

Principles of Crimping Technology

Wire End Ferrules

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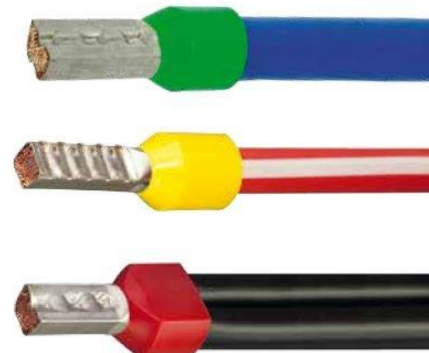
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3. WIRE END FERRULES - BASICS

The standard for the processing of ferrules is IEC 46228 (= DIN 46228).

Wire end ferrules are used as a joining aid when assembling the ends of the wire (in screw terminals), to protect the individual wire of the conductor and for good contacting in the spring terminal strip.



Wire end ferrule and clamp connections - Yes or no? A question that is always an issue in everyday practice.

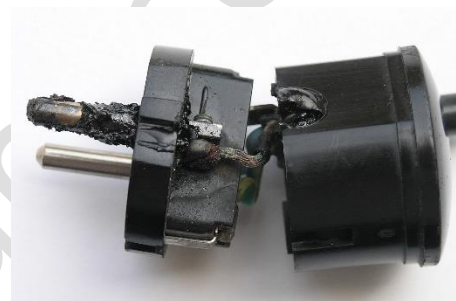
Standards & clamp connections: As in many areas of crimping technology, you can only find statements for the use of ferrules that leave some room for interpretation. Standards should essentially be there to provide a clear statement about the "how to"! Statements around clamping technology like: "The connection must be durable and safe" are not really helpful. So, connections are made because "it has always been done that way" or according to the principle "hope: it should work".

Only damage caused by problems of connection variants leads to normative prohibitions. A good example of this is the soldered stranded compound, which, when fixed in a screw terminal, inevitably leads to the failure of the connection! (see also: cold flow). This connection combination, soldering as a substitute for ferrules in screw terminals, is no longer permitted by the VDE 0100-520 standard.

When planning and implementing a connection via a terminal block, it is always important to consult the manufacturer's data sheet. In it, you will find the necessary information about the properties and the correct design of the connection. And in case of doubt? Simply ask the manufacturer! The prerequisite here is, of course, that you also find or have a competent contact person.

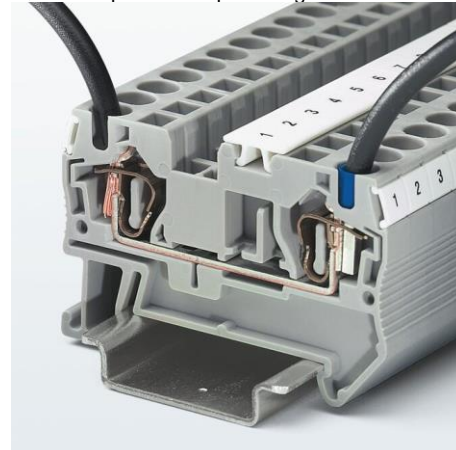
A rule or even a mandatory use of ferrules is not to be found in the known standards. The standard EN60999-1 / VDE 0609 defines all screw connections and also screwless clamp connections (only for copper conductors). In this standard, one finds the information that all mechanical clamp connections, regardless of the clamping principle, must be designed by the manufacturers in such a way that all "unprepared" conductors can be safely connected without "pre-treatment". This applies to the entire variety of conductors offered, from solid one-stranded conductors to flexible fine-stranded wires.

"Unprepared" or "without pretreatment" means: cutting, stripping and mounting the conductor directly in the clamp connection. If a ferrule is crimped onto the stripped conductor beforehand, it is then "prepared" or "pretreated". The standard for terminal blocks (IEC 60947-7-1) states: A manufacturer of a terminal connection must specify a "pre-treatment" of the conductor if this is relevant and therefore important for a safe connection in the terminal.

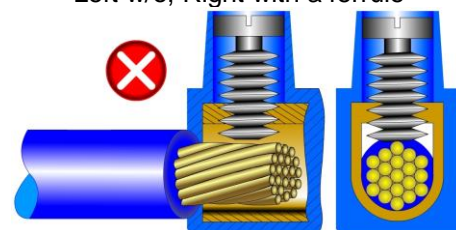


Defective mains plug caused by a soldered stranded conductor!

Quelle: <https://de.wikipedia.org/wiki/Kabelbrand>

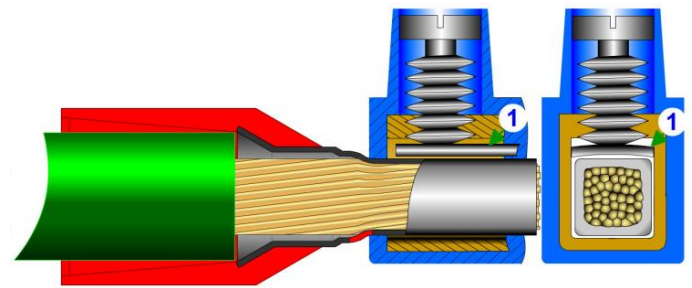


Spring-cage connection from Phoenix Contact
Left w/o, Right with a ferrule



Screw terminal - operating principle

Every transition point in a connection basically generates a transition resistance. Increased contact resistance leads to increased heat generation at high current loads, which can lead to a fire hazard, especially with poor connections. In principle, the aim is to keep the contact resistance as low as possible in a connection between two terminals or components. So, initially this would speak against the use of a ferrule. Especially since it is known that optimum crimping between the stranded conductor and the ferrule is not self-evident when using hand crimping pliers.



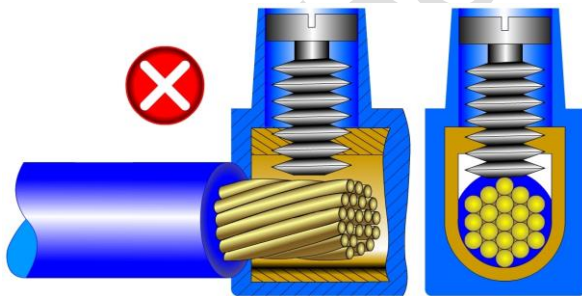
Screw terminals:
No direct contact of the screw to the ferrule. Pressing takes place via a pressure piece (1).

The use of ferrule has several advantages:

- The ferrule protects the individual wires of a stranded conductor against mechanical damage.
- Correct crimping of the ferrule and the stranded conductor breaks up the insulating oxide layer on the individual wires and creates an inseparable, form-fit, force-fit and, above all, compact connection with good contact resistance.
- The greatest advantage of wire ends with ferrules is that kinking of individual wires or broom-like opening is prevented. Everybody in the field of wire processing is familiar with this problem, when the stranded conductor of a stripped wire bumps against something and individual strands stick out. Or the unprotected stranded conductor has to be positioned in a spring clamp, and individual wires break off because they are not positioned correctly at the first attempt. A compact wire end fitted with a ferrule also offers many advantages in handling and, of course, in the safe positioning of the wire in the terminal strip when rewiring, e.g. in control cabinets or during repairs, often in quite narrow spaces.

A prerequisite for a crimp connection to work with a wire end ferrule is, of course, the correct assignment of the nominal cross-section of the wire to the diameter of the wire end ferrule. And ultimately also the use of certified, high-quality equipment.

Until the introduction of ferrules (in the 1960s), the end of the wire was either soldered or mounted directly in the screw terminal.



Screw connections in connection with a bare or soldered stranded conductor are generally not permitted! Depending on the current load, there is a great risk of fire!

The stranded conductor is not compacted (no breaking up of the oxide layer) and individual wire strands are damaged and/or squeezed off by the screw. Even with screw terminals that are specially designed for stranded conductors, there is no optimum compaction. In addition, the copper "flows" around the area of the screw. The result is that the connection loosens after some time.

