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Why Cable Cleats are Vital to Protect Major Infrastructure Projects

WHITE PAPER

When the decision is made to initiate infrastructure or facility projects, the engineers responsible for their design are often faced with multiple priorities and project tasks. Ensuring electrical infrastructure reliability, while protecting against short circuit events, are of paramount design consideration for engineers working on these projects and ultimately for their clients.

A KPMG International survey recently found that 78 percent of surveyed engineering and construction companies believe project risks are increasing[1]. This growing risk is a direct result of escalating project complexity, with clients challenging design engineers to complete projects at an unprecedented pace to realize the return on their investment while there is a need for infrastructure development in remote and complex environments.

[1] Armstrong, Geno, and Gilge, Clay. "Building a technology advantage." http://tinyurl.com/yyxuzj76

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One potential risk to these projects are short circuit events. This accidental conductive connection between two or more points of a circuit at different potentials can create tremendous magnetic forces. This results in a violent and catastrophic explosion damaging equipment and putting personnel at the plant at risk.

There are solutions that can help mitigate the damage caused by these short circuit events, but there is still resistance in the industry to adopt certain tools that can protect the installation cost-effectively and, most importantly, safely. Engineers are faced with the challenge of persuading clients to invest capital in short circuit protection at the start of the project to ensure long-term reliability and safety. It is imperative that electrical design engineers and electrical contractors know how to protect the project, people, and equipment from short circuit events. By preventing these occurrences downtime can be reduced, damage to equipment can be avoided, and the workforce can be protected from significant injuries or death.

Cable cleats set projects up for success from the very beginning. They are assurance and insurance bundled together, an investment worth making to prevent project rework and, most importantly, ensure safety.

The Causes of Electrical Incidents and the Havoc They Wreak on Infrastructure Projects

There are many ways for a short circuit fault to develop, and they can happen anywhere along the electrical distribution system. Short circuit faults occur when an abnormal connection between two nodes of an electric circuit is made.

During a short circuit fault, maximum electromechanical stress between conductors occurs at or before 0.005 second. Current levels in these events can range upwards of 200 kA. In the worst case of a 3-phase short, magnetic field induced repulsive forces between the cables can range upwards of 10,000 pounds. When a short circuit fault occurs, tremendous magnetic forces repel the power cables from each other resulting in violent forces that damage everything in their path. Typical circuit breakers and other protection devices trip and interrupt a fault between 0.06 to 0.1 second, leaving just enough time for substantial damage to occur.

Cable cleats reduce damage and rework by performing their function within those first 0.005 second (i.e. at peak kA) before a circuit breaker trips and interrupts a fault, making them the best option for short circuit mitigation.

Without the use of a cable cleat system, there is no protection for the employees or equipment in a facility when the short circuit forces are at their peak prior to a circuit interrupter engaging. To avoid potentially severe damage to the facility and infrastructure, as well as personal injury, cable cleats are used to restraint cables during short circuit events.

Specifying and installing the right cable cleats when electrical infrastructure is first established is paramount to setting projects up for success. While metal conduit is often used in several areas of a project to distribute power, it is also often distributed by cables in a cable tray system. Cable tray systems provide more design flexibility and can be easier to install than traditional pipe and wire but must be properly engineered for protection against short circuit faults. Cable tray applications are only a safe and viable solution when paired with the right cable cleat.

In the U.S., NEC 392.20(C) is the National Electrical Code that governs the safety of the cable installations in cable tray. NEC Article 392.20(C) states: “Parallel connected single conductor cables shall be securely bound in circuit groups to prevent excessive movement due to fault current magnetic forces.”

While NEC 392.20(C) includes language for securing cables during a short circuit fault, is does not specify how to design the proper containment system to meet those forces. Often the lack of clear guidelines on short circuit protection in the NEC results in inadequate or no cable containment to protect against short circuit events in tray cable installations.

Europe has been utilizing cable tray systems for several decades and leads the industry in design standards and best practices. As such, the IEC 61914:2015 standard provides the testing methodology and process to ensure reliability of cable cleats and ultimate protection in the event of a short circuit event. Cable in cable trays are only a safe and viable solution when paired with the right cable cleat solution to protect against short circuit events.

Unfortunately, NEC 392.20(C) does not currently provide adequate guidance on how to securely contain cables in the event of a short circuit when routing cables in a cable tray. To protect electrical infrastructure when using power cables in a tray, installing an IEC 61914:2015-compliant cable cleat is the best option when facing a peak short circuit fault.

Cable Cleats Set Projects up to Avoid Delays and Rework

Panduit’s extensive line of cable cleat solutions provides various options to fit the needs of the project and provide job productivity, reliability, and safety. Panduit recommends the following solutions: stainless steel locking strap cleat, stainless steel buckle strap cleat, stainless steel trefoil cleat, and aluminum and polymer cleats. These cable cleats are designed to perform in a wide range of harsh environments, reduce material cost, and reduce installation time.

An additional cost benefit that Panduit cable cleats offer is the ability to allow for future proofing by preventing short circuit events from occurring and costly rework being needed.

Short circuit incidents can happen at any stage of a project's lifecycle, but proper product installation during initial construction can mitigate long-term issues.

Lab tests performed on Panduit cable cleats verify strength of cleats and provide a baseline rating, in addition to being validated at a third-party test facility to ensure they perform to specifications when needed. They are designed to perform in a wide range of harsh environments and can be installed twice as fast as other similar products while reducing material cost in half. Their simple and intuitive design leads to increased productivity, and they are compatible with a variety of ladder racks and cables.

Features of Panduit's Most Commonly-Used Cable Cleats

Stainless Steel Buckle Strap Cleat

- Rounded edges prevent cable damage
- Buckle design provides low finished profile
- Compatible with a variety of cable trays and cables
- No sharp edges after tensioning with cut end locked inside buckles

Stainless Steel Trefoil Cleat

- Nylon insert lock nut for vibration dampening
- Tightening bolt can be installed from top or bottom
- Removeable spacer for cable range taking
- Mounting bracket slot allows for installation flexibility

Polymer Trefoil Cleat

- Dual bolt installation
- Rounded edges for cable protection
- Ridges to hold cable in place
- Corrosion resistant body

How to Select the Right Cable Cleat

Choosing the correct cable cleat to protect your unique project will assure optimal performance, reliability, and quality. Panduit has solutions to suit a variety of environmental conditions, industrial applications, and short circuit fault current requirements. Having the right cable cleat provides restraint and protection in the event of a short circuit fault.

Panduit has developed the Cleat kAlculator™ to help engineers, designers, and installers determine the correct cable cleat for their application. To simplify this selection decision, three easy steps allow users to:

1. Select a cable layout
2. Input cable outer diameter
3. Input peak short circuit current

Cleat kAlculator™ is available for download in the Apple Store or Google Play, and Panduit.com/cablecleat.

When Selecting Cable Cleats, Consider a Variety of Factors

Cable Layout: How the cables are arranged and secured will determine which cable cleat fits them best.

Cable Outer Diameter: The diameter of the cable determines what the correct size of cleat is and is also required for calculating the short circuit forces the cleat could face.

Peak Short Circuit Current Rating in kA

Cable Tray Rung Design and Spacing

Environment Performance: The cable cleat should have the material and specification features needed for it to withstand the elements it will face. Examples include fire resistance, extreme cold resistance, or chemical and corrosion resistance.

Cable Cleat Short Circuit Force Formula

$$Ft = \frac{0.17 \times ip^2}{S}$$

Ft = maximum force on conductor (N/m) ***ip*** = peak short circuit current (kA)
S = center to center distance between two neighboring conductors (m)[2]

[2] International Standard IEC 61914 Edition 2.0 2015-11

Using this data, force between conductors during short circuit event can be calculated and correct cleats at appropriate spacing can be determined. Whether on a horizontal or vertical run, cleat spacing is always a function of the peak kA, distance between the centers of neighboring conductors, and the rated strength of a cleat. NEC 392.20(C) and The Cable Tray Institute provide guidelines for securing cable on horizontal and vertical runs, but cable cleat spacing is determined by the calculated forces during a short circuit fault.

The Importance of Having a Solutions Partner That can Address Unique Needs

In a study of 50 countries and seven industry sectors it was found that $3.7 trillion must be invested in infrastructure every year to meet global demand, according to the G20-backed Global Infrastructure Hub and Oxford Economics. The ability to meet this need is dependent on the successful completion of the electrical infrastructure portion of these projects, making it imperative that electrical design engineers, electrical contractors, and safety engineers know how to protect designs and avoid putting plans at risk.

To ensure the long-term safety and integrity of the electrical infrastructure, professionals should adopt cable cleats as a standard product in design and maintenance.

A dedicated team of Panduit Cable Cleat Engineers are also available for technical and pre-sale support, including installation and configuration inquiries. Panduit works alongside its partners to support custom engineered cleat solutions for demanding applications.

Panduit's global network of distributors ensures local product inventory, product support, and a wide range of logistical services no matter where a project is. As an added level of support, Panduit also offers an optional engineering review, including physical documentation such as test reports, product brochure, drawings, and data sheets.

Panduit has more than 60 years of experience working with electrical design engineers, electrical contractors, and safety engineers and continuously reinvests in R&D. To date, Panduit has secured more than 2,000 patents, including several for cable cleats alone. With operations in 35 countries and customers in 120, Panduit distributes products, provides design expertise, and supplies technical support to customers on an international scale. Panduit is committed to helping organizations become more productive and profitable, and is always striving to put its partners ahead of their competition.

Since 1955, Panduit's culture of curiosity and passion for problem solving have enabled more meaningful connections between companies' business goals and their marketplace success. Panduit creates leading-edge physical, electrical, and network infrastructure solutions for enterprise-wide environments, from the data center to the telecom room, from the desktop to the plant floor. Headquartered in Tinley Park, IL, USA and operating in 112 global locations, Panduit's proven reputation for quality and technology leadership, coupled with a robust partner ecosystem, help support, sustain, and empower business growth in a connected world.

For more information

Visit us at www.panduit.com/cablecleat

Contact Panduit North America Customer Service by email: cs@panduit.com
or by phone: 800.777.3300

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PANDUIT US/CANADA
Phone: 800.777.3300

PANDUIT EUROPE LTD.
London, UK
cs-emea@panduit.com
Phone: 44.20.8601.7200

PANDUIT SINGAPORE PTE. LTD.
Republic of Singapore
cs-ap@panduit.com
Phone: 65.6305.7575

PANDUIT JAPAN
Tokyo, Japan
cs-japan@panduit.com
Phone: 81.3.6863.6000

PANDUIT LATIN AMERICA
Guadalajara, Mexico
cs-la@panduit.com
Phone: 52.33.3777.6000

PANDUIT AUSTRALIA PTY. LTD.
Victoria, Australia
cs-aus@panduit.com
Phone: 61.3.9794.9020

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