SLEEVE ADAPTED TO BE SHORTENED IN AN EXPANDED STATE

Abstract: The present invention relates to a shrink sleeve (1) which for easier adaptation of the sleeve (1) to varying required lengths of a cable to be insulated comprises at least one cutting area (2) having a wall thickness (T) reduced in comparison with the cylindrical wall thickness (W) of the sleeve. The sleeve can be used for insulating or connecting wires. The inventive sleeve might also be used for other purposes such as stress grading or conductively extending rather than just insulating.
Shrink Sleeve

The present invention relates to a shrink sleeve, as is particularly used for the electrical, mechanical and/or physical insulation of cables relative to the surroundings. A shrink sleeve within the meaning of the present invention is any sleeve or tubing that by relaxation of the material forming the shrink sleeve completely or in part is placed on the outer circumferential surface of the product to be wrapped, i.e. the outer circumferential surface of the cable or cable section.

Shrink sleeves are e.g. expanded during manufacture onto a support structure that holds the internal stresses of the shrink sleeve. In the thus pre-expanded state the shrink sleeves are positioned over the object to be wrapped. The supporting structure is subsequently removed so that the shrink sleeve comes to rest under elastic pre-stress on the object to be wrapped and protected (cold shrink sleeve). The above-mentioned examples (heat shrink sleeve, push-on elastomeric sleeve, cold shrink sleeve) are shrink sleeve within the meaning of the present invention.

Shrink sleeves are e.g. radially expanded during manufacture and cooled in the expanded state to freeze the chains of the plastic molecules inside the shrink sleeve in a specific orientation. As an alternative, the shrink sleeve, which has been expanded under heat and pressure, may also be bombarded with carbon atoms. In both cases, a certain heating of the shrink sleeve has the effect that the radial expansion of the shrink sleeve is offset entirely or in part (heat shrink sleeve). Moreover, there are shrink sleeves which are delivered in the unexpanded state and are radially expanded during shrinkage onto the object to be wrapped to introduce the object under elastic pre-stress of the shrink sleeve into said sleeve and to enclose the object (push-on elastomeric sleeve).

The present invention is not limited to the use of special materials for making the shrink sleeves. For instance, a shrink sleeve according to the present invention may be made from silicone and/or EPDM, rubber or elastomer, polyolefins, polyvinylidene fluoride, PVC, PTFE, ethylene, propylene.

Possible applications for the shrink sleeves according to the patent are air- and/or watertight and thus corrosion-protected wrappings of a cable connected at the terminal side to another
component, such as a connector, or the repair of a damaged cable insulation. Furthermore, shrink sleeves may be used for insulating components at their joint, forming a kind of shrink type connecting sleeve at said place.

Due to the internal stresses prevailing in the shrink sleeve or due to the expansion of the shrink sleeve in the delivered state (in the case of a cold shrink sleeve) or during processing of the shrink sleeve (push-on elastomeric sleeve), shrink sleeves have the basic problem that they must be cut to length, or adapted in their length, without any cracks propagating in the sleeves due to the internal stress of the shrink sleeve material. Due to the high stress of the shrink sleeve, even minor cracks or notches may propagate to form a long crack that makes the shrink sleeve useless either entirely or in part. The problem varies with the shrink ratio that can be achieved with the shrink sleeve at the most. However, the problem is found in the still unshrunk, i.e. expanded, sleeve and also after shrinkage of the sleeve.

Particularly difficult is the cutting of sleeves that are placed without the action of heat on the object to be wrapped, either by removal of the internal support structure or by elastic pushing and pulling of the shrink sleeve onto and over the object to be wrapped. In the cold state this produces particularly great strains that may lead to the immediate propagation of cracks.

It is the object of the present invention to eliminate or at least reduce the problems entailed by the cutting or cutting to length of shrink sleeves in the shrunk or unshrunk state.

To achieve said object, the present invention provides a shrink sleeve with at least one cutting area having a wall thickness reduced in comparison with the cylindrical wall thickness of the sleeve.

The shrink sleeve according to the invention differs from a commercial shrink sleeve with cylindrical outer circumferential surface in that it has a cutting area at least at one discrete point in the longitudinal direction of the shrink sleeve.

This cutting area has a reduced wall thickness in comparison with the wall thickness of the sleeve that is otherwise present in cylindrical form. It is regarded as expedient to form the region of the cutting area with a reduced wall thickness on the whole, namely in circumferential direction with a wall thickness that is constant but reduced in comparison
with the cylindrical wall thickness. The reduced cross-section can for instance be
accomplished by heating the shrink sleeve during manufacture in a circumferential segment
of a predetermined axial extension and by pulling it apart. As an alternative, the region of
reduced wall thickness can also be produced in that the sleeve which is first cylindrical is
plastically, preferably thermoplastically, deformed in the region of the cutting area, so that
the material of the shrink sleeve is displaced from the cutting area in axial direction and
accumulated in the form of a material accumulation provided on the inner circumferential
surface and/or the outer circumferential surface of the cylindrical sleeve and e.g. solidifies at
said place.

In the case of a material accumulation on the inner circumferential surface, this
accumulation, on condition it is provided over the whole inner circumferential surface, may
rest in the manner of a collar in a particularly tight manner on the outer circumferential
surface of the object to be wrapped, thereby effecting a special sealing measure at the end
of the shrink-on sleeve, by which measure the entry of moisture, for instance, into the space
between the shrink sleeve and the object to be wrapped is made more difficult. Such a
sealing bead is particularly formed by an annular bead, which is provided in the vicinity of
the region showing a reduced wall thickness. If desired, a plurality of such beads may be
arranged one after the other in direct vicinity of the region of reduced wall thickness in the
axial direction of the shrink sleeve.

If the material accumulation is provided on the outer circumferential surface of the cylindrical
material, it should preferably be provided in the vicinity of the region of reduced wall
thickness in the form of at least one web projecting from the outer circumferential surface of
the sleeve, which may e.g. be shaped as a guide surface for a cutting tool by which the
shrink sleeve is severed in the region of the cutting area. Such a web projecting from the
outer circumferential surface need not necessarily be formed on the outer circumferential
surface of the sleeve in a surrounding configuration, i.e. in the manner of a surrounding
collar, although such a configuration is preferred for manufacturing reasons. It is just as well
possible to provide a single, circumferentially relatively short web on the outer
circumferential surface. If necessary, a plurality of webs may also be provided distributed
relative to one another in circumferential direction. Design and arrangement of the webs are
particularly predetermined by the selection of the cutting tool and its configuration.
For reasons of a safe guiding of the cutting tool it is preferred that at least one respective web or surrounding collar is provided at both sides of the region of reduced wall thickness on the outer circumferential surface of the shrink sleeve. This material accumulation on the outer circumferential surface serves particularly to guide the cutting tool at both sides. In the case of an annular bead provided at both sides of the region of reduced wall thickness on the inner circumferential surface, both pieces that have been created after separation or cutting have an inner sealing collar in the region of their cutting areas.

As usual, the shrink sleeve of the invention can first be produced by way of extrusion. The cutting areas are then produced on said cylindrical semi-finished product, for example by local melting of the plastic material and the displacement thereof out of the cutting area. The shrink sleeve, which is thus contoured at least in axial direction, can then be expanded under heat and cooled rapidly to freeze the orientation of the molecule chains created during expansion. As an alternative, a bombardment by carbon atoms of the contoured shrink sleeve is also possible.

As a further alternative possibility of production, blow molding of the contoured shrink sleeve, for instance against a cold mold, is feasible. Finally, length pieces of the shrink sleeve can be produced by means of injection molding with one or more cutting areas arranged one after the other in axial direction and these can then, if necessary, be treated for generating and introducing a pre-stress relaxing during wrapping of the object. Presently, injection molding and comparable techniques (compression or transfer molding) are considered as the main methods of manufacturing parts according to the present invention. Mechanical or laser cutting are not of relevance in this respect.

The shrink sleeve may preferably comprise a plurality of cutting areas provided at a constant axial distance relative to one another. This offers the possibility of cutting the shrink sleeve into discrete predetermined length pieces. In practice, it has also turned out to be advantageous to make the distance between two neighboring cutting areas range from 8 mm to 15 mm at a sleeve diameter of the cylindrical region of about 16 mm. Due to technical manufacturing considerations the shrink sleeve is preferably provided as a length piece which comprises a cutting area in the center. Moreover, the length piece comprises a plurality of cutting areas, at the end side each time, the cutting areas being preferably provided at a constant axial distance from one another. A smooth cylindrical region is
provided between said end regions provided with cutting areas and the central cutting area. Such a shrink sleeve may e.g. be produced during injection molding, namely with a total length between 400 mm and 700 mm.

Further details and advantages of the present invention become apparent from the following description in combination with the drawing, in which:

Fig. 1 is a longitudinal sectional view through a first embodiment of a shrink sleeve according to the invention;

Fig. 2 is a longitudinal sectional view through a second embodiment of a shrink sleeve according to the invention;

Fig. 3 is a longitudinal sectional view through a third embodiment of a shrink sleeve according to the invention;

Fig. 4 is a partly cut side view of an embodiment of a length piece of a shrink sleeve according to the invention with cutting areas according to the illustration in Fig. 1; and

Fig. 5 is a perspective side view of the embodiment shown in Fig. 4.

Fig. 1 shows a longitudinal sectional view through an embodiment of a shrink sleeve of the invention, the section thereof shown in Fig. 1 comprising two neighboring cutting areas and being continued next to and outside of said cutting areas in the form of cylindrical portions with a cylindrical wall thickness in axial direction. The cylindrical portion has mainly been cut away on the outside in the illustration.

Each of the cutting areas comprises a cutting groove by which the wall thickness is reduced in comparison with the cylindrical portion. In the present case the embodiment shows a wall thickness in the cylindrical portion of about 2.4 mm, whereas the wall thickness in the region of the cutting area is about 0.25 mm. In the extension of the radially extending sidewalls of the cutting groove, bead-like material accumulations protrude over the cylindrical portion. Said material accumulations form a radius area with a radius ranging from 1.5 mm to 1.00 mm with respect to the cutting groove. A convex radius in the
said order is also provided between the cylindrical portion 3 and the material accumulation 6.

While the embodiment shown in Fig. 1 has a cylindrical inner circumferential surface, the embodiment illustrated in Fig. 2 shows, next to the cutting groove 4, the material protrusions in the form of annular beads 7 protruding over the inner circumferential surface of the shrink sleeve 1. Insofar as Fig. 2 shows identical or similar components as Fig. 1, these are marked with the same reference numerals. In comparison with the embodiment in Fig. 1 the material accumulations 6 are formed in the embodiment shown in Fig. 2 as webs 5 with a strict radial extension, thereby forming guide areas 8 for a cutting tool. In the embodiment shown in Fig. 2, the webs 5 are also identical in their substance with the material of the shrink sleeve 1 and thus show a certain elasticity by which a cutting tool inserted into the cutting groove 4 is oriented towards the groove in centered fashion. In the region of the cutting groove 4 the material thickness T of the shrink sleeve 1 is considerably reduced. In the instant case the material thickness T is about 10% of the material thickness W of the cylindrical portion 3. The cutting area 2, i.e. the region of reduced wall thickness T, is positioned in radial direction approximately in the center of the wall thickness W of the cylindrical portion 3. The outer circumferential surface and also the inner circumferential surface of the shrink sleeve 1 form a substantially concave trough in the region of the cutting area 2, the trough beginning at the base of the webs 5 or the annular beads 7.

In the embodiment shown in Fig. 3, like components as compared with Figs. 1 and 2 are also provided with like reference numerals. This embodiment substantially differs from the previously shown ones in that a smaller web 5 and a guide web 9 protrude from the outer circumferential surface of the cylindrical portion 3, said webs 5 and 9 being provided directly next to the cutting area 2. The guide web 9, in particular, serves to position a cutting tool which can first be supplied in axial direction to the guide web 9 and which, when reaching the guide web 9, can finally be introduced into the cutting area, safely guided by said web, so as to separate the portion of reduced wall thickness T. The webs 5, 9 remaining on the separated end pieces can be used as a flange for fastening and/or further sealing a cable wrapped with the shrink sleeve 1. Large webs 9 can be used for forming shed like elements which makes the creapage path of the outer surface longer which is useful for i.e. electrical applications like terminations. Like in the previously discussed embodiments, the webs 5, 9 are provided in rotational symmetry.
In the embodiment according to Figs. 4 and 5, the shrink sleeve is shaped in the form of a length piece 10 and has a cutting area 2a provided in the center, and a plurality of cutting areas 2b, each formed at the end side in accordance with the illustration of Fig. 1. A smooth cylindrical portion 3 without any cutting area is formed thereinbetween. The terminal cutting areas 2b have each an identical axial distance from one another. The illustrated embodiment is for instance suited for insulating cable pieces having about half the length of the length piece 10. This piece is for instance first produced by way of injection molding as a semi-finished product, and internal stresses are introduced by way of an aftertreatment into the component produced in this way, which can then be pulled, for instance, onto a temporary inner support structure (cold shrink sleeve). A simple separation or cutting in the area of the central cutting area 2a during final assembly yields two pieces of identical length that can be adapted by the user by way of appropriate cutting in the region of the cutting areas 2b to the real, sometimes varying, length of the cable piece to be insulated.
List of Reference Numerals

1 Shrink sleeve
2 Cutting area
3 Cylindrical portion
4 Cutting groove
5 Web
6 Material accumulation
7 Annular bead
8 Guide surface
9 Guide web
10 Length piece
W Wall thickness
T Wall strength
Patent Claims

1. A shrink sleeve (1), characterized by at least one cutting area (2) having a wall thickness (T) reduced in comparison with the cylindrical wall thickness (W) of the sleeve (1).

2. The shrink sleeve (1) according to claim 1, characterized by a material accumulation (5, 6, 7, 9) provided next to the area of reduced wall thickness (T), which protrudes from the inner and/or outer circumferential surface of the sleeve.

3. The shrink sleeve (1) according to claim 1 or 2, characterized in that the material accumulation is formed at least in part by displacement of a material forming the shrink sleeve (1) out of the region of reduced wall thickness (T).

4. The shrink sleeve (1) according to any one of the preceding claims, characterized in that a material accumulation (6) is formed at least in part by displacement of material of the shrink sleeve (1) at a side opposite to the region of reduced wall thickness (T) towards the cutting area (2).

5. The shrink sleeve (1) according to any one of the preceding claims, characterized in that the reduced wall thickness (T) is 10% to 90%, preferably 30% to 70% of the cylindrical wall thickness (W).

6. The shrink sleeve (1) according to any one of the preceding claims, characterized in that at least one annular bead (7) is formed next to the region of reduced wall thickness (T) on the inner circumferential surface of the sleeve.

7. The shrink sleeve (1) according to any one of the preceding claims, characterized in that next to the region of reduced wall thickness (T) on the outer circumferential surface, at least one web (5, 9) is provided projecting therefrom.

8. The shrink sleeve (1) according to claim 7, characterized in that the web (5, 9) is configured in circumferential direction at least in sections to be of a surrounding type.
9. The shrink sleeve (1) according to any one of the preceding claims, characterized in that at least one web (5, 9) is provided at both sides of the region of reduced wall thickness (T), two webs (5, 9) directly enclosing thereinbetween the region of reduced wall thickness (T).

10. The shrink sleeve (1) according to any one of the preceding claims, characterized in that the shrink sleeve (1) comprises a plurality of cutting areas (2b) provided at a constant axial distance from one another.

11. The shrink sleeve (1) according to any one of the preceding claims, characterized in that the shrink sleeve (1) is configured as a length piece (10) with a cutting area (2a) formed in the center thereof, a plurality of cutting areas (2b) each provided at the end side, and a corresponding smooth cylindrical portion (3) disposed thereinbetween.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION & SUBJECT MATTER**

**INV. H02G 15/18**

According to International Patent Classification (IPC) or to both national classification and IPC.

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

H02G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**EPO-Internal**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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**D**

Further documents are listed in the continuation of Box C

X: See patent family annex

1. Special categories of cited documents:
   - 'A': document defining the general state of the art which is not considered to be of particular relevance
   - 'E': earlier document but published on or after the international filing date
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   - 'O': document referring to an oral disclosure, use, exhibition or other means
   - 'P': document published prior to the international filing date but later than the priority date claimed

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'A': document member of the same patent family

Date of the actual completion of the international search: 5 September 2007

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Name and mailing address of the ISA:

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Authorized officer: Jansen, Helma
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