

AN ANNEX PUBLISHING & PRINTING INC. PUBLICATION • VOLUME 49 • ISSUE 3

# Electrical Business

MARCH 2013

A new  
electrical box  
for ICF  
is on  
page 5.

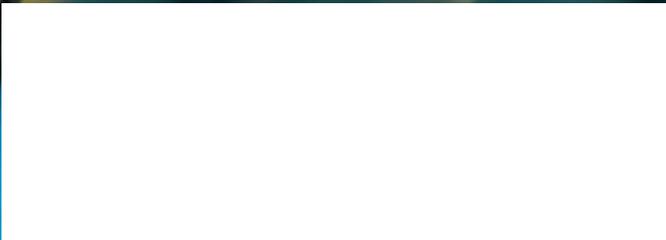


# Taming MISCHIEVOUS motors

### ■ Also in this issue...

- Arc-resistant IR windows
- CEC Rule 4-006 and CSA product standards
- The power of oscilloscopes

PM # 40065710



## ENERGEX® EXTRA – Own the Power

Nexans MV Cable with DOW ENDURANCE™

HFDC-4202 EC insulation

- Excellent TR-XLPE Performance
- Extended MV Cable Life
- Lower Life Cycle Cost



 **Nexans**  
www.nexans.ca

©™ ENDURANCE and the Dow Diamond are trademarks of The Dow Chemical Company



Made in Canada 



# IPEX NEW PRODUCTS FROM IPEX ELECTRICAL SYSTEMS

## Universal F Series Double Gang Boxes and Covers



Scepter® F Series double gang boxes, weather-proof covers and cover plates have been redesigned for universal compatibility with any industry

standard double gang box or cover. CSA approved, the new universal boxes and covers are easy to use, have more internal wiring space and include reducer bushings to accommodate various sizes of conduit. All the weatherproof covers have been designed to ensure a watertight seal using a new foam gasket, with an adhesive layer for ease of installation.

## Round Floor Box and Stand



Simple yet innovative, the new Round Floor Box Stand is designed to raise the Round Floor Box off the concrete form allowing the ENT or

conduit to enter the Box in a flat and straight path. Installed together, the Floor Box and Stand accommodates the different rebar and post-tensioned cable heights and slab depths found from job-site to job-site.

Sold as a kit, IPEX Electrical offers the Round Floor Box and Stand conveniently packaged together as one complete product offering.

## SceptaCon Trenchless Raceway for Traffic Signal & Street Lighting



The new 2" SceptaCon is ideally suited for street lighting and traffic signal cables where installation requires a smaller diameter pipe than your

typical electrical raceway. Now contractors can install RW cables instead of the more expensive TECK cables required with the use of HDPE pipe.

**For more information call  
Toll Free: 1-866-473-9462  
or visit  
[www.ipexelectrical.com](http://www.ipexelectrical.com)**

Products manufactured by IPEX Electrical Inc.

Kwikon® is a trademark of IPEX Branding Inc.

# Dual Mounting System from Kwikon



## Slab Box Installation Made Easy

Designed to withstand tough jobsite environments, Kwikon® ENT slab boxes are nonmetallic, nonconductive and noncorroding. All Deep Round Series slab boxes feature our new CORNER MOUNTING TABS. These uniquely positioned corner tabs allow contractors to easily nail Kwikon slab boxes to the slab deck. The angled design guides the nail to be positioned inside the fixture's trim cover, reducing the threat of visible rust bleeding through the finished ceiling.

- Approved for support of ceiling fans up to 35 lbs and luminaries up to 50 lbs
- Corner and traditional mounting tabs offer contractors two options when installing to the slab deck
- Angled design guides the nail into position within the trim cover area
- Ready to install – no assembly required

Toll Free: 866-473-9462 | [www.ipexelectrical.com](http://www.ipexelectrical.com)

Products are manufactured by IPEX Electrical Inc.



## EPR Kit Adapters make Duct repairs quick & easy!



New Adapters for our EPR Conduit Repair Kits allow contractors to repair a broken section of DB-II duct while leaving the cables inside and restoring the duct to its original form. The

pre-cut adapters easily open around existing cabling to make repairs quickly and effectively, reducing end-user downtime and complaints, and saving contractors time, labour and money.

## The Perfect Expansion Fitting for Short Runs!



The One Piece Expansion Joint (OPEJ) is designed to accommodate thermal expansion and contraction on shorter runs of PVC Conduit. The efficient design of

the One Piece Expansion Joint provides fast trouble-free installation and will ensure the owner receives a secure and appealing installation that will last the life of the system.



## The story of Eli

**You never know when technology is going to put you out of a job.**

**R**ather than bother with traffic and airport parking, I will often leave the driving to someone else by arranging airport transportation with a local van shuttle service. Much like cabbies, the drivers often have interesting stories to tell... we only have to care enough to listen.

The driver on my latest trip was 63-year-old Eli (not his real name), who started his working career back in the late 1960s/early 1970s as a projection technologist, which used to be a bona fide skilled trade. He attended trade school for several years, and served an apprenticeship before he could write his exam and get his ticket.

He operated and maintained projection equipment for Famous Players theatres for 30-odd years. The company was later acquired by Cineplex Odeon, which closed down a number of theatres—and Eli was out of work.

He said he made a good living as a projection technologist, but now drives a shuttle van for minimum wage, adding that 2013 is the last year movie theatres will show anything on film, as everything goes completely digital next year. And he has only a few years left of driving the shuttle: when he reaches 67, the cost to insure him will skyrocket, and the company will let him go.

“30-40 years ago, I figured so long as they keep making movies, I’ll always have a job,” Eli mused, adding, “You never know when technology is going to put you out of a job.”

I am sure Eli’s story is not unique. We’ve all likely met or know an Eli, if not several, and their stories always trouble me. I find myself wondering: In those 30-odd years working as a projection technologist, did you do nothing to upgrade your skills? Did you not read industry literature to learn about technologies on the horizon? How could you have been completely caught off guard?

We already know about death and taxes, but Change is also a sure thing in life. And while numerous so-called ‘consultants’ and ‘visionaries’ conduct expensive workshops on Change Management, I’d like to see someone talk about Change Preparation. Rarely does Change happen by surprise: when all incandescent bulbs are banned and replaced by LEDs, OLEDs or something else, will anyone actually scratch their head and cry they never saw this coming?

If you’re the kind of person who assumes nothing ever changes, you won’t read up on the literature (like EBMag), nor attend industry conferences, distributor events or tradeshow. You’ll eventually discover you cannot do the kind of work your clients expect. What will you do then... drive me to the airport? **EB**

*Anthony Caplan*



On the cover and page 10

### Taming mischievous motors

Given the number of motors in most plants, it’s not surprising they sometimes behave mischievously. Don’t get stumped by these three problem behaviours.

## Contents

### 12 Unlocking the power of oscilloscopes

We’ve all heard that preventive maintenance is better than post-failure response, and keeping good records will enhance your capability to keep things running smoothly. This article looks into how the oscilloscope, which takes voltage readings and displays the information graphically, can help you achieve that.



### 15 Dispelling the myth of arc-resistant IR windows

There exists a dangerous misconception regarding the arc rating of infrared (IR) windows or viewing panes. Many reliability and maintenance professionals are under the impression that an IR window will protect them in the event of an arc blast; still others are under the impression that installing IR windows will turn non-arc-rated switchgear or electrical equipment into arc-rated cabinets. So which is true?



## DEPARTMENTS

- 4 Letters
- 4 Industry News
- 7 Mind Your Safety  
Handling mine trailing cables (Part 3)
- 8 From the Legal Desk  
Whither Eichleay in Canada?
- 18 Personalities
- 19 Products & Solutions
- 21 Calendar
- 22 Code File  
CEC Rule 4-006 and CSA product standards
- 22 The Code Conundrum



page 19

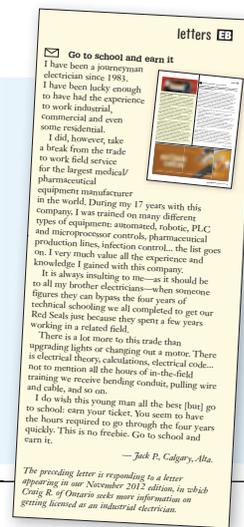


page 20

**Big thanks to Jack P. of Calgary, Alta.**

... who wrote in with what we feel was the best letter (January 2013, page 7 “Go to school and earn it”) addressing Craig R.’s letter of November 2012 edition, in which the latter seeks more information on getting licensed as an industrial electrician.

For his efforts, EBMag and our friends at Milwaukee Tool are sending him a cool prize pack, with items such as a 21-pc Thunderbolt Black Oxide drill bit set, 8-in. reaming pliers, Tapcon screw installation kit, and Jobsite Armor fingerless work gloves. Be sure to visit MilwaukeeTool.com to learn more about all their professional tool offerings.



**EB industry news**

**Philips, Schneider, Siemens and GE among Global 100 most sustainable corporations**

Corporate Knights recently announced its Global 100 list of the world’s most sustainable corporations, and included in that list are some familiar names: Philips Electronics NV (#7, www.philips.com); Schneider Electric SA (#13, www.schneider-electric.com); Siemens AG (#31, www.siemens.com); and General Electric Co. (#51, www.ge.com). Congratulations!

“The Global 100 are leading a resource productivity revolution, transforming waste into treasure and doing more with less. They are steering our civilization away from ecological overshoot and back to a place of balance with our planet,” said Toby Heaps, Corporate Knights CEO.

The Global 100 consists of the 100 top-performing stocks worldwide on a range of sector-specific sustainability metrics. In aggregate, the Global 100 had revenues of \$3 trillion US and a workforce of nearly 5.3 million in 2011.

On carbon, water, energy and waste, the Global 100 are on track to double their resource productivity by 2025 in two-thirds of the cases and, in an era of peak commodity prices, this makes as many dollars as it does sense.”

**Take Centre Stage! EBMag’s “Partners in Training” 2013 Calls for Presenters**



Electrical Business Magazine (along with sister publications Plant Engineering & Maintenance and Resource Engineering & Maintenance [PEM & REM])

has announced the dates and locations for its 2013 “Partners in Training” events, and we want you to take centre stage!

Launched last fall, Partners in Training events (www.partnersintraining.ca) combine a series of educational training seminars with a tradeshow profiling the newest products and services for the benefit of delegates who are serious about workplace production and uptime. The 2013 dates/locations are:

- **May 14:** TCU Place, Saskatoon, Sask.: “Shutdowns & Turnarounds”
- **June 18:** Holiday Inn Harbourview Halifax, Dartmouth, N.S.: “Electrical Maintenance & Reliability”
- **September 24:** Holiday Inn, Sudbury, Ont.: “Shutdowns & Turnarounds”
- **October 17:** Apollo Convention Centre, Mississauga, Ont.: “Electrical Maintenance & Reliability”

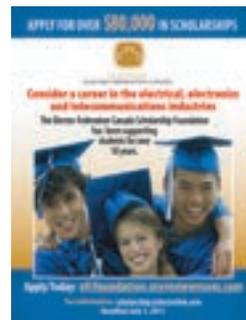
Are you a subject matter expert? For more information, and to pitch a speaking topic, contact Partners in Training’s program manager, Anthony Capkun, at acapkun@annexweb.com or call (905) 717-6421.

For sponsorship and exhibiting opportunities, contact:

- Peter Helston, (905) 726-4666, phelston@annexweb.com
- Scott Hoy, (905) 726-4664, shoy@annexweb.com
- Leesa Nacht, (905) 713-4372, lnacht@annexweb.com
- John MacPherson, (905) 713-4335, jmacpherson@annexweb.com

**\$80,000 in Scholarships UP for GRABS in 2013 EFC Scholarship**

Electro-Federation Canada (EFC, www.electrofed.com) is now accepting applications for the 2013 EFC Scholarship Foundation program, which provides Canadian post-secondary students with funding support for their education.



Visit bit.ly/ZjwAYm to see our VIDEO about the program.

“The industry is challenged with recruiting talent and meeting succession planning needs. The Scholarship Foundation is focused on improving the availability of talent for its member companies and on creating awareness of the career opportunities within its flourishing industry,” said Tim Horsman, 2013 chair of the EFC Foundation and president of E.B. Horsman & Son.

Applications for the 2013 program will be accepted until July 1, 2013. Visit efcfoundation.myreviewroom.com to apply.

Scholarships are awarded to post-secondary students studying in an electrical or electronics concentration, including electrical apprenticeship, electrical engineering technology, electrical technician, electrical engineering, supply chain management or business administration. Scholarships are also awarded on the basis of academic achievement, areas of study, leadership, and career interests.

Supporting students for 18 years, the EFC Foundation Scholarship Program encourages Canadian youth to pursue a career in the electrical, electronics and telecom industries. To date, EFC says it has invested over \$600,000 in the post-secondary technical training and education.

**Electrical Business**

March 2013 • Volume 49 • Issue 3

ELECTRICAL BUSINESS is the magazine of the Canadian electrical community. It reports on the news and publishes articles in a manner that is informative and constructive.

**Editor**

Anthony Capkun - acapkun@annexweb.com

**Group Publisher**

John MacPherson - jmacpherson@annexweb.com

**Account Manager**

Scott Hoy - shoy@annexweb.com

**Associate Editor**

Alyssa Dalton - adalton@annexweb.com

**Art Director**

Svetlana Avrutin - savrutin@annexweb.com

**Production Manager**

Kathryn Nyenhuis - knyenhuis@annexweb.com

**Subscriber Customer Service Representative**

Marie Weiler - mweiler@annexweb.com

**President**

Mike Fredericks - mfredericks@annexweb.com



Published by Annex Publishing & Printing Inc.  
222 Edward Street, Aurora, Ontario L4G 1W6  
Tel. 905-727-0077 • Fax 905-727-0017

Publication mail Agreement #40065710  
Return Undeliverable Canadian Addresses to Circulation Department  
P.O. Box 530, Simcoe, ON N3Y 4N5  
e-mail: mweiler@annexweb.com

United States Second Class Postage paid at Lewiston, NY (USPS-741-470) US POSTMASTER: Send address changes to ELECTRICAL BUSINESS, P.O. Box 8145, Lewiston, NY 14092

Printed in Canada  
ISSN 0013-4244

CIRCULATION: Marie Weiler  
e-mail: mweiler@annexweb.com  
Tel: 1-866-790-6070 • Fax: 1-877-624-1940  
Mail: P.O. Box 530, Simcoe, ON N3Y 4N5

**SUBSCRIPTION RATES:**  
**Canada:** Single issue \$7.00  
12 issues: \$35.00 (includes tax)  
**USA:** \$59.00 (US)  
**International:** \$75.00 (US) per year

Occasionally, *Electrical Business* will mail information on behalf of industry-related groups whose products and services we believe may be of interest to you. If you prefer not to receive this information, please contact our circulation department in any of the four ways listed above.

The contents of *Electrical Business* are copyright ©2013 by Annex Publishing & Printing Inc. and may not be reproduced in whole or part without written consent. Annex Publishing & Printing Inc. disclaims any warranty as to the accuracy, completeness or currency of the contents of this publication and disclaims all liability in respect of the results of any action taken or not taken in reliance upon information in this publication.



**NETCO developing Electric Vehicle Infrastructure Training Program for Canada**

The National Electrical Trade Council (NETCO, [www.cecacouncil.org/netco](http://www.cecacouncil.org/netco))—the joint training arm of the Canadian Electrical Contractors Association (CECA, [www.cecacouncil.org](http://www.cecacouncil.org)) and IBEW First District, Canada ([www.ibew1st.org](http://www.ibew1st.org))—is developing a Canadian Electric Vehicle Infrastructure Training Program (Can-EVITP) in partnership with EVITP in the States.

Can-EVITP will provide the EV transportation sector of the electrical industry and its stakeholders a structured platform to facilitate training and certification for the installation of EVSE (electric vehicle supply equipment) across residential and commercial/public markets.

“It will assist the electrical contracting industry in accessing training and certification based on national standards and embracing emerging electric technologies early,” said NETCO treasurer Eryl Roberts.

With the assistance of a Can-EVITP Curriculum Committee, work is underway to adapt the American EVITP curriculum to the Canadian context. In June 2013, a train-the-trainer program will be pilot-tested by the Electrical Joint Training Committee (IBEW, Local 213 and Electrical Contractors Association of British Columbia [ECABC]) under the direction of training director Andy Clevin. A second train-the-trainer program will be delivered shortly afterward by the Ontario Electrical Industry Training Centre under the direction of training coordinator Peter Olders.

“We are pleased with the degree of industry support demonstrated by the talent recruited for NETCO’s National Can-EVITP Advisory Committee and Curriculum Committee,” said NETCO president Phil Flemming.

Can-EVITP partners to-date include a range of players from coast-to-coast, including:

- British Columbia Institute of Technology (BCIT)
- Canadian Electrical Contractors Association
- Electrical Contractors Association of Ontario (ECAO)
- Electrical Joint Training Committee (IBEW, Local 213 & Electrical Contractors Association of British Columbia)

- Electrical Industry Training Centres of Alberta
- IBEW, First District Canada
- IBEW Local 353
- IBEW Local 586
- Joint Apprenticeship & Training Committee, IBEW Local 625
- Joint Apprenticeship & Training Committee, IBEW Local 502
- Toronto Joint Apprenticeship Council

- Ontario Electrical Industry Training Centre
  - Roberts On-site Inc.
  - Robertson Bright Inc.
- The National Electrical Trade Council (NETCO) is a joint labour-management partnership of the IBEW First District, Canada and the Canadian Electrical Contractors Association (CECA).



More **news** can be found online. Visit us at **EBMag.com**

**Solutions for residential construction.**

**Introducing the Iberville® LMS™ box. The new standard for Insulated Concrete Form (ICF) construction.**

All of the benefits of Iberville® steel boxes in a family of boxes designed specifically for ICF construction:

- Heavy-duty steel construction for maximum strength and durability
- 1-, 2-, 3- and 4-gang models AND an octagonal box
- One device box model (1- to 4-gang) can be used for both nonmetallic sheathed and armoured cable
- Installation after the concrete pour in any location, even next to supports
- Simple installation - no 'TEETH' to engage or remove
- Five screw positions - countersunk holes prevent screw heads damaging drywall
- CSA Certified
- Designed and manufactured in Canada

Request your free sample at [mrkt.canada@tnb.com](mailto:mrkt.canada@tnb.com). Complete details at [www.tnb.ca](http://www.tnb.ca).

**Thomas & Betts. Your best connection for innovative solutions.**

Wire & Cable Management • Cable Protection Systems • Power Connection & Control • Safety Technology

[www.tnb.ca](http://www.tnb.ca) **Thomas & Betts**

**Say Hello to Westinghouse Lighting Canada!**

Westinghouse Lighting (www.westinghouselighting.com) announced the establishment of Westinghouse Lighting Canada (WLC)—a joint venture with Combi Inc. (www.combiinc.com), a Montreal based sales and marketing agency.

Westinghouse says it currently sells products into Canada through distributors and retail partners, and Combi will remain Westinghouse Lighting's representative and third-party logistics provider. However, the purpose of this new company is to "provide superior products and services to Canadian customers, while positioning the company for growth in the distribution and retail markets".

"Our longstanding relationship with Tony Di Natale creates a natural expansion opportunity for Westinghouse Lighting. We believe that Combi's Canadian-market expertise combined with the experience and product assortment of our company provides a solid foundation to build upon for many years to come," said Ray Angelo, Westinghouse Lighting president and CEO.

Combi remains an independent entity supporting its current customers and manufacturers; WLC is a separate entity led by Tony Di Natale. Neither Combi nor Westinghouse business operations will be impacted by the establishment of this new entity, say the partners. WLC will have dedicated resources, including an office and distribution facility in Montreal.

"The establishment of Westinghouse Lighting Canada recognizes the great synergies that both companies have enjoyed, and is the evolution of a great relationship that will provide Canadians with quality lighting products and a brand that is trusted by consumers," said Di Natale.

**NAIT launches Trades to Degrees initiative to meet Alberta's needs**

The Northern Alberta Institute of Technology (NAIT, www.nait.ca) has launched what it calls one of the first pathways in North America—Trades to Degrees (www.nait.ca/35964.htm)—to allow certified tradespeople the opportunity to move directly from a trades certificate to the third year of a degree program.

"Trades to Degrees will be transformative," said Dr. Glenn Feltham, NAIT president and CEO. "By providing a direct pathway from trades certification to a degree, we're acknowledging the work experience and post-secondary education that led to certification. The pathway recognizes the value of what has been achieved by the tradesperson."

The pathway is a response to workforce demand for tradespeople with managerial, leadership and entrepreneurial skills, says NAIT.

Trades to Degrees was introduced in the 2012 fall semester through NAIT's JR Shaw School of Business, with an inaugural cohort of 22 students comprised mostly of NAIT instructors, who are helping to shape and define the pathway.

Under Trades to Degrees, certified tradespeople can be admitted directly into



PHOTO COURTESY NAIT.

Photo (left to right): NAIT provost and vice-president Academic, Dr. Paula Burns; Minister of enterprise and advanced education, Stephen Khan; Premier Alison Redford; NAIT board chair, James Cumming; NAIT president and CEO Dr. Glenn Feltham.

the third year of the Bachelor of Business Administration (BBA) program. The pathway will be expanded to other degree programs offered at NAIT.

"This is huge step forward for Alberta's students," said Premier Alison Redford. "They can enter the trades confidently, knowing that they have the best of both worlds—great jobs and opportunities for further post-secondary education. NAIT is opening these doors by helping people in the trades use their skills and experience to step into positions as managers and leaders in our economy."

**Hydro One first North American utility to launch innovative Asset Analytics tool**

Hydro One (www.hydroone.com) says it is the first North American utility to launch an "innovative, online, asset analytics tool", giving it the ability to make "more effective and prudent investment decisions". Electrical Business contacted the utility to learn more about this tool.

"This tool will help us increase reliability and value for our customers and ratepayers by directing our resources and investments to where they are most needed across the province," said Carmine Marcello, president and CEO of Hydro One. "It allows us to plan our work to ensure the highest asset risks are prioritized first, which will help manage the bulk of aging infrastructure that is affecting the entire utility industry." By using a combination of mapping software, asset condition and location information, and business intelligence, Hydro One says it can now instantly get "accurate, complete, cross-referenced, analyzed data".

The Asset Analytics tool was created with software firm Space-Time Insight. A system was created that grafts its own data onto Google Maps. The initial Wave 1 deployment gives Hydro One planners a real-time view of the condition of their assets on both distribution and



transmission systems. For example, when more information is needed about the assets associated with a specific circuit, a few clicks will take a Hydro One planner from a basic Google Earth view to the transmission line, right through to a crystal-clear view of the circuit.

The initial deployment of the asset analytics tool gives planners an onsite view of the condition of all poles, lines and stations across the province. The second wave of deployment will alert planners to the consequences should the asset fail. This provides the utility with a comprehensive view of operational risks and will shape decisions when it comes to the prioritization of investments.

The tool doesn't just allow us to see the circuit, says the Hydro One spokesperson, but it instantaneously provides valuable information such as circuit type, the asset class and, more importantly, the condition of the assets on this circuit. **EB**

**HAMMOND MANUFACTURING™**  
Quality Products. Service Excellence.

**Stainless Steel Enclosures**

Hammond gives you options

- Wide range of standard designs and sizes
- Large inventories of 304 and 316 SS products
- Flexible modification services program

Contact your Hammond Rep today or visit:  
**hammondmfg.com**

CAN 519.822.2960 | USA 716.630.7030 | sales@hammfg.com



# Handling mine trailing cables

## Part three

In my last column, I identified the parts of a cable determine where faults could happen: 1) the end junctions or terminations, 2) in the length of the cable where there is damage, 3) splices in the cable, and 4) in the length of the cable where there is no damage. Let's get to the last one, No. 4.

It is far more common to have an internal fault in the length: possibly a manufacturer's defect, but much more likely from external abuse. We have one client with many decades of operation, and we know its operators often abuse the cables during moving. Their procedure calls for safety hooks or loops to be put in at least two places on the cable a certain distance apart but, for ease and speed, they will often just put one loop around the cable and start pulling with the machine. I have had operators describe seeing the cable twisting and looping back on itself as this is happening, though the cable does not fail immediately.

The difficulty this creates is that operators know the cable can take a tremendous amount of abuse so, for their own efficiency, they abuse the cable. Abuse such as this will typically end up creating internal damage, as the flexing will eventually cause the cable to break down. It is difficult to convince a person to quit abusing cables when they've been doing it for years with no immediate failure.

Interestingly, although the acceptance test voltage might be 36kV on a 5kV cable, trying to intentionally fail the cable with either an AC or DC hipot would actually take well over 100kV. As we train mine operators about the dangers of these, we explain the type of damage that can happen in a cable, and what they should be watching for. It is a lot easier to do this in daylight, but they should be concerned anywhere close to a junction box or a splice. When faults

These are large extension cords and, when they are installed correctly and treated properly, then there is no more danger to them than touching a low-voltage cable.

are in the length of the cable, and operators do a visual inspection, moving a high-voltage trailing cable by hand would have a higher safety factor built into it than either a 120V or 600V cable.

It's important to evaluate the literature and the accidents to determine where the accident occurred. Many accidents have occurred where the victim was working at the junction box. Contact with a live system at the junction box does not apply to a risk in moving a mine trailing cable or touching it. A failure of a splice because it was poorly done also does not impact the danger of moving a perfectly good, undamaged cable in the length.

When I have operators tell me they've seen cable flashes (and they describe a huge flash), I always ask them, "How long ago was that?". I typically get the response, "About 10 years", which is a lifetime of technological change. Most clients now have very sensitive, high-speed relays that operate fast enough to minimize the arc flash.

Companies make the decisions on how they are going to operate their system but, at minimum, there should be the fastest relays as possible on the system, then train operators on the dangers and how to perform inspections. Then, they have to ensure inspections are done properly.

Where operators occasionally hand-bomb mine trailing cables, there are many protective products available. Some companies require rubber gloves and, while you cannot go wrong with them, they are truly annoying for continuous heavy work, worse in hot weather, and contaminants such as

tar sand can quickly destroy them. Many companies require ropes, slings and saddles properly spaced apart, but the abusers will continue to abuse them. There are D-rings that counter this with the proper bending radius in the design. Other companies will use insulated hook sticks or tongs, but dry conditions will quickly marginalize the insulating value.

We get both emotional and rational responses in our own instructor group. We have one very experienced substation electrician/electrical technologist who is absolutely adamant he would never touch the outside of a live 15kV cable. We have another instructor with the same credentials who just shakes his head and says it's just a big extension cord. Both of these men each have over 40 years of high-voltage field experience. Who is right? Actually, both.

The bottom line is, there is a tremendous amount of danger when you are dealing with high voltages and high currents. At the same time, these are large extension cords and, when they are installed correctly and treated properly, then there is no more danger to them than touching a low-voltage cable. But hey... that's a rational response.

Until next time, be ready, be careful and be safe. © **EB**

*Canada Training Group has been providing consulting services to industry since 1980; Dave Smith, the president, can be reached at [davesmith@canada-training-group.ca](mailto:davesmith@canada-training-group.ca). At [www.canada-training-group.ca](http://www.canada-training-group.ca), you will find this article (and others) to help support your own safety initiatives.*

Canadian manufacturer specializing in  
AC90 (Cu & Al) ACWU90, TECK90, NMD90

The Armoured Cable Specialists

**northern  
cables**  
INCORPORATED

P.O. Box 1564, 50 California Avenue, Brockville, ON K6V 6E6  
Tel: 613.345.1594 Fax: 613.345.3147 Toll Free: 1.888.524.5050

**getwired.**  
[www.northerncables.com](http://www.northerncables.com)



# Whither Eichleay in Canada?

## Formulas for home office overhead claims

It is a far too common scenario: a contractor's productivity is materially impacted—sometimes to a point where he sits idle—waiting to resume work on a project that has been delayed by another party. But while the project is stalled, the contractor's overhead costs continue to add up. The question then

becomes how to compensate the contractor for its unrecovered overhead costs and, in particular, how to calculate the compensation for extended overhead costs.

In American jurisprudence, the answer has often been found in the Eichleay formula. Designed to address this very scenario, the Eichleay formula calculates

the total project overhead and divides it by the number of days in the project to produce the rate for daily overhead costs. This daily amount is then multiplied by the number of days the project was delayed to generate an amount compensable to the contractor. In its purest form, it is a three step process:

1.  $\frac{\text{Billings on Delayed Project}}{\text{Total Billings during Project Period}} \times \frac{\text{Total Overhead for Project Period}}{\text{Total Project Overhead}} = \text{Total Project Overhead}$
2.  $\frac{\text{Total Project Overhead}}{\text{Number of Days in Project}} = \text{Daily Overhead Costs}$
3.  $\text{Daily Overhead Costs} \times \text{Number of Days Delay of Delay} = \text{Amount Claimed}$

The formula, therefore, seeks to calculate a daily overhead rate for the delayed project by using the billings for concurrent projects as a baseline indicator.

While the calculation is not exact, the Eichleay formula provides an approximation of the attributable overhead costs incurred as a result of any delay that was not the contractor's responsibility. Yet, while the Eichleay formula has gained some traction in Quebec jurisprudence, its status in other Canadian jurisdictions is far from certain.

In *Doran Contractors Ltd. v Russell (Township)* (1997), the Ontario Court of Justice upheld an arbitrator's decision *not to apply* the Eichleay formula, noting that it had not been formally endorsed within Canada. Although some critics have interpreted this to be a firm rejection of the Eichleay formula, all Doran truly established was that a decision-maker need not apply the formula when he does not think it appropriate.

By contrast, the Ontario Superior Court of Justice gave a rather cautious endorsement of the Eichleay formula 10 years later in *Bianchi Grading Ltd. v University of Guelph*. The court accepted the defendant's argument that the Eichleay formula, after being modified to "better fit the facts" of the case, was an appropriate measure of recovery of the contractor's overhead damages. Clearly, the formula has found at least some limited acceptance as a useful mechanism

for quantifying delay-related overhead costs.

Yet this cautious backing also demonstrates its potential weaknesses: in *Bianchi*, the original calculation proposed by the contractor included change orders, as opposed to just the original project figures. As the change orders included a component of overhead built into them, the result would have been a 22.5% overhead recovery that, when added to the original bid price, would have resulted in the contractor's overhead recovery being more than its total overhead for all of its projects for a year.

Rather than accept what it felt was an absurd result, the court modified the Eichleay formula to reflect the overhead margin that had been built into the original project pricing. In doing so, the court reasoned that the same overhead rate the contractor had felt was acceptable for the base contract should be applied for the period of delay. By tying the overhead recovery for the period of delay to the same overhead recovery on the base contract, the court found that a consistent overhead recovery rate of 4.5% produced a more just result.

By doing so, the court in *Bianchi* recognized the formula had been modified into something closer to the Hudson formula. Widely used in the United Kingdom, the Hudson formula relies on the overhead percentage as it appears in the contract to determine the overhead recovery for the period of delay. It is expressed:

$$\frac{\text{Percentage of Overhead in Contract}}{\text{Total Billings during Contract}} \times \frac{\text{Contract Price}}{\text{Contract Period}} \times \text{Period of Delay}$$

However, this formula assumes the percentage overhead estimated at the outset of the contract will remain constant throughout the delay period. As such, the Hudson formula may not reflect the actual overhead expenses incurred during the delay period.

In response to the shortcomings of the Hudson formula, the Emden formula uses the actual total overhead percentage for

all projects during the contract period to produce a less speculative figure. To determine the overhead percentage, all of the contractor's overhead costs are added to the total profit the contractor made during the contract period, then divided by the contractor's total billing during that same period. The remainder of the formula is then unchanged:

$$\frac{(\text{Total overhead} + \text{profit})}{\text{Billings during Contract Period}} \times \frac{\text{Contract Price}}{\text{Contract Period}} \times \text{Period of Delay}$$



## Take a step towards trade certification.

### Electrical Techniques:

Students gain a solid understanding of the various technical elements of the electrical trade and gain experience with trade regulations and practices – the first academic requirement of trade certification.

### Electrician Construction and Maintenance Apprenticeship:

This program teaches students high-level skills in power, lighting and central systems, and gives them hands-on experience during an 8- or 10-week work placement.

### Electrician Industrial Apprenticeship:

The industrial electrician powers, controls, and maintains Ontario's factories, plants, and industries. Students gain knowledge in state-of-the-art technologies and apply these skills during their apprenticeship.

Contact Humber for more information  
Michael Auchincloss, Program Coordinator  
416.675.6622 x78002  
michael.auchincloss@humber.ca



[humber.ca/appliedtechnology](http://humber.ca/appliedtechnology)

To this point, however, the Emden formula has been neither used nor recognized in Canadian jurisprudence.

While acknowledging that a method such as the Eichleay formula may need to be adapted (depending on the particular circumstances of a case), there is much to recommend the degree of consistency and predictability that a framework like this can produce. A review of Canadian jurisprudence reveals that, to this point, a variety of approaches and assumptions have been used to calculate damages for the recovery of delay-related overhead costs.

The Alberta decision of *Interprovincial Concrete Ltd v Robert McAlpine Ltd.* advocated a 9-step process for calculating recovery:

1. Determine the number of days of actual production the plaintiff could have worked during the period in which it was committed to the project.
2. Determine the number of days the project should have taken.
3. The difference between No. 1 and No. 2 equals the total number of days of lost production.
4. The daily gross revenue of a crew on production must be calculated.
5. The total number of days of lost production multiplied by the daily gross revenue produces a gross loss of production figure.
6. There must then be a determination of the percentage return for overhead and profit the plaintiff could have realized on the gross loss of production.
7. Applying that percentage to the gross loss of production produces a net revenue loss.
8. From that net revenue loss is deducted a 10% contingency to cover occurrences such as bad weather.
9. Deducted from the determined net loss figure is the overhead and profit return from any other jobs actually performed by the plaintiff during the period at issue. The resulting figure is the plaintiff's net loss of revenue in the form of overhead and profit.

Apart from this approach being unwieldy in its application, it also contains a number of arbitrary steps. In particular, the 8th step requires a 10% deduction to be made for contingencies. How this percentage was arrived at, and to what degree it is justified, is not fully explored.

Similarly, in the 2002 British Columbia case of *Tibe Enterprises Inc. v Bearpaw Silvicultural Services Ltd.*, the B.C. Supreme Court had to resort to guesswork to determine the percentage to compensate the plaintiff for delay-induced overhead costs. After declaring that it was not possible to accurately determine the amount of damages for an overhead claim, the court concluded that 10%

of the plaintiff's annual overhead costs were to be compensated. No explanation as to how this figure was arrived at was offered.

While the Eichleay formula may not provide a complete solution to the quantification of damages for delay-induced overhead damages, a practical and flexible application may provide some much needed certainty and predictability to this

area of law. Equally important, a consistent application of the formula can assist contractors in managing some of the risks inherent in the construction relationship. **EB**

*Dan Leduc is a partner at Norton Rose LLP and co-chair of the firm's Canadian Construction Law Practice Group. Dan can be reached at (613) 780-1536 or dan.leduc@nortonrose.com.*



# Dollar Days *Plus*

*Purchase a FLIR Infrared Camera and Get ITC Training Dollars, Gifts & FREE Extech Products*

Purchase a new FLIR thermography camera between January 10 and March 31, 2013 and we'll help you stretch your budget dollars further than ever.

Earn **FLIR Dollars** to spend on valuable Infrared Training Center courses and events that will help you get the most out of your camera and do wonders for your career!



**x2 Double Your Rewards**  
Trade in your old thermography camera and receive FLIR Dollars & Free Gifts.



Camera Model	FREE GIFTS	OR	FLIR Dollars
i3, i5, i7, or E30	Tool Bag	OR	\$425
E40, E50, or E60	Tool Bag & Carhartt Vest	OR	\$925
T420 or T440	Tool Bag & Carhartt Vest plus Extech M0297 Moisture Meter and EX845 AC/DC Clamp Meter	OR	\$1,850
T620 or T640	Tool Bag, Carhartt Vest & an iPad Mini plus choice of: Extech HDV640 Hi-Deg VideoScope or PQ3450 PowerQuality Analyzer	OR	\$3,700

Get details on all the high performance thermal imaging you ever desired at [www.flir.ca](http://www.flir.ca) or call 1-800-613-0507 x24 / x25 today.



Quality - Innovation - Trust

Buy your choice of one of the following new FLIR Thermography cameras: i3, i5, i7, E30, E40, E50, E60, T420, T440, T620, or T640 (standard or bx models) from FLIR Systems Canada, its affiliates, or an authorized distributor or representative between January 10, 2013 and March 31, 2013. See Promotion Terms, Conditions, Limitations and Exclusions for additional requirements and other important information. TRADE-INS: To double your rewards, allowing you to receive both FLIR Dollars and free gifts, trade in a qualifying camera and complete the online trade-in form. Images/content are for illustration purposes only.



# Taming **MISCHIEVOUS** motors

Troubleshooting tips for some  
of the most common problems

Thomas H. Bishop, P.Eng.

**G**iven the number of motors in most plants, it's not surprising they sometimes behave mischievously.

Maintenance professionals are well-equipped to correct most unruly motors, but they are occasionally stumped by three problem behaviours:

1. The motor is drawing high no-load current.
2. The current of the three line leads is not balanced.
3. The motor is running hot.

When any of these problems pop up, it's helpful to know how to assess them, the likely causes, and how to prevent future occurrences.

## **1. The motor is drawing high no-load current**

A good way to determine when a motor is running properly at no load is to check the current draw with an ammeter. Low-speed motors, typically with 8 or more poles (900 rpm and slower), draw relatively high no-load current. When possible, compare the suspected high

no-load current reading to the motor manufacturer's data and previous service centre repair or onsite test records. The applied line voltage should also be compared to the rated voltage of the motor. Table 1 provides typical ranges for motor no-load current.

Higher-than-rated line voltage will increase no-load current; lower-than-rated voltage will reduce it. As obvious as this sounds, it is often overlooked when test running a motor, such as one rated 575 volts and tested at an actual line voltage of 630 volts or higher.

Had the motor been rewound recently, the situation may be different. Magnetic flux values that are too high, or core loss that is excessive, will often result in higher-than-normal no-load current. Good service centre repair practices can prevent the high-current issue by checking the magnetic flux densities and verifying or correcting the winding data when the motor is rewound.

Good service centre repair practices minimize downtime while conserving copper and other valuable materials that would be needed to repair

or replace a defective winding or core that is discovered after the motor has been reassembled.

## **2. The current of the three line leads is not balanced**

The current unbalance could be due to the motor or the supply line. To determine which is the source, arbitrarily label the supply lines A, B and C, and the motor leads 1, 2 and 3. Connect A to 1, B to 2 and C to 3, then operate the motor and measure the current in the three lines. Next, de-energize the motor and connect A to 3, B to 1 and C to 2, then operate the motor and, again, measure the current in the three lines.

When the high current and low current readings follow the same line leads, the supply is the cause. When the high and low readings follow the motor leads, the motor is the source. This is illustrated in Table 2.

When the supply is the source of the unbalance, the supply voltages need to be better balanced. NEMA MG 1 "Motors and Generators" prescribes a 1% limit for voltage unbalance,

noting that current unbalance can be expected to be 6-10 times the voltage unbalance on a percentage basis. When the supply voltage unbalance exceeds 1%, or the current unbalance exceeds 10%, the supply voltages must be corrected to less than 1% unbalance or the motor must be de-rated.

When the motor is the source of the unbalance, the turns-per-phase or per parallel circuit in the windings are probably not balanced, or the winding is misconnected. The unbalanced turns or a misconnected winding will result in unbalanced currents much the same as with unbalanced supply voltages. Measuring the lead-to-lead resistance with a digital low-resistance ohmmeter (DLRO) may also detect unbalanced turns or a misconnection. The lead-to-lead resistance should be within 5% of the average.

When the air gap (the space between the stator and the rotor) is eccentric, unbalanced currents can occur. In that case, the 'high leg' will stay with the motor. Another possibility is an open connection that leaves out a circuit in a multiple circuit winding. Figure 1 is an example of a 4 parallel delta connection with one circuit of one phase not connected. The result is a winding with 3 circuits in one phase and 4 circuits in each of the two correctly connected phases. Testing lead-to-lead with a DLRO will detect this condition.

### 3. The motor is running hot

There's no way to determine whether a motor is running hot just by touching the frame—and doing so is dangerous. Maximum temperature ratings are based on insulation class and apply to the winding temperature at the hottest spot inside the motor. As a general rule, the frame can be 20C to 40C cooler (less or more), depending on the design and the enclosure. Still, with some modern insulation systems, the surface temperature of the motor could be hot enough to burn your fingers or hand. Never use a part of your body to check the temperature of a motor; use a temperature-detection device.

To illustrate just how hot a frame could be, assume a high-efficiency design motor with Class F insulation has a 40C ambient temperature and operates with a Class B temperature rise i.e. a 90C winding temperature rise. At full load, that means the total winding temperature would be about 130C, well below the 155C design limit for the Class F insulation. Assuming the frame temperature is 40C lower than the winding temperature (pretty liberal), the surface temperature of the frame would be about 90C. Suffice to say, no one should touch a frame that hot.

A safer and more effective way to determine whether a motor is running hot is to estimate the temperature of the winding. The estimated winding temperature will be about 5C to 10C hotter than the temperature at the outside of the axial centre of the stator core. For critical applications, a thermocouple for this purpose can be installed on the stator core in the terminal box (Figure 2). A temperature detection device like the one shown in Figure 3 can also be used to safely measure the temperature at the same location, or to check other parts of the motor.

Causes of excessive heat in the winding can be either external or internal.

External causes include high ambient temperature, contaminants, mechanical overload, high-inertia loads, high- or low-supply voltage, or unbalanced voltages.

TABLE 1

Poles (rpm) of 3-phase induction motor	Expected no-load current as a fraction of FLA	Approximate percent of FLA
2 (3600)	1/4 to 1/3	25-33
4 (1800)	1/3 to >3/8	33-40
6 (1200)	1/3 to <1/2	33-45
8 (900)	1/3 to >5/8	33-63
10 (720) or higher	3/5 to >FLA	60-110

Typical ranges of no-load current versus winding poles (rpm).

Total winding temperature is the combination of winding temperature rise plus ambient temperature. When the ambient is 10C hotter than normal, the winding under the same conditions will likewise be 10C hotter, and will have about half of its normal thermal life. Contaminants that build up on the motor or that block ventilation passages increase the temperature of the winding and other components, such as bearings, resulting in premature failure. Mechanical overload simply means the driven load is greater than the motor's power rating.

A pump or fan with a discharge valve or damper open too wide can increase load, as can putting too much load weight on a conveyor. High-inertia loads such as fans or blowers that result in extended starting time increase heating of both the rotor and the stator.

High- or low-supply voltages will result in either excessive core losses or reduced torque capability, respectively. Unbalanced voltages increase current in at least one phase, increasing the  $I^2R$  (current squared x resistance) copper losses of the winding. They also create 'negative sequence' currents that heat the stator and rotor surface at twice line frequency.

Internal causes of excessive winding temperature include contaminants that build up in the motor or that block ventilation passages, missing or damaged air deflectors, or a winding with incorrect data.

Examples of incorrect winding data include a misconnected winding (e.g. a winding connected delta instead of wye), a winding with 'dropped' turns (reducing turns increases magnetic flux density, current and core losses), or incorrect voltage (e.g. an older 550-volt motor winding being operated on a 600-volt supply system with an actual voltage above 605 volts). A damaged stator core can greatly increase core losses and cause excessive heating and high current even at no-load.

### Conclusion

It takes a lot to stump most maintenance professionals, but the points raised in this article should help them be even more successful in taming those mischievous motors. **EE**

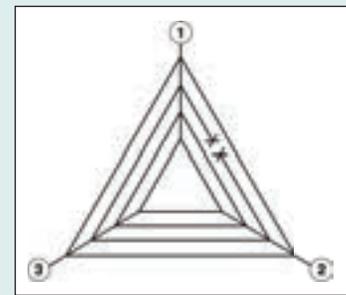
*Thomas H. Bishop, P.Eng., is a senior technical support specialist at the Electrical Apparatus Service Association (EASA), an international trade association of more than 1900 firms in 58 countries that sell and service electrical, electronic and mechanical apparatus. Visit [www.easa.com](http://www.easa.com).*

TABLE 2

Line leads	Amps	Motor leads
<b>INITIAL TEST</b>		
A	112	1
B	126	2
C	116	3
<b>RECONNECTED TEST</b>		
B	126	1
C	116	2
A	112	3

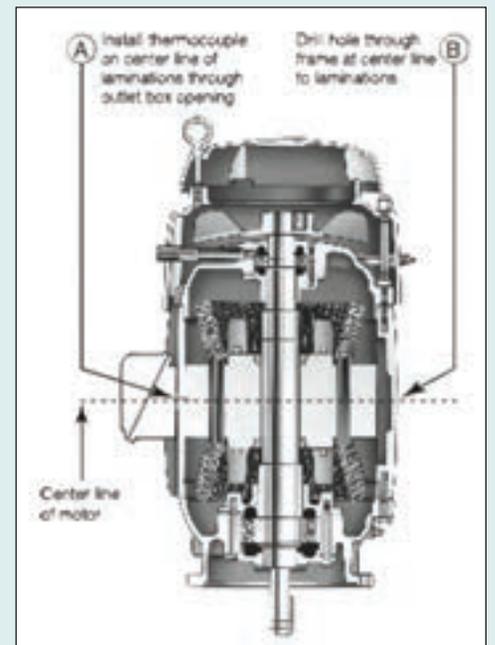
Example of unbalanced current following the line leads, a supply voltage issue.

FIGURE 1



Example open connection in one phase of a 4-delta motor winding.

FIGURE 2

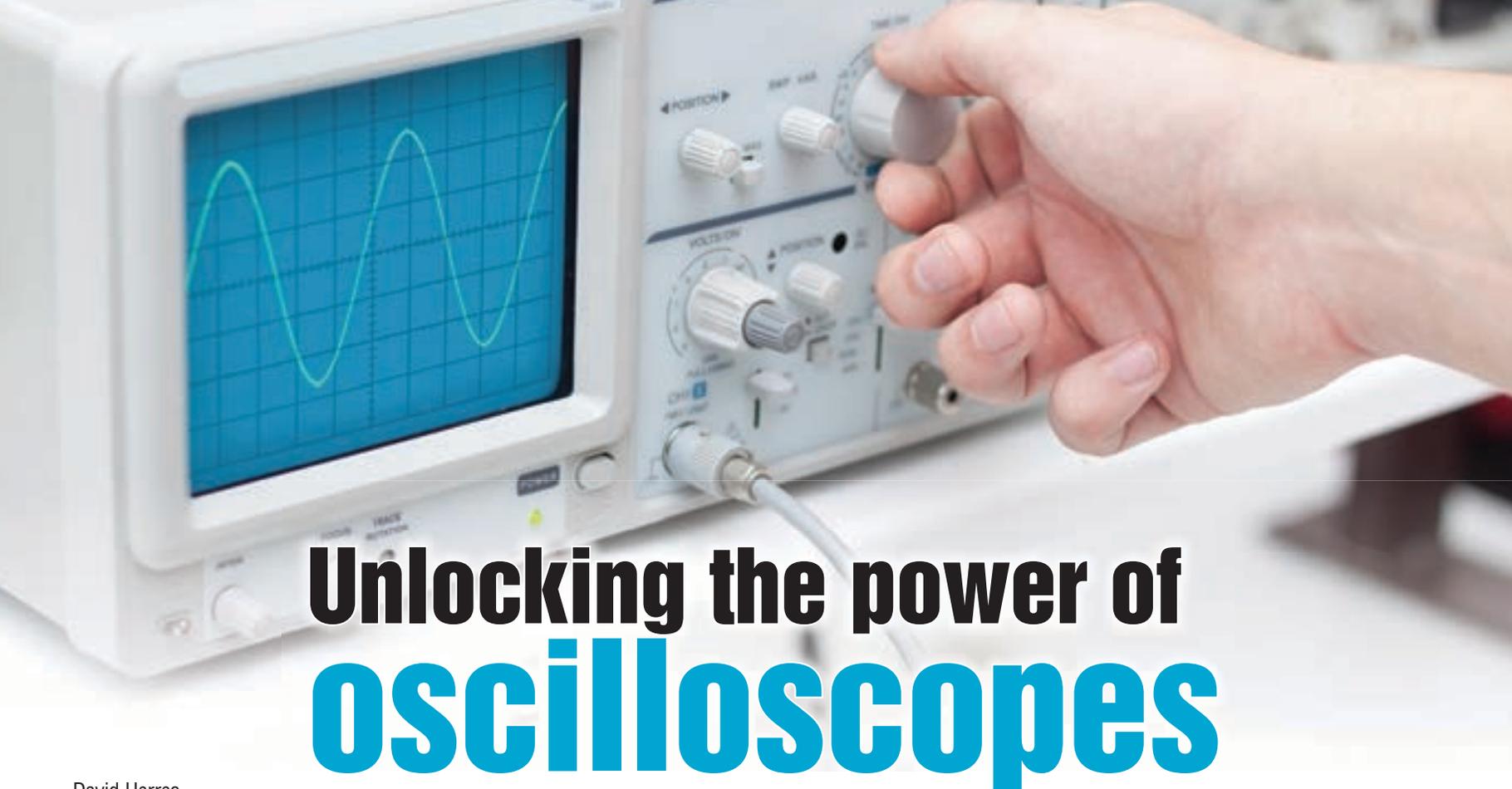


Use of a thermocouple on stator core in terminal box to estimate winding temperature.

FIGURE 3



Use of a digital infrared thermometer to check motor bearing temperature.



# Unlocking the power of oscilloscopes

David Herres

Working electricians quickly become adept at using the multimeter. It is needed to see what is going on electrically, and with multiple operating modes—voltmeter, ohmmeter, milliammeter—it is a superb instrument to have on the bench or in the toolbag.

But there is a still more-capable diagnostic tool: the oscilloscope, which takes voltage readings and displays the information graphically. You can actually see the waveform in all its complexity, and this ability makes possible a great amount of insight into the inner workings and failure modes of equipment and circuitry.

Like many graphs, there is a horizontal X-axis that corresponds to the passage of time, while a Y-axis corresponds to the voltage level. Intensity is sometimes regarded as a third, Z-axis, which can be used to represent another variable as needed.

At first encounter with all the switches and dials, you may ask “What was I thinking?”, and go back to wiring three-way switches and changing motor bearings, but once you become familiar with the terminology and understand the principles involved in generating a stable display, you are more than halfway there—the endpoint being to become skilled at using the oscilloscope to diagnose malfunctions and verify normal operation.

## Oscilloscopes come into being

For perspective, it's valuable to take a look at the development of the oscilloscope over the past century or so. The earliest version might be called an oscillograph. Fluctuating voltage was graphically represented by an inked line on paper. The paper was attached to a drum that rotated at a uniform rate, corresponding to the passage of time. A pen moved perpendicular to the drum's rotation. Mechanical linkage governed the motion of the pen. Coils, connected to the fluctuating input voltage, produced varying magnetic flux that caused the pen to draw a waveform on the moving paper.

This arrangement worked to a certain extent, but there were limitations. Because of the mass of

the pen and linkage, inertia prevented good frequency response. Also, the lack of any triggering mechanism (because the cylinder rotation did not relate to the period of the recurring waveform) severely limited the quality of the display. Early attempts to improve resolution involved averaging out measurements over many cycles and combining them to make a composite image.

William Duddell, an electrical experimenter and skilled instrument maker, built a moving-coil oscillograph in an effort to make it less noisy so he could better observe the waveforms generated by arc lighting. His machine consisted of a lightweight mirror floating on the surface of an oil bath. The mirror was capable of moving fast enough to capture the waveforms encountered at the time, and he successfully transferred the images to film. Still, there was no triggering, and a further disadvantage was that the photographs had to be developed before they could be examined.

A number of improvements were made by the early 1900s, resulting in better frequency response. These new optical-mechanical devices established new upper limits, reaching the low audio level.

Another dramatic breakthrough occurred when it was realized a cathode ray tube (CRT) could display waveforms. This electronic solution made for much higher frequency response. The fluctuating voltage was applied to vertical deflection plates and time bases, first external and then internal, constituting the first swept-trace oscilloscope. These early CRT machines required as much as 30,000 volts to deflect a beam of electrons across the phosphor screen. Before long, the heated cathode was developed, and the CRT required less than 1000 volts, making these instruments at last feasible outside the laboratory.

During World War II, England hastily built a great many radar installations to protect against air attack. On an emergency basis this equipment had to be maintained and serviced. Technicians used dual-trace oscilloscopes, developed less than 10 years earlier, by a British company

eventually acquired by Raytheon.

The postwar years saw great advances in electronics technology. A prominent player was Tektronix, which brought out its Model 511 in 1946: the first triggered-sweep oscilloscope. Prior to this development, horizontal deflection had been produced by means of a continuously free-running sawtooth wave generated within the machine. The sweep had to be synchronized with the signal—a problematic solution giving rise to instability.

## Triggering solves instability

If the display could be infinitely wide—the X-axis or timeline extending indefinitely—there would be no problem but, due to the limited screen size and deflection voltage, the trace quickly runs into a brick wall, so to speak. Consequently, the electron beam has to be repeatedly deflected back to the left side of the screen so the waveform can be repeated. The retrace created when the beam cuts back across the screen could be a serious distraction, but thanks to internal circuitry it is easily blanked out, as in various TV protocols.

A more difficult problem arises due to the fact that the new trace will rarely coincide precisely with the one that preceded it, making for a meaningless blur of light rather than the stable depiction of the waveform as we are accustomed to seeing on the screen of a modern instrument.

The problem was resolved by the mechanism known as triggering, which permits a stationary graphic image on the oscilloscope screen to represent the repeating waveform. A variety of triggering arrangements are possible. Triggering can initiate a new sweep whenever a specified voltage is seen at the vertical deflection plates. Alternately, triggering can occur in response to polarity of the signal i.e. whether the slope is positive or negative.

## Increasing capabilities

Oscilloscope capability has increased over the years. A recent development has been trigger holdoff, whereby the instrument is prevented

from retriggering during a specified interval so that spurious triggering will not occur in response to multiple rising waveform edges.

Other developments expanded oscilloscope capability even further. Tektronix, founded by Howard Vollum and Jack Murdock, came out with calibrated and multiple trace instruments that became popular with an emerging generation of TV technicians who needed to display two or more signals simultaneously for comparison purposes.

LeCroy Corp., founded in New York by Walter LeCroy, came out with the now widely used digital oscilloscope, providing a robust cluster of features compared to its analogue counterpart. The heart of the instrument is a high-speed analogue-to-digital converter (ADC). Internal memory chips record and display a detailed profile of the voltage input. The advantage over a strictly analogue instrument is that the machine, guided by powerful software, can process and display this information in a great many ways, even capturing the waveform prior to triggering. In troubleshooting, you can preserve intermittent and rare anomalies.

### Equipping yourself

The modern digital sampling and triggering oscilloscope is far more complex than its analogue forerunner, but is incredibly user-friendly once you get a feel for it. It's also quite expensive, with many full-featured models with high-frequency response going for well over \$5000, so they may be beyond reach unless you are fortunate enough to work at an advanced laboratory or manufacturer that has a need and budget for such things. If you are willing to stay under 100 MHz, you might find an excellent instrument for around \$1000.

There are plenty of old analogue clunkers out there for under \$100, but they are worthless. The bandwidth is minimal and, if they work at all, they will be hopelessly out of calibration. Parts and service are, for the most part, unavailable.

It is possible to convert a TV into an oscilloscope by bringing the deflection coil leads out of the enclosure and attaching an appropriate probe. Similarly, you can connect to an ADC within a computer and fabricate an oscilloscope. (In both instances, beware of hazardous voltages that persist long after the chassis is powered down and disconnected from the electrical supply. This is because power supply capacitors store powerful electrical charges for long periods, and there is also stray capacitance.)

Neither of these expedients will provide a full-featured scope that could compete with new models currently available. Moreover, manufacturers furnish excellent documentation. Users' manuals can be downloaded and that

is the key to learning how to operate specific models and to get good, stable displays.

On first encountering a new oscilloscope, you will notice that the front-panel controls are grouped into three or more sections, usually separated by a heavy border. They are:

- Vertical: controlling input signal amplification or attenuation.
- Horizontal: controlling

the time base.

- Triggering: initiating a new sweep when the input voltage on the vertical deflection plates rises to the chosen level.

Normally, the oscilloscope triggers on the signal being displayed, but it can trigger on other sources, as well. Possibilities are the AC source, any external source connected to the oscilloscope or an internal signal. The most common

triggering mode is by means of the signal that is fed to the vertical deflection plates.

An important part of the mix, though separate from the main chassis, is the probe. It is common practice to have an assortment of probes. The probe must match both the oscilloscope and the circuit being tested. Since the probe is part of the circuit, its capacitance and inductance—particularly at high

### ASSISTANT WANTED!

SEEKING RELIABLE DEPENDABLE HARD WORKER. ABLE TO HAUL ANYTHING AND EVERYTHING REQUIRED. MUST BE ABLE TO GIVE ME THE TOOLS I NEED WHEN I NEED THEM. ORGANIZATION IS A MUST. BE PREPARED TO BE ON-CALL 24 HOURS A DAY 7 DAYS A WEEK 365 DAYS A YEAR EVERY YEAR UNTIL THE WORK IS DONE.



Position filled.

#### OPTION A

UP TO  
**\$2657 - VANS**  
UP TO \$1750 - TRUCKS  
WORK READY EQUIPMENT  
FROM ADRIAN STEEL

#### OPTION B

**\$450**  
COMMERCIAL UPFIT  
CASH BACK

#### OPTION C

**\$500**  
IN GM DEALER ACCESSORIES

#### OPTION D

**\$250**  
CASH INCENTIVE

There's more riding on this vehicle than your equipment. When you run your own business your reputation is always along for the ride, and you can't afford to have a van or truck that can't be counted on.\*\* The GM Business Choice program helps you build the vehicle you want the way you want it, as well as giving you a choice of one of four incentive options, so you get your vehicle, your way.\*

[gmbusinesschoice.ca](http://gmbusinesschoice.ca)



\*Adrian Steel is a registered trademark of Adrian Steel. Value of equipment depends on upfit package selected. Eligible vehicles, equipment, tools and accessories may differ slightly from version shown. Customer may choose only 1 option (A,B,C,D) per eligible vehicle. All incentive packages are tax inclusive. Options B and C inclusive of parts and labour. Business Choice valid toward the purchase or lease of eligible new GM vehicles in Canada for eligible companies with an active FAN or business number. See Dealer for full program details and eligibility. \*\*Contact your local dealer for details on all 4 Business Choice options. This offer expires October 31, 2013. ©Copyright 2013 General Motors of Canada Limited.



frequencies—are critical.

The probe will also possess a certain finite resistance. To keep loading to an acceptable level, it is necessary to choose the correct probe. Passive probes are used most of the time; the effect is to attenuate or reduce the signal. An active probe amplifies the signal. A typical attenuation factor is 10X. Amplification is expressed by putting the X before the factor.

When the probe is a passive, attenuation device, it is necessary to compensate it to the oscilloscope before performing any readings. There should be a terminal on the front panel where there is available a square wave reference signal. Attach the probe's ground clip to the ground. Connect the probe to an activated channel and touch the tip of the probe to the square wave terminal. The square wave will be

displayed on the screen. Adjust the probe controls to make a good square wave with corners that are not rounded. When the corners are rounded, the probe is not adjusted properly and is loading the circuit.

#### Armed and ready

There are usually a great many motors in a manufacturing facility. Large three-phase motors are expensive, and there can be expensive

downtime should one of them quit during a shift. Aside from bearing failure, most motor malfunction relates to breakdown of winding insulation. This comes on slowly at first, then rapidly escalates. Insulation can deteriorate due to high ambient temperature, moisture or vibration. Another contributing factor is poor power quality, which has to be watched carefully where expensive motors are concerned.

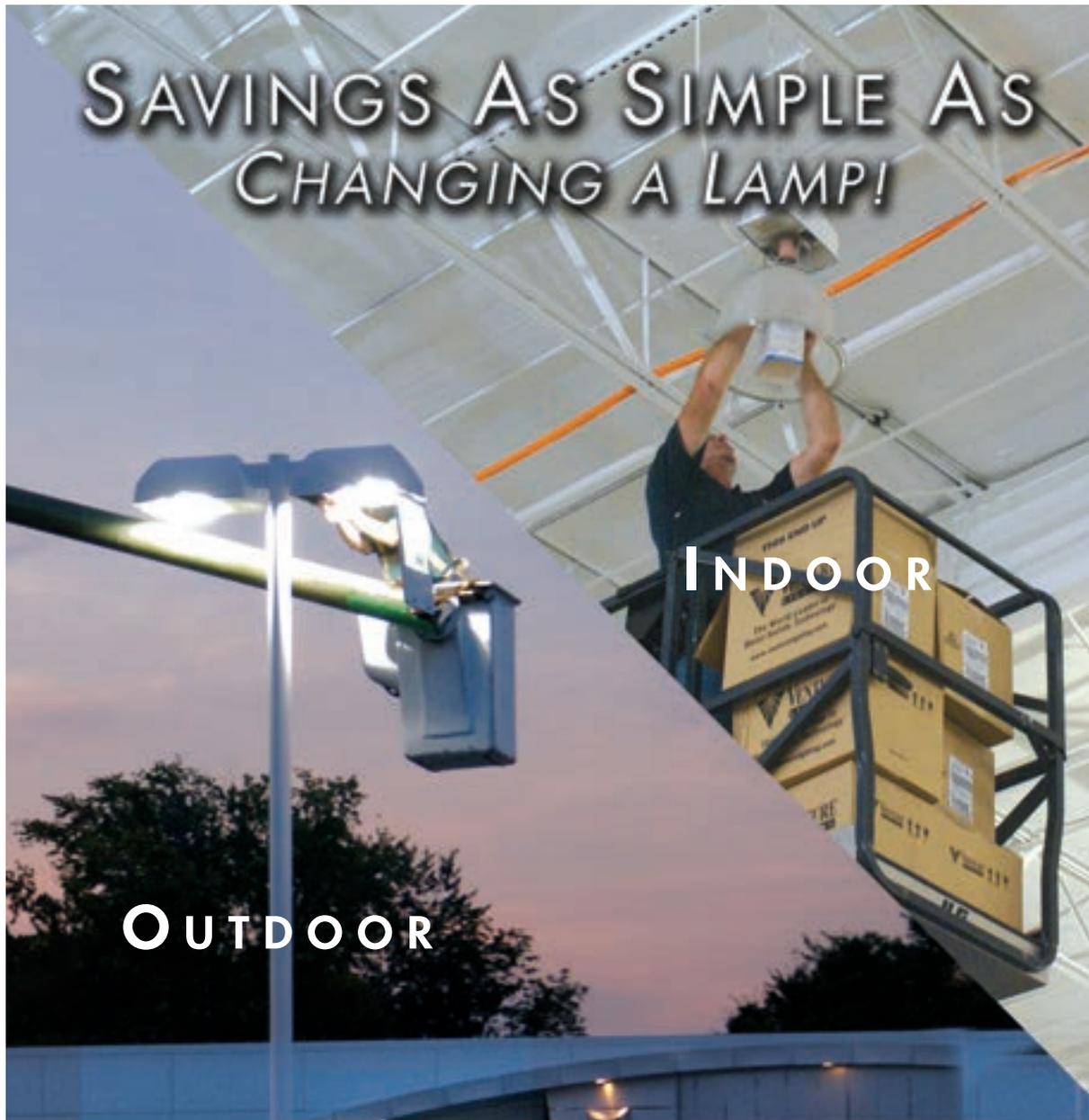
A lot of power quality problems may be attributed to non-linear loads either within the facility or in neighbouring industrial premises. Harmonics give rise to voltage spikes that, as the name suggests, have the ability to puncture and degrade electrical insulation by creating ionized paths to ground. Sometimes it is possible to bake these defects out of a motor in a special oven made for the purpose. More often, the process is irreversible and the motor has to go out for a major overhaul.

An oscilloscope is a great maintenance tool for motors. On a regular basis, look at the waveforms at the motor terminals and other access points back through to the service. When everything is functioning optimally, that is the time to look at these displays. A good digital storage oscilloscope is capable of downloading waveform images via USB cable to your computer where the files can be saved and/or printed. Put these graphics along with the lubrication log in a folder for each motor and you'll increase the efficiency and safety of your facility.

Variable frequency drives (VFDs) add enormous functionality to AC motors, making it possible to control the speed with great precision over a wide range so they can be used for elevators, ski lifts and wherever smooth variable speed operation and reliability are required. The motor's speed is varied by changing the frequency, rather than the voltage, of the electrical supply. Line power is first rectified, then inverted to the frequency required. Synchronous or induction motors may be used.

When one of these systems exhibits performance problems, the oscilloscope is the diagnostic tool of choice. Input, output and intermediate waveforms may be examined to see whether the problem is within the VFD. As always, preventive maintenance is better than post-failure response, and keeping good records will enhance your capability to keep things running smoothly. **EB**

*A regular contributor to Electrical Business, David Herres is a Master electrician and author of nearly 40 articles on electrical and telecom wiring. He recently authored "2011 National Electrical Code: Chapter-by-Chapter", published by McGraw-Hill and available at Amazon.com.*



#### Venture Lighting's Energy Master® 330W Ever-Start™

- Replace 400W/U and Save 18% Energy
- Operates on Probe or Pulse Start Ballasts
- Energy-Saving Green Technology
- Energy Savings of \$140.00 Over the Life of the Lamp\*
- Change Just the Lamp and Save!
- 23% Better Lumen Maintenance (LLD of 0.80 versus 0.65)
- Save 70 Watts in Comparison to 400W Lamp



NOTE: \* Based on \$0.10 kWh



**800-265-2690**

For more information about this product,  
and where to find a local representative go to

**VentureLighting.com/Canada**



# Dispelling the myth of arc-resistant IR WINDOWS

Martin Robinson

There exists a dangerous misconception regarding the arc rating of infrared (IR) windows or viewing panes. Many reliability and maintenance professionals are under the impression that an IR window will protect them in the event of an arc blast; still others are under the impression that installing IR windows will turn non-arc-rated switchgear or electrical equipment into arc-rated cabinets. Neither are the case, and both misconceptions need to be corrected because they present very real safety concerns.

All major brands of IR windows are available as standard options on various brands of switchgear, MCC buckets and other electrical equipment. All have undergone extensive evaluation and testing as parts of arc-rated systems, yet none of them should ever lead the public to believe that any of these tests or system certifications have any broad-based or generic rating across all varieties of switchgear or electrical equipment. The simple fact is there is no such 'component rating' for generic 'arc resistance'. Any claims to the contrary are dangerous and negligent.

IR windows are not intended to protect a user from an arc flash; they are intended to eliminate additional triggers of an arc flash during an inspection and replace a high-risk activity with a risk reduction/elimination strategy during inspection. IR windows and closed-panel inspections help companies comply with American OSHA and NFPA mandates to eliminate risk wherever possible; conversely, a protection strategy is acceptable only after other methods of risk elimination or reduction have been exhausted.

## The anatomy of an arc flash

An arc flash occurs when a phase-to-phase or phase-to-ground fault causes a short circuit through the air. The core of the arc flash can reach temperatures of up to 38,000F; at this high temperature, copper turns into a plasma instantaneously, expanding 67,000 times its original volume in a fraction of a second. The heat and resulting expansion cause a pressure wave that carries thousands of pounds of force, a blinding flash of light and molten shrapnel.

Differences in the volume (cubic feet) of the switchgear, MCC bucket or electrical cabinet will affect the amount of force that impacts the cabinet panel/IR window, just

as the result of an explosive device placed in a mailbox will differ from one placed in the back of an empty train car. A cabinet with large amounts of copper available for expansion would be capable of producing an explosion with much more force than the same cabinet with very little copper cable or busbar.

Other differences, such as current-limiting fuses or distance and position of the arc flash relative to the panel door/IR window will have a major impact on the force that impacts the panel/window. As a result, arc ratings are given to systems that are able to withstand a blast in a specific model of switchgear with a standard size and configuration.

## Arc ratings

Because of the near-infinite variety in size, contents and position of connections, it would be impossible to have a one-size-fits-all rating for arc resistance. As a result, arc fault tests are performed on systems, not on the individual components that make up a system. Therefore, the resulting arc ratings are given to the system and not to the individual components that happened to be in place during the test. Consequently, any changes in switchgear design require re-testing to verify the rating of the new design, even though it may be very similar to the previous arc-resistant version.

Arc-rated switchgear and MCCs enlist a



PHOTO BY JACQUELINE MILNER, WITH HELP OF BERGERON ELECTRIC.

IR windows are not intended to protect a user from an arc flash; they are intended to eliminate additional triggers of an arc flash during an inspection and replace a high-risk activity with a risk reduction/elimination strategy during inspection.

variety of safety mechanisms, such as additional barriers and pressure-relief mechanisms. These safety features redirect the force and heat of an arc flash away from the panel doors and up through a series of plenums that systematically reduce the force of the blast and minimize any damage that might have otherwise occurred had the blast escaped the confines of the system.

Any IR window, visual viewing pane, or panel meter that happened to be in place

during this test would not have been responsible for the arc resistance of the system, but would merely be shown to not interfere with any safety mechanisms which were in place to redirect the blast. Just as the bolts holding the panel in place are not universally arc resistant, they are simply the proper strength to hold the panel in place on that specific model of switchgear.

Consider the following analogy: A luxury car manufacturer is preparing its new sedan for crash testing. They include the high-end stereo option manufactured by Uber-Audio, complete with voice-activated MP3 catalogue features. As expected, the crumple zones in the sedan's frame absorb huge amounts of force on impact; safety belts keep test dummies properly placed for maximum protection and airbags deploy to cushion the occupants. The stereo, as expected, does not interfere with the proper functioning of any of the safety mechanisms. The car receives a 5-star crash rating. Would you expect to see the Uber-Audio stereo company claim that its stereo system received a 5-star crash rating? Would you expect to see advertisements leading consumers to believe that this stereo could actually protect passengers in the event of a crash? Of course not.

Keep in mind that the forces and temperatures that a panel or window encounters in an arc flash in arc-resistant gear are vastly different than those that are present in the same blast in un-rated gear. Since less than 1% of the switchgear and MCCs in the field have safety mechanisms designed to redirect the forces of a blast, 99% of consumers who are expecting a window to withstand a blast on un-rated gear are asking the laws of physics to be suspended.

In a tightly closed box, an arc blast will blow a steel door right off steel hinges and steel bolts. With such extreme forces applied to an unyielding system, even the steel doors of a piece of switchgear cannot 'protect' a worker who happens to be in the vicinity of the explosion. That is why switchgear had to be re-engineered to redirect and mitigate the blast effects.

It is also important to understand that the test procedures defined in IEEE C37.20.7 "Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults" are performed with the window in a closed position. When the switchgear 'passes the test', it does not

**Systèmes d'éclairage Inc.**  
**STANPRO**  
Lighting Systems Inc.  
Axé sur la Qualité • Focused on Quality

We **Light Up** Your Life!

**Stanpro Lighting Systems**  
has Canada's widest choice of energy efficient technologies...

**It's simple. The choice is yours.**

### Induction

- up to 50% energy savings
- up to 10 year warranty

### LED

- up to 50% energy savings
- reduced footprint
- up to 5 year warranty

Tel.: 514-739-9984 • Toll free: 1-866-280-2332 • Fax: 514-739-9912 • [www.stanprols.com](http://www.stanprols.com)

matter whether the optic material was damaged or even disintegrated, so long as the heated gas from inside the cabinet does not ignite a flag placed outside the cabinet. Therefore, any implied protection for a thermographer while using the window in an open position is not only questionable, it is a total misrepresentation of the test.

**So why use IR windows?**

Infrared windows are intended to allow safer, more efficient access to the thermographic data recommended in NFPA 70B "Recommended Practice for Electrical Equipment Maintenance":

Dependability can be engineered and built into equipment, but effective maintenance is required to keep it dependable. Experience shows that equipment lasts longer and performs better when covered by an EPM (Electrical Preventative Maintenance) program.

Infrared inspections of electrical systems are beneficial to reduce the number of costly and catastrophic equipment failures and unscheduled plant shutdowns.

Routine infrared inspections of energized electrical systems should be performed annually prior to shutdown. More frequent infrared inspections, for example, quarterly or semiannually, should be performed where warranted by loss experience, installation of new electrical equipment, or changes in environmental, operational, or load conditions.

Infrared surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected.

NFPA 70E "Standard for Electrical Safety in the Workplace" lists the removal of panels on electrical equipment as one of the riskiest activities a worker can perform on that piece of equipment. The risk is elevated because the most common arc triggers occur either because the panel covers are open or as a result of removing the panel covers.

Closed-panel inspection using infrared windows will eliminate 99.9% of arc flash triggers during inspection. Therefore, the core benefit of IR windows is they comply with OSHA and NFPA 70E's focus on removing the risk of an accident. Protection with PPE is only used as a last resort, and the implementation of engineered controls is only

used where risk elimination and substitution are not feasible.

**Summary**

IR windows are intended to remove the risk of triggering an arc flash incident during a thermographic inspection. That said, the windows should also offer the same level of structural integrity that UL 746 requires of other

common meters and controls, and the same integrity that IEEE C37.20.2 requires for impact and load of viewing panes. However, any claims by any manufacturer to have an arc-resistant IR window are misleading and negligent, since there simply is no test which offers a component level rating.

Due to the endless variety of switchgear geometry and contents

that exist in the field, the forces that a given piece of switchgear or MCC might experience in an arc blast are equally varied. Therefore, regardless of how many arc fault tests to which the window may have been subjected, it is impossible to infer generic resistance. **EB**

*Martin Robinson is a Level III thermographer.*

**SEE WHY OUR CUSTOMERS ALWAYS SAY  
"I WISH I FOUND YOU EARLIER!"**

**Split Bolts & Grounding Connectors**



Our superior quality Split Bolt & Grounding Connectors are manufactured in the USA by Penn-Union—a long time trusted supplier to utilities and other electrical professionals.

**Type 'S' Copper Alloy Split Bolt**

- Type 'S' Copper Alloy Split Bolt
- Suitable for Direct Burial
- Highly resistant to corrosion and season cracking
- Under torque this design provides high contact pressure between conductors

Starting from **\$1.78 each**



**The Largest Online Selection  
of Crimp Terminals**

**Over 1,000 Types In Stock**

- Nylon, PVC, Non-Insulated. Hi-Temperature, Heat Shrinkable
- Terminals Made in USA with economy versions available.

Ratchet Crimp Tools from **\$55.23**



**NOW SHIPPING DIRECT FROM ONTARIO  
FREE SHIPPING ON ORDERS OVER \$100**

Visit our easy-to-use website **www.elecDirect.com**



**Rectangular Connectors**



Complete Kits from **\$44.27**



**Pin & Sleeve Devices**



30Amp/600V Plug **\$91.79**



**Control Transformers**



Class 2 Control Transformers from **\$27.92**



**Mechanical Lugs**



With Stainless Set Screw from **\$1.00**



**elecDirect.com**

www.elecDirect.com 1-800-701-0975 support@elecDirect.com  
Sanborn, NY

It is with sadness that EBMag reports the passing of **Ideal Industries' Brian Blanchette**, who died on January 16, 2013. "Brian's gentle and kind demeanor—coupled with his vast knowledge, problem-solving skills and smooth communication—endured him to everyone that he helped," said **Jim Gregorec**, business unit

manager of the Ideal Test & Measurement Division. "Over the past 12 years, Brian's contributions touched so many of us that he will be sorely missed." Blanchette served as a field sales engineer for Ideal ([www.idealindustries.ca](http://www.idealindustries.ca)) since 2001, teaching and developing training courses for the measurement of energy, power quality

and thermal imaging. A respected expert and speaker on the topic of electrical testing, Blanchette also was the author of a number of technical articles.

**Nuheat** ([www.nuheat.com](http://www.nuheat.com)) has named **Kevin McElroy** president, where he will lead operations in both Canada and the States. **John**

**Rose**, Nuheat's former president and CEO, will remain CEO moving forward. "Kevin's strong leadership skills and a commitment to deliver superior customer service have helped Nuheat become the electric radiant heating company of choice for contractors, builders and architects alike," said Rose. McElroy started his career at Nuheat 18 years ago as the company's first inside sales person, said Rose. He most recently served as VP of sales. Nuheat is a manufacturer and distributor of electric floor heating systems and freeze protection products for pipes, roofs & gutters, and slab.

The **Canadian Electricity Association** (CEA, [www.electricity.ca](http://www.electricity.ca)) has appointed **Anthony Haines**, president and CEO of **Toronto Hydro Corp.**, as chair, replacing outgoing chair **Chris Huskison**, president and CEO of **Emera Inc.** Haines' career in the Canadian energy industry spans 25 years, including 15 years in various senior roles in the natural gas industry. He has been a member of CEA's board since 2006, and is involved with the Ontario Coalition of Large Distributors. He is also a past board member of the Electricity Distributors Association (EDA).

The **Canadian Solar Industries Association** (CanSIA, [www.cansia.ca](http://www.cansia.ca))—which represents more than 650 solar energy companies throughout Canada—has announced its 2012-13 board of directors and executive. Leading the pack as chair is **Jared Donald**, president of **Conergy Canada**, and **Gregory Scallen**, counsel with **SunEdison** as vice-chair. Rounding out the group are:

- **Jim MacDougall**, Treasurer (president, **Compass Renewable Energy Consulting Inc.**)
  - **Jacob Sadikman**, Secretary (associate, corporate, **Osler, Hoskin & Harcourt LLP**)
  - **Michelle Chislett**, past chair, ex-officio (VP solar development, **GDF SUEZ Canada**)
  - **David Kelly** (president, **Sedmek Inc.**; partner, **SkyFire Energy Inc.**)
  - **Ron Mantay** (VP, Engineering and Construction, **Powerstream Solar**)
  - **Bob Waddell** (GM, **Centrosolar**)
  - **Rob Waters** (solar product manager, **Viessmann Mfg. Co. Inc.**)
- "I am pleased to have this opportunity to work with such an experienced group as we face a year that will be key to our industry," said Donald. **EB**

PARTNERS  
in Training

SAVE  
THE  
DATES!

We are pleased to announce  
4 EDUCATIONAL EVENTS FOR 2013

These events combine a series of **educational training seminars** presented by leading industry experts and a table-top trade show section profiling new and relevant products and services.

This is your opportunity to learn valuable information, network with industry peers and **meet with suppliers of products and services** that can save you time and money.

**MAY 14**  
TCU Place, Saskatoon, Sask.  
Shutdowns & Turnarounds

**JUNE 18**  
Holiday Inn Halifax Harbourview & Conference Centre, Dartmouth, N.S.  
Electrical Maintenance & Reliability

**SEPTEMBER 24**  
Holiday Inn, Sudbury, Ont.  
Shutdowns & Turnarounds

**OCTOBER 17**  
Apollo Convention Centre, Mississauga, Ont.  
Electrical Maintenance & Reliability

For more information, visit: [www.partnersintraining.ca](http://www.partnersintraining.ca)

Brought to you by  
the publishers of

Electrical  
Business

PEM  
PLANT ENGINEERING  
AND MAINTENANCE

REM  
RESOURCE  
ENGINEERING &  
MAINTENANCE



### Standard Products wireless control system



Standard Products says it has developed a unique wireless lighting system to help companies meet current energy codes and reduce energy consumption. The wireless control system delivers intelligent room controls, occupancy sensors, and daylight harvesting, giving users battery-free control at their fingertips. With the wireless control system, these wireless devices can be installed and mounted on any surface, adds Standard Products.

**STANDARD PRODUCTS**  
[www.standardpro.com](http://www.standardpro.com)

### Cree LM16 LED lamp claims 80% energy reduction



Cree has released its new LM16 LED lamp, claiming to deliver the industry's best centre beam candlepower for 25° beam angles for various applications in retail, hospitality and residential settings. According to Cree, the lamp uses up to 80% less energy and is designed to last up to eight times longer than traditional 50W halogen MR16 lamps to deliver a payback in less than 12 months. Available in two options, the Cree LM16 halogen equivalent delivers 620 lumens (consuming 9W) and the 35W halogen equivalent delivers 425 lumens (consuming 7W).

**CREE**  
[www.cree.com](http://www.cree.com)

### Universal Lighting debuts ULTim8 HEH programmed start ballasts



Universal Lighting Technologies has expanded its family of ULTim8 ballasts with the new high (HEH) ballast factor model with programmed start technology. Suitable for retrofit or new construction, the ULTim8 HEH programmed start ballasts boast a start time of less than 700

milliseconds. The entire ULTim8 line is designed to provide up to 6% energy savings over standard electronic T8 ballasts and as much as 40% energy savings over T12 ballasts. The ULTim8 ballasts are CEE and RoHS compliant.

**UNIVERSAL LIGHTING TECHNOLOGIES**  
[www.unvlt.com](http://www.unvlt.com)

### ZigBee Alliance completes ZigBee Lighting Link standard

The ZigBee Alliance has completed development and ratified the ZigBee Light Link standard, offering wireless control for various LED lighting solutions. According to the Alliance, light bulbs, LED fixtures, sensors, timers, remotes and switches built using ZigBee

Light Link will easily connect into a single network, without special devices to coordinate the network. ZigBee Light Link devices can be controlled over the internet through computers, tablets and smartphones.

**ZIGBEE ALLIANCE**  
[www.zigbee.org/LightLink](http://www.zigbee.org/LightLink)




### ELECTRICAL SAFETY TRAINING SYSTEM



Rev 2.0

[www.arcflash-training.ca](http://www.arcflash-training.ca)

### Multi-Media State-of-the-Art Online Safety Training System

Take control of the quality, consistency and cost of your arc flash and shock training for your electrical workers! Increase the frequency of training which will assist you in moving the training knowledge to electrical worker electrical safety competency. Classroom training is expensive, can be inconsistent as you get different instructors provided by the vendor and not sustainable; you can only retrain every 3 to 5 years due to the high overall cost!

The Electrical Safety Training System (ESTS) is a multi-media based, highly interactive experience comprised of several modules with multiple lessons, knowledge checks and a final assessment. The ESTS uses 3-D "Virtual Electrical Workplace" scenarios and our unique digital electrical classroom as a learning aid to teach concepts. Each module includes a knowledge check that utilizes interactive elements that engage the student in the learning process. The ESTS is available for both Electrical Workers (4 hour of instructional content, ~6 hour duration) and Non-Electrical Workers (45 minutes content, ~1 hour duration). An electronic PDF Certificate of Completion is provided.

**Electrical Worker (EW)** course is comprised of ten (10) Modules, each Module has a varying number of independent lessons.

- Curriculum equivalent to one full day of classroom training.
- Course includes 4 hours runtime or ~6 hours total time in one sitting to complete.
- Up to 30 days allowed for completing or accessing the Training Materials and the Resource Toolbox.

**Non-Electrical Worker (N-EW)** course is comprised of eight (8) Modules, each Module has a varying number of independent lessons.

- Curriculum equivalent to one half day of awareness course.
- Course includes 45 minutes runtime ~1 hour duration.
- Up to 30 days allowed to complete the course

Terry Becker, P.Eng., a CSA Z462 Technical Committee Voting Member and independent Electrical Safety Consultant, is the Subject Matter Expert and Visionary of the ESTS and advises that the training system is credible, high quality multi-media adult learning delivered online. Every worker can receive training.

**Contact us today for more details!**

**ESPS Electrical Safety Program Solutions INC.**  
E-mail: [terry.becker@esps.ca](mailto:terry.becker@esps.ca)  
Telephone: (403) 532-9050  
[www.esps.ca](http://www.esps.ca)

**Eaton unveils VCPW-HD medium voltage vacuum circuit breaker**



Eaton has introduced the VCPW-HD medium voltage vacuum circuit breaker for utility, industrial and commercial applications. The new 38kV circuit breaker is designed to protect transformers, capacitor banks, motors, busbar sections, and cable, and engineered to withstand high altitude, shock, vibration and high ambient temperatures. According to Eaton, the VCPW-HD is engineered to reliably switch normal load currents and high-stress fault currents. It also provides current ratings up to 3000A without fan cooling and up to 40 kA.

**EATON**  
[www.eaton.com](http://www.eaton.com)

**GE Multilin A60 light and pressure arc flash detection system**

GE released its Multilin A60 arc flash

system, which uses GE's patented light and pressure wave detection technology to help minimize equipment damage and reduce the costs associated with unplanned downtime and lost production. Designed for medium-voltage switchgear and motor control centre (MCC) applications, the A60 is a protection relay-independent, stand-alone device that can be used in new or existing installations for continuous monitoring and fast detection of an arc flash event. Its design includes five arc flash sensors to optimize coverage, and its scalability allows multiple A60 devices to be connected, delivering increased fault isolation. The Multilin A60 promises simplified installation, commissioning and maintenance, with sensor auto-calibration, eliminating the need for CT connections or setup software.

**GE**  
[www.ge.com](http://www.ge.com)

**Techspray E-Line Zero-VOC and Hi-Flash cleaners for electrical applications**

Techspray has developed the new E-Line Zero-VOC general cleaner 1611-12S and E-Line Hi-Flash



maintenance cleaner 1626-11S for electronic assemblers, general manufacturers, and repair operations. E-Line Zero-VOC is designed for heavy-duty degreasing and for removing paint and sticky adhesive residues. In electronic assembly and repair, it can be used to remove uncured adhesive from stencils and conformal coating from circuit boards. E-Line Hi-Flash is a non-chlorinated degreaser and electrical cleaner, suitable for cleaning light oils and carbon residues from control panels, switch plates, enclosures, and work surfaces. According to Techspray, E-Line Hi-Flash is a safer alternative than other solvents because it ignites at higher temperatures (over 60C) and has low toxicity.

**TECHSPRAY**  
[www.techspray.com](http://www.techspray.com)

determining arcing current, incident energy, arc flash protection, limited, restricted and prohibited shock approach boundaries, initial arc pressure, arc explosive TNT equivalent, hazard risk category, typical clothing system; saving input configurations, calculation results for future reference or printing; generating JPG, BMP, PDF format customized colour, black-and-white warning labels in English, French and Spanish; and customize labels by selecting and adding information displayed on them.

**ARCAD**  
[www.arcadvisor.com](http://www.arcadvisor.com)

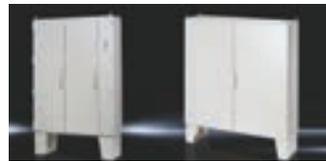
**Outdoor writing products for outdoor writing people**

When at Acklands-Grainger's The Works 2013, we stumbled upon a vendor whose motto is "Outdoor writing products for outdoor writing people". Back in the 1920s, Jerry Darling developed the early version of Rite in the Rain all-weather writing paper to address hassle of soggy and illegible paperwork for the Pacific Northwest logging industry... and the product has been evolving since. Today, the product is totally recyclable as standard paper, while its 'Polydura' cover and reference card substrate contains post-consumer recycled materials and is, itself, recyclable.

**RITE IN THE RAIN**  
[www.riteintherain.com](http://www.riteintherain.com)



**Rittal offers the floormount TSFM modular enclosure**



Rittal's latest addition to the TS8 Freestanding family of modular enclosures is the floormount TSFM. Building on the TS8 design, the TSFM features an internal punched frame to help provide strength and flexibility, says Rittal. The TSFM comes fully assembled with 12-in. high removable legs that provide separation from any hazards or mishaps that may occur at ground level—a necessity for applications in areas prone to flooding or where it is crucial to lift components up off of the plant floor, it adds. The exterior skins are pre-installed and made of 14-gauge (2mm) steel and are internally fastened.

**RITTAL**  
[www.rittal.ca](http://www.rittal.ca)

**Heyco-moulded Liquid Tight Break-Thru plugs**

Heyco Products has announced its Heyco-moulded Liquid Tight Break-Thru plugs. Used as a liquid tight bushing, the plugs insulate and help protect electrical and telecommunications cable, tubing, hose, rope, and utility lines. When pierced, they function as a liquid tight bushing that converts raw edged holes to smooth, neat, insulated holes, explains Heyco. Designed for use in panels as thin as 0.020-in. and as thick as 0.063-in. and mounting hole diameters of 0.500-in. to 1.093-in., the co-moulded nylon and elastomer parts function with an IP 67/68 rating and CSA-certification.

**HEYCO PRODUCTS**  
[www.heyco.com](http://www.heyco.com)



**ORGANIZATIONAL NEWS**

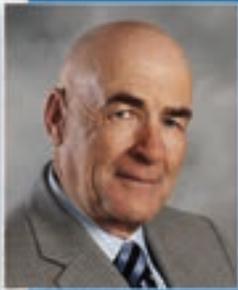
*Nathalie Pilon, President, Thomas & Betts Canada, announces the following organizational changes:*

**Patrice Jomphe - Retirement**

After more than 37 years of loyal service, Patrice Jomphe, Vice President, Commercial Division, retired on January 31, 2013. Pat began his career with the company in 1975 as a Sales Representative for the Quebec region and rose through the ranks of the sales organization. In 1997, he was appointed to the position of Vice President, Commercial Division.

Pat successfully managed Thomas & Betts' commercial business and was an active presence in the Canadian electrical industry. In 2011, Pat was presented with the prestigious «Tom Torokvei» Award by IED in recognition for his exceptional support and leadership.

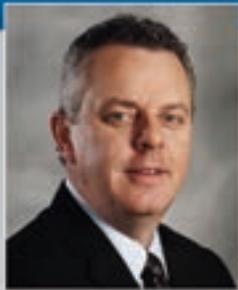
Thomas & Betts thanks Pat for his outstanding dedication and wishes him a happy and healthy retirement with his wife, Pierrette. He will be missed.



**André Boudreau, Vice President, Commercial Division**

Effective February 1, André Boudreau has taken over as Vice President, Commercial Division, responsible for overseeing all Thomas & Betts sales activities in the commercial markets in Canada. During his more than 30 years of service with Thomas & Betts, André has held many positions in sales and marketing including Director of Marketing and most recently, Director of Market Development for Thomas & Betts' commercial business.

André will continue to be based at the company's head office in Saint-Jean-sur-Richelieu, Quebec and can be reached at **450.347.5318, x287** ([andre.boudreau@tnb.com](mailto:andre.boudreau@tnb.com)).



Thomas & Betts is a global leader in the design, manufacture and marketing of essential components used to manage the connection, distribution, transmission and reliability of electrical power in industrial, construction and utility applications. With a portfolio of over 200,000 products marketed under more than 45 premium brand names, Thomas & Betts products are found wherever electricity is used. The company has a strong Canadian presence, with 8 manufacturing facilities across the country and headquarters in Saint-Jean-sur-Richelieu, Quebec. Approximately 80% of the company's products sold in Canada are manufactured in Canada. For more information, please visit [www.tnb.com](http://www.tnb.com) and [www.tnb.ca](http://www.tnb.ca).

[www.tnb.ca](http://www.tnb.ca)

**Thomas & Betts**



Visit **EBMag.com** and click **Calendar** to see an extensive list of upcoming events.



**IN CASE YOU MISSED IT...**

**VIDEO** • “Learning, fundamentally, is the key to success in life”, says young Muhammad Kazim Ali, a 2012 recipient of a \$1000 EFC University Scholarship. Visit [bit.ly/ZJwAYm](http://bit.ly/ZJwAYm).

**PHOTOS** • Canada’s EV industry gathers for 2nd annual Electric Vehicle & Infrastructure Summit. Visit [bit.ly/Wv6kz9](http://bit.ly/Wv6kz9).

**VIDEO** • Who benefits from Ontario’s Victim Fine Surcharge? Plagued by curiosity, EBMag’s editor gets it figured out. Visit [bit.ly/X30Mlq](http://bit.ly/X30Mlq).

**VIDEO** • Electrical contractors and IBEW represent at Solar Canada 2012. Visit [bit.ly/XrEpiX](http://bit.ly/XrEpiX).



**EBMAG PRESENTS:**

**Partners in Training 2013**

- **May 14**, Saskatoon, Sask. “Shutdowns & Turnarounds”
  - **June 18**, Dartmouth, N.S. “Maintenance & Reliability”
  - **September 24**, Sudbury, Ont. “Shutdowns & Turnarounds”
  - **October 17**, Mississauga, Ont. “Maintenance & Reliability”
- DETAILS coming soon!  
Visit [www.partnersintraining.ca](http://www.partnersintraining.ca)

**IEEE IAS Electrical Safety Workshop**

**March 11-15**, Dallas, Texas  
Visit [www.ewh.ieee.org/cmte/ias-esw/index.html](http://www.ewh.ieee.org/cmte/ias-esw/index.html)

**BICSI Canadian Region Meetings**

**March 14**, Vancouver, B.C.  
**March 19**, Montreal, Que.  
Visit [www.bicsi.org](http://www.bicsi.org)

**RETScreen Training Institute**

**March 19**, Montreal, Que. - 203: Analyse de projets de production d’électricité  
Visit [www.retscreen.net/ang/training\\_institute.php](http://www.retscreen.net/ang/training_institute.php)

**Enercom Conference & Exhibition**

**March 19-20**, Toronto, Ont.  
Visit [enercom.to](http://enercom.to)

**LEducation 7**

*Designers Lighting Forum of New York (DLFNY)*  
**March 20**, New York, N.Y.  
Visit [leducation.org](http://leducation.org)

**EC Ontario Region Breakfast Meeting with ESA’s Ted Olechna**

*Electrical Council of Electro-Federation Canada (EFC)*  
**March 21**, Vaughan, Ont.  
Visit [bit.ly/X2Z8GR](http://bit.ly/X2Z8GR)

**AEL Learning Expo**

*Alberta Electrical League*  
**March 21**, Lethbridge, Alta.  
Visit [albertaelectricalleague.com](http://albertaelectricalleague.com)

**6th Biennial Construction Labour Relations**

**March 26-27**, Toronto, Ont.  
Visit [www.insightinfo.com/constructionlabour2013](http://www.insightinfo.com/constructionlabour2013)

**National Renewable Energy Forum**

**April 2**, Toronto, Ont.  
Visit [www.ofit2013.com/nref-agenda](http://www.ofit2013.com/nref-agenda)

**Ontario Feed-In Tariff Forum 2013**

*Canadian Clean Energy Conferences*

**April 3-4**, Toronto, Ont.  
Visit [www.ofit2013.com](http://www.ofit2013.com)

**Ontario Power Conference**

*CI Energy Group*  
**April 16-17**, Toronto, Ont.  
Visit [www.canadianinstitute.com/ontariopower](http://www.canadianinstitute.com/ontariopower)

**MCEE (Mécanex, Climatex, Expolectriq, Éclairage)**

**April 17-18**, Montreal, Que.  
Visit [www.mcee.ca](http://www.mcee.ca)

**EFC AGM: Business Program & Industry Recognition Award Presentation**

*Electro-Federation Canada*  
**April 23**, Mississauga, Ont.  
Visit [www.electrofed.com/newsroom/events](http://www.electrofed.com/newsroom/events)

**BICSI Canadian Region Meeting**

**April 23**, Calgary, Alta.  
Visit [www.bicsi.org](http://www.bicsi.org)

**Lightfair**

**April 23-25**, Philadelphia, Pa.  
Visit [www.lightfair.com](http://www.lightfair.com)

**OEN Spring Networking at Woodbine RaceTrack**

*Ontario Energy Network*  
**May 3**, Toronto, Ont.  
Visit [www.ontarioenergynetwork.org](http://www.ontarioenergynetwork.org)

**OEL Electrical Industry Conference**

*Ontario Electrical League*  
**May 8-11**, Chatham, Ont.  
Visit [www.oel.org](http://www.oel.org)

**ADVERTISER INDEX**

ADVERTISER.....	PAGE	ADVERTISER.....	PAGE
A-D Rewards .....	24	Humber College .....	8
Arlington Industries .....	23	IPEX Electrical Inc.....	2
Canadian Standards Association.....	22	Nexans .....	1
ESPS.....	19	Northern Cables.....	7
ElecDirect.....	17	Partners In Training .....	18
Falvo Electrical Supply.....	21	Stanpro Lighting Systems .....	16
FLIR Canada .....	9	Suderman.....	21
Fluke .....	21	Thomas & Betts.....	1,5,20
GM Canada .....	13	Venture Lighting.....	14
Hammond Manufacturing .....	6		

**LEARN HOW TO BUILD WINNING BIDS**  
Solid Bidding is the Core of Your Business

Attend our hands on Electrical Estimating Course and learn how to systematically put together an accurate and sellable bid for electrical work.



**Toronto, ON**  
Course #1 April 18 & 19

**Cambridge, ON**  
Course #1 April 29 & 30

Tel: 877-275-7194 or  
E-mail: [sudermanestimating@bellnet.ca](mailto:sudermanestimating@bellnet.ca)

[www.sudermanestimating.com](http://www.sudermanestimating.com)

**SEE BEYOND TEMPERATURE**  
The NEW Fluke VT02 Visual IR Thermometer

A spot thermometer with the visual advantage of a thermal image. It's a troubleshooting camera with an infrared heat map.

See it in action:  
[FlukeCanada.ca/beyondtemp](http://FlukeCanada.ca/beyondtemp)

**FLUKE**

**WANTED**

**Molded Case Circuit Breakers.  
New & Used, All Brands.  
Motor Control & MCC.  
Buckets in A&B, S.D. & W.H. & C.H.**

*Please call, email or fax Ralph Falvo with your list.*

**FALVO ELECTRICAL SUPPLY LTD.**

5838-87A St., Edmonton, Alberta  
1-800-661-8892  
780-466-8078 Fax 780-468-1181  
email: [rjf@falvo.com](mailto:rjf@falvo.com)

**Electrical Business**

Visit [www.EBMag.com](http://www.EBMag.com) and click the icon for our **DIGITAL EDITION!**





# CEC Rule 4-006 and CSA product standards

New Rule 4-006 in CEC 2012 mandates considering the maximum equipment termination temperature when determining the conductor ampacity. This rule was introduced as part of the conductors' ampacity harmonization between the U.S.'s NEC and Canada's CEC. Let's analyze this rule, and discuss two issues causing discrepancies between it and CSA Part 2 certification standards for several products.

Rule 4-006 requires the temperature rating associated with the ampacity of a conductor be selected so as not to exceed the temperature rating of any connected termination or device. Conductor sizes must be determined by considering where they will terminate and how that termination is rated; when a termination is rated for 75C, the maximum temperature should be 75C when the equipment is loaded to its ampacity.

Subrule (1) says: "Where equipment is marked with a maximum conductor termination temperature, the maximum allowable ampacity of the conductor shall be based on the corresponding temperature column from Tables 1, 2, 3 or 4."

The first issue causing a discrepancy is referencing Tables 1 and 3 in Subrule (1), which are for free air rating. CSA Part 2 certification standards for many products require products to be evaluated together with conductors. Based on the standard's requirements for breakers (CSA standard C22.2 No. 5) for example, the ampacities of the conductors chosen to do the testing is included in the standard, and are similar to

Table 2 for copper conductors and Table 4 for aluminum conductors. Breakers and switches are never tested based on conductor sizes based on free air ratings (Tables 1 and 3).

However, installers or designers unaware of product standard requirements—and based on Rule 4-006—will attempt to select conductors based on Tables 1 or 3 where the wiring method used allows the use of ampacities in these tables. That scenario can result in overheated terminations at the equipment, as the conductor used for a certain amperage is now smaller than that with which the breaker was tested.

It is not only the breaker standard that specifies the ampacities of the field wiring conductors be similar to Tables 2 and 4; many other product standards have similar requirements, such as CSA C22.2 No. 4 for switches, No. 14 for control equipment and No. 29 for panelboards.

In accordance with product standards, the selected conductor ampacity should be based only on CEC Tables 2 or 4 in CEC where conductors are terminated to equipment rated 600V or less.

It is also important to note that product standards for testing (e.g. breakers or switches standard) specify 75C- or 60C-rated conductors for field wiring. Currently, there is no circuit breaker or a switch rated for 600V or less that is approved for 90C termination/conductors.

And this is where the second issue with Rule 4-006 arises. Subrule (2) says: "Where equipment is not marked with a maximum

conductor termination temperature, 90C shall be used by default".

Both breakers and switches standards require products to be marked with 75C termination temperature when they are tested with 75C-conductors 1 AWG and smaller. Otherwise, the products rated 100A or less are tested with 60C-rated conductors *and are not required to be marked*. The same standards specify the field wiring conductors are required to be rated 75C for equipment rated higher than 100 A. However, both standards do not require any termination marking for devices rated higher than 100A.

It is obvious the marking requirements in these standards are in contradiction with Subrule (2) of Rule 4-006, which specifies 90C as a default when the equipment is not marked with a maximum conductor termination temperature.

Hopefully, we will see some harmonization between Rule 4-006 requirements and product standards in CEC 2015.

Do we have any other options? Yes. We can change product standards to always require temperature termination markings, or better permit the products to be designed and tested with 90C-rated conductors with sizes based on 90C ampacity. However, considering that the introduction of Rule 4-006 in CEC was part of the harmonization process—and that the NEC is already harmonized with product standards—it is reasonable to expect some changes in Rule 4-006 in CEC 2015. **EB**

*Nancy Hanna, P.Eng., is the engineering manager for Codes & Standards Department at Electrical Safety Authority (ESA) where, among other things, she participates in the development of bulletins, guidelines and technical communication concerning code interpretation and consistency issues. She is a LEED Accredited Professional, and is a member of several CSA TSCs for CEC Part 1, including Sections 24, 32, 46, 50 and 64. Nancy can be reached at nancy.hanna@electricalsafety.on.ca.*



Questions and answers compiled by the Electrical Safety Authority | VISIT WWW.ESASAFE.COM

Tackle The Code Conundrum... if you dare!

Answers to this month's questions in April's Electrical Business.

How did you do with the last quiz? Are you a...

Master Electrician ? (3 of 3)  
Journeyman ? (2 of 3)  
Apprentice ? (1 of 3)  
Plumber ?! (0 of 3)

Question 1

For hotels, the minimum ampacity for service or feeder conductors shall be based on a basic load of [ ] w/m<sup>2</sup> of the area of the building plus other lighting loads for special areas and heating and air conditioning loads.

- a) 15      b) 20      c) 30      d) 50

Question 2

The radius of the curve on the inner edge of bends made on mineral-insulated cable shall be not less than [ ] times the external diameter of the sheath and shall be made so as not to damage the outer sheath.

- a) 3      b) 4      c) 5      d) 6

Question 3

Electrical metallic tubing shall have an inside diameter of not less than [ ] tubing.

- a) 14 Trade size      c) 19 Trade size
- b) 16 Trade size      d) 21 Trade size

Answers: EBMag February 2013

Q-1: A separate bonding conductor shall be installed in rigid RTRC conduit.

- a) True. Ref. Rule 12-1220.

Q-2: Solid-state devices are permitted to be used as isolating switches but not as disconnecting means.

- b) False. Ref. Rule 14-700.

Q-3: The supply conductors for a deep well submersible pumps installed in wells shall be suitably supported at maximum intervals of [ ] to the discharge pipe.

- d) 3.0m. Ref. Rule 26-954(b).

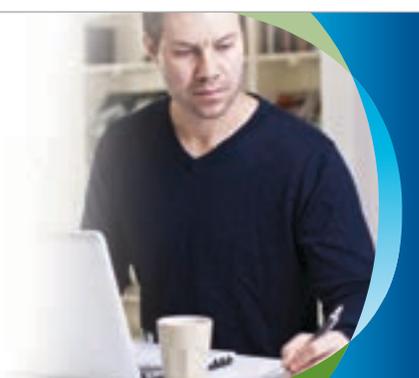


## 2012 CE Code Online Training

CSA Group CE Code online training is now approved by Alberta Safety Codes as meeting re-certification requirements for Master Electricians and Safety Codes Officers. With over 180 revisions, including new and emerging technologies, now is the time to make sure **you know the code.**

KNOW THE CODE IT'S UP TO YOU

VISIT SHOP.CSA.CA OR CALL (877)622-3160



NON-METALLIC

# ONE BOX™

FOR NEW OR OLD WORK



ONE-BOX mounts to a wood or steel stud for an extra-secure installation.

- Angled screws INSIDE attach box to stud
- No wings – no wobble
- Fast, easy to install
- Extra-large 22 cu. in. capacity (single gang)



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

NON-METALLIC • ADJUSTABLE DEPTH

# MOUNTING BRACKETS

FOR CLASS 2 LOW VOLTAGE WIRING



Patent pending © 2012 Arlington Industries Inc.



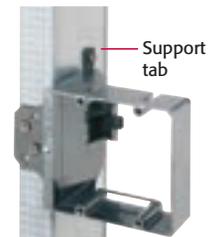
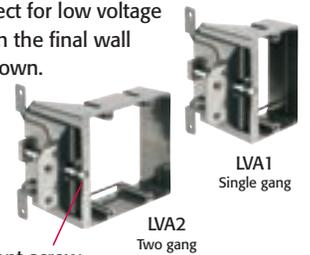
Arlington 800/233-4717 • www.aifittings.com

Arlington's non-metallic adjustable mounting brackets are perfect for low voltage installations when the final wall thickness is unknown.

Set for a 1/2" wall, they adjust to accommodate a wall finish up to 1-1/2" thick.

- Depth adjustment screw is always accessible – for adjustments before or after the wall is done

- Mounting bracket support tab provides extra-secure mounting to wood or steel studs in new construction



Two gang LVA2 on metal stud

BOX EXTENDERS

# CSA LISTED

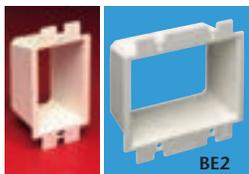
FOR SETBACK ELECTRICAL BOXES



Our CSA/UL Listed Box Extenders extend setback electrical boxes up to 1-1/2".

- Heavy-duty, non-conductive plastic
- Level, support wiring devices
- Protect wires against damage, stripping

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



Try them *all* for the safe, easy way to meet CEC 12-3018 (1) for flush boxes!

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

NON-METALLIC

# MOUNTING BRACKETS

FOR CLASS 2 LOW VOLTAGE WIRING • IN NEW AND RETROFIT WORK



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

Arlington's non-metallic mounting brackets are the best way to install Class 2 wiring! They seat wall plates flush with the mounting surface – install faster and cost less than metal!

In *existing* construction, centered mounting wing screws pull bracket securely against the wall. The LV series (LV1 and multiple gang brackets) adjust to fit 1/4" to 1" wall thicknesses.

For *new construction*, the nail or screw-on LVN series brackets attach to a wood stud. They cost less than extension rings and install faster than mud rings. For screw-on, steel stud installations, try the LVS or LVMB series.

All are available in one to four-gangs.



Patented/Other patents pending ©2008-2011 Arlington Industries, Inc.

View Video for LV1



NEW & OLD WORK • NON-METALLIC

# IN BOX™

RECESSED ELECTRICAL BOX



For new or old work indoors, recessed **IN BOX™** electrical box allows close to the wall placement of furniture and countertop items.

- Non-metallic with paintable trim plate
- Plugs stay inside – don't extend past wall
- One, two, three, four-gang for power and low voltage

View Video



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

EMT

# BUSHINGS

THE BEST 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



Listed for Air Handling Spaces



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

© 2008-2011 Arlington Industries, Inc.

©2001-2011 Arlington Industries, Inc.



IED Rewards  
has made a  
*change.*



IS NOW



**Our name may be new, but all the things you love about us haven't changed at all.**

You'll find the same great selection and quality rewards, the same exclusive promotions and the same amazing prizes you've come to expect from the best rewards program in the industry.

*NOW, WITH EVEN MORE BRANCHES ACROSS CANADA TO SERVE YOU!*

Get the things you've been *wishing* for.

[ADRewards.ca](http://ADRewards.ca)

