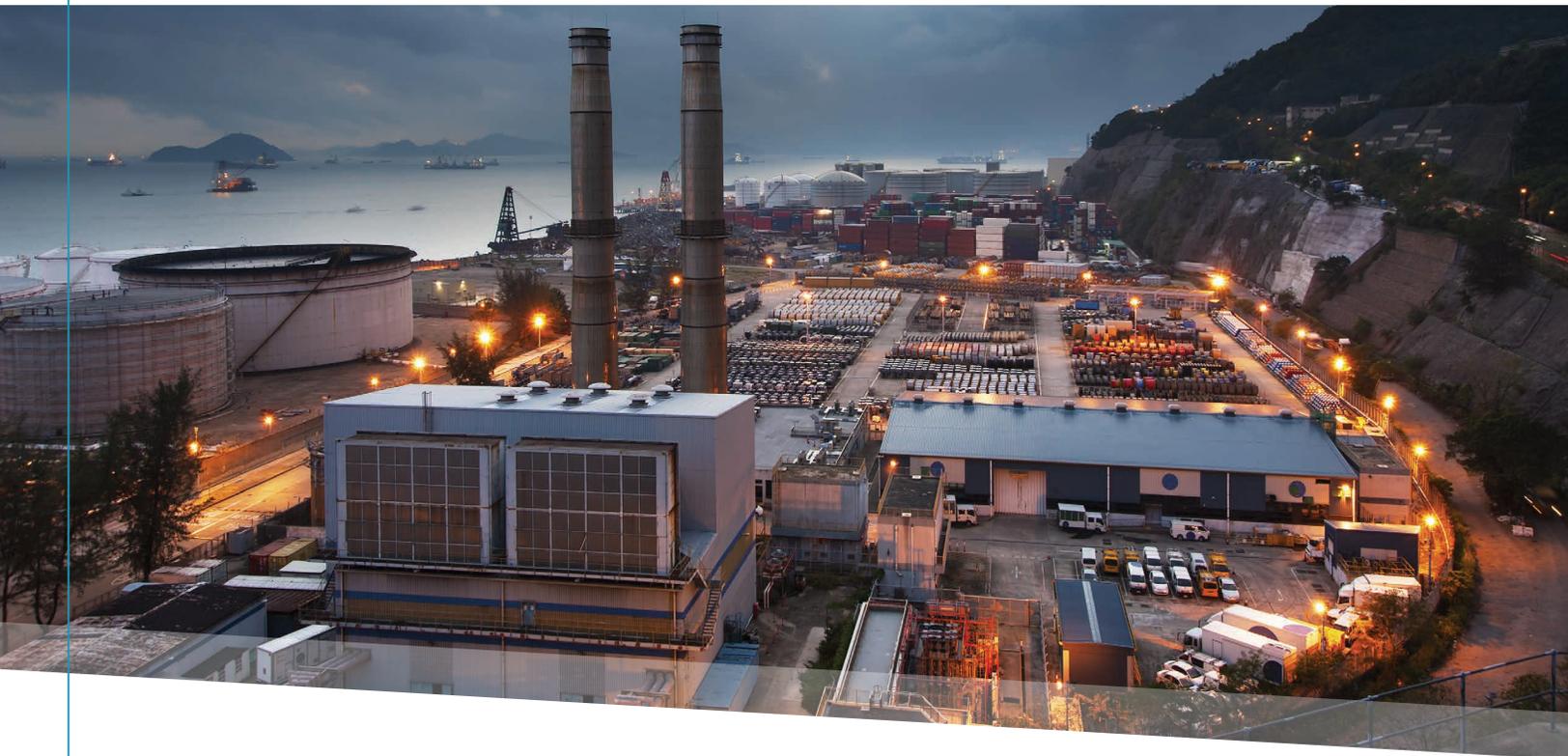

Strapping Bands vs. Cable Cleats – Exposing the Misconceptions



Recent articles in the industry suggest that a banding system is not capable of withstanding the electromechanical forces between the conductors in the event of a phase to phase fault. There is also a perception that a band type cleat product will cut the outer insulation of the cable under fault conditions. This paper challenges these misconceptions and offers a more logical, engineered route to the correct specification of a cable fixing system. The reasoning is backed up and proven by independent third-party analysis and testing.





Traditional cable cleats started to appear in 1940's and 1950's predominantly in the U.K and Germany. These early products were constructed from a variety of materials including timber, die cast aluminum and injection molded polymers. Due to the relatively weak or brittle mechanical properties of these materials the designs tended to be 'over engineered' to achieve the strength and performance required e.g.. (Figure 1)

In more recent years, galvanized mild steel and 316 stainless steel options were developed which offered improved strength but still had a very bulky form factor. Early designs made in these materials offered a finished cable cleat which was twice the width and twice the height of the cable(s) being retained. This was acceptable in single run applications e.g. when fastened sparingly to a wooden pole for utility applications, but when used in a cable ladder or tray application with multiple cable runs or within a substation where space and weight need to be carefully considered, the early designs did not meet requirements. Bulky cleat designs are not optimal.

However, recently introduced designs, materials and technologies have allowed Panduit to develop a high-end range of Strap Band products which meet or exceed the performance of a traditional cleat design when testing in accordance with IEC 61914:2015 by a third party lab. (Figure 2)



Figure 1. A 'traditional' Cable Cleat (Panduit 2-Hole Cleat used for illustration purposes)



Figure 2 - A highly engineered banding system – note integral cushion sleeve



What is a ‘Cable Cleat’?

Although the standard does require the manufacturer to describe a material type, it does not exclude any specific material, dictate any minimum dimensions or physical attributes. Annex A (informative) in the IEC cable cleat standard provides examples of various cable cleats which include products made from timber, steel and plastic. There is a variety of designs and methods of ‘securing cables’, designs start at 15mm wide and go up to 150mm wide.

¹International Electrotechnical Commission (2015). International Standard Edition 2.0 2015-11.

Defined by the IEC International standard, a cable cleat is simply:

“A device designed to secure cables when installed at intervals along the length of the cables¹”

Examples of Cable Cleats



Figure A.1 - Strap Cleat



Figure A.2 - Aluminum



Figure A.3 - Stainless Steel Cleat

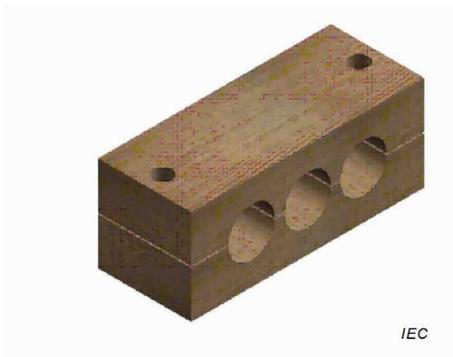


Figure A.4 - Wood



Figure A.5 - Glass Filled Polymer

Providing that the manufacturer tests and declares certain performance criteria, a ‘cable cleat’ can be any shape, size or material. Hence, for example, a 19mm wide banding system can be used to secure cables in line with the IEC Cable Cleat standard providing it undergoes all the required tests and that they are carried out in accordance with the standard.

The term ‘cable tie’ is commonly used to describe a ‘strap cleat’ system which is not correct. A light duty stainless steel tie or an injection molded ‘zip’ tie has many uses and play a vital role on many cable routing installations, but they must not be confused with a high-end strap cleat solution which can withstand immensely high electro-mechanical forces and are resistant to corrosion and ultra violet degradation.



What is the appropriate IEC International standard?

The IEC standard was originally a European standard, BSEN 50368:2003, which was improved and adopted over time by the International Electrotechnical Commission and the first version of IEC 61914 was published in 2009. The standard was further improved, and the current version of IEC 61914 was released in 2015.

What specific tests does the IEC 61914:2015 Cable Cleat standard require²?

The standard provides harmonized testing procedures for the following aspects:

- Temperature rating (-60°C to +120°C)
- Adequate resistance to flame propagation (very similar to UL 94)
- Lateral load testing (at maximum declared temp)
- Axial load testing (at maximum declared temp)
- Impact resistance (at lowest declared temp)
- Corrosion resistance
- UV resistance
- Resistance to electromechanical forces – the ability to withstand one short circuit event or two short circuit events in succession
- 2015 Revision standardizes cable diameters for testing and permits clients to compare performance between manufacturers

²International Electrotechnical Commission (2015). International Standard Edition 2.0 2015-11.

What does the NEC code say about cable cleats?

In the United States the National Electric Code (NEC) Art 392.20 states “Single conductors shall be securely bound in circuit groups to prevent excessive movement due to fault-current magnetic forces³”. While this section of the code dictates that the conductors must be bound securely to protect against fault-current magnetic forces, it does not specify how to secure the conductors nor recommend test methods to ensure products meet the force requirements. Therefore, it is recommended that the IEC 61914:2015 standard is followed to comply with NEC Art 392.20.

Short circuit testing requirements of IEC 61914:2015⁴ – an overview

IEC 61914:2015 focuses on this most demanding aspect of testing compliance, short circuit testing, the manufacturer is required to test in accordance with section 9.5 of the standard which gives guidance for a suitable set up. The cables, which must be of a certain type and outside diameter, must be restrained at a minimum of five positions along the cable run. The cables must be fastened to a surface defined by the manufacturer, and this is usually a standard cable ladder, with rungs every 300mm.

The cables are then subjected to a three-phase short circuit consisting of an initial peak current and then a decaying R.M.S. of a duration of not less than 0.1s.

The accredited test laboratory must include the following information in the published test report:

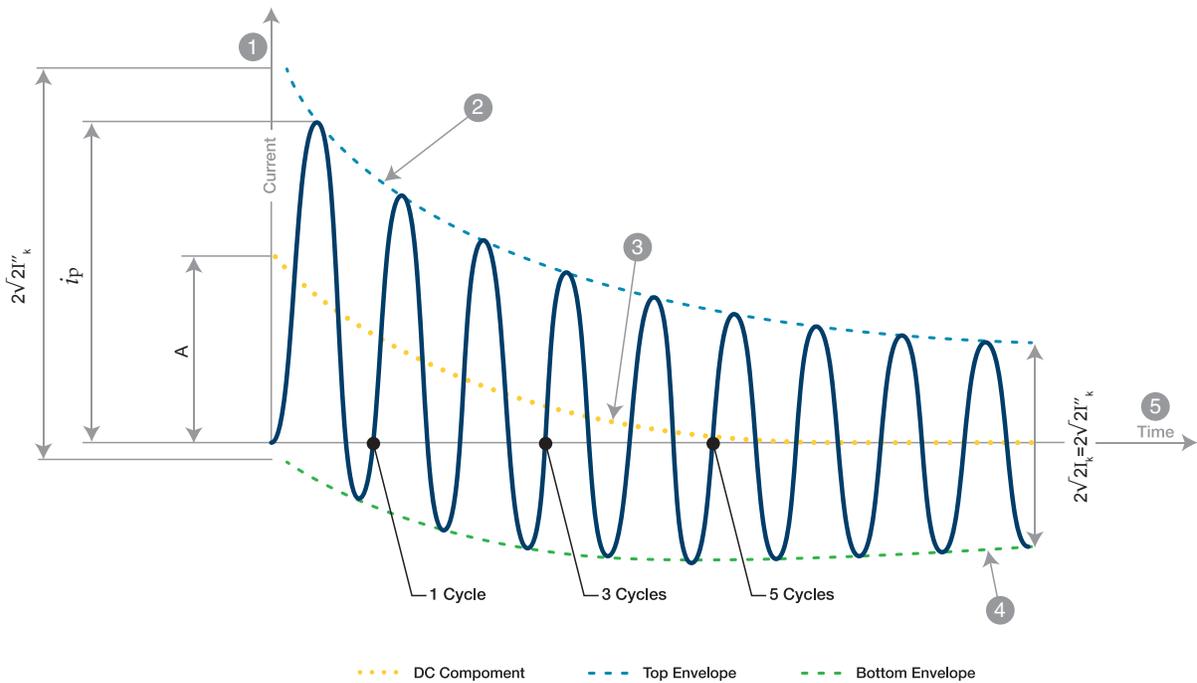
- The manufacturers catalogue references
- The assembly details showing:
 - The number of restraints and their spacing
 - The cable centre to centre spacing
 - Cable conductor diameter, insulation thickness, external diameter and markings
 - A pre-test photograph of the set-up and a post-test photograph commenting on the condition of the restraints
 - The test duration
 - The ambient temperature
- For cleats which are classified to 6.4.4 (one short circuit):
 - There shall be no failure that will affect the intended function of the cable of holding the cables in place.
 - All restraints shall be intact with no missing parts
 - There shall be no cuts or damage visible to normal or corrected vision to the outer sheath of each cable, caused by the restraints



³National Electrical Code 2017 Edition (2017).

⁴International Electrotechnical Commission (2015). International Standard Edition 2.0 2015-11.

- And for cleats which are classified to 6.4.5 (two short circuits):
 - The restraints shall comply with all the requirements shown above for the first hit, but then in addition, after the second hit, a voltage withstand test is performed by applying a minimum test voltage of 2.8kV d.c. or 1kV a.c. for a period of 60 (+5/-0) seconds. The test is administered between the cable cores, which should be connected together and the mounting frame. The cable jackets, restraints and mounting frame should be pre-wetted with sufficient water to facilitate a current leakage path along the outer jacket for 2(+1/-0) minutes before the test begins. The cables shall meet the requirements of the voltage withstand tes without failure of the insulation.



Key	
1	Current
2	top envelope
3	decaying d.c. component, $i_{d.c.}$ of the short-circuit current
4	bottom envelope
5	Time
A	initial value of the d.c.component, $i_{d.c.}$ of the short-circuit current

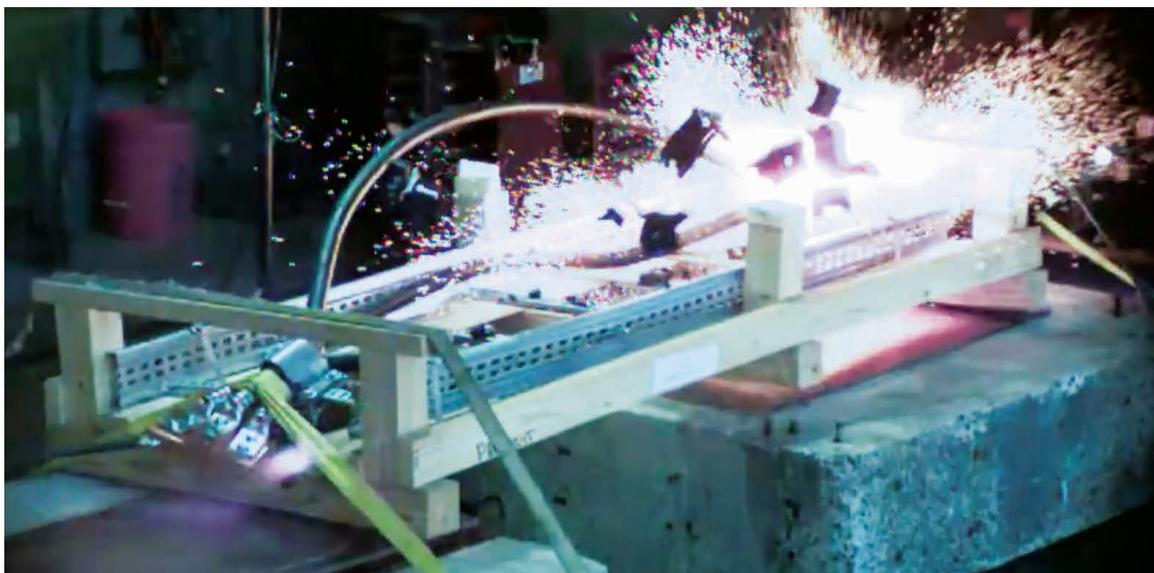
The electromagnetic forces during a fault can be enormous and occur instantaneously at the peak of the fault, i.e. the first quarter cycle (5ms on a 50Hz system and 4ms on a 60Hz system). Considering the pass criteria described above it is not easy to obtain a successful result. However, further to extensive research and development Panduit now have scores of successful short circuit rated banding systems. Depending upon the project requirements, Panduit has a fully tested, full approved banding solution to accurately match the specific needs of the project.



‘Debunking the myths’

Misconception #1 – a banding system cannot restrain the forces during a fault

Recent articles in the industry press suggest that a banding system is not capable of withstanding the electromechanical forces and a series of video clips show an incorrectly specified cable tie installation failing during fault. The issue here is that the tested product was not suitable for the intended installation. It might well have been the case that this weaker tie was specified by the system designer, and here lies the true problem, an incorrect specification. The product used in the test was never designed to withstand these forces; a correctly specified and engineered banding system certainly would.



To suggest that a strap banding system is not suitable for short circuit rated installations is incorrect and is out dated information. The cable system designer must make sure that the fault levels have been accurately calculated and then specify a fixing system which meets that requirement and complies fully to IEC 61914:2015

Misconception #2 – a banding system has sharp edges and will cut the installer during installation / damage the cable during fault conditions

As described previously, to achieve a successful short circuit test is difficult. After both the first and second short circuits each cable at every restraint position is inspected by test laboratory personnel; there can be no cuts or damage to the outer jacket. Furthermore, after the second short circuit the laboratory carry out the voltage withstand test to check for current leakage and any hidden damage which may have occurred underneath the band itself. Panduit's extensive range of banding products have full certification to both classifications of short circuit test. The use of a protective sleeve moulding, common on many cleat types, and the use of rolled edge banding material ensures the cable is protected regardless of fault level.

To suggest that this type of product is not suitable for short circuit rated installations because it will damage or cut the cable or cause cuts and injury to personnel is incorrect and out dated information.

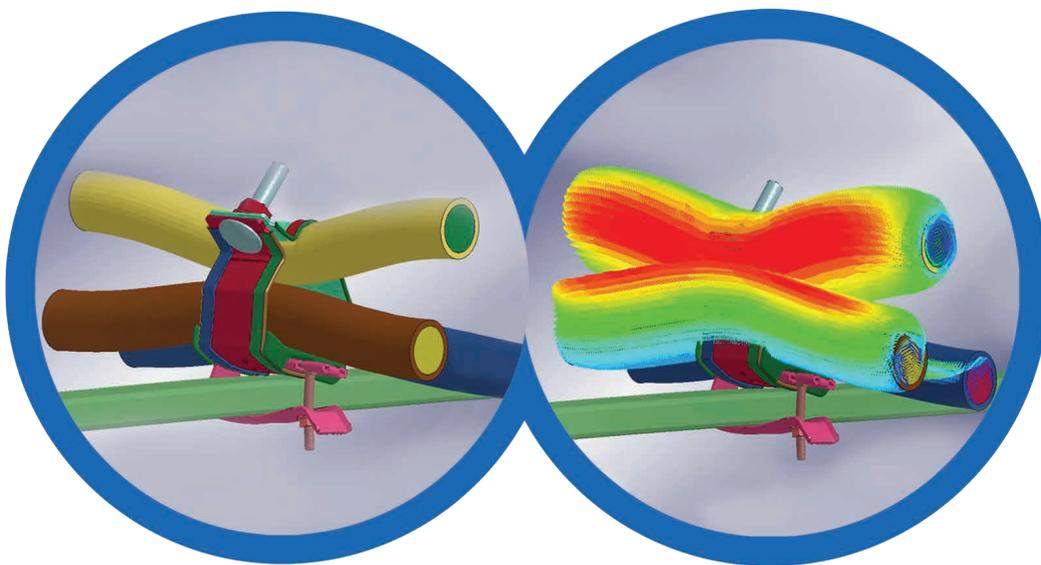


Figure 3 - Panduit ANSYS simulation software showing electromagnetic forces during a short circuit event.



Other advantages of Panduit's Banding Systems

- When compared to a 'traditional' design of cable cleat the banding system has a much larger range taking ability. This is a huge advantage from a purchasing and stock keeping perspective; quite often one part number from a Banding System covers the same range take as perhaps four or five 'traditional' cleat part numbers.
- A banding system takes up minimum space when installed around the cables. This is a very important factor when space is limited e.g. across the width of a ladder rung or when available height is limited e.g. between layers of ladder runs.
- A fault rated band will be typically less expensive to buy and quicker to install.
- A large quantity of banding system products takes up much less physical space on site before installation compared to 'traditional' cleat systems. This also leads to less packaging, less waste and generally a lower carbon footprint.
- 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.
- The Panduit strap cleat system is considerably lighter than the traditional cleat alternatives offering huge advantages for transportation and moving around site.
- The Panduit strap cleat system can be used on a variety of cable configurations and layouts, including single (multi-core) cables, trefoil, quadrafoil, and a whole variety of special cable layouts and arrangements.
- 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.
- Choosing the correct cable cleat to protect you unique project will assure optimal performance, reliability, and quality. Panduit is proud to introduce the new Cleat kAlculator™ App for IOS and Android



- To simplify this selection decision, three easy steps allow users to:
 1. Select a cable layout
 2. Input cable out diameter
 3. Input peak short circuit current



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

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