New Class 4 Systems Change How Technology is Powered

WHITE PAPER

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Introduction

Hailed as the ultimate playbook for safe installation of electrical systems, the National Electrical Code® (NEC) is in a constant state of improvement. Updated once every three years, work is always being done behind the scenes on the NEC (also called NFPA 70®) to protect people and property from the potential hazards that arise when using electricity.

Eighteen Code-Making Panels comprised of electricians, inspectors, users, installers, laborers, testing lab specialists and manufacturers (Belden included) frequently collaborate to review and update the code.

The latest update, which is currently underway, will be released as the 2023 National Electrical Code in Fall 2022. This edition will include an exciting addition that's set to change how buildings and technology are powered.

Learn everything you need to know about this new type of power—Class 4—here.

The Differences Between Class 1, 2, 3 and 4 Power

To make a clear distinction between wiring for "ordinary" circuits and specialized circuits with limited power and/or voltage, the NEC classifies circuits based on their electrical usage and how they should be applied.

Until recently, there were three classes for power-limited circuits. In 2022, however, a fourth circuit type will be introduced into the NEC.

According to Stephen Eaves, the CEO and founder at VoltServer, the creator of Digital Electricity™—a Class 4 power system—says it's easiest to think about the classes being organized based on fire safety and human safety.

Class 1 (CL1) Circuits

The NEC divides Class 1 systems into two categories:

1. Remote-control/signaling systems
2. Power-limited circuits

Remote-control and signaling circuits shall not exceed 600V; power-limited circuits operate at no more than 30V and 1,000VA with limited source output. Power-limited circuits also restrict the amount of supply current on the circuit in the event of a ground fault, short circuit or overload.

"Class 1 power is relatively safe from the standpoint of electrical shock," explains Eaves, "but it has limits on power. Class 1 is not considered an acceptable safety risk in terms of fire. If it's run through a wall, then it must be contained in conduit, for example, in commercial installations."

You typically find Class 1 circuits in environments where motors and compressors are in use.

Class 2 (CL2) Circuits

These circuits can support lower power (up to 100VA) in many types of environments. A Class 2 circuit considers safety from a fire initiation standpoint and provides acceptable protections from electric shock. Applications include audio systems, low-voltage lighting systems, security systems, thermostats and PLCs.

Class 2 power loads are often delivered through Power over Ethernet (PoE) cables, which combine power and data in a single cable run to save valuable installation time.

Class 3 (CL3) Power Circuits

Class 3 circuits function similarly to Class 2 circuits, but with higher voltage and power limitations. They also support low-energy, low-voltage applications, but Class 3 circuits aren't as common as Class 2 circuits.

"Class 3 is like a Class 2 only at higher voltages," says Eaves. Class 3 circuits are occasionally used to power equipment that requires more power than what Class 2 can safely provide. This can include certain types of nurse call systems, commercial public address systems and commercial intercom systems, for example.

Similar to Class 2, Class 3 power loads are often delivered through data cables.

NEW: Class 4 (CL4) Power Circuits

With voltage ratings of up to 450V, Class 4 circuits bring a new type of circuit to the NEC. They will be incorporated into the 2023 NEC as part of New Article 726, which has a proposed publication date of October 2022.

"When everyone took a look at these types of systems, which are called fault-managed power systems, they realized it was unique, different, and specialized enough to form a specific code section around it," describes Eaves. "The Pulse Energy Transfer Group—a task group within the NEC—was formed to provide recommendations to Code-Making Panels to create Class 4."

Class 4 circuits provide the convenience and safety of low-voltage power, just like PoE; however, Class 4 also offers close to 20 times the power of PoE across hundreds of meters, presenting a safe alternative to AC power.

Similar to Class 2 and Class 3, Class 4 power loads are often delivered through technology that combines power and data in a single cable run.

To learn more about power circuit classes, refer to Tables 11(a) and 11(b) in the National Electrical Code.

Why Class 4 Systems—and Why Now?

Class 4 circuits were established to properly bring this new type of technology into the NEC. They're also called fault-managed power systems, packet energy transfer (PET), Digital Electricity (DE), pulsed power or smart transfer systems.

Class 4 allows the industry to support power at higher levels and across longer distances with cables that were previously limited to power levels of 100W and distances of 100 m.

These systems are designed with safety at the forefront. Instead of limiting power source output like Class 2 and Class 3 circuits do, Class 4 circuits limit energy and power available during a fault event.

In other words: If someone accidentally touches exposed wires or splashes water onto circuits during operation, then the circuit immediately and automatically shuts off before causing harm. To limit fault energy, a transmitter and receiver monitor for faults and control power delivery. This technology makes Class 4 circuits just as safe as—if not safer than—Class 2 and Class 3 circuits while offering more available power.

Class 4 circuits can also be installed by the same integrators and contractors that install Category cabling.

Because it's such new technology, Class 4 interoperability is still being investigated. For now, the manufacturer of a fault-managed power system must be involved in engineering and installing these systems.

But, as smart buildings become increasingly intelligent, we predict that Class 4 usage will explode. Class 4 power is already being deployed in all types of markets, including:

- Airports
- Class-A offices
- Hospitality environments
- Stadiums and arenas
- Warehouses and manufacturing plants

Within these environments, Class 4 circuits support technology like:

- Distributed antenna systems (DASs)
- Passive optical networks (PONs)
- PoE LED lighting and other systems that use PoE switches
- Power distribution infrastructure
- Small cells and 5G radios

Circa Resort & Casino Las Vegas is a great example of what the future holds for Class 4. Instead of using dedicated AC power, the resort's owners chose DE to serve as the backbone power distribution infrastructure. DE decreases energy use and creates an intelligent building that can take advantage of cutting-edge technology like

advanced building automation, digital in-room controls, cryptocurrency exchange kiosks and LED lighting. A Class 4 power circuit is used to power everything from lights and switches to in-room climate control and wireless access points.

VoltServer is the mastermind behind these Class 4 circuits. It was the first company to develop technology that combines the convenience and safety of low-voltage power similar to PoE with the power and distance capabilities of AC power.

Today, other companies are following in VoltServer's footsteps by creating Class 4 technologies of their own.

"Class 4 is simply an improved format of electricity," Eaves says. "It has the power capabilities of industrial power and the safety characteristics of Ethernet cable. It offers advantages in terms of conversion efficiency and control of high-voltage DC power but doesn't have the downside of safety and management issues. Over time, it will displace the way electricity is distributed across buildings and venues. In the future, once costs of things like Digital Electricity come down even more, it won't make a lot of sense to rely on conventional electricity, which is inherently dangerous."

Codes and Standards: How Are They Different?

As we talk about the NEC, it's easy to become confused. The NEC is a code, not a standard. What are the differences between a code and a standard?

Codes are created to protect life, limb and property. They don't necessarily take performance or efficiency into account. As it stands on its own, a code must be followed—and a code can be adopted into a law.

Standards are created to ensure interoperability and establish minimum performance levels. The National Fire Protection Association (NFPA) describes standards as the "nuts and bolts of meeting a code." In other words: A code describes what to do; a standard tells you how to do it.

Cable safety starts with the NFPA. For example, you often see cables labeled with "CMP," "CMR" and "CM" descriptors. These listings are defined by the NFPA; they're the NEC's ratings for cable jackets. The rating indicates what type of jacket is used on the cable, which determines where and how the cable can be used.

A "C" and "M" in the cable descriptor indicates a cable for general use (with the exception of risers and plenums) that can be deployed in accordance with NFPA 70 and is listed as resistant to the spread of fire.

A "CMR" cable (riser-rated cable) indicates that the cable can safely run between floors through risers or vertical shafts. It's listed as having fire-resistant characteristics that prevent fire from spreading between floors in vertical installations.

A "CMP" cable (plenum-rated cable) is a cable that is suitable for installation in ducts, plenums and other spaces that circulate environmental air within buildings, such as raised floors or spaces above suspended ceilings. It's listed as having adequate fire-resistant and low smoke-producing characteristics, such as restricting flame propagation to five feet or less and limiting the optical density of smoke produced during a fire.

The type of space where cable will be installed determines the listing that your local authority having jurisdiction (AHJ) will require for NFPA code compliance. (Remember, safety begins with the NFPA.) Most AHJs across the United States have adopted the NEC, which means it's law within every jurisdiction that adopted it.

Where Do Cable Certifications Fit In?

Today, the requirements necessary to comply with a listing are regulated through certifications. Once you know how your space should be listed (as determined by your AHJ), then you need to find a product certified to that listing.

Certification is granted through an OSHA-authorized Nationally Recognized Testing Laboratory (NRTL).

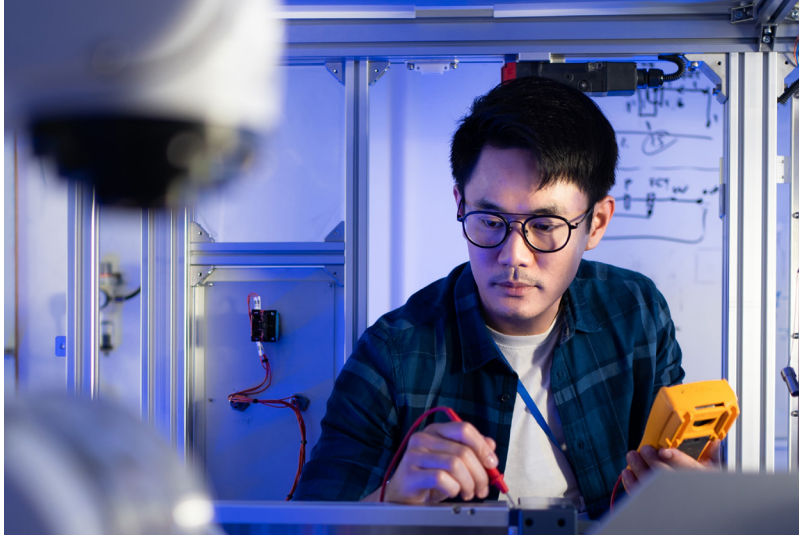
Several NRTLs can perform tests and grant certification to products that meet construction requirements and OSHA safety standards. Some well-known NRTLs include:

- CSA Group Testing & Certification Inc.
- FM Approvals
- Intertek Testing Services (ETL)
- NSF International
- Southwest Research Institute
- TÜV Rheinland of North America Inc.
- Underwriters Laboratories (UL)

Each NRTL is approved to certify products to certain industry standards, and each NRTL uses its own registered certification mark that certifies a product's conformance to its product safety test standards.

After a product is certified by an NRTL, then that same NRTL permits the manufacturer to place its registered certification mark on the product. This confirms which NRTL tested and certified the product for compliance. The certifications you need for the products you use on your next project are based solely on how and where cables will be used.

Once you've found an appropriate certified product, you must then make sure that your local AHJ—whether it's the fire marshal, electrical inspector or building official—accepts that product as compliant. The AHJ has final say in whether the necessary requirements have been met.



Get to Know UL 1400-1 and UL 1400-2 Certifications

Because certification is the tool used to ensure compliance, Class 4 circuits must be certified to verify that they comply with NEC requirements.

UL—one of the NRTLs mentioned earlier—has been working behind the scenes to prepare for these Class 4 circuits. It recently published UL 1400-2 as an Outline of Investigation (the first step toward a standard), which defines the safety considerations and criteria for evaluating Class 4 circuit cabling. Class 4 cable circuits will be certified to the published document.

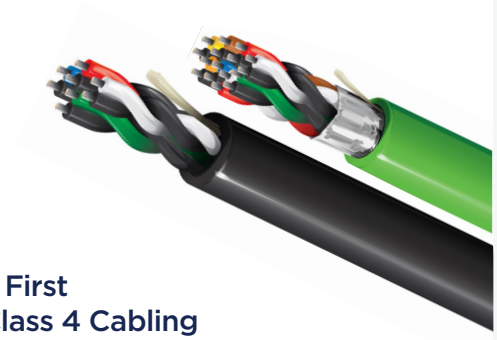
Belden is very familiar with UL 1400-2 certification—we helped create it. As new technologies like fault-managed power systems emerge, we think it's important to assist the industry in defining and supporting standards around their safe application.

Study the NEC for Free

There are many types of certifications necessary for life safety within the NEC, but you don't have to purchase a printed copy or PDF to learn about them. The entire document is available for free viewing online here.

UL 1400-1 will be published soon to describe requirements for fault-managed power systems. Similar to UL 1400-2 for Class 4 cabling, Class 4 circuits will be certified to the UL 1400-1 published document.

The published documents for UL 1400-1 and UL 1400-2 will both be submitted through the ANSI process to become a standard.



The Industry's First UL-Certified Class 4 Cabling

As the industry's first UL-certified Class 4 cable, Belden's Digital Electricity Cables allow end users to take advantage of DE to safely deliver significant power across long distances using smaller conductors.

To ensure they can support many types of applications, DE Cables were designed in conjunction with VoltServer, the creator of Digital Electricity. They're available in copper-only and hybrid copper/fiber constructions to transmit power and data over long distances in a single cable run.

Similar to PoE, DE Cables can be installed by the same low-voltage integrators that install Category cabling, and within the same pathways.

In the future, it will be necessary to operate Class 4 circuits with a UL-certified Class 4 cable—and Belden is honored to be the first to offer a portfolio of UL-certified Class 4 cabling. Learn more about our certified DE Cables here.

How and Why Belden Helps Drive Standards

Have you ever thought about the people behind cabling standards? Those who serve on the National Electrical Code (NEC) panels of the National Fire Protection Association (NFPA) help develop the codes that protect people and property from the hazards that arise from the use of electricity.

Through active participation in organizations like TIA, IEEE, NFPA and ISO, reputable organizations and industry experts come together to provide input that shapes cabling codes and standards.

A few Belden team members—including me—choose to be involved in NFPA's code-making process by volunteering our time on the NFPA 70 panels.

We participate for a few reasons:

- To build alliances with industry colleagues. We meet new professionals, hear different perspectives and discuss upcoming technology and safety challenges.
- To gather first-hand knowledge of proposed changes and share feedback. If we disagree with a proposed addition, change or deletion, we can share our justifications for others to consider.
- To prepare for new and updated cabling technology and requirements.
- To make sure our company and the industry are represented in the code-development process.

As a member of NEC Code-Making Panel 3, serving as a representative of the Communications Cable & Connectivity Association (CCCA), I'm part of the decision-making process for practical safeguarding of people and property against the hazards that arise from using cables designed for PoE and DE. I'm proud to say that Belden was a driving force behind making sure Class 4 circuits are incorporated into the 2023 edition of the NEC.

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