



The Importance of Electrical Product Safety Testing

Why UL and other NRTL Listings are Critical





Introduction

Electrical product safety is a serious matter. According to a recent study conducted by [IEEE in conjunction with Los Alamos National Laboratory and the Department of Energy](#), between 2012 and 2016, 9,760 workers in the U.S. were injured through exposure to electricity – an average of 1,952 annually. Between 2007 and 2016, 21,550 workers in the U.S. experienced some type of non-fatal electrical injury. Many electrical injuries result in significant time away from the job – 41 percent of injuries require more than two weeks away from work. The study says that 34-years' worth of OSHA data base records show 4,255 fatal electric shock incidents, or an average of 125 per year.

The [National Fire Protection Association report released in 2018](#) stated that nearly three workers die every week from exposure to electricity – a total of 739 deaths during that period. One-fifth of the victims were self-employed. The report added that 80% of fatal injuries from direct exposure to electricity occurred while workers were engaged in constructing, repairing, or cleaning activities. Workers who were fatally injured as a result of indirect exposure to electricity were most often engaged in construction, repairing, or cleaning activities (37%) or were using or operating tools or machinery (32%) at the time of injury.

This White Paper will discuss the business impact that can result from a failure to take preventative efforts to address specific electrical hazards, and how certified electrical safety testing is crucial to meet workplace safety regulations and meet agency compliance requirements. It will also provide recommendations and best practices for minimizing these risks.

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The NRTL System for Safety Testing

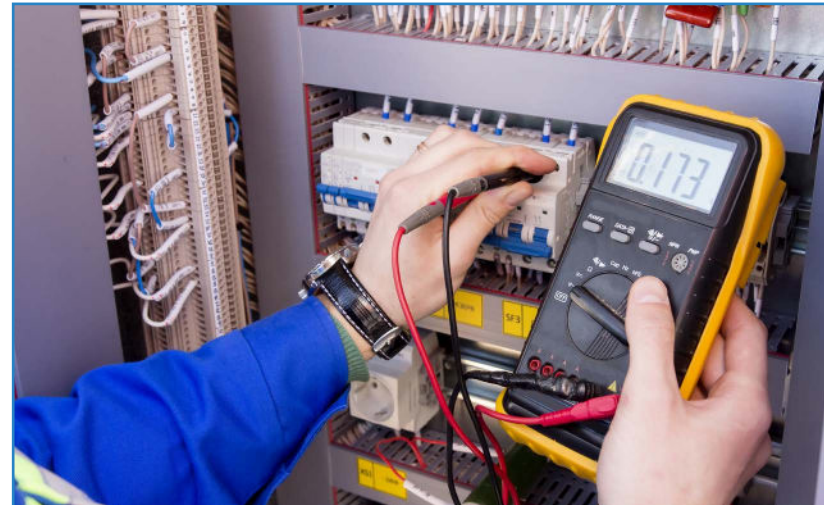
The United States Occupational Safety and Health Administration (OSHA) requires that 38 different types of products, devices, assemblies, or systems used in the workplace be “approved” (i.e., tested and certified) by third-party organizations identified as Nationally Recognized Testing Laboratories (NRTLs).

Typical tests for electrical products prove that no dangerous voltages will be exposed to users, and that the product will not cause a fire, even in the case of equipment overload or failure.

The rigorous standards established by OSHA’s NRTL Program verify that each testing facility has the necessary qualifications to perform safety testing and certification of specific products covered within their scopes of expertise, and to provide product safety testing and certification services to manufacturers for use of select types of products, devices, assemblies, or systems. Because of the particular importance of electrical equipment in regards to worker safety, and

because of both the danger of electrocution and the risk that it can start fires, the number one category of covered items is “electrical conductors and equipment”, of which electrical surge protective devices are included.

Submitting and testing a product is not a trivial exercise since it requires significant design information, sometimes including design calculations, drawings showing manufacturing tolerances and similar details. In some instances, the testing lab will even visit the manufacturing facility to confirm that construction is as it has been described. OSHA created the NRTL program to ensure that certain types of equipment be tested and certified to establish their safe use in the workplace. Typical tests for electrical products prove that no dangerous voltages will be exposed



to users, and that the product will not cause a fire, even in the case of equipment overload or failure. The nature of specific tests varies widely, but in each case, testing is appropriate for the possible conditions that a product may experience during use. OSHA’s NRTL regulations were established in 1988. The first organization became recognized as a NRTL in 1989.

Testing and certification are conducted in accordance with U.S. consensus-based product safety test standards. OSHA doesn’t develop or issue any of the product test standards; rather it acts more as a facilitator for other U.S. standards organizations such as the American National Standards Institute (ANSI), NFPA, IEEE, and the oldest of all global safety certification organizations, UL LLC – formerly known as Underwriters Laboratories. While UL is the best-known of the NRTLs, there are currently about 17 others as well. Some of these specialize in certain product types, while others may compete for business with speed or cost. These organizations then arrive at a consensus with representatives of other standards



organizations, government agencies and consumer groups. The range of products covered is limited to those to be used in any work-related facility, for which OSHA safety standards require “certification” by a NRTL. Other submissions are voluntary, and manufacturers must pay for the service, so some manufacturers choose to skip testing and sell only in the aftermarket, where the lack of approval may go unnoticed. However, legitimate companies welcome the chance to prove the safety of their products and will not skip this important step.

A NRTL is a private-sector organization that OSHA has recognized as meeting the legal requirements to perform testing and certification of products using consensus-based test standards (29 CFR 1920.7). OSHA’s standards contain requirements for approval (i.e., testing and certification) of certain products by an NRTL. For example, in 29 CFR 1910.303, OSHA requires NRTL approval for many kinds of electrical equipment when they are used in the workplace.

Standards like these help protect workers by ensuring products and equipment are designed for safe use in the workplace. Typical tests for electrical products prove that no dangerous voltages will be exposed to users, and that an electrical product will not cause a fire, even in the case of equipment overload or failure.

When an organization applies for recognition as a NRTL, OSHA staff thoroughly reviews their application materials for completeness and to determine whether the applicant has met the requirements for recognition. In conjunction with this determination, the NRTL program

staff generally performs an in-depth on-site assessment of the applicant’s organization, programs, and facilities. If the NRTL program staff makes a positive determination, they prepare a report and recommendation that the application be approved by the Assistant Secretary, on behalf of the agency.

OSHA publishes the Agency’s preliminary findings on the application for NRTL recognition in the Federal Register. Following a 30-day comment period, OSHA publishes a second notice announcing its final decision and response to any comments received.

After publication of a final decision to recognize a NRTL, the Assistant Secretary of Labor for Occupational Safety and Health sends the applicant a formal notification of its approval. This notification outlines the specific scope and terms of the NRTL recognition. The NRTL must apply for renewal of recognition every five years.

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The UL Way

So, how does an organization like UL see its role in security product safety and how does the process for testing and certification work?

According to Ken Boyce, corporate fellow and principal engineer director of UL's Energy Power & Technology division, UL has focused on its mission of working for a safer world. One important element where UL empowers trust is through its testing and certification programs, which have been regarded as an industry standard for decades. Manufacturers submit their products for UL certification to the applicable requirements contained in a UL (or other) standard, along with critical information about the product design features that are related to its safety. UL's engineers review the information, assess the product design for conformance to the applicable requirements, and conduct a testing program. The nature of specific tests varies widely, but in each case is appropriate for the possible conditions that a tested product may experience during use.



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Depending on a manufacturer's products and abilities, there are some variations that can be introduced, such as acceptance of data generated at a manufacturer's site. Once the results of the engineering investigation demonstrate conformance with all of the applicable requirements, the UL certification is granted. At that point, the agreement between UL and the manufacturer permits the use

of the UL Mark on products that comply with the requirements for safety, and UL conducts periodic surveillance visits (generally once per quarter) to the site producing products bearing the UL Mark to audit continued compliance.

The standards for safety testing come from several sources like ANSI and government agencies, but sometimes they are a result of consumer groups and organizations coming together to protect their industry. UL certifications are based on published requirements, frequently in the form of standards that address specific products, systems or aspects. The

American National Standards Institute (ANSI) does not itself publish standards but accredits standards development organizations using an ANSI-accredited process to publish American National Standards.

For example, Underwriters Laboratories Inc. is accredited by ANSI to publish American National Standards. UL standards are developed using an open process and consensus bodies with balanced representation from different interest groups. If standards do not exist for new



technologies, UL can develop requirements to use as a basis of certification; these Outlines of Investigation are publicly available and often serve as the proposed first edition of new consensus standards to be developed by Underwriters Laboratories Inc. using the ANSI-accredited process. UL certification requirements and standards are developed with the intent of establishing compatibility of the product/system requirements with applicable model installation codes such as those published by the National Fire Protection Association and the International Code Council.

Safety Standards and Local Regulations

There is a close relationship between NEC, UL, NFPA 79, NRTL and the authority having jurisdiction, or AHJ, in ensuring electrical and fire/life safety compliance in buildings. Among the primary responsibilities of the AHJ in accordance with other standards and compliance agencies is to enforce the locally adopted safety codes and standards in that municipality.

Those codes and standards become the de facto law for that jurisdiction, much like those

developed by the NFPA. Adopted across the United States, the National Electric Code (NEC) or NFPA 70 are the rules and regulations that dictate safe electrical design, installation and inspection of electrical systems and equipment in all commercial and industrial facilities.

It is also important to remember that the term “listed” that is found in some but not all NEC codes and standards, doesn’t imply that the product is “UL Listed” or that the product has been “approved” by any standards body. The term “Listed”, according to the NEC, means that the equipment, materials, or services are included in a list published by a NRTL. There are no laws specifying that listed products must be used, however, in the United States many municipalities have laws, codes and regulations that require a product be certified by a nationally

recognized testing laboratory before it can be used. Products which carry listings and are labeled as such are quickly identified by the authority having jurisdiction, or inspector, to satisfy strict safety requirements.

While the NEC covers electrical products and installations in the field, NFPA 79 is the section that covers the products and installation on a machine, electrical and electronic equipment, or systems of industrial machines supplied from a nominal voltage of 1000 volts or less. NFPA 79 is also voluntary and more of a best practice outline of standards for machine building across North America, however most states, local authorities and end customers in North America will demand compliance with NFPA 79. To be clear, the terminology “approved”, defined by the NEC under Article 100 as “acceptable to the authority having jurisdiction”. Article 100 is where you will find definitions “essential to the application of this Code.” A change that can be found in the scope that you will see applied throughout the Code is the high voltage threshold. The high voltage threshold of equipment operation has been raised from 600 volts to 1000 volts.

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The responsibility for interpreting and enforcing the requirements of a code (NEC) or standard (NFPA 79), and for approving equipment, materials, installation or a procedure as the final authority, is up to the AHJ and would require the products to be listed with a NRTL and

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labeled as such as a basis for approval. Insurance and liability coverage may also rely upon the use of approved products in the facility. In the case of an incident, coverage may be denied if it is found that unapproved products had been installed at any time and had any impact on the occurrence or severity of the incident. As a contractor or installer, if they install unapproved products at any time, the firm could become party to lawsuits. Using approved products wherever they may apply is recommended.

A NRTL must use appropriate product safety test standards in certifying products. These test standards contain technical requirements that products must meet for workplace safety. OSHA does not develop these test standards. However, OSHA defines what it means by “appropriate test standard” in its regulation (29 CFR 1910.7). Organizations such as the American National Standards Institute (ANSI) and the American Society for Testing and Materials (ASTM) publish many appropriate product safety test standards. A product safety test standard for which a NRTL is recognized is different than, but must be consistent with, OSHA standards, with which employers must comply pursuant to the Occupational Safety and Health Act of 1970 (29 USC 651 et seq).

There are various methods of establishing compliance with standards, broadly referred to as conformity assessment. For critical attributes such as safety and security, “third-party conformity assessment” is generally valued and prioritized by regulators, the market and others. Third-party conformity assessment involves an evaluation of conformance by an independent third party (i.e. neither the manufacturer nor the user), bringing additional confidence to the assessment and mitigation of the high risks associated

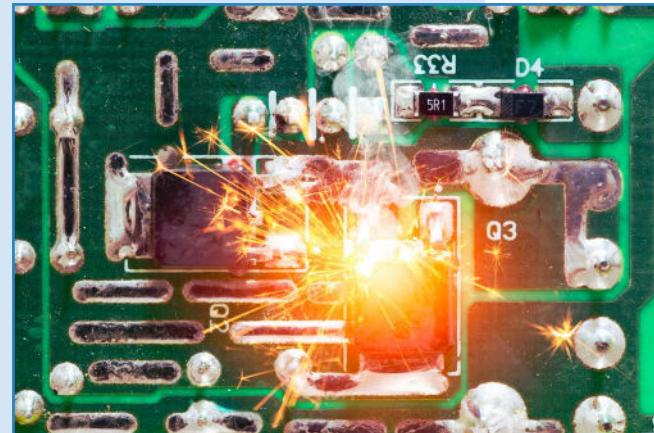


Most facilities experience an average of over four power surges per day. A serious power surge can damage business equipment, interrupt crucial security & data information systems and cripple crucial fire alarm systems. Electrical industry experts estimate that businesses alone lose tens of billions of dollars every year from power quality issues. And, while it is unknown how many fires result from power surges, according to the U.S. Fire Administration (USFA) electrical issues in buildings caused over 1,318,500 fires, resulting in 3,655 deaths, 15,200 injuries and \$25.6 billion in property damage in 2018. Surge protection addresses both power reliability and power quality. A power surge takes place when the voltage in a building's electrical wiring spikes to 110% or more above the normal operating voltage. Power surges are so brief they are measured in nanoseconds, microseconds, and milliseconds, but can cause considerable damage to equipment. Minor electricity fluctuations (either up or down) are normal in any electrical system.

Between 60-80% of all power surges originate inside a building. About 20-40% of power surges are created outside a building. The most common cause of power surge inside a building is from larger electrical equipment being turned on and off throughout the day. Under these conditions, lights will flicker, equipment will shut off, and computer equipment will experience operating errors or data loss. The most common cause of power surge outside a building is from utility grid switching where utility companies re-route electricity on the grid.

There are three ways in which a surge will cause damage:

- **Disruptive:** A surge enters an electronic component which interprets this as a valid logic command. The result: system lockup, machine malfunction leading to faulty output, or corrupted files.
- **Dissipative:** A repetitive, pulsing of short duration energy. The result: Long term machine or system degradation leading to system replacement at earlier intervals.
- **Destructive:** A high-level energy surge that immediately results in equipment failure or destruction.



The longer a surge travels, the more the surge magnitude is reduced due to the high frequency effects. If susceptible equipment is closer to the source of the surge, the surge will transmit more energy to the equipment. There is a way to protect your building's wiring, equipment, and business income from downtime caused by an unavoidable power surge by using a **Surge Protective Device (SPD)**, which is an electrical device that smooths out spikes in electricity to prevent damage to electrical equipment, especially electronic equipment downstream. An SPD is a device that has a positive effect on the power quality and reliability of equipment used by a building.

The SPD absorbs the power surge energy and safely reroutes it to the facility's electrical grounding system before it has a chance to reach equipment in its electrical path. SPDs do not provide 100% protection, but other than surges from direct lightning strikes, they will adequately protect your facility when properly installed.





with non-conformance. The benefits of that independent assessment and the resulting confidence in the safety and security of the products benefits the manufacturer as a demonstration of commitment to safety and due diligence, and to the public in the form of safe and secure living and working environments. For these same reasons and outcomes, other interested parties such as regulatory authorities, insurers, retailers, employers and others often seek or require third-party approval in the form of certification.

UL has also been involved with the NEC since its inception in 1897. Today, UL continues to be heavily involved in its development, with members on the Correlating Committee and each of the 19 Code Making Panels. Three UL experts also serve as Code Making Panel Chairmen. It is important to note that whereas the NEC is not a design specification, it does play a tremendously important role in the safety and installation of the electrical infrastructure. The NEC provides active development of certification requirements to address new technologies, programs to promote safety, and support in preparing manufacturers for the approval process. UL certification requirements and standard are developed with the intent of establishing compatibility of the product/system requirements with applicable model installation codes such as those published by the National Fire Protection Association, including the NEC, and the International Code Council.

Looking at Best Practices

Establishing a baseline of best practices during the planning stages of a project will ensure that a UL testing and certification experience, or any other NRTL experience, will be successful and provide the regulatory insurance a manufacturer is looking to gain. During the planning stages, it is crucial that you understand all of the formal requirements appearing in written laws and contracts, as well as the informal policies as they relate to all the applicable AHJs who will inspect and provide their approvals. It is also important to review your list of standard offerings to make sure that wherever possible, NRTL approved products are offered – and that they are highlighted to your customers and users.

Establishing a baseline of best practices during the planning stages of a project will ensure that a UL testing and certification experience will be successful.

A NRTL that OSHA has recognized as meeting the legal requirements in 29 CFR 1910.7 to perform testing and certification of products using consensus-based test standards will meet the following requirements:

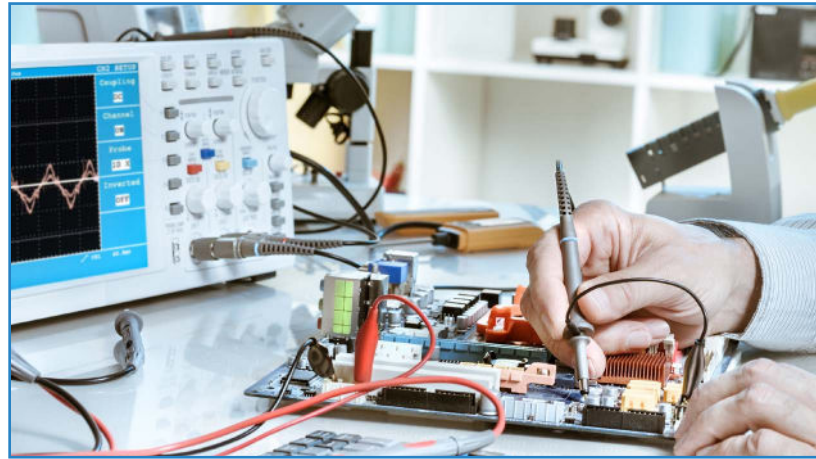
- The capability to test and evaluate equipment for conformance with appropriate test standards.



- Adequate controls for the identification of certified products, conducting follow-up inspections of actual production.
- Complete independence from users (i.e., employers subject to the tested equipment requirements) and from any manufacturers or vendors of the certified products.
- Effective procedures for producing its findings and for handling complaints and disputes.

Manufacturers should contact one or more NRTLs directly to obtain a time and price quotation for product certification. The NRTL will advise what documentation and samples are required for testing and certification. OSHA does not need to be contacted for product evaluation, testing, registration or certification.

OSHA's authority is limited to employers; therefore, OSHA does not require manufacturers or suppliers, as applicable, to have the products they manufacture or supply certified by an NRTL. That said, it would be in the best interest of manufacturers or suppliers, as applicable, to have products requiring approval under OSHA standards to be NRTL-certified. Many, if not all, of their customers are employers that must follow applicable OSHA standards requiring approval of products and equipment.



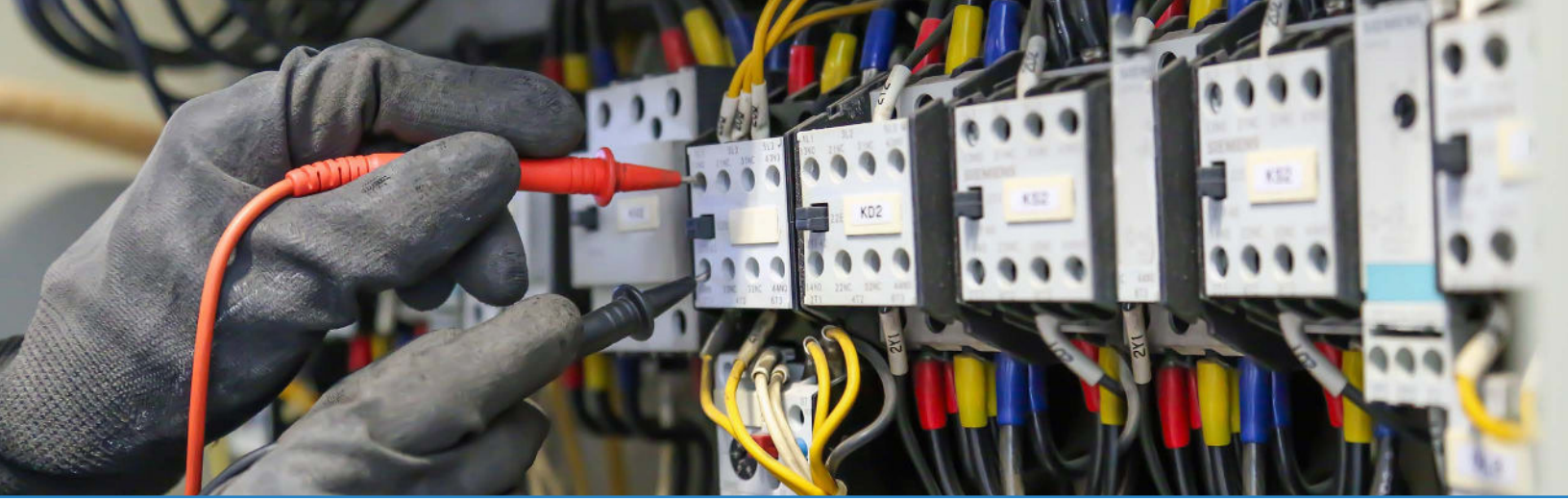
Safety testing is required at the point of manufacture before the product is available to the end user. Manufacturers of electrical and electronic products must ensure that no hazardous voltages or currents are accessible to the user. They need to test their products to determine if they meet minimum safety levels. Electrical safety testing is not just a legal obligation - it also leads to design improvements and good technical documentation.

As a leading voice in the NRTL universe, UL encourages manufacturers to engage with them early in the product development cycle since it will promote the timely and relevant exchange of information, the best decision-making, and a more streamlined path to certification.

Leveraging the use of appropriate UL Recognized Components helps promote conformance with the applicable requirements for safety. Reviewing the applicable standard as the design process unfolds is an important element to prevent surprises in the certification process. Similarly, for manufacturers with the ability to conduct tests, it is always helpful to understand how the product performs compared to the test requirements in the standard.

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In Summary

Since its establishment in 1970, OSHA has embraced the goal of providing for safe workplaces, believing that vision should be shared and supported by every company providing covered products, and electrical products in particular. In the past four decades, workplace fatalities have been cut by 62 percent and occupational injury and illness rates have declined 40 percent. For businesses, protecting workers' safety and health is the right thing to do. It saves money and adds value to the organization. When workers stay whole and healthy, businesses experience lower workers' compensation insurance costs, reduced medical expenditures, decreased payout for return-to-work programs, fewer faulty products, and lower costs for job accommodations for injured workers. There are also indirect benefits such as increased productivity, lower costs for training replacement workers, and decreased costs for overtime.

DITEK strongly supports electrical product safety regulations and gladly submits surge protection products for NRTL testing and approvals by UL, the premier standards and testing agency.

Protect your safety, and the safety of your customers, visitors, and facility – insist on NRTL listing and approvals for electrical devices used for your systems.

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