

Raychem **RPG**

ENGINEERED FOR GROWTH



Power Cable Accessories



Power Cable Accessories

Raychem RPG(RRL) supplies cable accessories for almost all types of power cables up to 245kV.

RRL power cable accessories have over 40 years of design life – which has been proven by long-term ageing tests and as has been witnessed in the field.

RRL products are distinguished by their good insulating & sealing characteristics, high mechanical toughness and superior resistance to weathering and chemicals, such as UV radiation and alkaline soils.

The product line includes:

- Power Cable Joints and Terminations up to 245 kV
- Transition Joints
- Link Boxes and Sheath Voltage Limiters
- Cable End Caps
- Cable Entry Sealing System
- Cable Sealing Glands
- Repair Kits
- Installation & Spiking Tools
- Fault Passage Indicators
- Tamper Proof Meter Boxes & Connectors

All MV, HV and EHV cable accessories include a specially designed stress control mechanism, which controls the electrical stress distribution for an enhanced product performance. In terminations, the insulating tubing ensures non-tracking and an erosion resistant surface even at extreme operating conditions.



Low-Voltage Joints

RRL's products offer excellent insulating and sealing performance with heat-shrinkable gel & resin materials. These proven materials form the basis of straight and branch joints for voltages up to 1 kV.

While fully comparable in ease and speed of installation to other modern methods, RRL joints also eliminate mixing, pouring and topping-up delays. As the joint components are of heat-shrinkable material, they can also be held in stock in varying climatic conditions without the risk of long-term deterioration.

These proven sealing systems are designed for plastic, concrete or steel duct cables.

Features :

- Heat-shrink and cold applied technologies
- Environmentally friendly sealants
- Quick and easy installation
- Re-instatement and energisation can follow immediately after installation
- Solutions for all cable constructions

Low-Voltage Terminations

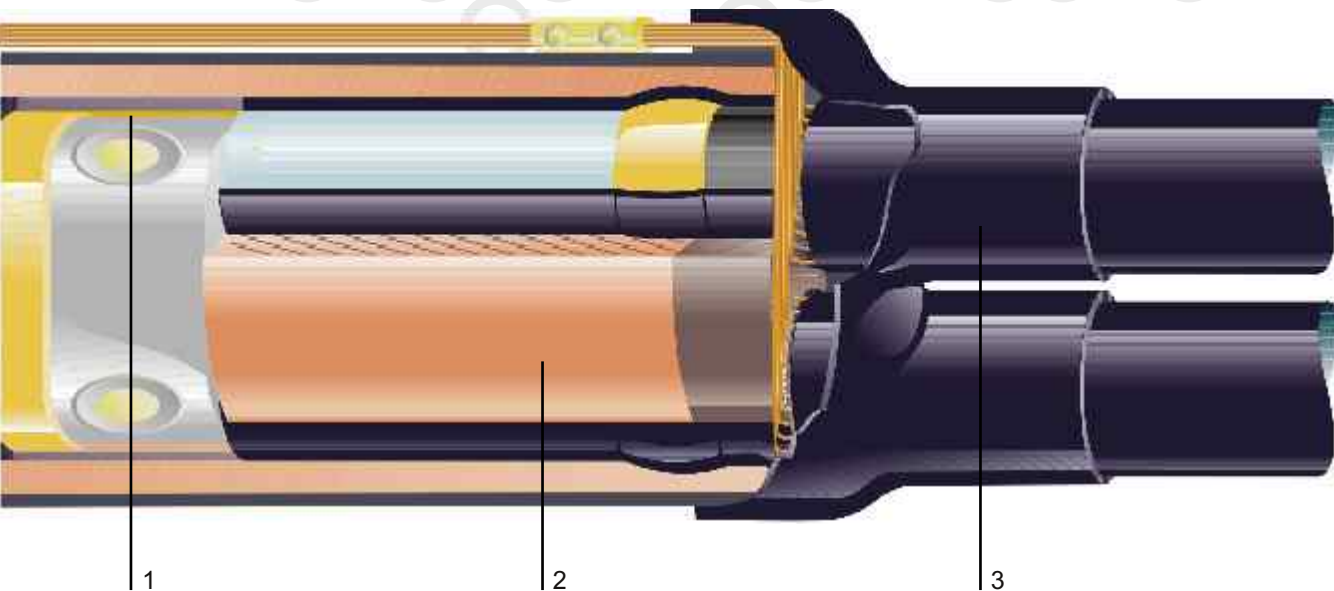
RRL's cable terminations for up to 1 kV are acknowledged to be more reliable and quicker to install than other conventional systems.

RRL makes a wide range of terminating systems and supports them with full customer service, installer training and technical assistance to meet the demands of the growing world of energy.

Features :

- Heat-shrink technology
- Quick and easy installation
- Solutions for all types of cable constructions





1. Electrical stress control

The mechanical connector is covered with yellow void filler tape and JSCR stress control tubing. These are the same materials used in RRL's inline medium voltage joints.



2. Spacer profile

This specially extruded profile is made from a red high-performance insulating elastomer. The material properties guarantee a void-free crutch filling and tight electrical interfaces between the two branch cables.



3. Breakout cap

The adhesive coated two finger breakout provides water-sealing for the branch side in the same way as the jacket does for the single side. This also gives the flexibility needed to ensure good sealing under temperature changes due to load cycling.

Rayfit -Heat-Shrinkable Joint Sleeve for Medium Voltage Joints up to 33kV

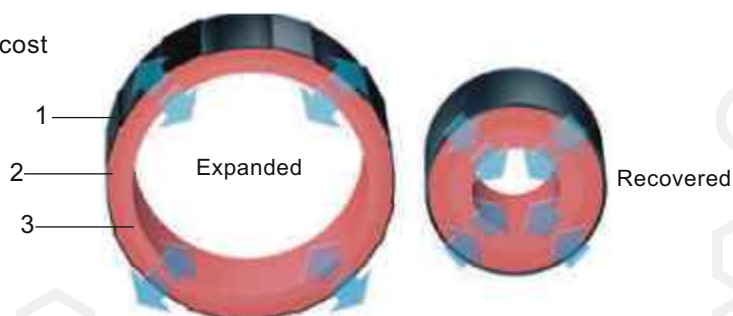
Rayfit represents the new generation of heat-shrinkable jointing technology. It is based on a triple-extruded, heat-shrinkable, elastomeric joint sleeve component. The system is suitable for paper and polymeric cable constructions and is designed to accommodate modern jointing requirements such as mechanical shear bolt connectors.



Features :

- Triple-extruded body provides a pre-engineered joint unit with fewer kit components
- Advanced shrink behaviour and profile-following are combined with a significant reduction in shrink time
- High recovery forces result in tight electrical interfaces and perfect sealing ability
- Optimised heat transfer due to reduced thermal capacity
- The reduced overall joint diameter provides a slimmer and space saving profile
- As an alternative to crimp connectors, kits can be selected with mechanical shear bolt connectors for conductor and shield continuity
- Unlimited shelf-life simplifies material logistics and reduces cost

1. Heat-shrinkable outer conductive layer
2. Heat-shrinkable insulation layer
3. Elastomeric insulation layer



Medium-Voltage Switchgear Connection Systems

Heat shrink and cold-applied systems for switchgear with standardised bushings for 250A, 400/630A and 800A have been installed by utilities and industrial organisations.

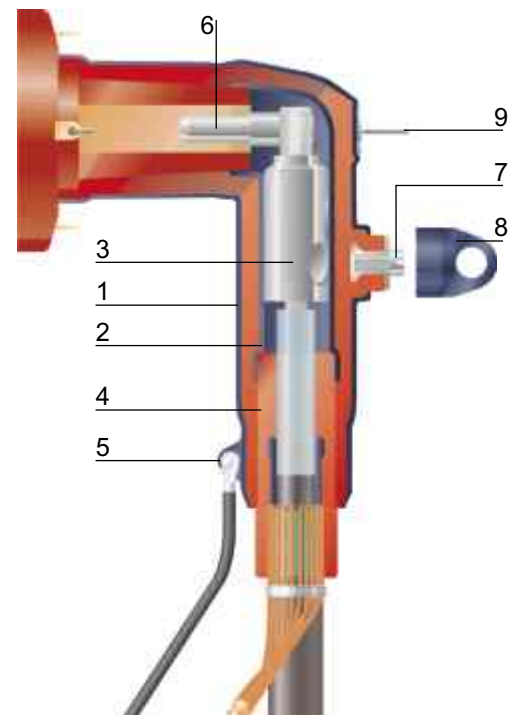
Features :

- Heat-shrink and elastomeric technologies
- Right-angled insulated boots
- Straight insulated boots
- Separable screened adaptor systems for 250A, 400/630A and 800A
- Suitable for crimp and mechanical lugs
- Plug in termination 1250A
- Easy and highly reliable installation
- Solutions for all cable constructions

RSES / RSS Screened Adaptor System 250A, 22kV

RSES / RSS are designed to connect single-core polymeric cables to medium voltage equipment (transformers, switchgears, motors etc.) up to 22kV.

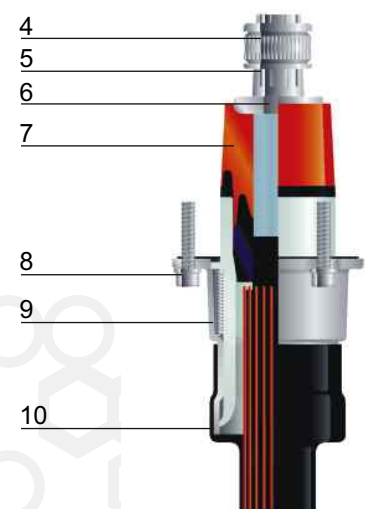
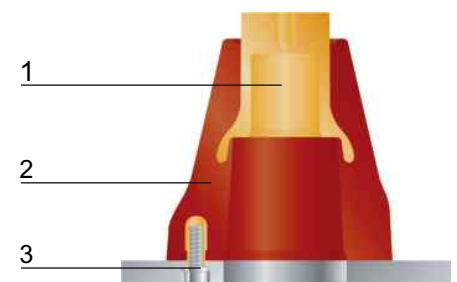
1. Screened body
2. Inner screen
3. Compression or mechanical lugs
4. Stress cone adapter
5. Earthing eye and ground lead
6. Pin
7. Test point
8. Conductive covering cap
9. Stainless steel bail



RPIT Plug in Termination System up to 52kV for Gas Insulated Switchgear

Separable inline connection for high current, gas insulated switchgears up to 52kV. Termination connects interfaces in accordance to EN50180 and EN50181 for inner cone connections.

1. Conductor
2. Epoxy resin
3. Hexagon socket head cap screws
4. Contact ring
5. Wedge
6. Stopper ring
7. Stress relief cone
8. Hexagon socket head cap screws
9. Protection cover
10. Water proof seal



RRL's Screened, Separable Connection System RSTI-Large for Large Cross Sections 1250 A up to 42kV

RSTI screened separable connectors are designed to connect single and three-core polymeric cables to medium-voltage gas insulated switchgear and other equipment.

RSTI Screened Coupling Connections System 800A up to 42kV

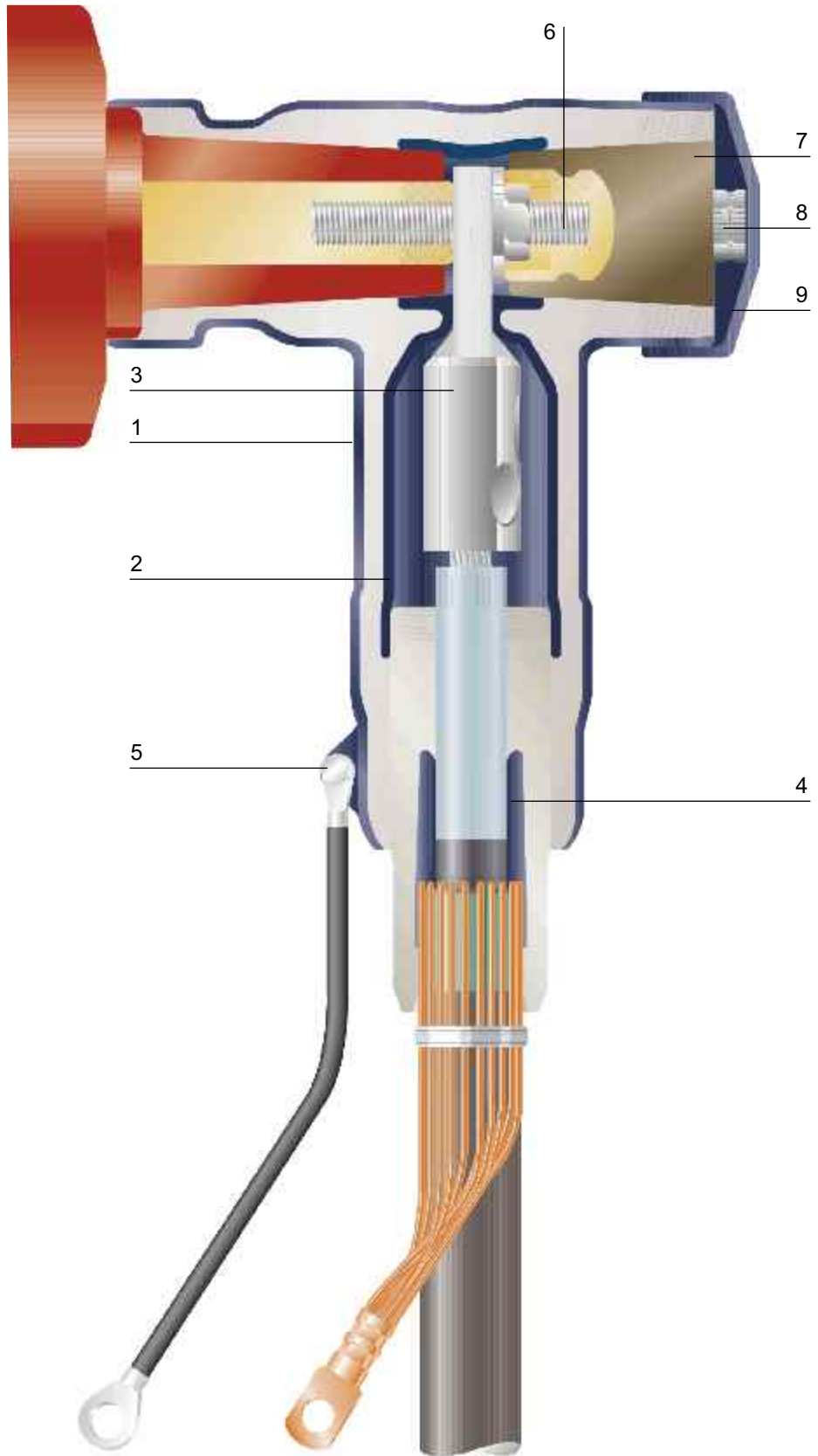
The screened coupling connector is designed to connect with the rear end of the base screened connector system RSTI designed for 42kV.

RSTI Screened, Separable Connection System 800A up to 42kV

RSTI screened separable connectors are designed to connect single and three-core polymeric cables to medium-voltage gas insulated switchgear and other equipment.

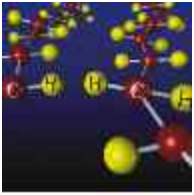
RSTI Screened, Separable, Coupling System 800 A up to 33kV

The screened coupling connector is designed to connect with the rear end of the base screened connector system RSTI designed for 33kV.

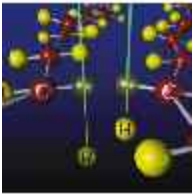


1. Screened body
2. Inner screen
3. Compression or mechanical lugs
4. Stress cone adapter
5. Earthing eye and ground lead
6. Threaded pin
7. Rear plug with test point
8. Test point
9. Conductive end cap

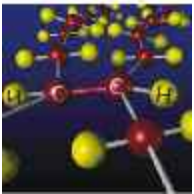
Technology of Heat Shrinkable Products



Cross Linking and Shape Memory - Thermoplastic materials are composed of extremely long, very thin molecules in a random arrangement. The strength of such a material depends upon the distance between its molecules and the crystalline nature of its molecular structure. As the material is heated, these crystals disappear. The molecules can then slip past each other easily and the material flows. While in this heated condition the material may be formed into almost any desired shape. Then, when the material is subsequently allowed to cool, the crystals reform and again provide substantial strength to retain the plastic in the shape in which it has been formed.



With the advent of atomic energy, the important discovery was made that the exposure of some plastic materials to high-energy electron beams can cause the permanent crosslinking, or intermolecular joining, of adjacent molecules. This crosslinking results in the chemical bonding of the plastic structure into a new three-dimensional system.



Once the material has been crosslinked, it will not melt or flow at any temperature. When the material is heated, the crystals still disappear as before, but it will no longer flow or change shape because the crosslinks act as ties between the molecules. The crosslinked structure, however, is elastic. Thus, when it is heated to a temperature where the crystals have melted, the material behaves like rubber.

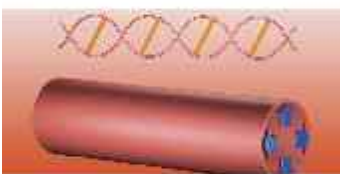
Manufacture and Installation of Heat-Shrinkable Tubing



Beaming the tubing causes permanent crosslinking of adjacent molecules. The graphic is an enlarged schematic view of a very small crosslinked section of extremely long molecules and an end view of a piece of heat-shrinkable tubing.



Once the tubing has been crosslinked, the next step in imparting elastic memory is to heat the compound above its crystalline melting point. The molecules are then tied together only by the crosslinks.



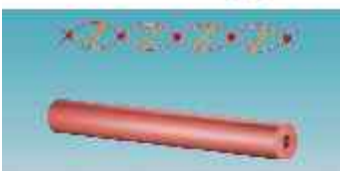
While hot, the tubing is deformed by applying pressure, thus stretching the crosslinked molecule.



While in this deformed position, the tubing is cooled; the crystals then reappear, thereby locking the structure together in this deformed condition indefinitely. This is the form in which tubing is supplied to customers.



The customer then heats the tubing, melting the crystals. The crosslinks allow the material to return to its original shape.



After cooling, the crystals reform and the tubing is locked in its recovered form.

Advantages of RRL Heat-Shrinkable Products

Properties	Advantages	Benefits
Cross linked material	<ul style="list-style-type: none"> Inexhaustible shelf life Mechanical resistance Chemical resistance Putting into service immediately after installation 	<ul style="list-style-type: none"> No warehouse losses Long lifetime Long lifetime Reduced outage time
Heat-shrinkable	<ul style="list-style-type: none"> Excellent range taking Independent of large cable tolerances Use of hot melt adhesives No reduction of shrink strength Possible to install at low temperatures 	<ul style="list-style-type: none"> Less stock required Installation and operational reliability Excellent sealing and operational reliability Installation reliability Universal use
Raychem design	<ul style="list-style-type: none"> Exceeding specifications Fits on different cable types and sizes of different manufacturers Consistent installation procedures Tolerates typical variations of cable prepared in the field 	<ul style="list-style-type: none"> Operational reliability in demanding environments Universal use Installation reliability Installation reliability
Non toxic and environmentally friendly	<ul style="list-style-type: none"> No health hazards Minor waste, environmentally friendly 	<ul style="list-style-type: none"> Health & safety Low disposal cost
Complete kits with factory tested insulation	<ul style="list-style-type: none"> Simple installation Fast installation 	<ul style="list-style-type: none"> Operational reliability Reduced outage time
Triple extruded tubing	<ul style="list-style-type: none"> Improved interfaces 	<ul style="list-style-type: none"> Operational reliability
Elastomeric and heat shrinkable insulation / screen	<ul style="list-style-type: none"> Reduced partial discharges 	<ul style="list-style-type: none"> Operational reliability
Stress control tubing, coating or patch	<ul style="list-style-type: none"> Single piece, less risk of misplacement Improved level of partial discharge 	<ul style="list-style-type: none"> Operational reliability Operational reliability

HV

High-Voltage Joints & Terminations for up to 66 kV

RRL's knowledge and experience in the field of material science and its technical advancements in cable accessories technology, is the reason why heat-shrinkable accessories are well accepted by utilities, equipment manufacturers and industrial users.

Features :

- Heat-shrink and elastomeric technologies
- Cross-bonding, shield-break and external grounding facilities
- Link boxes for cross bonding
- Mechanical lugs and connectors
- Joints and terminations have been proven by extensive use in the field
- Suitable for all polymeric cables

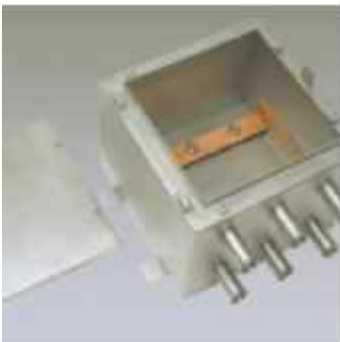


Link Boxes

Link boxes are used with cable joints and terminations to provide easy access to shield breaks for test purposes and to limit voltage building up on the sheath. Lightning, fault currents and switching operations can cause over voltages on the cable sheath. The link box optimises loss management in the cable shield on cables grounded from both sides.

Features :

- Compact design
- Stainless steel
- 1-phase and 3-phase boxes
- Sheath voltage limiters (SVL)



Grounding box



Link box with sheath voltage limiters (SVL)

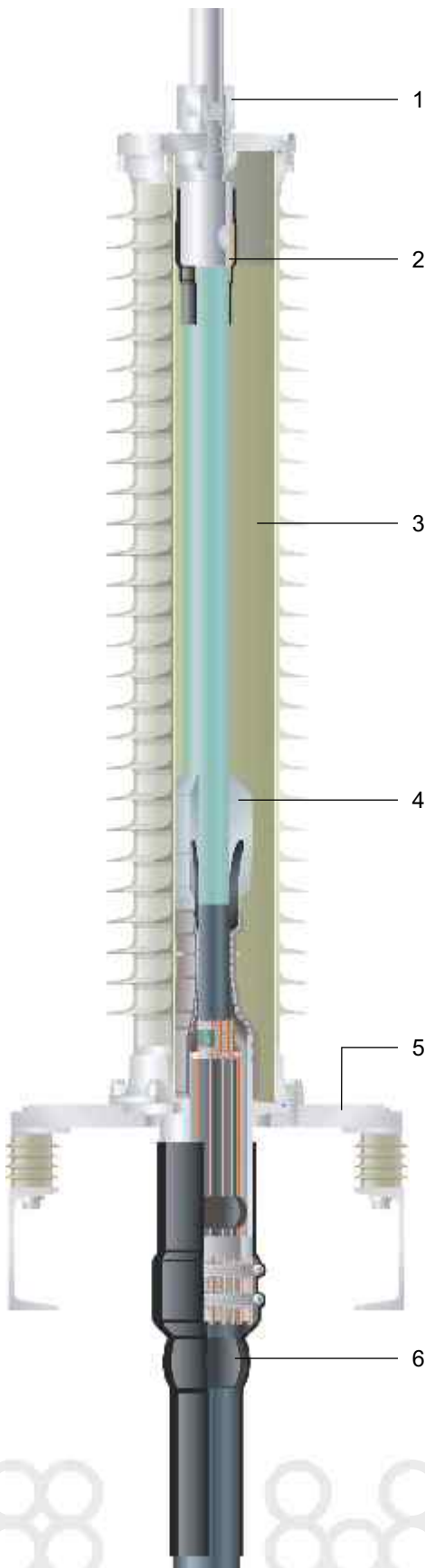


Link box installed with cross bonding cables

Extra-High Voltage Outdoor Termination up to 245 kV

The extra-high voltage outdoor termination (OHVT) is designed for voltages up to 245 kV. Polymeric insulated cables of various designs can be adopted with respect to shielding and metal sheath. Composite or porcelain housings with different creepage lengths are available covering the most common and also extreme pollution levels.

The termination is designed according to following standards: IEC-60840, IEC-62067, IEC-60815, IEEE-48 & IEEE-1313



1. Cable lug

The cable lug is suitable for all common conductors made of aluminum or copper.



2. Sealing system

The flexible double sealing system is installer-friendly and ensures permanent protection against environmental influences of the top assembly. Heat-shrinkable polymeric tube containing oil-resistant sealant encapsulates the connector barrel and the polymeric insulation transition.



3. Insulator housing and oil-filling

The pressure-tight composite housing is made of a glass fibre reinforced (GFR) resin tube with silicone rubber sheds moulded to the tube. The interface between stress cone, cable insulation and inner housing will be filled from the top with silicone oil. No prior heating of silicone oil is required.



4. Stress cone

The silicone rubber stress cone provides the electrical field control function and can easily be applied without tools. The application range is taken by different sizes of stress cones.



5. Base plate and support insulators

Four support insulators can be used on the base plate to mount the termination insulated. The termination can be mounted directly on the support structure. All metallic fittings are made of corrosion resistant Aluminium alloy.



6. Gland and seal

The cable gland outer serving is adapted through different gland sizes, which can serve the individual shielding and armouring of the cable. The heat-shrinkable tube provides the outer protection and sealing for the cable gland area.

Dry Self-Supporting Outdoor Termination for 145kV

OHVT



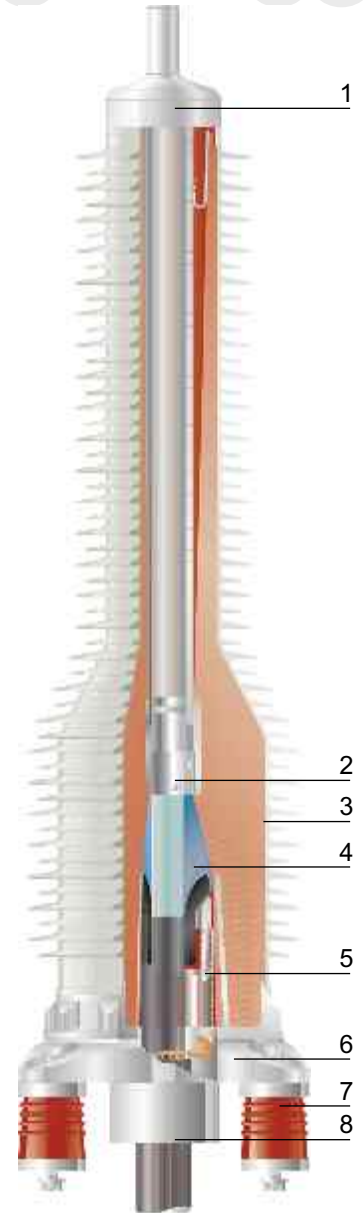
RRL's dry self-supporting termination is designed for voltage class 145kV. It is free from any insulating liquid or gel. Polymeric insulated cables of various designs can be adopted with respect to shielding and metal sheath.

The polymeric housing with long creepage length is operational under severe environmental conditions according to IEC 60071-1 1996, IEC 60071-2 1996, and IEEE-1313.1-1996.

Features :

- Dry interface, no oil-filling
- Self-supporting
- Pre-fabricated and factory tested silicone-rubber stress cone
- Torque-controlled multi-contact conductor bolt
- Fast and simple installation combining GIS plug-in technology with polymeric insulators
- Isolated cable gland for sectionalisation
- Type tested according to IEC 60840

1. Upper metal fitting
2. Mechanical connector
3. Resin body with silicone shed housing
4. Stress cone
5. Spring-loaded compression ring
6. Base plate
7. Support insulators
8. Gland and sealing



Extra-High Voltage Joints up to 245kV

The joint is a pre-fabricated one-piece design for voltage classes up to 245 kV. Polymeric insulated cables of various designs can be adapted with respect to shielding and metal sheath. The silicone rubber joint body with integrated geometrical stress control provides proven electrical function. The joint components combine electrical performance, stress control and moisture sealing to provide the important functions required for all High Voltage products.

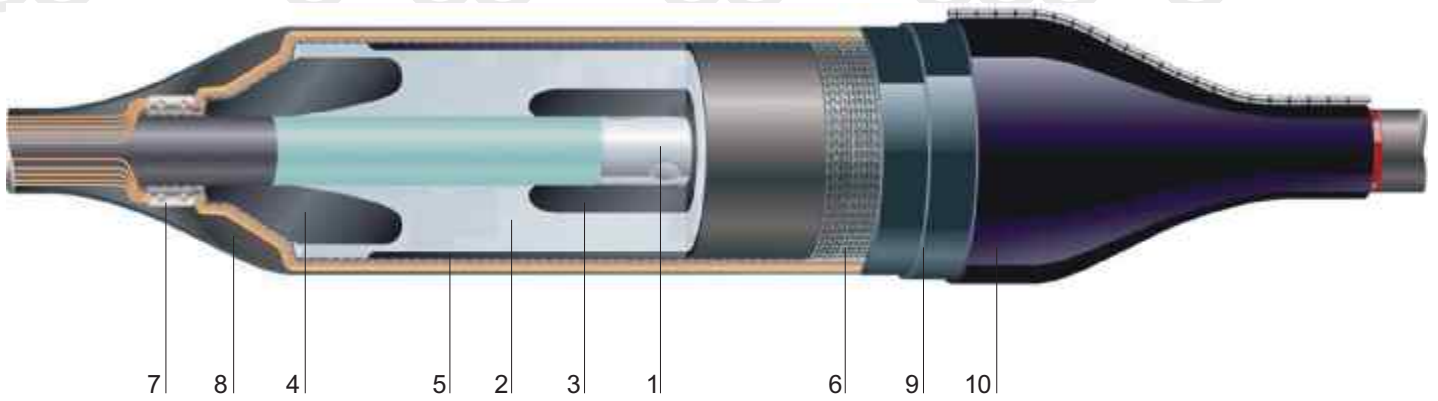
Features :

- Pre-moulded one piece joint body
- Proven shield continuity concept
- Factory tested silicone-rubber body
- Special silicone-rubber provides perfect compression force for optimised electrical performance
- Simple assembly
- Moulded thick outer conductive screen
- Geometrical electrical stress control by moulded conductive deflectors

The joint is designed according to following standards:

Type tested according to IEC60840, IEC 62067, IEEE404 & GB11017

Manufactured according to ISO9001 and ISO14001



- | | |
|-----------------------------------|---|
| 1. Mechanical connector | 6. Copper mesh |
| 2. Silicone rubber body | 7. Solderless shield connection |
| 3. Inner electrode / Faraday cage | 8. Sealant / mastic |
| 4. Deflector | 9. Insulating tubes |
| 5. Outer screen | 10. Outer protection with integrated moisture barrier |

Construction and Design of Extra-High Voltage Joints up to 245kV

Mechanical connector



- Mechanical connector with torque controlled shear-off bolts
- No additional metallic Faraday cage required up to 170 kV (integrated in joint body)
- One connector length for cable cross sections up to 1200 mm²
- Suitable for aluminum and copper conductors

Joint body



The joint body with sustainable mechanical properties allows a wide application range. For installation, simple re-usable tooling is needed to push on the joint body on the cable. Electrical stress control is fully integrated in the silicone joint body. Conductive electrodes, with an exactly defined geometrical design over the screen cut area, provide a well defined electrical stress distribution. The connector area is screened by an integrated conductive tube performing as a Faraday cage. The Faraday cage is designed to deal with cable insulation shrink back. The material used in the joint body is based on proven silicone compounds, exhibiting sustained thermal stability and long term performance.

Joint shield conductivity

- Solderless grounding connection
- Typical shield wire cross sections can easily be connected by either mechanical or compression connectors
- Shield break, straight through and grounding joints using the same basic components



Straight through connection



Grounded connection



Shield break connection

Cable metal shielding



Grounding kits for commonly used cable constructions like lead sheath, corrugated aluminum sheath, copper tape and wire screens, etc. are available.

Outer joint protection



Glass fibre reinforced heat shrink wrap around with integrated radial and axial moisture barrier



Copper casing with pre-molded polypropylene outer corrosion protection



Copper casing and glass fibre reinforced enclosure (2 half shells) with cold pour filling compound

EHVS - Inline and Shield Break Splice from 123kV up to 170kV

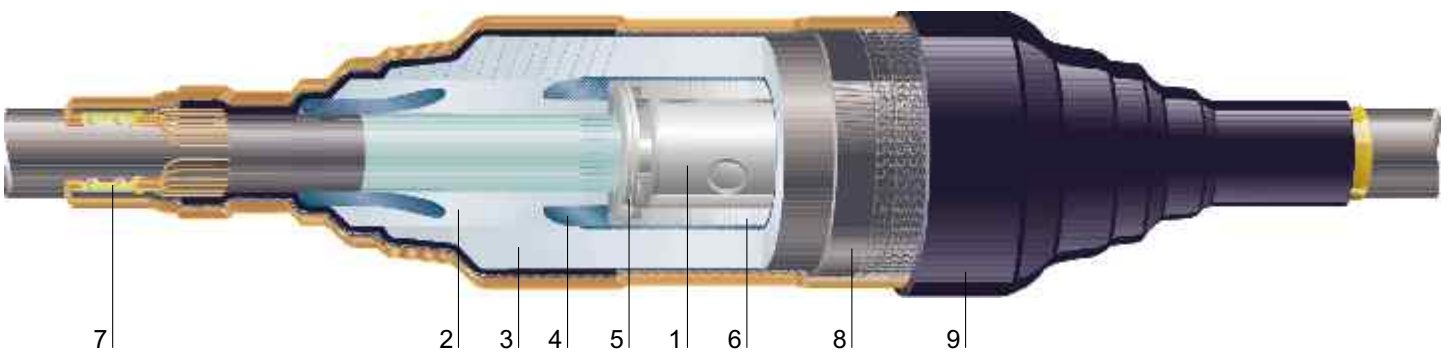
EHVS

EHVS joint is a pre-fabricated three-piece design for voltage classes up to 170kV. Polymer-insulated cables of various designs can be adopted with respect to shielding and metal sheath.

Cross-section up to 250 mm² is applicable.

Features :

- Pre-fabricated three-piece splice design
- Using torque-controlled conductor sleeves
- Short cut-back dimensions
- Integrated moisture barrier using H/S components
- Can adapt shield-break applications
- Pre-fabricated and tested Si-rubber
- Type tested according to IEC 60840 and IEEE 404 standards



1. Mechanical connector
2. Adaptor
3. Main body
4. HV electrodes
5. Fixing ring
6. Metal shielding clamp
7. Solderless shield connection
8. Conductive tubing
9. Outer sealing sleeve

Major Design Elements

The splice consists of connector (1), cable adaptors (2) – including stress cones and main splice body) – (3) containing Faraday cage (4) and outer serving by heat-shrink technology. The conductors of the cable are connected by a mechanical connector sleeve (1) using torque-controlled shear-off bolts. A metal shielding clamp (6) on top of the connector provides a smooth interface fit. A metal shielding clamp on top of this connector ensures perfect heat transmission. The fixing rings (5) keep the cable dielectric in position.

The Si-rubber cable adaptors (2), accommodating the various cable insulation diameters, will build up the connection area to an almost constant diameter. This makes it possible to cover four cross-section ranges with just one main insulation splice body (3). Cross-section transitions are feasible without any extra components. No extra tooling is needed to push-on the Si-rubber cable adaptors(2) and the Si-rubber splice main body (3) due to its excellent elasticity.

Mechanical solderless connector technologies (7) are used to connect metal shields – copper wires, metal sheath and CAS.

Heat-shrink technologies (8,9) replace the cable serving and the moisture barrier.

The joint concept is similar for the shield-break splices, despite the shield continuity. Special sealant components make it possible to use coaxial or double-insulated ground leads, and thereby to utilise the proven heat-shrink technology.

EHV Dry Compact Switchgear & Transformer Termination PHVS & PHVT for 72 kV, 145 kV and 245 kV

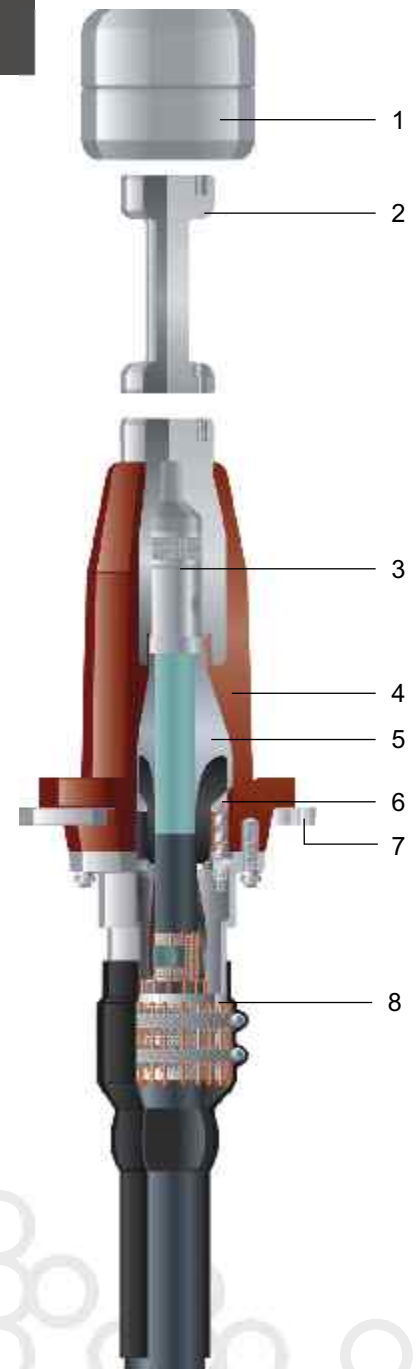
The dry compact switchgear termination for voltage classes up to 245 kV is designed to be installed in cable entry housings of gas-insulated switchgear (GIS). It complies with IEC 62271-209 standard, which essentially specifies the interfaces between the termination and the switchgear. Therefore the termination will fit into all GIS complying with IEC 62271-209. Adapters are available to match the dimensions of wet (oil-filled) type terminations, and older designs specified in IEC 60859. The termination operates in SF6 but also in insulating liquids like transformer oil.

Features :

- Dry interfaces, no oil-filling
- Dimensions comply with IEC 62271-209
- Pressure-tight resin housing
- Operates in SF6 and insulating liquids
- Pre-fabricated and factory tested Si-rubber stress cone
- Torque controlled or wedge-type multi-contact conductor bolt
- No special tools required to install the termination
- Isolated cable gland for sectionalisation
- Type tested according to IEC 60840, IEC 62067 and IEC 62271-209 standards

Design elements :

1. Corona shield (PHVT only)
2. Adapter (optional)
3. Mechanical connector
4. Resin housing
5. Stress cone
6. Spring-loaded compression ring
7. Fixing ring
8. Gland and sealing



Switchgear & Transformer Termination SHVT & THVT for 72 kV up to 170 kV

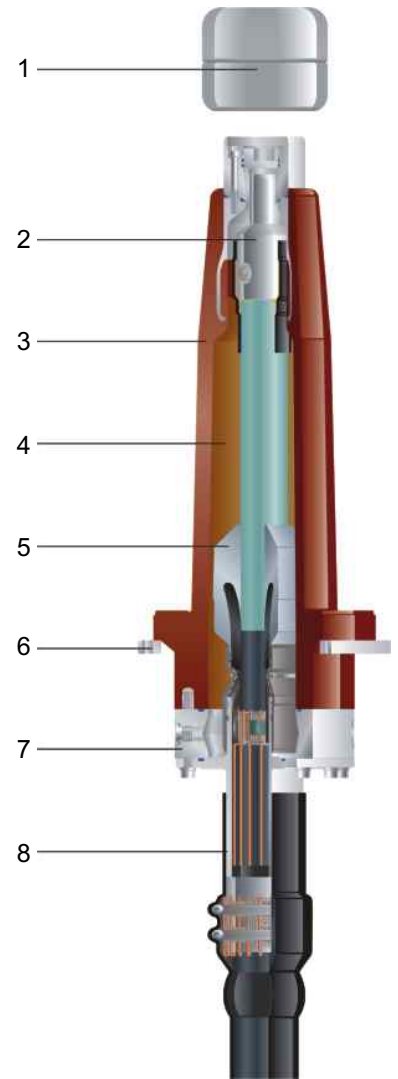
The switchgear termination for voltage classes up to 170 kV is designed to be installed in cable entry housings of gas-insulated switchgear (GIS). It complies with IEC 60859 and IEEE 1300 standards, which essentially specify the interfaces between the termination and the switchgear. The termination operates in SF₆, and also in insulating liquids like transformer oil. A corona shield at the top of the transformer termination then provides the necessary shielding of the terminal.

Features :

- Si-oil filling
- Dimensions comply with IEC 60859 and IEEE 1300
- Pressure-tight resin housing
- Operates in SF₆ and insulating liquids
- Pre-fabricated and factory tested Si-rubber stress cone
- Torque-controlled conductor bolt
- Isolated cable gland for sectionalization
- Type tested according to IEC 60840, IEC 60859 and IEEE 1300 standards

Design elements :

- | | |
|------------------------------------|----------------------|
| 1. Corona shield (THVT only) | 5. Stress cone |
| 2. Connector (mechanical or crimp) | 6. Fixing ring |
| 3. Resin housing | 7. Base plate |
| 4. Oil-filling | 8. Gland and sealing |



CABLE CARE SOLUTIONS

Cable Repair Sleeves

Heat-shrinkable wraparound sleeves are a fast, versatile and permanent method of repair for damaged cable outer sheaths. Upon application of heat, the sleeve shrinks and adhesive melts and bonds to the cable sheath, creating a permanent seal against moisture entry into the cable. Wraparound sleeves are useful for repairs to cable outer sheath where it is not possible to use tubular sleeves.



Cable Repair Sleeve

Stripping Tool

Stripping tool for extruded and bonded cable screens and primary insulation for cable diameters from 35 to 90 mm.

Notes:

- The tool is supplied with blades and packed separately in the case
- The cables must be aligned at right angles to the stripper tool
- Apply a thin layer of silicon lubricant to the bonded screen for easy movement
- The tool should be operated only by people trained in handling this type of tool



Cable Stripping Tool

Other Tools



Cable End Caps



Cable Entry Glands



Cable Spiker Tool



Cable Cutting Tool

ZCSM - Heat-Shrinkable Heavy-Wall Tubing for Low Fire Hazard Areas

This new low fire hazard material has been developed using the latest polymer technology to provide low smoke, low toxicity and low acid gas generation while being highly flame retardant and having a low calorific value.

- ZCSM tubing is halogen-free and flame-retardant. A range of established tests, such as flame propagation tests, limiting oxygen index and temperature index have been carried out to assess the flame retardation properties of this material
- Corrosion damage depends on the amount of acid gases generated when a material is burned, and therefore on the level of halogens and other acidic components in the insulation material. Pyrolytic analyses show only trace quantities of these substances in the ZCSM tubing. The low toxicity index rating derived from measurements of these and further combustion products, provide additional evidence of the material's suitability for meeting special requirements of this kind.



SERVICES

RRL provides one stop, multi-disciplinary solutions to the power industry all over India.

Our services include:

- Cable route selection and thermal surveys
- Cable structure and support system designs
- Grounding and sheath bonding designs
- EHV cable installation
- LV ABC installations
- Installation of cable joints and terminations
- Cable spiking and hipot testing
- Contract maintenance (cable network services)
- Customised insulation solutions
- Energy meter installations
- Audits and consultancy of cable networks with utilities and industries
- Thermo-scanning
- Failure analysis
- Training programmes for engineers and jointers



WEATHERING AND AGEING RESISTIVITY

The excellent weathering and ageing resistance of RRL's cable accessories is continuously proven by natural and accelerated ageing tests. These tests include even 10 years lasting service tests with intensive UV radiation.

Phenomenon of tracking and erosion: Over the years, the surface of terminations, especially in outdoor applications, will become contaminated and leakage currents will develop in wet conditions. Under certain environmental conditions, these leakage currents can deteriorate the surface of a termination by building tracking paths or by erosion. Both would finally lead to a failure of the termination by breakdown. RRL has developed specially formulated insulation materials for heat-shrinkable accessories which resist this phenomenon of tracking as well as other degrading factors like erosion, UV-light or other environmental stresses.

This formulation consists of a blend of polymers and a sophisticated additive package which is designed to retain its performance over the lifetime even in the most severe environments.

