 4" hole saw.

- Mounting wing screws hold it firmly in place
- Accommodates most sconce light canopies

FSC405R
Sconce Box



Patented



Product info aifittings.com/landing/sconce-box



800/233-4717 • www.aifittings.com

PRESS-ON INSTALLATION

EMT BUSHINGS

ECONOMICAL CABLE PROTECTION

- Fast & easy press-on installation
- Holds tight as cables are pulled
- Protects cable from abrasion
- Less expensive alternative to costly fittings when used just for wire
- Meets NEC requirements (2020) for 300.15 protection. Listed for use in environmental air handling per NEC 300.22(c)



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Focus on Tools

Pliers

The 9-in. universal pliers are designed for safe use in arc flash environments. The double-insulated pliers feature a yellow warning layer underneath the outer orange layer. In addition, the pliers are heat-treated and feature a compact head with serrated jaws and a crushing area. The product features a high-leverage design for greater cutting and gripping power and is designed for cutting round cable up to 9.2 mm or soft steel wire up to 2 mm. Universal pliers are capable of crimping non-insulated terminals and are tested to 10,000VAC and rated for 1,000VAC when working on or around live parts. The pliers comply with ASTM F1505 and IEC 60900 standards and help meet the requirements of OSHA 1910.331-335, MFPA 70E, and CSA-Z462.

Cementex



Tape Measure

The Mammoth Insta-Lock tape measure features high-impact housing with a non-slip TPR grip to protect it from damage and ensure it will stand up to any job site. The coating on the 25-ft-long tape prevents abrasion from repeated use. The tape measure is designed with an auto-lock mechanism that will hold the tape in place for accuracy and control. It features English and metric units that are easy to read and is marked with lines every $\frac{1}{32}$ in. for the first foot, then every $\frac{1}{16}$ in. afterward.

Jonard Tools

Screwdriver Set

The 14-piece insulated screwdriver set with interchangeable blades features a variety of Phillips, Torx, and slotted tips. The tips are precision-machined for an exact fit and have easy-to-read identification. The blades fit securely in a high-visibility, cushion-grip handle, which is VDE tested for protection against electric shock up to 1,000V, according to the company. For precision work, a plastic cap can be attached to the bottom of each screwdriver blade instead of using the cushioned handle. A 1,000V voltage tester is also included in the set for checking electrical sources. Roll packaging is provided for convenient carrying and storage.

Dynamic



Ratchet Cutters

The new line of ratchet cable and ACSR cutters offers up to 35% reduction in peak energy when cutting copper in comparison to a manual cutter, according to the company. The line includes five cutters — three cable cutters and two ACSR cutters — and comes in both open jaw and flip-top designs. Together, the ratchet cutters provide a complete solution for cutting copper up to 600 MCM, aluminum up to 750 MCM, and ACSR up to 336 MCM. The precision ratcheting mechanism holds cable tight to allow for rapid advance cuts; a material-specific blade design gives clean cuts and robust durability; and the two-step ratchet mechanism enables fewer strokes per cut. In addition, elongated handles give better leverage, while a quick-release lever allows mid-cut release.

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3-1/2"
8418

8418 for 1000 Mcm wire and TECK90

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

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

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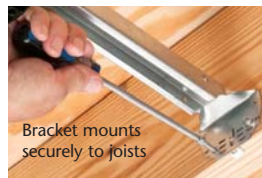
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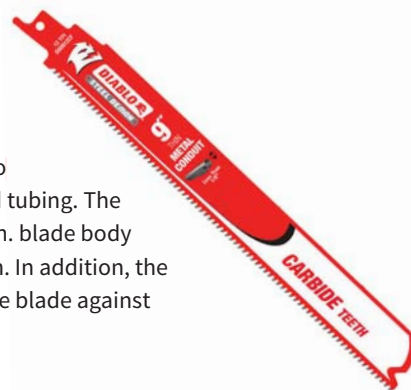
Product info aifittings.com/landing/fbr423

NEW PRODUCT SHOWCASE

Reciprocating Blade

Carbide blades for thin metal conduit cutting are part of the Steel Demon Carbide reciprocating blade family. The product comes in 6-in. or 9-in. options. According to the company, it is the industry's first carbide teeth blade for thin metal conduit and tubing. The blade's optimized tooth count rips through thin metals, producing clean cuts. The blade's optimized tooth count rips through thin metals, producing clean cuts. A 1-in. blade body height provides the rigidity and stability needed for straight cuts with less vibration. In addition, the product is equipped with Perma-SHIELD that resists heat build-up by protecting the blade against gumming and corrosion.

Diablo



Cutting Pliers

The cutting pliers provide users with easy cuts and feature an optimized pivot point design that gives maximum leverage to cut through tough materials. The product is offered in comfort grip with lanyard hole and dipped grip with a splitting hole and are tether-ready for complete tie-off while working on the job site. Lineman's Pliers feature a reaming head for ½-in. to 1-in. conduit. Select models include an integrated crimper for insulated and non-insulated terminals, #6 and #8 bolt cutters, and straight fish tape puller or an integrated thread cleaner. Long-nose pliers are designed to deliver an optimized grip, featuring cross-hatched, laser-hardened teeth for maximum grip in pulling or twisting applications. They also feature a fish tape puller and a reaming head for ½-in. to 1-in. conduit.

Milwaukee Tool

Reciprocating Blade

The WAVE EDGE reciprocating saw blade features a tooth form design that utilizes a 3-stage tooth formation to help improve cutting life, according to the company. The thin blade design is ideal for making quick cuts through a range of metal types and gauges. The product comes equipped with a high-speed steel cutting edge and spring steel backing that helps strengthen the blade, reduce breaks, and provide durability.

LENOX



Crimping Pliers

The CRIMPFOX DUO 16S crimping pliers allow front or side entry of the ferrule, so they are flexible for use in different locations. The pliers are the latest addition to the TOOL fox product line. It is designed for insulated and uninsulated single ferrules from 24 AWG to 6 AWG and twin ferrules up to 10 AWG. According to the company, the crimping die provides a square crimp profile, and the ergonomically shaped and ratcheting handles reduce the amount of force required.

Phoenix Contact



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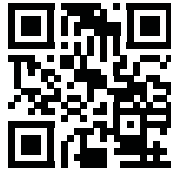
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Temporary Installations

Do you understand how the requirements for temporary installations differ from the requirements for permanent installations?

By Mike Holt, NEC Consultant



Fig. 1. If you have a temporary installation, you don't just apply the requirements of Art. 590 and consider the installation Code-compliant. Instead, you apply the relevant requirements of Chapters 1 through 4, and check Art. 590 for modifications of those.

Based on the 2020 NEC.

Article 590 addresses the practicality and execution issues inherent in temporary installations, making them less time consuming to install and remove.

The requirements of Art. 590 apply to temporary power and lighting installations/removals, including power for construction, remodeling, maintenance, repair, demolition, and decorative lighting.

This Article also applies when temporary installations are necessary during emergencies or for tests and experiments [Sec. 590.3(C)]. But you can't use temporary wiring just anywhere. It's permitted for only:

- Construction, remodeling, maintenance, repair, or demolition of buildings, structures, or equipment.
- Activities like the preceding.
- Emergencies.
- Tests, experiments, and developmental work.

Temporary installations for carnivals, circuses, fairs, and similar events must be installed per Art. 525, not Art. 590.

After the construction is completed, emergency has passed, etc., you no longer require the temporary wiring. The justification for installing it is gone, so you must remove it [Sec. 590.3 (D)].

Temporary electrical power for decorative holiday lighting and similar

purposes is permitted for a period of up to 90 days. Once that clock runs out, you must remove the temporary electrical power [Sec. 590.3(B)].

NOT A REPLACEMENT

Temporary wiring methods are acceptable only if approved by the authority having jurisdiction based on the conditions of use and any special requirements of the temporary installation [Sec. 590.2(B)].

Article 590 does not replace Chapters 1 through 4 of the NEC for temporary installations. If you have a temporary installation, you don't just apply the requirements of Art. 590 and consider the installation Code-compliant. Instead, you apply the relevant requirements of Chapters 1 through 4, and check Art. 590 for modifications of those [Sec. 590.2(A)] (**Fig. 1**).

If installing a temporary service, you must do so per Parts I through VIII of Art. 230 as applicable [Sec. 590.4(A)].

If installing temporary feeders, you must provide overcurrent protection per Sec. 240.4 and Sec. 240.5 [590.4(B)]. If installing temporary branch circuits, you must provide overcurrent protection per Sec. 240.4 and Sec. 240.5 [Sec. 590.4(C)].

For feeders and branch circuits, you can use only these wiring methods:

(1) Type NM cable, Type SE cable, and flexible cords. You can use these in a building without height limitations or limitations by building construction type. Nor do you have to conceal them within walls, floors, or ceilings; they will be easier to remove if you don't.

(2) Type SE cable. You can install it underground if you install it in a suitable raceway.

RECEPTACLES

On a construction site, receptacles are not permitted on a branch circuit that supplies temporary lighting [Sec. 590.4(D)(1)]. This requirement is necessary so illumination is maintained, even when the receptacle's GFCI-protective device opens.

15A and 20A receptacles installed in a wet location must be within an enclosure that is weatherproof when an attachment plug is inserted [Sec. 590.4(D)(2)]. The outlet box hood must be listed for extra-duty use. Nonlocking-type receptacles in a wet location must be listed as weather-resistant [Sec. 406.9(B)(1)].

Though the NEC doesn't specify how many receptacles you need in a given area, you should put some thought into having enough that people don't have to play portable cord games just to get their work done. For example, instead of a bank of receptacles in one central location,

strategically run branch circuits out to where power is needed or is likely to be needed.

DISCONNECTING MEANS

Install suitable disconnecting switches or plug connectors to permit disconnecting all ungrounded conductors of each temporary circuit [Sec. 590.4(E)]. If multiwire branch circuits are installed, they must disconnect all ungrounded conductors simultaneously; you can use identified handle ties for this purpose.

LAMP PROTECTION

Lamps (bulbs) must be protected from accidental contact by a suitable luminaire or lampholder with a guard [Sec. 590.4(F)]. This requirement is less of a burden if you use LED luminaires since the lamps themselves are at 5V and don't run hot. Best results in both safety and energy efficiency are achieved by using an integrated LED

lighting product rather than a retrofit lamp screwed into a fixture designed for incandescent.

SPLICES

A box, conduit body, or other enclosure (with a cover installed) is required for all splices [Sec. 590.4(G)].

Exception No. 1: On construction sites, a box is not required if the circuit conductors being spliced are all from:

(1) *Nonmetallic multiconductor cord or cable assemblies, if the equipment grounding continuity is maintained with or without the box.*

(2) *Metal-sheathed cable assemblies terminated in listed fittings that mechanically secure the cable sheath to maintain effective electrical continuity.*

Exception No. 2: On construction sites, a box is not required for GFCI-protected branch circuits that are permanently installed in framed walls and ceilings and are used to supply temporary power or lighting.



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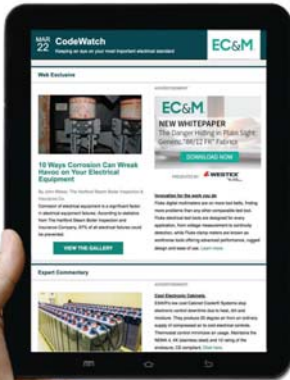
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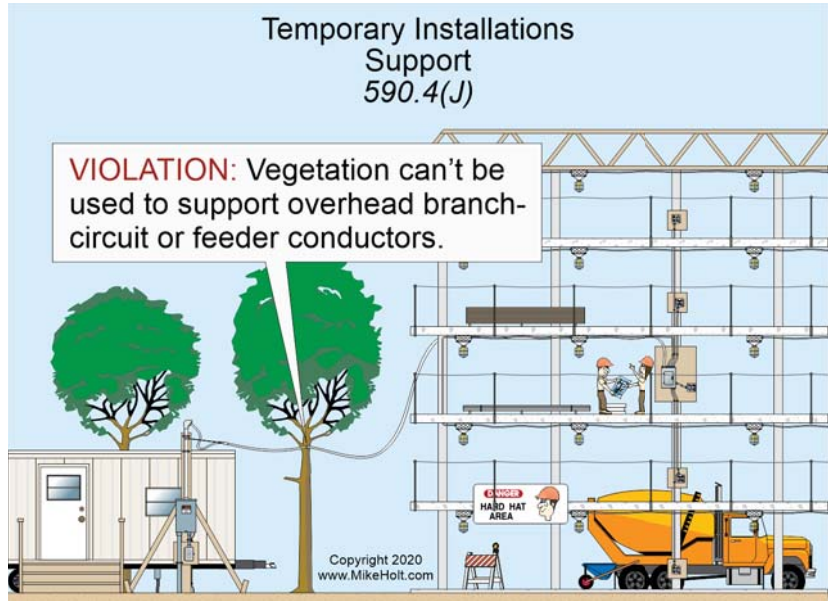


Fig. 2. The support requirement for temporary cables is determined by the authority having jurisdiction based on the job-site conditions.

- (1) A box cover is not required for splices installed completely inside of junction boxes with plaster rings.
- (2) Listed pigtail-type lampholders can be installed in ceiling-mounted junction boxes with plaster rings.
- (3) Finger-safe devices are permitted for supplying and connecting devices.

PHYSICAL PROTECTION

Cables and flexible cords must be protected from physical damage and from sharp corners and projections when the cables and flexible cords pass through doorways or other pinch points [Sec. 590.4(H)]. Cord protectors and related products are available for this purpose; don't rely totally on that roll of duct tape.

Cable assemblies and flexible cords must be supported at intervals that ensure protection from physical damage [Sec. 590.4(J)]. Support must be in the form of staples, cable ties, straps, or other similar means designed not to damage the cable or flexible cord assembly. Flexible cords (other than extension cords) are not permitted to lie on the floor or the ground when used as branch circuits or feeders.

The support requirement for temporary cables is determined by the authority having jurisdiction based on the job-site conditions. You can't use vegetation

to support overhead branch-circuit or feeder conductors [Sec. 590.4(J)] (**Fig. 2**).

GFCI PROTECTION

GFCI protection is required for receptacles used for construction, remodeling, maintenance, repair, or demolition of buildings, structures, or equipment [Sec. 590.6(A)].

GFCI protection is required for:

- 15A, 20A, and 30A receptacles that are not part of the permanent wiring of the building. Section 590.6(A) requires 125V and 125/250V, 15A, 20A, and 30A receptacles to have GFCI protection. Section 590.6(B) requires all other receptacles used on temporary installations to be GFCI protected. This simply means all 125V and 125/250V receptacles used for temporary power require GFCI protection.
 - 15A, 20A, and 30A receptacles that are being used as temporary power but are part of the permanent wiring of the building. Listed flexible cord sets or devices that incorporate listed GFCI protection can be used in addition to the required GFCI receptacles.
 - 125V and 125/250V, 15A, 20A, and 30A receptacles that are part of a portable generator rated not greater than 15kW.
- Receptacles other than those covered by Sec. 590.6(A)(1) through

(A)(3) that supply temporary power used by personnel during construction, remodeling, maintenance, repair, or demolition of buildings, structures, equipment, or similar activities.

OVERCURRENT PROTECTIVE DEVICES

Where previously used overcurrent protective devices are installed in a temporary installation, they must be examined [Sec. 110.3(A)] to ensure they have been properly installed/maintained and that there is no evidence of impending failure [Sec. 590.8(A)].

The phrase “evidence of impending failure” means there is evidence such as arcing, overheating, loose parts, bound equipment parts, visible damage, or deterioration. The phrase “properly maintained” means the equipment has been maintained per the manufacturer’s recommendations and applicable industry codes and standards.

References for manufacturers’ recommendations and applicable industry codes and standards include:

Remember that mistakes with temporary installations can have permanent consequences.

- NEMA AB 4, *Guidelines for Inspection and Preventative Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications.*
- NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance.*
- NEMA GD, *Evaluating Water-Damaged Electrical Equipment.*

• IEEE 1458, *IEEE Recommended Practice for the Selection, Field Testing, and Life Expectancy of Molded-Case Circuit Breakers for Industrial Applications.*

Overcurrent protective devices for 277/480V services must be of the current-limiting type [Sec. 590.8(B)].

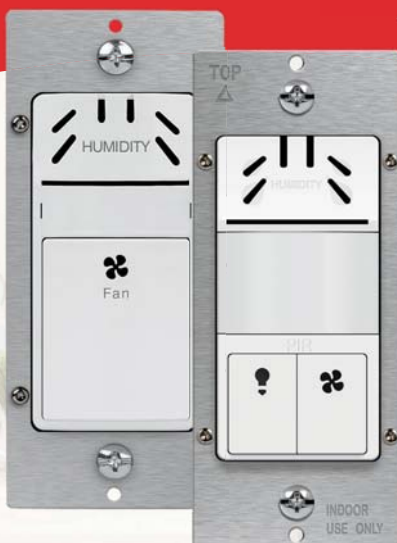
DIFFERENT, NOT LOWER

Remember that mistakes with temporary installations can have permanent consequences. It is a common misconception that temporary wiring represents a lower standard of wiring than permanent wiring. In truth, it merely meets a different standard. The same rules of workmanship, ampacity, and overcurrent protection apply to temporary installations as to others. **EC&M**

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Stumped by the Code?

By Mike Holt, NEC Consultant

All questions and answers are based on the 2020 NEC.

Q. What are the NEC rules related to the mixing of conductors of different systems in the same raceway, cable, or enclosure?

A. These requirements are outlined in Sec. 300.3(C).

(1) Mixing. Power conductors rated 1,000V or less can occupy the same raceway, cable, or enclosure if all conductors have an insulation voltage rating not less than the maximum circuit voltage (see **Figure**).

Author's comment: Control, signaling, and communications wiring must be separated from power and lighting circuits so the higher-voltage conductors do not accidentally energize the control, signaling, or communications wiring. Reference the following Sections of the Code:

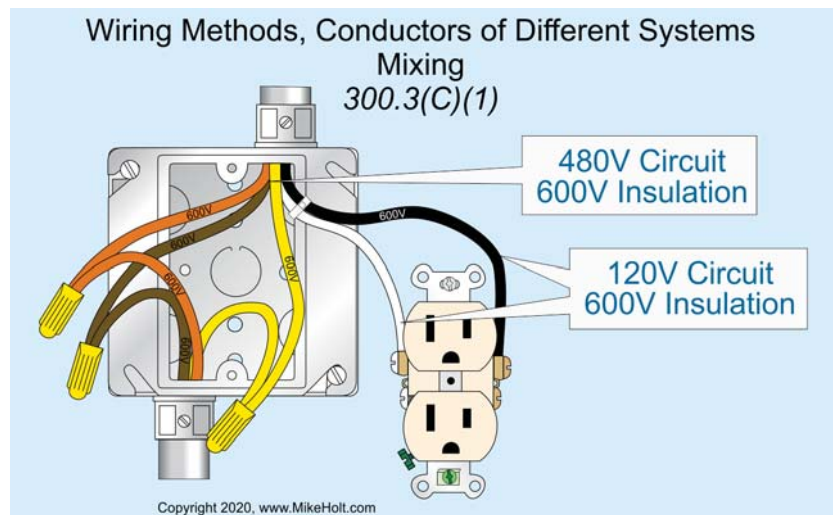
- Class 1 control circuits [Sec. 725.48]
- Class 2 control circuits [Sec. 725.136(A)]
- Communications circuits [Sec. 808.133(A)(1)(c)]
- Coaxial cable [Sec. 820.133(A)]
- Fire alarm circuits Sec. 760.136(A)]
- Sound circuits [Sec. 640.9(C)]

Q. What is the definition of shore power for marinas?

A. As shown in Sec. 555.2, shore power is defined as the electrical equipment required to power a floating vessel including, but not limited to, the receptacle and cords.

Q. What are the Code rules relating to the protection of conductors as they exit raceways?

A. Raceways containing insulated circuit conductors 4 AWG and larger that enter a cabinet, box, enclosure, or raceway, must have the conductors protected as follows [Sec. 300.4(G)]:



Power conductors rated 1,000V or less can occupy the same raceway, cable, or enclosure if all conductors have an insulation voltage rating not less than the maximum circuit voltage.

(1) A fitting providing a smoothly rounded insulating surface.

(2) A listed metal fitting that has smoothly rounded edges.

Ground-fault circuit-interrupter (GFCI) protection must be provided as required in Sec. 210.8(A).

(3) Separation from the fitting or raceway using an identified insulating material securely fastened in place.

(4) Threaded hubs or bosses that are an integral part of a cabinet, box, enclosure, or raceway that provide a smoothly rounded or flared entry for conductors.

Author's comment: If an intermediate metal conduit (IMC) or rigid metal conduit (RMC) enters an enclosure without a connector, a bushing must be provided

regardless of the conductor size [Sec. 342.46 and Sec. 344.46].

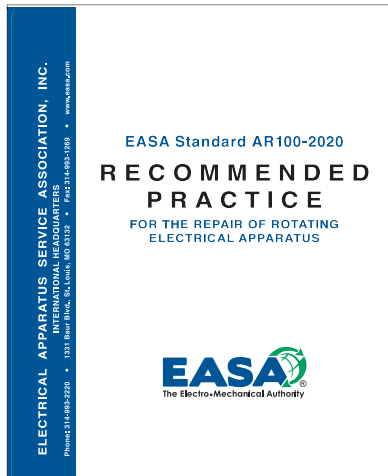
Q. What are the Code requirements for GFCI protection in mobile homes and manufactured homes?

A. Ground-fault circuit-interrupter (GFCI) protection must be provided as required in Sec. 210.8(A). GFCI protection is not required for other than 125V, 15A and 20A receptacles installed within a mobile or manufactured home in the following areas [Sec. 550.13(B)]:

- (1) Compartments accessible from the outdoors.
- (2) Bathroom areas.
- (3) Kitchens, where receptacles are installed to serve countertop surfaces.
- (4) Sinks, where within 6 ft from the top inside edge of the sink.
- (5) Dishwasher outlets. **EC&M**

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Illustrated Catastrophes

By Russ LeBlanc, NEC Consultant

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

LOUSY LIGHT FIXTURE WIRING



Henry Caratura was kind enough to share this photo with us. He found this on a rehab job where he rewired the whole house. “When the plug is plugged in, the outside light comes on,” says Caratura. While this may be a quick and easy way to provide power to the outside light, it certainly does not mean this installation is Code-compliant or safe. While Sec. 400.10(A)(2) does permit flexible cords and flexible cables for wiring of luminaires, Sec. 400.12(1)-(7) imposes many restrictions on the use of flexible cords, flexible cables, cord sets, and power supply cords, including: (1) As a substitute for fixed wiring; (2) Where run through holes in walls, ceilings, or floors; and (5) Where concealed by walls, floors, or ceilings. It seems like all those restrictions were ignored here. Another concern I have is the lack of connection to an equipment grounding conductor (EGC) for the outside luminaire. If the luminaire is metal, Sec. 410.42 requires either a connection to an EGC or a listed system of double insulation. After seeing this photo, I have a feeling neither of those options was implemented here.

OVERPACKED PANELBOARD

Thomas Carlins, P.E., LC for Carlins Consulting LLC of Pittsburgh, shared this photo with us. “The panel looks innocent from the front (except for the tandem circuit breakers),” says Carlins. “When I took the cover off, I discovered a 2-pole circuit breaker in the bottom gutter of the panel. It was hot and in use. We are now including the replacement of the panelboard in the construction documents.” Thomas, I think replacing this panelboard is a great idea. Panelboards must not have more overcurrent devices than the amount for which the panelboard is designed, rated, and listed. Installing too many overcurrent devices is a violation of Sec. 110.3(B). Section 408.54 requires a panelboard to be provided with means to prevent the installation of too many overcurrent devices. The free-floating breaker in the bottom of the enclosure is very dangerous, since this type of device is designed to be plugged onto the busbars of the panelboard. This type of installation is a recipe for poor connections and an elevated risk of fire and shock. Misusing this breaker in this manner is also another violation of Sec. 110.3(B).



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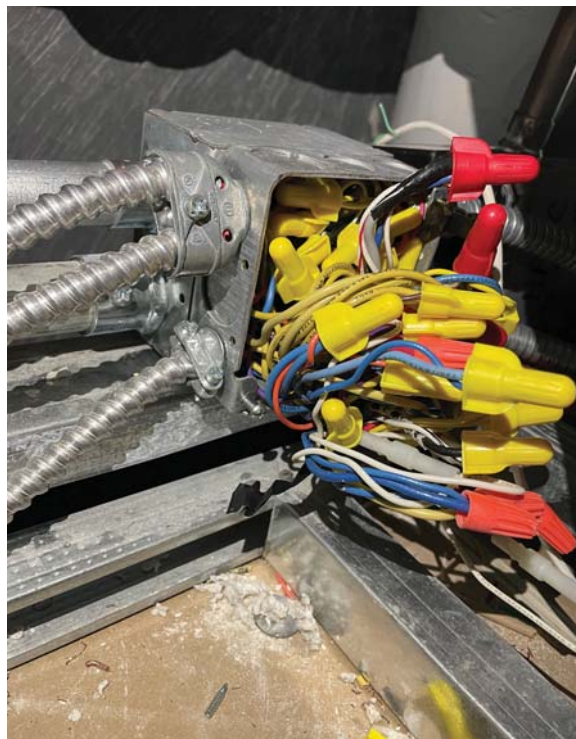
By Russ LeBlanc, NEC Consultant

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

Hint: I demand a recount.

— 'TELL THEM WHAT THEY'VE WON...' —

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



JULY WINNERS



Our winners this month were: John Barnhart, retired master electrician, IBEW L.U. 58 of Warren, Mich.; Cameron Milloy, academic coordinator/journeyman electrician, A.J. Kirkwood & Associates, Inc. of Fullerton, Calif.; and David Heath, Waccamaw Electric Company, Inc., Whiteville, N.C. They were all able to correctly cite Code violations with this installation.

For wet locations, Sec. 406.9(B)(1) requires these receptacles to be installed in an enclosure that is weatherproof whether or not an attachment plug is inserted. The type of cover installed here is only weatherproof when closed. This same Section of the NEC requires these receptacles to be listed and identified as weather-resistant (WR) type receptacles. Outlet box hoods for this type of installation must be "extra duty" rated. The box is not properly supported either. Section 314.23(F) requires enclosures containing devices such as receptacles or supporting a lampholder/other equipment to be supported by two or more conduits threaded into the enclosure. There are two exceptions to this general rule, but neither is applicable here. Section 352.12(B) prohibits using rigid PVC conduits for support of luminaires or equipment other than nonmetallic conduit bodies.

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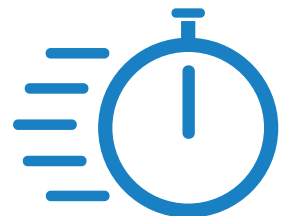
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