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SPRING 2021

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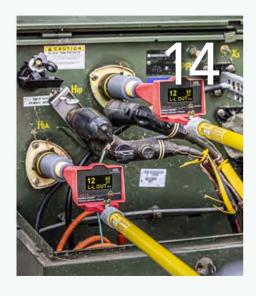
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PUBLISHER'S NOTE

It's May - which means its National Electrical Safety Month. To commemorate the occasion, we compiled a brief reference guide from the NPFA to help you stay up to date with all the latest information and resources, to reduce the number of electrically related fires, fatalities, injuries, and property loss.

- Get up to speed with changes to NFPA 70E®, Standard for Electrical Safety in the
 Workplace®, with real-time classroom training in an all-digital environment. The 2021
 NFPA 70E Live Virtual Training (LVT) delivers a convenient and effective way to learn to
 identify, understand, and implement changes to the standard. This web-based program
 not only provides quality instruction on each change but also breaks down why edits,
 revisions, and additions were made and how the change might affect you in your work.
- OSHA requires employers to provide their employees with a working environment that
 is free from known and recognized hazards. For the electrical world, an employer must
 develop an electrical safety program. In Derek Vigstol's NFPA blog, "Saving Lives by
 Following the Law and Electrical Safety Program," he discusses the basic principles of an
 Electrical Safety Program.
- Go by the book without the book. Introducing NFPA LiNK™, providing digital access to NFPA codes and standards, at your fingertips.
- Across the world, dozens of people each day suffer injuries from electrical hazards such as shocks and arc flashes. Survivors of these incidents list a range of devastating symptoms, from burns and chronic pain, to insomnia, muscle spasms, depression, and various other mental health issues. Many of the full effects of these injuries are still not fully understood. On a recent episode of the NFPA Podcast entitled "The Mysteries of Electrical Injuries" an NFPA electrical expert speaks with three renowned doctors about what a powerful shock can do to the human body, the treatments available, and how our understanding of these injuries is evolving.
- Download the NFPA 70E Fact Sheet for a general overview of how the NFPA 70E®, Standard for Electrical Safety in the Workplace®, is a critical document to help provide a working area for employees that is safe from unacceptable risk associated with the use of electricity in the workplace.
- The latest NFPA 70B fact sheet available for download, provides a general overview of the purpose of NFPA 70B "Recommended Practice for Electrical Equipment Maintenance", which is to provide guidelines for creating an effective electrical preventive maintenance (EPM) program. Check out the blog, "Electrical "Cycle of Safety" Keeps People and Property Protected in an Electrical World" which highlights how the NFPA is steadfast in providing codes and standards such as NFPA 70®, National Electrical Code® (NEC®), NFPA 70B®, Recommended Practice for Electrical Equipment Maintenance®, and NFPA 70E®, Standard for Electrical Safety in the Workplace® and how these NFPA documents are dependent on one another as well to ensure an electrical "Cycle of Safety."
- Adopted in all 50 states, the National Electrical Code (NEC) from the NFPA, is the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards. Stay connected and up to date with the NEC by following the NEC Facebook Page, where you will find ongoing posts and weekly Facebook Live events.

As always, please feel free to email or call me with any comments, suggestions, or if you would like to contribute an article this year.

Best wishes.

Randy Green

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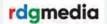
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For more information or to get involved please visit our website, PartnershipForElectricalSafety.org

Electrical Trends for 2021 and Beyond

By Erika Shaugnessy, Contributor

2020 was a year of unexpected and unprecedented circumstances, leading to a massive shift in priorities and trends throughout the electrical industry. The past year has seen drastic changes to the commercial landscape due to citywide shutdowns and the need for social distancing and other precautions. Because of this, it is more important than ever for electrical contractors to stay up to date with the latest trends and practices to ensure that safety remains a top priority for both contractors and visitors to commercial spaces throughout the country. Here are some insights on the newest trends and technologies that will impact the industry this year and for years to come.

PRODUCTIVITY IN THE WORKPLACE

Perhaps the most important and all-encompassing trend to shape the electrical industry this year is the heightened awareness of productivity and safety. Efficiency is key in the workplace, and it's even more important for large industrial and commercial spaces. A simple way to increase productivity and efficiency in the workplace is to install the proper electrical infrastructure system. Installing a well-designed electrical infrastructure system leads to lower initial and maintenance costs, and, more importantly, an increase in worker and facility safety.

When designing large commercial spaces like factory floors, consider installing an open cable management system. Ladder tray and wire mesh cable management systems are two easy-to-install options and allow for better access to electrical infrastructure, adding flexibility and functionality to the workplace. If the facility design requires overhead access to infrastructure power, choose power poles and retractable cord reels that allow contractors to easily place power access throughout a facility. In the event of a disaster, it is also important to consider installing temporary power solutions for recovery and restoration. Having temporary power solutions on hand will allow for a quick recovery with little interruption to production schedules.

ACCESS TO FLEXIBLE POWER

The need for flexible power has been a growing trend throughout the industry for some time now, but the events of 2020 heightened awareness of the lack of flexible power options in commercial spaces. With people making their returns to offices

and schools after working from home for much of the last year, it is important that the workplace is set up for standard health and safety protocols, including social distancing, to be implemented. With workstations needing to be spaced out by at least six feet, it can be a challenge to provide easy access to power throughout the workplace. The experts at Legrand recommend flexible power solutions like the Wiremold ModPower™ System, the first code-compliant modular power system that allows for six feet of separation and can connect up to six separate units to bring power where it's needed. The ModPower System can be attached to desks or tables without requiring them to be fixed in place. Because it is code compliant, contractors will not have to resort to dangerous daisy-chained solutions for access to power.

INCREASE IN COMMERCIAL RENOVATIONS

With the passing of the CARES Act in 2020, facility managers are now able to write off 100% of qualifying facility improvement costs in the first year of construction. Before 2020, facility upgrades were still qualified for tax deductions, but to take full advantage of the deduction, facility managers had to claim only a 2.5% write up each year for up to 39 years following the construction. Because of the new rule, expect an uptick in interest in commercial renovations. Facility managers should work with a tax advisor to confirm that their projects qualify for the write off. Some improvements that qualify for the tax deduction are the installation of air flow management accessories, HVAC devices, and physical security and access control solutions.

Following the unpredictable year that was 2020, the electrical industry is sure to be feeling the effects of the wave of changes. While we look toward the possibility of a return to normal, it is important for contractors and facility managers to continue to be aware of the newest trends and technologies set to impact the industry and provide for more safety, accessibility, and productivity in the workplace. **ESW**



Erika Shaughnessy is a product manager for Legrand's Wiremold business and leader of the new technology initiative. She focuses on bringing power to new and existing spaces with advanced

technology and product innovation (www.legrand.us).

NEW PRODUCTS



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NEW PRODUCTS



GREENLEE® ANNOUNCES NEW HDE® RT-10 ROPE TESTER

Greenlee, part of Emerson's professional tools portfolio, released its new HDE RT-10 rope tester, offering crews a portable and easy way to test a rope's dielectric strength in the field. The RT-10 rope tester is designed to test any length of rope before use, providing clear visual and audible indications of contaminated sections. Professionals interested in the HDE RT-10 rope tester can visit greenlee.com/HDE to learn more.

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Cementex, the safety tool specialists, announces the release of a new lift-front hood in their Ultralight Series of Arc Flash PPE. The lift-front hoods provide a larger viewing area through the updated clear gray color shield, and remain compatible with Cementex's innovative hood ventilation system, for the greatest possible safety of personnel in environments in and around energized equipment. For more information about Cementex's industry-leading arc flash PPE with lift-front hood options, visit our website or call 1-800-654-1292.





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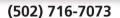
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Before You Get Started: Things to Consider in High Voltage Work

By Brian Kester, Contributor

esting, measuring, and controlling electric power with precision and efficiency is an essential part of the work of every power utility and electrical professional. There are a variety of considerations that utility and electrical professionals must consider regarding safety around high voltage and using test meters. These include following OSHA and employer rules, becoming familiar with the site where work will be performed, tool selection, and understanding the instruction manual. One such related rule you may encounter when working to measure electricity, especially high voltage, is what is known by electricians as the three-step verification process.

After selecting the best meter for the project, the operator should confirm the meter is working correctly by using the industry recognized threestep process of verifying, testing, and reverifying. These steps are:

- First test the meter on a known live circuit or approved testing device to confirm the tool is working properly.
- 2. Next, use the meter to verify the circuit that is being worked on or repaired.
- 3. Third, re-test the meter on a known live circuit or approved testing device, to confirm the meter is still working properly.

A three-step process of verifying, testing, and reverifying will go a long way in ensuring a safe work environment. Taking time at the start of every job to go through the process will ensure work is completed successfully and with improved safety measures.

As you think about applying the three-step process, here are some related things to consider:

- Understand lockout/tagout procedures It is important to not only disconnect all circuits, but also ensure all lockout/tagout procedures are followed to control hazardous energy.
 Procedures will vary by type of equipment.
- Do not skip a step It can be tempting to complete only the first two parts of the process thinking that reverification is not necessary when the first two steps have been done properly. However, what if the meter is not working properly and the first reading was inaccurate? The only way to know would be to do a second verification to compare readings.
- Err on the side of caution If, during the lockout/tagout process, confirmation of shutoff cannot be confirmed, make sure a separator or isolator is used to ensure a safer work area (i.e., rubber blankets, rubber boots).

Along with the three-step process, the type of

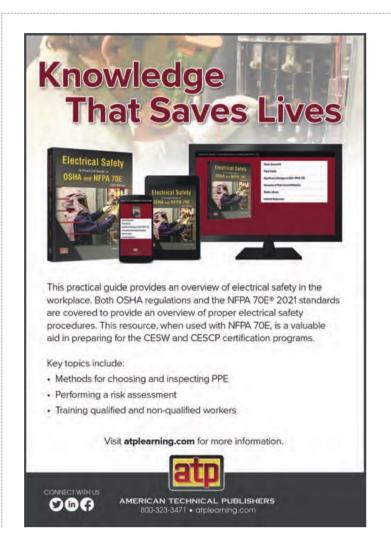
tools you use on the job site are equally important. A few things to consider as you select a tool are:

- Testing tool type matters In assessing a job site, choosing the correct testing tool to use is important. Voltage testing tools come in three categories - non-contact, sensing, and contact -the optimal tool for measurement will vary depending on the application. Some general examples:
 - o Non-contact tool This type of testing tool is used to learn more about an electrical field, but without discovering voltage or a true reading. For example, non-contact tools can be attached to a hot stick for utility line repairs, or a non-contact personal voltage detector worn on the outside of clothing or other protective gear can be used by first responders and storm restoration crews to alert them to hidden live wires. Here, just knowing electricity is present is helpful to the worker.
 - o Sensing/Indication This type of testing tool is used to ascertain a general idea of voltage in the area. For example, utility workers in bucket trucks will attach this type of tool to a fiberglass hot stick and contact the power line to help identify if voltage is present without requiring an extremely accurate voltage reading.
 - o Contact This type of testing tool is used when a more accurate voltage reading is required. For example, in industrial settings where three-phase electrical systems are regularly used, a contact testing tool can help provide a more accurate reading of voltage in each phase.
- Add additional protection In addition
 to the basic testing tools and equipment,
 depending on the type of job site you most
 frequent, other tools and gear can add an
 extra level of protection. For example, is there
 a new advanced type of glove that would
 be beneficial? Or tools that can test ancillary
 equipment for dielectric strength? Always be

- sure to follow industry, OSHA, and company work practices and safety procedures.
- Take time for tool maintenance Regardless of the tools being used, a regular review of tools for any needed maintenance is essential. It is important to look for wear and tear and follow maintenance requirements to keep testing tools and other equipment in top shape.

Taking some time to select the best tools, following proper procedures on the job site, and keeping up with maintenance are simple steps that will go a long way in ensuring safety in high voltage work.

Brian Kester is a professional tool specialist at Greenlee, a leading manufacturer of high-quality tools for electrical and utility trade professionals (greenlee.com).





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High Performance FR Is Changing The Industrial Market

By Brad Sipe, Contributor

here is a movement within the industrial market for flame resistant (FR) apparel to be more stylish, functional, and performance driven. Workers are transitioning from work to date night, working out, and even doing chores around the house in their FR, and as such they are demanding performance. There are more moisture wicking options of FR fabrics than there are in the consumer market, but the problem is most American workers don't understand the technology.

WHAT ARE HIGH-PERFORMANCE FABRICS?

High performance is a term used to describe moisture-wicking technology. These specialized fabrics have been around for over twenty years. They were created to boost an athlete's performance in extreme outdoor situations, keeping them drier and cooler in hot conditions, and warmer and drier in cold conditions. The challenge for many is understanding the science behind the fabric. The world's top athlete's wear high-performance fabrics to optimize their performance and have a better concentration on the task in front of them.

Moisture wicking's history started with a synthetic fiber (like polyester) with a chemical finish applied to allow moisture to spread. Eventually the finish would wash out and the fabric lost its wicking abilities. The tag on garments will reveal the blend of fibers. A blend of 100% of any fiber along with claims of moisture wicking identifies the presence of a chemical finish. Check to see if the manufacturer guarantees wicking for life of the garments chances are they don't.

A NEW GENERATION OF FABRICS

Today, the next generation of high-performance fabrics have a combination of hydrophobic (water-hating) and hydrophilic (water-loving) fibers. Examples of hydrophobic fibers include modacrylic, aramids, para-aramids, while hydrophilic fibers include rayon and lyocell. The combination of these two fibers blended together



The next generation of high-performance fabrics have a combination of hydrophobic (water-hating) and hydrophilic (water-loving) fibers. The best blend ratio of these is 60/40.

ensure permanent moisture wicking for the life of the garment. The big question then becomes: what is the optimal blend of these two fibers that create a soft hand while performing the best?

Data has proven that the optimal blend is when both numbers are closer together, such as a 60/40 blend, this allows for better face (skin side) pick up and transport. If you don't have enough hydrophilic fiber the fabric won't absorb well, and if you don't have enough hydrophobic the fabric will not push the moisture to the front as well. It is the balance of the blend that creates a high-performance product.

When choosing a high-performance FR fabric based on a number alone, be wary of marketers. Ask for the data; it is available. There are different

HIGH PERFORMANCE FR

blends of high-performance fabrics and they all perform differently. Smart shoppers look at the tags to determine the blend of fabrics and what high performance is. The same high-performance fabrics that the world's top athletes wear, is available in this market!

There must be a blend of hydrophobic and hydrophilic to have permanent moisture wicking. Most consumer performance products are 100% polyester with a finish. Look at the tags as they reveal everything.

These performance fabrics allow for garments to be lighter weight and layering to become the norm. Look for a complete layering system to allow for maximum protection, comfort, and performance. The system must wick moisture throughout each garment or it will not work.

The last characteristic for a successful FR program is style and fit. Not all FR garments are styled alike and not every manufacturer cuts a garment alike. Specify the fabric first then the manufacturer of that



There is a movement within the industrial market for FR apparel to be more stylish, functional, and performance driven.

fabric. Chances are your FR program will be less expensive and your garments will last longer. Your employees and your industrial athletes will be more comfortable, better protected, and more focused on the task in front of them.

Brad Sipe is the Director of Business Development for Lakeland Industries. He has been in the FR market for over 10 years 15 years in the apparel industry. Sipe is also a speaker throughout the country on heat stress and the relationship with FR fabrics (Lakeland.com).



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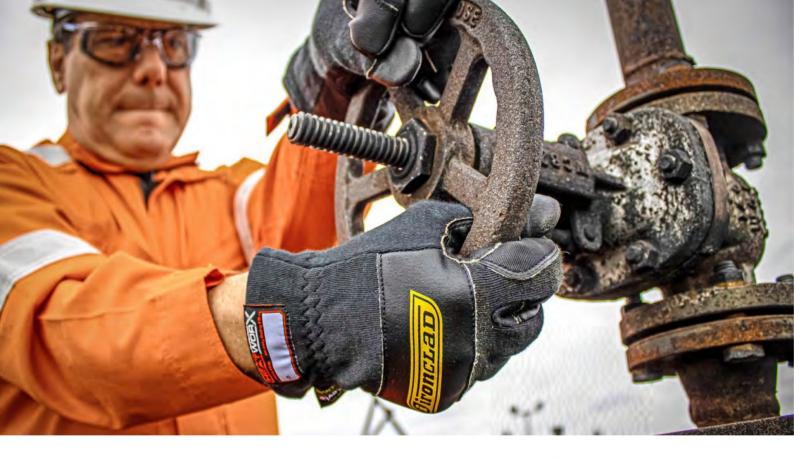


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Flash Fire Protection Now Extends to Hands with NFPA 2112:2018 Certified Gloves

By Eric Jaeger, Contributor

lash fire is a serious hazard in many workplace environments. Workers in the following industries could be exposed to locations that are at risk for flash fire: chemical processing, petrochemical processing, storage & distribution, oil and gas drilling, even certain production and material handling facilities.

FLASH FIRE TESTING STANDARDS

A flash fire is a sudden, intense fire caused by ignition of a mixture of air and a dispersed flammable substance such as dust, gas, or the vapors of an ignitable liquid. It is characterized by high temperature, a duration of typically 3 to 6 seconds, and a rapidly moving flame front. A flash fire can cause extreme heat and burn injuries to people, which can often be fatal. Facility safety professionals spend countless hours on prevention programs, to reduce the potential of a flash fire incident. While they are a rare event, the results are so destructive that employees at risk for flash fire exposure are typically required to wear flame-resistant clothing that is specifically designed to protect, as much as

possible, from serious injury and death.

The most utilized testing standard for flash fire clothing is NFPA 2112:2018, titled 'Standard on Flame-Resistant Clothing for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire'. NFPA 2112 sets the minimum performance criteria for flash fire rated FR fabric, thread, hardware and labels, and certain design criteria. It includes multiple tests on the fabrics, components, and complete garment, including flame resistance, heat resistance, thermal shrinkage, heat transfer performance, launderability, and percentage body burn. All garments must be tested, certified, and then retested and recertified annually by an authorized testing body such as Underwriter's Laboratory (UL). Production facilities are audited for quality control standards up to four times per year. Finally, a high durability label will be affixed to the garment, signifying its approved status.

The National Fire Protection Agency first issued NFPA 2112 in 2001. The standard has been updated several times in the past 20 years; surprisingly, though, gloves were not included in

the testing standard until the most current edition was released, which occurred in 2018. Due to this omission, workers hands have not been protected from flash fire incidences. Many people have wondered why gloves weren't included in the testing protocol. After all, if a person survives a flash fire incident but their hands are badly burned due to lack of certified flame protection, they will most likely never be able to return to work again in the same capacity. Hands are typically the most critical functioning element for your workforce - there is no reason for hands and fingers to be less protected than the rest of the body.

WHY AREN'T GLOVES TESTED?

Back to the question of why gloves weren't included in NFPA 2112 until recently. The answer lies in the details of the testing protocol, and the major differences between the construction of gloves versus clothing. An FR garment is typically constructed of a single type of fabric, cut into large swatches, and sewn together in flat seams. Gloves, on the other hand, are made from a wide variety of fabrics that could be man-made or natural, knit, woven or non-woven, with multiple layers that are often different from the palm to the back of the hand. Fabric and material swatches can be very small, sewn into three dimensional seams. And yet other gloves have no fabric swatches at all - they are constructed of engineered and natural yarns, knitted directly into a glove shape on computercontrolled machines, before being dipped into polymer solutions. Impact protection, knuckle panels, palm reinforcements, inner liners, etc. all complicate matters even further. In effect, gloves present an extremely difficult testing regiment compared to garments.

In fact, even after gloves were included in the testing standard in 2018, almost three years passed before a single glove successfully passed the NFPA 2112:2018 standard for flash fire protection. I was fortunate enough to have first-hand knowledge of that process. Engineers from the testing lab, Arc-Wear, the certifying body, Underwriters Laboratory, and the glove manufacturer, Ironclad Performance Wear, worked together for months dissecting each step of the testing process; creating the right meth-



The Heatworx® Heavy Duty FR is said to be the first ever NFPA 2112:2018 certified glove.

odology for testing every panel, every layer, and every thread of the glove according to each of the applicable test sections - flame resistance, heat resistance, thermal shrinkage, heat transfer performance, and launderability. It was a detailed, time-consuming, science-driven, and ultimately very rewarding process. Not only did the collaborative effort result in the first ever NFPA 2112:2018 certified glove, the Heatworx® Heavy Duty FR, but it paved the way for future NFPA 2112 glove certifications.

For the first time ever, you now have the ability to protect two of your workers' most valuable assets, their hands, from flash fire hazards. While there is only one glove option today, thanks to the work of this pioneering group there will be more options in the future. So, the next time you are creating a workplace safety flash fire protection program, include NFPA 2112 certified clothing AND GLOVES for your employees. They will thank you.



Eric Jaeger has been with Ironclad since 2001 and managing the Ironclad Performance Wear division of Brighton-Best International since December 2017. Prior to being named General Manager, he ran several departments

including research and development, sourcing, and operations. He has a degree in Bioengineering and was a Biomedical Engineer prior to switching to the PPE market (www.ironclad.com).



Six Electrical Safety Tips for Construction Workers

By Jeson Pitt, Contributor

he safety of construction workers should be a priority on any construction site. Amongst various other hazards, a lack of electrical management is the primary concern. Electrical project supplies such as electrical cable, switches, and other equipment are present all around the site, and all increase risk of an accident.

If you are aware of the possible cause of an accident, you can prevent it, for instance using a GFCI outlet to trip quickly to prevent an electrical incident. But that's only one example.

Below are the top six ways to ensure electrical safety for construction workers, creating a safer work environment:

1. Perform Everyday Audits

You should regularly check the new development related to construction electrical safety, like new equipment and site layout change. If there is a new joiner, make him aware of the site layout. Provide him or her knowledge and training regarding the usage of electrical equipment and cables on the site.

You should exchange information with budding contractors and engineers of nearby sites. A new safety measure followed by them may prove to be useful at your site as well.

2. Ensure Residual Current Device (RCD)

RCD is a life-saving supply measure of electricity. All electrical construction equipment should get their electric supply through RCD. It can prevent any fatal shock due to electrical surplus or any other mishap, like open live wires. All electric equipment, such as light sources, kettles, microwaves, etc., should be RCD protected. You can test the active residual current device through test buttons.

3. Fix the Faulty Electrical Equipment

You need to check various electrical equipment for faults and damage. You can face cracked casings, RCDs not working, brittle insulation, damaged guard, overheated cables, and more. Some of the flaws can be repaired. At the same time, you need to throw out or return the beyond-repair electrical project supplies.

No matter how much experience you or anyone else on your team has, appoint qualified and



trusted electrical liquidators only to handle this critical task, since they are trained and licensed to identify these kinds of faults.

4. Plan for Natural Hazards

You should also consider the environmental factors of each season and weather. Excessive heat and UV rays are not suitable for specific electrical construction equipment. It would help to protect your cables and wires from dust, corrosion, rain, and humidity. During rain, construction workers should get proper cover as it is not advisable that they come in contact with water.

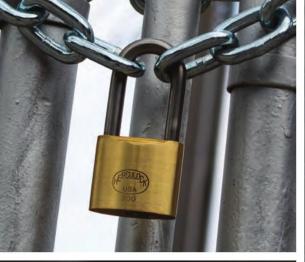
5. Cover the Leads & Cords

Unorganized and scattered cables and cords can be the reason for the tripping of workers. There is a hazard of open current also if they get damaged. For the sake of the electrical safety of the site, keep the leads and cords arranged or stored away when not in use. Take extra care on high levels of the building.

6. Personal Protective Equipment (PPE)

Every worker should wear PPE without fail to ensure construction electrical safety. In fact, keep some extra at the site. It directly protects you in case of any unfortunate incident. Exclusive electrical gloves, shoes, face shield, helmet, eyewear, earmuffs, etc., are all part of an electric PPE kit.

Jeson Pitt works with the marketing department of D & F Liquidators in Hayward, CA and regularly writes to share his knowledge while enlightening people about electrical products, as well as solving their electrical dilemmas (https://www.dfliq.net).















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Understanding the Cybersecurity Standards Enabling Trusted IIoT Connections

By Max Wandera, Contributor

oday's exponential industrial internet of things (IIoT) growth creates a crucial need for robust cybersecurity practices and well-defined standards that provide customers with confidence that their connected devices will operate securely throughout their entire lifecycle.

By 2025, 41.6 billion connected devices will be generating 79.4 zettabytes (ZB) of data that will need to be securely maintained and processed. Analysts forecast that this increase in connected devices and the data they generate will continue to grow exponentially. Our world is also becoming increasingly electrified. The increase in critical data and computing is expected to require four times more electricity over the next decade.

A world with amped up connectivity and electrical demand needs confidence that electrical power systems are constructed with trusted products. Cybersecurity is a must-have for product development, much like safety and quality. This means strict procedures and cybersecurity protocols need to be integrated at every phase of product development that involve people, processes, and technologies.

CYBERSECURITY CERTIFICATIONS FOR CONNECTED PRODUCTS

For power management devices that are connected, UL created its 2900 Standard for Software Cybersecurity for Network-Connectable Products (UL 2900). These guidelines were the first of their kind and include processes to test devices for security vulnerabilities, software weaknesses, and malware. This standard confirms that the device manufacturer meets the guidelines for:

- Risk management processes
- Evaluation and testing for the presence of vulnerabilities, software weaknesses, and malware
- Requirements for security risk controls in the architecture and product design

UL also provides a Cybersecurity Client Lab Validation program for manufacturers, which certifies testing laboratories with the global capability to test products with intelligence or embedded logic to key aspects of its 2900 standard. By purchasing products tested in these specialized labs, customers can rest easier, knowing their devices are compliant with the industry's highest cybersecurity requirements before they're installed in critical systems.

Similarly, the International Electrotechnical Commission (IEC) adopted the 62443 series of standards, which provides a framework to address the cybersecurity of Industrial Control Systems. These standards provide requirements for all the principal roles across the system lifecycle - from product design and development through integration, installation, operation, and support. In 2018, the IEC added 62443-4-2 to improve the security of products.

Just as product cybersecurity certifications are needed to support trusted connectivity, it is equally important to validate that manufacturers apply secure product development principles to product development. This can be confirmed through an accredited Secure Development Lifecycle (SDL) that provides assurance that cybersecurity has been embedded throughout the entire product development process.

WHAT IS A SECURE DEVELOPMENT LIFECYCLE (SDL)?

SDL was created in response to an increase in virus and malware outbreaks at the turn of the twenty-first century. This approach to product development places cybersecurity front and center from inception to deployment and lifecycle maintenance. SDL can help manufacturers stay ahead of cybercriminals by managing cybersecurity risks throughout the entire lifecycle of a product or solution.

As an early spearhead of the SDL initiative, Microsoft made its SDL tools, processes, and guidelines widely available. Since then, SDL has been widely adopted across industries including electrical and critical infrastructure. Today, SDL is a proven strategy to address risk proactively with a system-wide defensive approach.

CYBERSECURITY STANDARDS

For manufacturers, adopting an SDL approach that has been validated by a third-party is critical to creating trusted environments. It's the third-party certification that gives customers confidence in the processes and technologies they're applying, much like safety certifications and standards in the National Electric Code.

STANDARDS FOR SDL BUILD CONFIDENCE

Although SDL is not an inherent code or standard, it does dictate how cybersecurity should be integrated into processes for product procurement, design, implementation, and testing teams.

IEC 62443-4-1 lays out guidelines for secure product lifecycle development in the electrical industry. The IEC guideline specifies process requirements for the secure development of products used in industrial automation and control systems. It defines a secure development lifecycle for developing and maintaining secure products. These guidelines can be applied to new or existing processes for developing, maintaining, and retiring hardware, software, or firmware for new or existing products.

Third-party validation for SDL processes is important because it provides customers with confidence and helps reduce risk by confirming that the technologies and processes they're applying comply with proven industry guidelines. At Eaton, we take SDL very seriously to proactively manage cybersecurity risks in products through a framework involving threat modeling, requirements analysis, implementation, verification, and ongoing maintenance.

HOW SDL PROTECTS ELECTRICAL SYSTEMS IN THE LONG TERM

A "defense in depth" mechanism that is effective today may not be effective tomorrow because the vulnerabilities keep evolving. This is why administrators of industrial control system networks must be ever-alert to changes in cybersecurity landscape and work to prevent any potential vulnerabilities.

The cybersecurity process certifications outlined by IEC provide customers with confidence that manufacturers have instilled the organization-wide approaches needed to ensure robust cybersecurity over the lifecycle of any given product.

UNIFYING GLOBAL CYBERSECURITY STANDARDS FOR CONNECTED PRODUCTS

The security of a network or system is only as strong as its weakest link. Organizations should employ basic cybersecurity hygiene and continuously analyze emerging threats to ensure systems are deployed securely. Additionally, companies should take inventory of everything connected to their networks and employ a zero-trust model.

As more manufacturers and industries build and deploy IIoT devices, the security and safety of systems providing essential operations become more important and more difficult to manage. These complexities are due, in part, to a lack of a global, universally accepted cybersecurity standard and conformance assessment scheme designed to validate connected products.

The economic challenges to safeguarding IIoT ecosystems spawn from the complex manufacturing supply chain and the difficulty of assigning clear liabilities to manufacturers and system integrators for any vulnerabilities introduced. Most products and systems assemblies consist of components from different suppliers. Where should the element of trust begin and end if there is no global conformity assessment scheme to ensure that products and systems are designed to be compliant with the global standards defined by the industry?

There are currently a multitude of different standards and regulations created by various organizations, countries and regional alliances across the globe. All of these standards and regulations address the urgent need to secure our connected world, however they also create the potential for confusion and possibility of weak links in critical infrastructure ecosystems. A unified global conformance assessment would address these challenges and more. The time to drive this singular certification is now. We're working with leaders across the industry to do just that.

Max Wandera is the Director, Product Cybersecurity Center of Excellence at Eaton (www.eaton.com).



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How Understanding Bonding and Grounding Saves Lives and Equipment

By Samuel Rokowski, Contributor

ou can't talk about electrical safety in the workplace without involving some of the discussion around bonding and grounding. In 2016, OSHA determined what is called "The Fatal Four", one of which being electrocution on job sites. In that year, electrocution hazards led to 82 deaths, which is 8.3% of the 991 fatalities caused in the construction industry. The biggest problem in the industry is a misunderstanding and use of the requirements for grounding in bonding in the National Electrical Code.

What is the effective ground fault current path, and why is it so important? Because this path is a low impedance electrically conductive path that is designed to carry current during ground fault conditions and is designed to operate the overcurrent protection device or ground fault detectors (See NEC Article 100). To put it simply, without this low-impedance path during ground-fault conditions, normally non-current carrying metal and conductive materials are energized and can lead to shock or electrocution.

In this article I would like to focus attention on the requirements of bonding and grounding equipment and maintaining the effective ground fault current path to protect equipment and the safety of personnel in accordance with the 2020 National Electrical Code. My attention will focus on grounded systems only.

THE EFFECTIVE GROUND FAULT CURRENT PATH

It would be simple to understand this path if the path was singular, but it is not. The effective ground fault current path is a system of conductors and electrically conductive equipment that are connected to each other that creates this low impedance path. This path consists of any combination of conductors, equipment grounding, metallic raceways, metallic cable sheaths, electrical equipment, and other normally non-conductive metal material including building steel, metal piping systems, concrete encased rebar, shields of communications circuits, and the Earth. Understanding and maintaining this system is the difference between eliminating



The biggest problem in the industry is a misunderstanding and use of the requirements for grounding in bonding in the *National Electrical Code*.

electrocution hazards or introducing them on electrical equipment.

GENERAL REQUIREMENTS FOR BONDING AND GROUNDING

So, what is the difference? Bonding is to mechanically connect metal equipment, raceways, and conductors to establish electrical continuity. Grounding is connecting conductors, metal equipment, and raceways to a conductive body that extends to the Earth. Both are key components of an effective ground-fault current path.

Section 250.4 of the 2020 Edition of the National Electrical Code states the general requirements for bonding and grounding. Grounded systems are required to have grounding in accordance with section 250.4(A)(1). All electrical systems that are grounded shall be connected to Earth in such a manner that the system will limit voltage imposed by ground faults, unintentional contact, lighting, and higher voltage systems. Grounding and bonding both act together to limit voltage that may be imposed. All normally non-current-carrying conductive components that enclose electrical conductors and equipment shall be connected to Earth. At the same time normally non-current conductive materi-

BONDING AND GROUNDING

als shall be mechanically connected together and to the supply source in order to establish an effective ground-fault current path.

OBJECTIONABLE CURRENTS

Another often misunderstood issue with improper grounding and bonding is objectionable current. Objectionable current happens when a parallel path is created by an improper neutral to case bond and allows current to flow on normally non-current-carrying metal without the proper return to the power supply that would trip the overcurrent protection or ground fault protective device. This current on normally non-conductive materials can lead to electrical shock or electrocution.

Section 250.6 of the National Electrical Code addresses objectionable current and advises on how to avoid and eliminate any that exists. It states that the grounding of electrical equipment, circuit conductors, surge arrestors and protective devices, and normally non-current carrying metal shall be arranged in a manner that prevents objectionable current. In section 250.6(B) the code provides alterations that can be used to stop objectionable current, they include:

- To discontinue or disconnect one or more of the grounding connections to remove the objectionable current, but not all the connections.
- 2. Change the grounding connection locations.
- 3. To interrupt the conductor or continuity that is creating the objectionable current.
- 4. Utilize another suitable approved means

It is important to note that temporary currents that are considered ground-fault, or abnormal conditions cannot be classified as objectionable currents. There are no alterations to ground fault or abnormal conditions, the circuit needs to be deenergized immediately.

PERMITTED METHODS OF CONNECTION WHEN GROUNDING AND BONDING EQUIPMENT

The code specifies permitted methods for connecting the equipment grounding conductors, grounding electrodes, and bonding jumpers

in section 250.8(A). Equipment grounding conductors, bonding jumpers, and grounding electrodes shall be connected by one of the following means:

- 1. Listed pressure connectors
- 2. Terminal bars
- 3. Pressure connectors listed as grounding and bonding equipment
- 4. By exothermic welding
- 5. Machine screw-type fasteners that engage not less than two threads or are secured with a nut
- 6. Machine screw-type fasteners that engage not less than two threads or are secured with a nut
- 7. Connections that are part of a listed assembly
- 8. Other listed and approved means

Keep in mind in accordance with section 250.8(B), grounding and bonding connections shall not rely on soldering connections. These connections are fragile and may break with vibration and movement.

Anytime that there are exposed ground clamps or other fittings, those fittings shall be protected by enclosing them in metal enclosures, wood, or anything equivalent.

Section 250.12 identifies the surfaces that grounding and bonding connections will be attached to shall have a clean surface and be free of nonconductive coatings such as paint, lacquer, and enamel. Don't confuse this with the conductive paint that electrical manufacturers use to coat electrical equipment that is conductive, it's regarding foreign materials.

EQUIPMENT GROUNDING AND EQUIPMENT GROUNDING CONDUCTORS

The code identifies in section 250.109 that metal enclosures are permitted to connect equipment grounding conductors, bonding jumpers, or both to become a part of the effective ground-fault-current path. Any metal cover or fitting attached to the metal enclosures are considered connected to the equipment grounding conductors, bonding jumpers, or both. This is important to understand that if a fault happens on the cover, the low-impedance path will still clear the fault.

Equipment fastened in place or connected by

BONDING AND GROUNDING

permanent wiring methods that may become energized shall be connected by an equipment grounding conductor where within 8ft vertically or 5ft horizontally of ground or grounded metal objects subject to contact by people, when located in damp or wet locations and not isolated, in hazardous locations, where the wiring method provides the equipment grounding conductor, and for equipment that operates at over 150 volts to ground in accordance with section 250.110.

Equipment connected by cord and plug shall be connected to the equipment grounding conductor in hazardous locations, where operated at 150 volts to ground, in residential occupancies and other than residential occupancies that are connected to refrigerators, freezers, air conditioners, laundry appliances, non-portable kitchen appliances, portable luminaries, motor-operated tools, among other loads in accordance with section 250.114. Note, there are some exceptions to the identified cord and plug connected loads.

EQUIPMENT GROUNDING CONDUCTOR TYPES AND IDENTIFICATION

Equipment grounding conductors don't always have to be the conductor type. The code recognizes many different types including some more common ones, like the conductor type, solid metal conduits, listed flexible metal conduits that meet specific conditions, Armor type AC cable, metal-sheathed cable, MC cable that meets specific conditions, cable-trays, cable bus, and other listed electrically continuous metal raceways and gutters in accordance with section 250.118. These electrical conductors, raceways, cables, trays, and other listed means act as the equipment grounding conductor and are a part of an effective ground-fault current path.

In section 250.119, the code outlines that acceptable identification for equipment grounding conductors. Equipment grounding conductors shall be insulated, covered, or bare. The covered or insulated type equipment grounding conductors shall have a continuous green outer finish, or green with one or more yellow stripes. Conductors meeting the criteria specified shall not be used as ungrounded or grounded circuit conductors. Conductors that are 4 AWG or larger are permitted

to be permanently identified as an equipment grounding conductor at each end at the time of insulation, see section 250.119(A).

The majority of electrical professionals that I meet fail to completely understand the requirements of bonding and grounding in the *National Electrical Code*. Article 250 is long, often confusing, and takes someone experienced to completely understand it. Do your part in the industry and the workplace to keep yourself, and those around you safe from shock and electrocution by understanding the requirements and maintaining the effective groundfault current path. It's definitely not an easy task to do, it will take time, patience, and hard work; but that is no comparison to the risks you take when you don't understand the requirements.

Samuel Rokowski is a licensed electrical plans examiner, electrical inspector, a licensed electrical contractor in multiple states, and a Principal on NFPA 70 & 72.





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