



Cable connecting systems & Accessories

**High quality and innovative  
products in Medium Voltage**

**We connect your energy**

[www.cellpack.com](http://www.cellpack.com)

## COMPANY PROFILE

### Electrical Products



Being an SME company within the Behr Bircher Cellpack (BBC) Group in Villmergen/Switzerland, BBC Cellpack Electrical Products has successfully established itself in the global markets, in the fields of development, production and customer oriented sales of cable connecting systems and accessories for the low and medium voltage up to 42 kV.

### We connect your energy



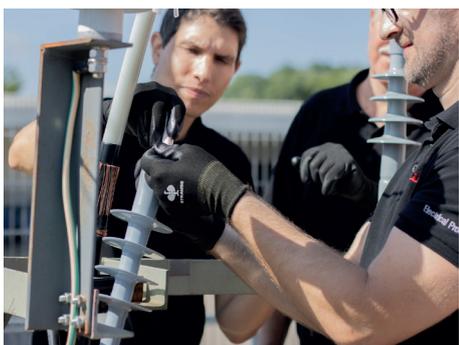
Power utilities, electrical wholesalers, specialist electrical trade or the industry – they all share one thing in common: regarding a high operational safety for the power supply services in the distribution network as their first priority. The system solutions and products developed by BBC Cellpack for complex, high-tech applications have significantly contributed to this.

### Technology & Innovation

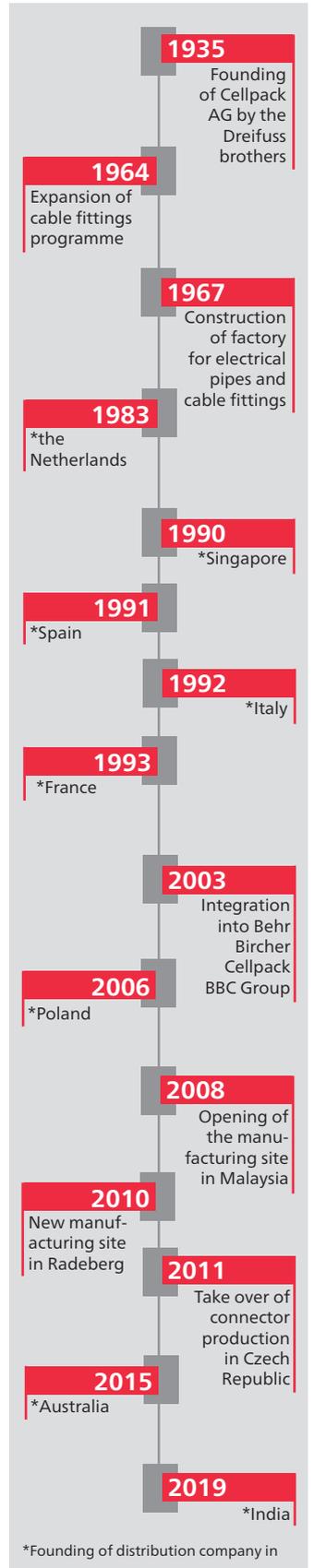


With our customer-oriented understanding of technologies and the distinctive culture of innovation, we have committed ourselves to concentrate, not only on the demands of our customers for technically innovative and thoroughly tested products, but also to ensure the safe and reliable functioning of our system solutions.

### Quality & Service



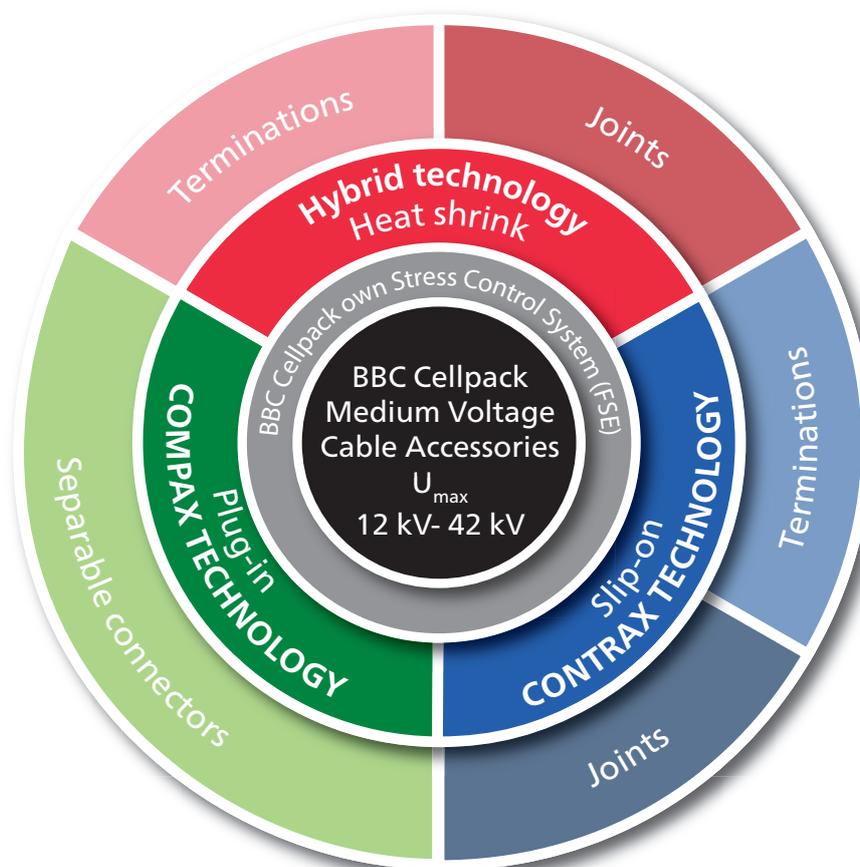
BBC Cellpack has gained worldwide recognition for highest material and product quality with standards being continuously controlled in our high-performance laboratories and testing facilities in Germany. This high benchmark also applies to the availability and delivery service of our products. The quality standard "Swiss Quality – Made in Germany" is our commitment.



## INTRODUCTION

Cable accessories are indispensable components of a cable network which exert a direct influence on its quality. The same level of operational safety must be guaranteed for the accessories as for the cable itself. Due to high operational costs incurred by medium voltage networks, it is necessary to avoid outages. The safe, quick and easy assembly of cable accessories is therefore essential for network reliability. Exceptional innovative solutions are thus required to ensure that excessive demands are not placed on the capabilities of assembly staff.

We at BBC Cellpack produce innovative, high-performance cable accessories for medium voltage networks based on the stress control system (FSE) developed by us. We offer a full range of products for a wide variety of applications using heat shrink, silicone, slip-on, plug-in and cast resin technologies which comply with the standard requirements for energy suppliers and the set industrial norms. The system components of all of our cable accessories are compatible so as to ensure safe and reliable functioning.



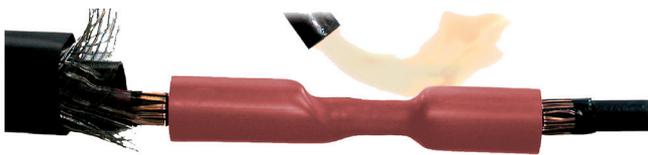
As a result of intensive testing carried out in our laboratories, as well as numerous type tests carried out in international test facilities, we are able to guarantee an operationally reliable conductor connection, an adequate insulation level and excellent resistance against all environmental influences for all our cable accessories. All our medium voltage products are tested according to DIN VDE 0278-629-1 and IEC 60502-4 and comply with BS requirements.

## HEAT SHRINK PRODUCTS- HYBRID TECHNOLOGY

Hybrid cable joints and terminations combine components made from silicone rubber with high voltage resistant heat shrink products. This renders our cable accessories compatible with all existing medium voltage cable cross-sections and ensures maximum operational reliability. The full product range comprises straight-through and transition joints, indoor and outdoor terminations for single and three-core cables, which comply with the standard requirements for energy suppliers and the set industrial norms. We also offer products based on customer specifications.

### Heat shrink Joints

The main insulation material used in hybrid straight-through and transition joints consists of a combination of heat shrink tubing supplied in telescoped form. The insulation materials are manufactured from high-performance polymeric materials with appropriate additives. Stress control is achieved by slipping the silicone rubber stress control elements (FSE) onto the prepared cable end using the patented slip-on auxiliary device. The resulting joint system can be positioned and heat-shrunk onto the cable cores to be connected.



#### Product Range

- Straight-through joints for single and three core cables
- Transition joints for single and three core cables

#### Voltage Range

- $U_0/U_m$  6/10 (12)kV - 19/33 (36) kV

#### Cross Section Range

- 10 Sqmm - 1000 Sqmm

### Heat shrink Terminations

The main insulation material used in terminations is heat shrink tubing, which is manufactured from high-performance tracking resistant polymeric materials. Stress control within cable terminations is achieved in the same way as for the hybrid joint system- by slipping the silicone rubber stress control elements (FSE) onto the cable end, using the patented slip-on auxiliary device. A sealing tape- another well-established product- is wrapped around the cable shielding and the cable lug to provide a reliable seal. A heat shrink spreader cap with integrated heat-sealing adhesive provides a reliable seal for the connector distributor and the cable sheath in the distribution region of three-core cables. To establish the necessary creepage distances, highly-elastic shields manufactured from tracking resistant silicone rubber are installed on the tubing after shrinking.



#### Product Range

- Indoor and outdoor terminations for single and three core cables

#### Voltage Range

- $U_0/U_m$  6/10 (12) kV - 20.8/36 (42) kV

#### Cross Section Range

- 25 Sqmm - 1000 Sqmm

## Anti-Tracking Properties

The medium voltage insulation properties of polymeric materials can be severely affected in polluted atmospheric conditions where moisture, together with salts, dust particles, acid gases and ultra-violet radiation reduce the surface resistivity of the insulation, thereby giving way for leakage currents to flow across the surface of the insulation. These leakage currents may cause a rise in temperature of the insulation material, causing surface moisture evaporation and the formation of dry solid bands of deposited material on the polymer surface. Electrical discharges or arcing can occur across these bands resulting in the degradation of the insulation and the formation of conductive paths on the surface. A complete failure of the system will occur when these paths reach to the extent that the remaining insulation can no longer withstand the applied system voltage.

To resist this phenomenon of tracking, Cellpack offers its own heat shrink tubes which are made from thermally stabilized, cross linked, anti-tracking and weather resistant polymeric material. The tubes are tested according to DIN standards and characterized by excellent resistance against ozone and UV radiation. Its unique design has undergone years of rigorous testing under challenging climatic conditions. Standard hybrid terminations are designed for challenging climatic conditions and comply with CENELEC and IEC 60815 requirements.

## Hydrophobic Properties

Another measure to avoid tracking and erosion is by using material with high hydrophobic properties and the ability to recover its hydrophobicity. "Hydrophobicity is the physical property of a material that allows it to be repelled by a mass of water". One such material is silicon rubber that offers exceptional hydrophobic properties and resistance against ozone.

Silicon rubber naturally repel water (causes droplets to form, instead of wetting the surface), ensuring that there is no decrease in the surface resistance of the rain sheds. Another important property of silicon rubber is, it is mostly Inorganic (i.e.) No conducting carbon path.

These combined properties of silicon rubber avoids the formation of dry solid bands in the surface of the end-terminations protecting it from electrical discharges or arcing guaranteeing operational safety.



## SILICON SLIP-ON PRODUCTS - CONTRAX TECHNOLOGY

The contrax slip-on products offer a compact and simplified design that ensures high reliability and fault tolerant installations. Here all primary components of the joints / terminations are integrated into a single-piece slip on silicon insulating body, greatly simplifying assembly. The insulating bodies are manufactured from high-voltage resistant silicone rubber using controlled injection process. Its compact design reduces the associated assembly, storage and transportation costs to the energy supplier.

### Silicon slip-on Joints

The single-piece insulating body of contrax straight-through joints consists of an inner conductive electrode which acts as a Faraday cage around the connector with the main insulating layer above it, and an outer semi-conducting layer. Each joint body comes equipped with an integrated slip-on auxiliary device for easy assembly and the prevention of damage during installation.

Stress control at the cable end is achieved by sliding our silicone rubber stress control element (FSE) onto the prepared cable using the patented slip-on auxiliary device. Cable screen continuity is achieved using a copper braid sleeve which is easily connected to the copper wire/ tape screen using highly-elastic pressure springs. Outer protection sheath is one single piece EPDM offered with heat or cold shrink variations.



#### Product Range:

- Straight-through joints for single and three core cables

#### Voltage Range:

- $U_0/U(U_m)$  6/10 (12)kV - 12.7/22 (24) kV

#### Cross Section Range:

- 35 Sqmm - 630 Sqmm

### Silicon slip-on Terminations

The silicon slip-on terminations consist of a single-piece insulating body manufactured from a creepage tracking resistant silicone rubber using a quality-controlled injection moulding process. The stress control element and necessary shields are also integrated into the insulating body. The compact optimized design minimizes assembly, storage and transportation costs to energy suppliers.

Assembly is carried out in a single-step process, in which the single-piece body is easily slid onto the prepared cable end using the patented slip-on auxiliary device.



#### Product Range:

- Indoor and outdoor terminations for single and three core cables

#### Voltage Range:

- $U_0/U(U_m)$  6/10 (12) kV - 19/33 (36) kV

#### Cross Section Range:

- 35 Sqmm - 630 Sqmm



A silicone spreader cap using special cold-shrink technology, patented by BBC Cellpack, and silicone tubes with an integrated slip-on auxiliary device are used in the distribution region of three-core cable, ensuring simple and accurate assembly. A special sealing tape provides a reliable seal at the cable shielding and around the cable lug.

## Anti-Tracking & Hydrophobic Properties

The silicone rubber used is characterized by excellent resistance against ozone and UV radiation, as well as exceptional hydrophobic properties. Its unique design has undergone years of rigorous testing under challenging climatic conditions. The silicon slip-on terminations are designed for challenging climatic conditions and thus comply with CENELEC and IEC 60815 requirements.



Hydrophobic properties of the silicone used

## Plug-in Connectors

The Cellplux plug-in connectors have been especially developed to connect plastic-insulated medium voltage cables to electrical systems with bushing types A, B and C. The components of the plug-in connectors are harmoniously matched to one another so that assembly is very simple, secure and done quickly.

Insulation materials in plug-in connectors possess exceptional electrical and mechanical properties and are manufactured from high voltage resistant EPDM using a controlled injection moulding process. Stress control is achieved by means of the silicone stress control element (FSE). Further, the connectors are equipped with a tried and tested screw-in cable lug system, compatible with all cross-sections, which has been designed to guarantee reliable connection for both copper and aluminium conductors. The optimized design of the contact bolts permits the use of a single conventional tool for assembly across the entire range of cross-sections.

CTKS  
630A



CTS  
630A



CGS  
250A



CWS  
400A



### Product Range:

- CWS 250A & 400A: Elbow separable connector
- CGS 250A: Straight separable connector
- CTS 630A & 1250A: T shaped separable connector
- CTKS 630A: T shaped separable coupling connector
- CTKSA: Coupling surge arrester

### Voltage Range:

- $U_0/U_m$  (12) kV – 19/33 (36) kV

### Cross Section Range:

- 25 Sqmm – 630 Sqmm

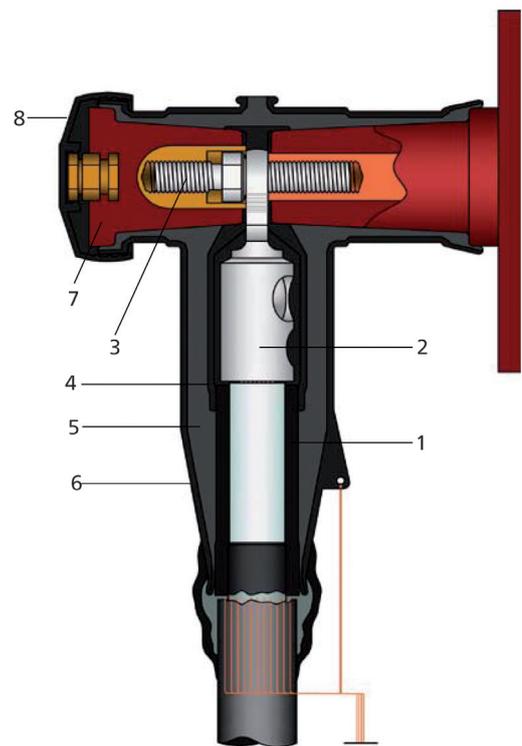


Diagram of CTS 630A Separable Connector

- 1 Silicone stress control element
- 2 Screw-in cable lug with shear bolt screw and integrated bracket
- 3 Contact bolts with shear bolt screw
- 4 Inner electrode
- 5 Main insulation
- 6 Shielding
- 7 Screw-in insulating supports with capacitive test point
- 8 Protective cap

## Stress control in MV cable accessories

Removal of the cable insulation and the outer semi-conducting layer when connecting or terminating medium voltage cables results in damage to the cable structure. In addition to this, the electric field becomes strongly inhomogeneous at particular points. During this process, the electric field strength value greatly increases, resulting in a risk of partial discharge, breakdown or spikes.

Stress control influences the strong inhomogeneous field distribution at the cable end so as to reduce the high field strengths to a non-critical value.

Refractive stress control is the most suitable method for medium voltage cable accessories. It offers the following significant advantages over other methods:

- Leaner stress control element design, enabling the development of compact solutions which are very easy to assemble.
- Reduced sensitivity to incorrect positioning or incorrect cable preparation, allowing compensation for errors made during assembly.

## Refractive stress control

Refractive stress control influences the electric field by combining two insulation materials with different dielectric strengths. The insulation material with the higher dielectric constant is placed in the area at which the higher electrical field strength occurs. The use of the term "refractive" derives from the fact that the process deflects electric field lines which cross the surface of these materials at an angle (see Figure 1).

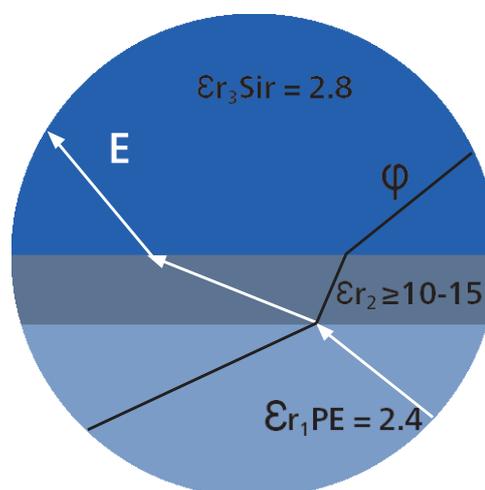


Fig. 1: Interruption of electric field lines at the point of transition between materials with different dielectric constants.

E: Equipotential lines  
 Ø: Electric field lines  
 $\epsilon_{r1}$ (PE): Permittivity of conductor insulation  
 $\epsilon_{r2}$ : Permittivity of soot-filled silicon  
 $\epsilon_{r3}$ (SiR): Permittivity of the surrounding silicon rubber

} FSE = Field control element

When using the above principle in medium voltage cable accessories, a thin stress control and insulation layer is placed in the region above the strippable edge of the outer semi-conducting layer (for cables with plastic insulation), or above the Hochstädter foil or lead sheath (for cables with paper insulation), or above the core insulation when the cable insulation has been removed. This layer has a considerably higher dielectric constant ( $\epsilon_r$ ) than the insulating material of the cable itself. This results in a targeted reduction of the original field strength (see Fig. 2).

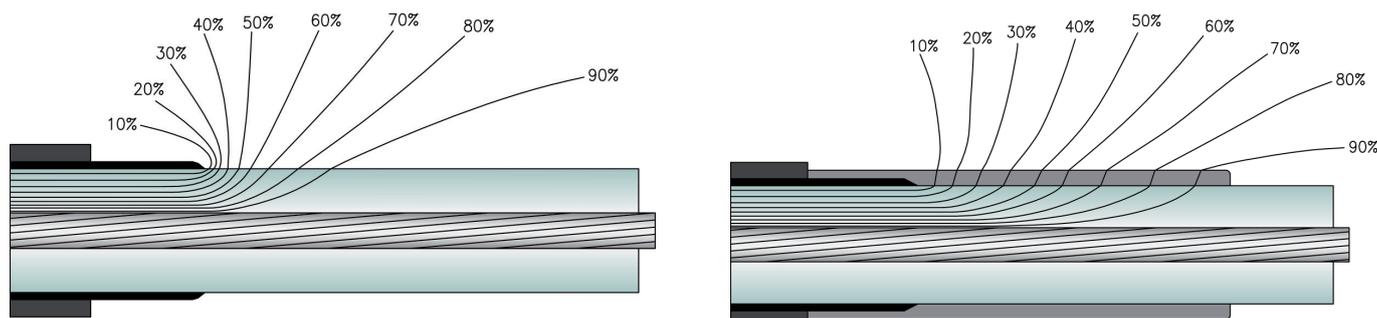


Fig. 2: Comparison of equipotential lines on cables without conductive layer and with refractive stress control.

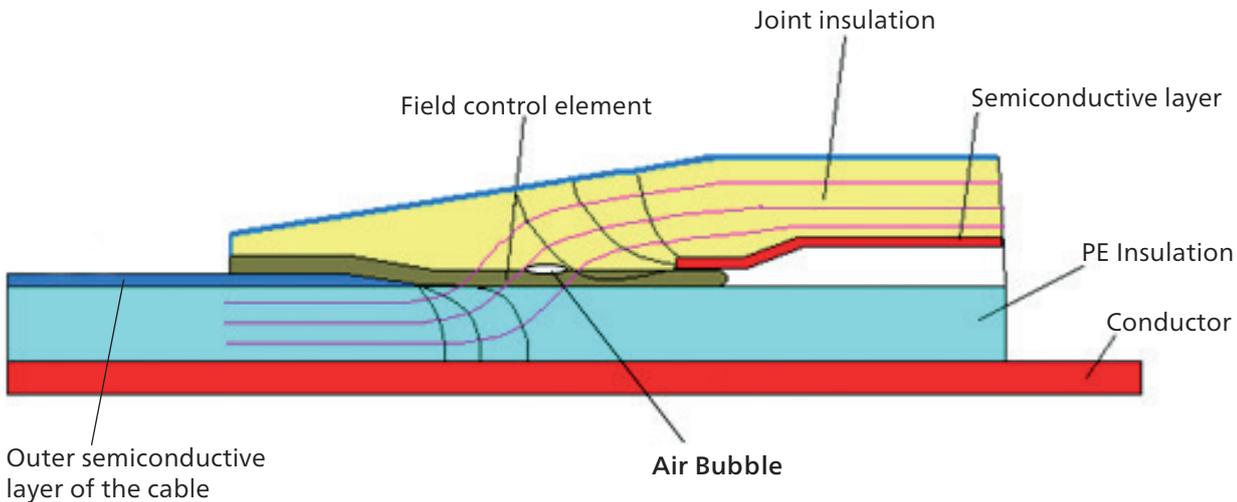
### Stress control element (FSE)

In addition to stress control itself, the positioning of the contact surfaces of cable insulation and accessory during assembly is very significant. Trapped air can result in partial discharge even at low voltages, particularly in the area of stress control, resulting in the breakdown of the cable accessory.

In order to avoid these problems, we have developed a stress control element (FSE) made from a special silicone rubber, manufactured using injection-molding. This product owes its uniqueness to its optimized design and to the specific properties of the HTV silicone rubber used. The dimensions of the cylinder body have been carefully selected to ensure that a single stress control element size is compatible with a wide range of medium voltage cable cross-sections. The dimensions of the inner cylindrical area allow the positioning of the FSE on the smallest possible cross-sectional area, where it expands to the correct size, thus exerting a permanent contact pressure on the base.

The permanent high elasticity of the silicone ensures that a constant pressure is applied to the contact surface under all operating conditions. The high gas permeability of the special material constitutes a significant advantage. As a result of constant pressure on the contact surface, pockets of air arising during assembly will completely diffuse through the stress control material within a few minutes (Fig. 3). This protects the cable accessory against partial discharge under all operating conditions.

#### Example: Main interface Contrax Slip-on Silicon Joint



- Air disappears through the silicone material
- Prerequisite: Press proof
- Effect: No air, no partial discharges

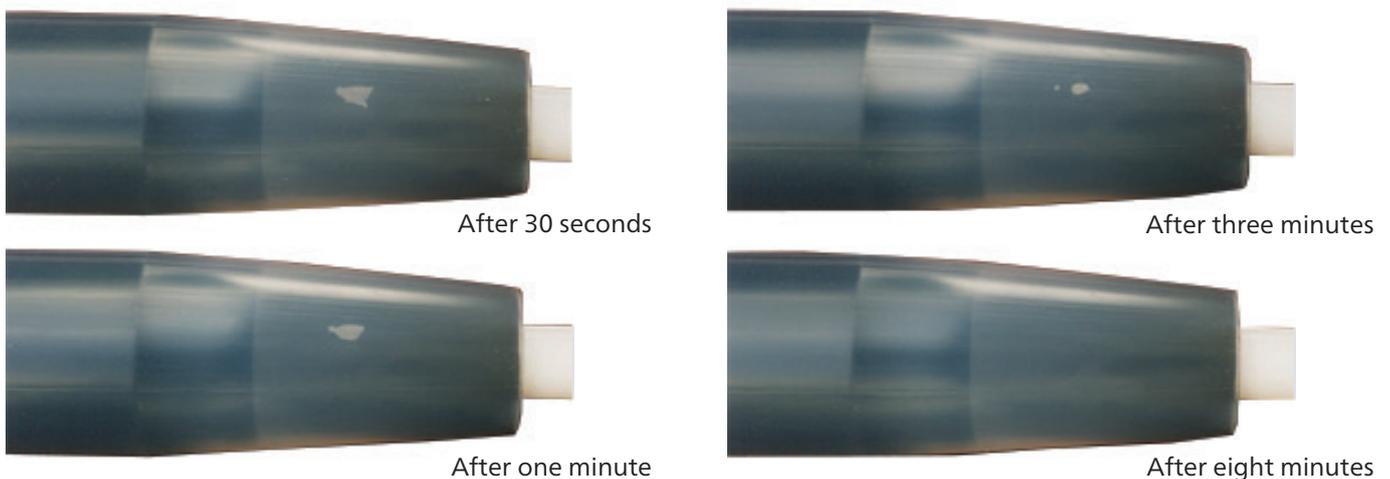


Fig. 3: Disappearance of an air bubble in the gap between the sleeve insulating body and the FSE.



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