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ELECTROINSTALLATION:

**Which cable  
lug suits which  
application?**

ORGAN DES  
ZVEH 

**AT A GLANCE**  
 Cable lugs provide safe electrical connections. We show which cable lug suit which application and which tool should be used.

# Which cable lug suits which application?

Small component with a great impact: A poor cable connection can result in an increased joint resistance and even in fire. We will show you the correct procedure.

**O**n the German market hundreds of different versions of cable lugs are available. For the electrician it is very difficult to choose from this broad range the correct cable lug for each specific application. The following article gives an overview of the different types of cable lugs for copper conductors and details the facts which will guarantee a safe and long-lasting connection.



**Incorrect tools or an unprofessional crimp can cause increased temperatures or even fire.**

Source: Klauke

In principle we differentiate between three types of cable lugs (picture 1).

- Compression cable lugs according to DIN 46235
- Standard tubular cable lugs
- Sheet metal terminals according to DIN 46234

## Compression cable lugs according to DIN 46235

DIN standard 46235 defines the application, dimensions and marking of cable lugs. This standard allows use of these cable lugs for compression of solid, stranded, fine stranded and finest stranded copper conductors. The Utilities market for instance offer a wide range of applications.

Markings on the product provide the installer with essential information relating to the origin and application of the DIN 46235 cable lugs, which also applies for standard tubular cable lugs. Marking "KL 22 12 – 150" shows:

- KL: indicates manufacturer (in this case Klauke)
- 22: Die code (only for compression cable lugs DIN 46235)
- 12: Metric bolt size for connecting bolt: size M12
- 150: Cross section of conductor in mm<sup>2</sup>

In addition, these cable lugs indicate the number of required crimps (picture 2).

For installing, the DIN standard recommends crimping dies according to DIN 48083, part 1, 3 and 4 for solid, stranded and fine stranded conductors. For braided ropes the standard refers to the information of the manufacturer. Klauke generally recommends the use of hexagon crimping dies according to DIN 48083, part 4 for installing of

compression cable lugs DIN 46235. Range of cross section is from 6 mm<sup>2</sup> up to 1000 mm<sup>2</sup>, bolt sizes range from 5 mm up to 20 mm. Electrolytic copper according to EN 13600 is mandatory. For corrosion protection, compression cable lugs – also standard tubular cable lugs and terminals – are tin plated.

## Copper tube cable lugs "standard design"

Apart from DIN cable lugs, many manufacturers also offer standard tubular cable lugs, also made from electrolytic copper according to EN 13600. As far as sizes are concerned, standard tubular cable lugs are mostly shorter than DIN cable lugs and also differ in tube



Source: Klauke

**Picture 1: Three types of cable lugs: DIN compression cable lugs, standard tubular cable lugs and sheet metal terminals (from left to right)**



Source: Klauke

**Picture 3: DIN compression cable lugs are longer than standard tubular cable lugs**



Source: Klauke

**Picture 2: Only DIN compression cable lugs show the required number of crimps stipulated by the manufacturer.**



Source: Klauke

**Picture 4: Standard tubular cable lugs (left) have different tube dimensions than DIN compression cable lugs (right)**



**Picture 5: Incorrect and correct crimps in comparison: An incorrect crimp (left: excess crimping, middle: low force crimping, and usage of incorrect crimping tools can result in an increase in joint resistance and may jeopardise the installation; right: correct crimping)**



**Picture 6: F-Cable lugs with flared entry represent an option when cables of class 5 and 6 will not fit into normal cable lugs.**



**Picture 7: The longer tube of Klauke cable lugs (above) guarantees a high quality connection.**



**Picture 8: High quality Klauke cable lugs (above) show a clean and vertical tube end**

dimensions (picture 3, 4). However, since these lugs are also subject to test standard IEC 1238 part 1, durability of electrical and mechanical connection is not affected.

All cable lugs – irrespective of type – can only be crimped properly when a suitable tool is used. Incorrect tools or an unprofessional crimp can result in increased joint resistance, increased temperatures and even fire. (picture 5). To exclude such consequences Klauke recommends for crimping of their cable lugs the exclusive use of their appropriate crimping tools.

#### Sheet metal terminals according to DIN 46234

Also for the sheet metal terminals certain standards apply regarding application, dimensions and marking. Other than compression cable lugs DIN 46235 terminals are designed only for crimping of stranded, fine and very fine stranded conductors – not for solid conductors.

Cross section ranges from 0.5 mm<sup>2</sup> up to 240 mm<sup>2</sup>, bolt sizes from 2 mm to 16 mm. Among others terminals they can be found in electrical control cabinets and vehicles of public transportation services.

Sheet metal terminals are also made from electrolytic copper according to EN 13600. But there is a difference in the basic material. While compression standard tubular cable lugs are produced from copper tubes, terminals are made from copper sheets. Terminals show a soldered seam as the DIN standard prescribes a closed tube. The DIN standard does not specify crimping tools – Klauke recommends their self-designed indent crimping tools.

#### Useful information

The selection of the correct cable lug very much depends on the cable type. For cables according to DIN 57295 the following cable lugs can be used.

- Cables class 1, 2, 5 and 6: Compression cable lugs DIN 46235
- Cables class 2: Standard tubular cable lugs
- Cables class 2, 5 and 6: Terminals

In practice it can happen that flexible class 5 and 6 cable conductors do not fit into the appropriate cable lug. For such cases Klauke recommends the so called F-cable lugs which have a larger inner diameter and feature a flared entry. Indent crimping is recommended (picture 6).

For installing the DIN cable lugs, crimping tools with die codes according to DIN 48083 part 4 have to be used. For tubular cable lugs please refer to the tool recommendations of the manufacturer.

#### Electrical and mechanical properties

The International Standard IEC 1238 part 1 applies to electrical and mechanical properties of cable lugs. The requirements for a permanent and safe electrical connection for the intended application are detailed in this standard. Both a mechanical pullout test and an electrical durability test are defined. A test cycle simulates the application in practice: The connection is being heated 1000 times up to 120° C, to imitate the morning voltage peak in the public power supply system. Also high current tests are being carried out at temperatures of 250° C.



#### MORE INFO:

For more literature on these subjects please go to

<http://www.vde-verlag.de/engl.html>



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The responsibility of adherence to these safety rules lies with every manufacturer of cable lugs. For this reason the manufacturers specify the appropriate cable type to be used with their cable lugs.

Apart from normative standards, renowned manufacturers stipulate additional quality requirements. Klauke made cable lugs are subject to an "annealing" process to condition the material from tension and hardness and to reduce the risk of fracture. This process increases the durability and provides greater protection for the lug against vibration. This is another reason why we only recommend use of high-quality cable lugs from well known manufacturers (**Picture 7**).

The quality of cable lugs can often be recognized by visual characteristics. A burr free lug, a flat palm and a cleanly machined end are signs of a high quality product (**Picture 8**).

### **Preview: Cable lugs for special applications**

Cable lugs per this article comply with nearly all standard requirements of day-to-day practice. A great number of applications, however, for instance solid conductors or connections in switch cabinets require special cable lugs. These will be featured in our next issue.

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