de das elektrohandwerk

de Special
»de« 12.**2013**

INDENT CRIMPING: WELL-TRIED YET RELIABLE?

Benefits and limitations

Indent crimping: Well-tried yet reliable?

BENEFITS AND LIMITATIONS The oldest form of electrical connection, indent crimping has proven its worth in countless applications. Yet for some time now, experts have been repeatedly asking the question: Is indent crimping still even reliable?

AT A GLANCE

FOR COPPER ONLY Indent crimping is only for copper

STRAIN RELIEF The connections produced by indent crimping must be strain-relieved

CABLE LUGS F or R tubular cable lugs can be used for indent crimping

Why this uncertainty: Today, hexagonal crimping is considered to be the technical standard that has generally become established. But: Indent crimping is considered to be an acceptable and a reliable form of crimping that is preferred for switch cabinets of up to 1000 V (**Picture 1**).

Indent crimping is a purely manufacturer-specific kind of crimping. In other words: The manufacturer must ensure that a standardised crimp can be produced using its components. Leading manufacturers demonstrate this through appropriate tests. In tests to IEC 61238, for example, Klauke proved its crimping tools and cable lugs combined can be used to make connections of equivalent quality to a hexagonal crimp. Warning: unlike hexagonal crimping, indent crimping is suitable only for processing copper.

In terms of technology, indent crimping is set apart by its high degree of compaction. The greater impact forces, however, cause high material stress. (**Picture 2**) So it's important to remember that connections caused by indent crimping are always strainrelieved.

The variants: W-crimp and indent crimp

There are two different versions of indent crimping in use:

- the W-crimp for cross-sections from 0.5 mm² to 16 mm² (**Picture 3**) and
- the indent crimp for cross-sections from 6 mm² to 400 mm². (**Picture 4**)

The W-crimp is preferred for smaller cross-sections, since the material in the region of the two tips of the crimp insert is extremely highly compacted. Indent crimping is commonplace and generally accepted for processing small cross-sections, since the hexagon crimp is normally used only from cross-sections upwards of 6 mm².

For multi-stranded, fine-stranded and ultrafine-stranded copper conductors

The permitted cable spectrum for indent crimping comprises both class 2 multi-stranded copper conductors, as well as class 5 and 6 fine and ultrafine-stranded types in accordance with VDE0295 up to a cross-section of 400 mm² (**Pictures 5/6**). In contrast to the hexagon crimp, thinned conductors can also be reliably crimped without transmission losses by means of indent crimping. The reason: Thinned cables have in reality a smaller cross-section than is nominally specified – a specified cross-section of 50 mm² can in actual fact only be around 43 mm², for example. Thinned lines are produced from high-purity copper. Despite its

INFOS

Technical reports

Hexagonal crimps for aluminium and copper
»de« 22.2010 ¬ P. 36

Which method is correct? Crimp types at a glance
»de« 15–16.2009 ¬ P. 36

Accurately connecting copper and aluminium
»de« 22.2008 ¬ P. 32

Best Practise for Installation of Aluminium Connectors
»de« 17.2008 ¬ P. 26

Tubular cable lugs for special applications
»de« 8.2008 ¬ P. 27

Which cable lug suits which application?
»de« 1–2.2008 ¬ P. 33

smaller cross-section, this material has identical conductivity characteristics. The benefit to the manufacturer is the reduced material usage and the associated lower costs.

One of the key advantages of indent crimping is this versatility in the wide range of the conductor types to be processed. What's more, all these conductor types can be indented simply and cost-effectively using one tool. Klauke offers a mechanical crimping tool for indent crimp that covers a crosssection range of 185 mm² to 400 mm², for example. (**Picture 7**).

Generally speaking, only mechanical hand crimping pliers are used for indent crimping. The crimping profiles to be used are based on the tube dimensions of cable lug and connector. But because indent crimping is not a standardised form of crimping, it is crucial that high-quality materials and tools tested to IEC61238 from the same manufacturer are used.

A professional indent is obtained only from clean workmanship using a suitable tool and matching cable lug. That means: The tool must be correctly applied and the indent made up to the end stop of the tool. The same number of indents as for a hexagonal crimp is required. For example: A professional hexagonal crimp of a tubular cable lug with a cross-section of 240 mm² calls for four narrow crimps; an indent likewise requires four crimps. (**Picture 8**) With indent crimping too, the cross-section is stamped on the back of the crimp for checking.

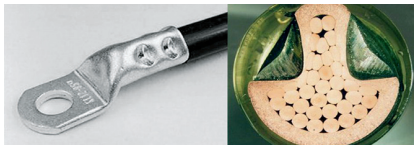
Important in all cases: To avoid under or over crimping, the use of a suitable and well-maintained tool is a basic pre-requisite. Incorrectly made crimps, due to an incorrect tool setting for example, can increase contact resistance which can in turn cause temperature rises and ultimately cable fires. (**Picture 9**) Klauke, for example, therefore recommends that its cable lugs are crimped using only its tools. This is the only way the electrical engineer is guaranteed the use of matched cable lugs or connectors and tools, which are the prerequisite for a reliable connection.

Also important in this regard: F or R cable lugs (Cu standard version) can be used for indent crimping (**Picture 10**).

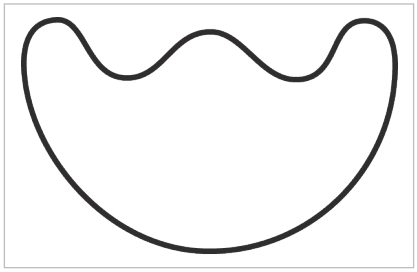
Focus: F and r series cable lugs

Thanks to their design, F cable lugs for fine-stranded and ultrafine-stranded conductors avoid the problem of fraying as they are introduced into the cable lug. These tubular cable lugs have a larger internal tube diameter

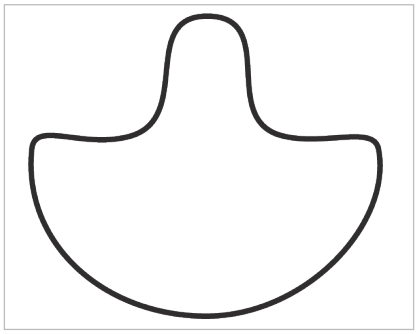
Picture 1: Indent crimping is still a reliable form of crimping, often used in the construction of switch cabinets up to 1 000 V



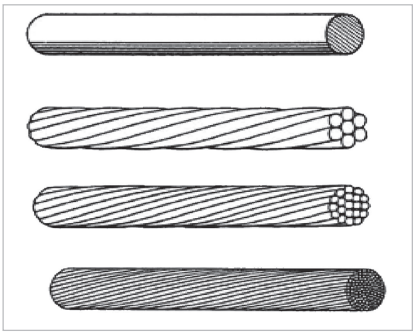
Picture 2: Indent crimping allows multi-stranded, fine-stranded and ultrafine-stranded con ductors to be permanently connected



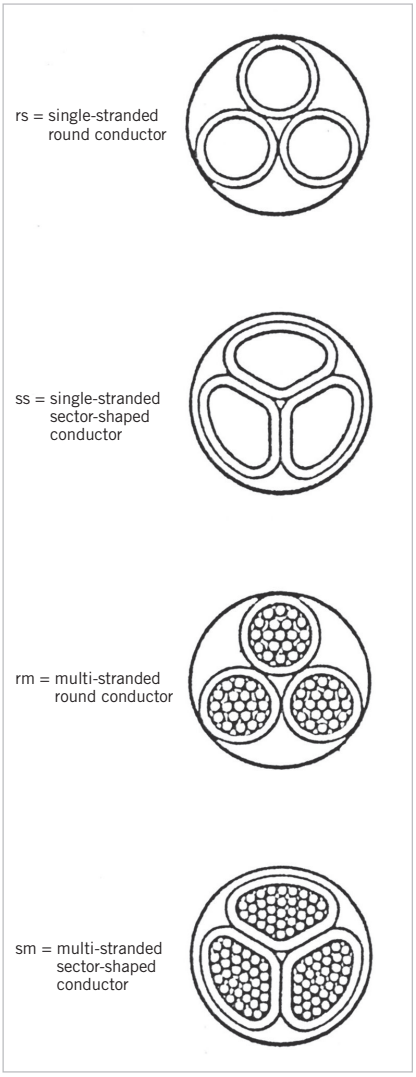
Picture 3: The W-crimp is ideal for smaller cross-sections, since the material in the region of the two tips of the crimp insert is extremely highly compacted



Picture 4: Indent crimping is especially suitable for cross-sections from 6 mm² to 400 mm²

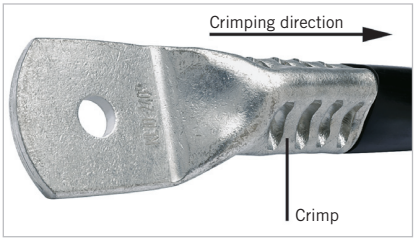


Picture 5: From top to bottom:
- class 1 round single-stranded (rs) conductor (commonly known as »solid conductor«)
- class 2 round multi-stranded (rm) conductor
- class 5 fi ne-stranded conductor 5 (commonly known as »fl exible conductor«)
- class 6 ultrafi ne-stranded conductor 6 (commonly known as »highly-fl exible conductor«)



Picture 6: The various conductor types at a glance

Picture 7: The Klauke mechanical crimping tool K07 for indent crimps covers a cross-section from 185 mm² to 400 mm²



Picture 8: Just like a hexagonal crimp, the indent crimp for a cable lug with 240 mm² cross-section also requires four narrow crimps

Picture 9: Indents made incorrectly due to unsuitable crimping tools, for example, can in the worst case cause a cable fire

Picture 10: F and R-series cable lugs can be used for indent crimping

Picture 11: F cable lugs have a larger tubular inside diameter than »standard« cable lugs; they also have a funnel-shaped widening

Picture 12: The funnel-shaped widening of the F cable lugs prevents a cross-sectional tapering of the cable caused by fraying

Picture 13: The standard R series tubular cable lugs, which are shorter than DIN cable lugs, guarantee a durable connection when indent crimping is carried out correctly

diameter than »standard« cable lugs. They also have funnel-shaped widening (**Picture 11**) to better guarantee cable entry. Besides easier handling, this also brings advantages in terms of safety: Cross-section tapering due to fraying is prevented, and so the cable retains its full cross section. (**Picture 12**) Suitable for use with »F« series tubular cable lugs, various manufacturers also offer joints for conductor extensions or repair purposes. These also have funnel-shaped widening and an enlarged tube diameter. A central impression prevents the two cable ends being inserted unevenly.

Tubular cable lug: Commercially available »standard design«

In addition to DIN cable lugs, various manufacturers offer standard R-series tubular cable lugs. Due to their dimensions, these tubular cable lugs differ from DIN cable lugs – they are usually shorter than the DIN designs. But because they are governed by the same test standard, this does not affect the durability of the electrical and mechanical connection (**Picture 13**).

Conclusion and outlook

Indent crimping remains a standardised and practical crimping method. For small cross-sections below 6 mm² in any case, and also in switch cabinet construction up to 1000 V. If the recommendations given in this article are followed, any uncertainties about their reliability are unfounded. There is no doubt, however, that the acceptance of indent crimping among experts isn't quite what it once was. It is therefore important to clarify with customers in advance as to whether they allow indent crimping in their technical facilities and plants.

The arbor and 4-arbor crimp offer a similar degree of compaction to indent crimping. These crimps even allow the production of gas-tight crimped connections. We will be explaining what is important to note about these types of crimp in a later issue.