

**Heat-shrinkable joints for  
screened plastic and  
rubber insulated cables  
for up to 36 kV**

# Heat-shrinkable joints for screened plastic and rubber insulated cables for up to 36 kV

For jointing plastic insulated cables for up to 36 kV Raychem offers a system based on heat-shrinkable materials which is fast and simple to install, eliminates shelf-life limitations even in severe climates and permits immediate back-filling of the trench and switching on of power.

## Reliability in installation

The insulating, screening and electrical field control layers of the joint are made of cross-linked polymeric materials with precisely defined electrical characteristics. The cross-linking process results in an "elastic memory", activated simply by heating. The memory then causes the components to shrink to a pre-determined diameter; the correct insulation thickness is thus achieved in one step automatically.

## A simple fast jointing technique

The joint components are supplied as a pre-engineered set of heat-shrinkable tubings, which means the cable fitter does not have to check the thickness or length of the system. The Raychem system thus ensures accurate installation work while enabling the joint to be installed in significantly less time than many alternative techniques.

## Proven technology

The long-term performance of Raychem heat-shrinkable materials has been demonstrated by the well-proven Raychem termination system. Millions of cable accessory installations for up to 36 kV in some of the severest service conditions have confirmed their reliability under high electrical, thermal and environmental stress.

## A universal system

Cable preparation and installation techniques for Raychem medium voltage joints are identical to those for Raychem heat-shrinkable terminations. The same basic design is also shared by Raychem joints for MIND paper insulated cables for up to 36 kV. In this respect, again, the heat-shrinkable system sets new standards of efficiency and simplicity for the cable fitter's work.

## Rational stock-keeping

The performance and ease of installation of Raychem high voltage heat-shrinkable materials are not sensitive to storage time or normal storage conditions. A few kits cover the standard size range of cables, including single core cables for 36 kV up to 630 mm<sup>2</sup>, allow the use of various types of connectors and shrink to fit either round or sector-shaped cores and different constructions.



## Mechanical strength

For steel wire or tape armoured cables Raychem joints incorporate a light-weight impact-resistant galvanized steel joint case which is quick to install and provides earth fault current capacity. Heat-shrinkable sleeves provide outer sealing and corrosion protection of the joint.

## Technical field service

Raychem power cable joints are the result of continuous research efforts and long experience in this field. Raychem supports its customers at every step, from specific product development and selection through laboratory and field testing, to training of the customer's operators in cable preparation and installation techniques. As the leader in heat-shrinkable materials and one of the largest cable accessory manufacturers, Raychem offers a wide range of jointing, sealing and corrosion protection systems to meet the demands of the growing world of energy.

Cover photo: During extension of an urban transportation system, 12 kV cables with sector-shaped cores are connected using Raychem joints. The photo shows the installation of a dual-wall tubing with an inner red insulation layer and integral outer black conductive screen.

1 A 24 kV plastic insulated cable being jointed in Scandinavia after the electrical components have been installed. The joint is permanently sealed and mechanically protected with adhesive-lined heat-shrinkable tubing.

2 The ease and speed of installation of the Raychem system has led to wide adoption in developing countries. Moreover, the system is not subject to storage limitations in hot climate. The photo shows a 36 kV Raychem joint being installed on a 400 mm<sup>2</sup> single core cable.

# Construction and electrical design of Raychem joints for plastic insulated cables for up to 36 kV

## Installation procedure

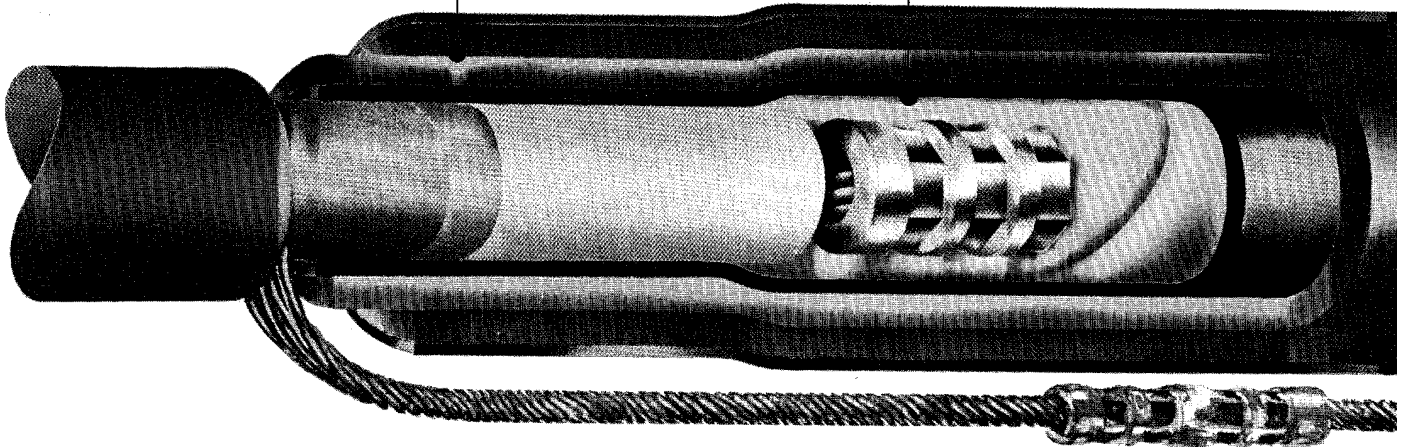
Pre-packed in the correct nested sequence, the joint components are slid over the prepared cable end. After jointing the conductors, each tubing is positioned over the connector and shrunk into place. In three core cable joints one heat-shrinkable sleeve (unarmoured cable) or joint case (armoured cable) over all three cores replaces the outer sealing sleeve shown in the single core cable joint below. All kits are complete with illustrated installation instructions.

## Insulation

High voltage insulating tubings and the inner wall of the screened tubing restore the conductor insulation. The elastic memory of the heat-shrinkable components ensures the correct wall thickness is obtained.

## Electrical field control

Heat-shrinkable tubing with a precisely defined impedance characteristic smoothes the electrical field over the connector and screen ends. The shrinking action during installation causes the special low viscosity void filler to flow into position around the connector area at the same time. Pencilling of the conductor insulation at the connector is not necessary.



## Electrical field distribution

At the cable screen ends and over the connector itself, the electrical field is controlled by a material already proven in Raychem terminations for up to 36 kV. The connector area is first smoothed electrically and mechanically with a

special low viscosity void filler. Installation of a heat-shrinkable tubing then causes the void filler to flow into position. The tubing is made of material with a carefully controlled volume resistivity and permittivity, smoothing out the electrical

field at the screen ends and over the conductor joint. The resulting field distribution between the outer conductive layer and the inner field control tubing is shown in the computer study below.

joint insulation screen

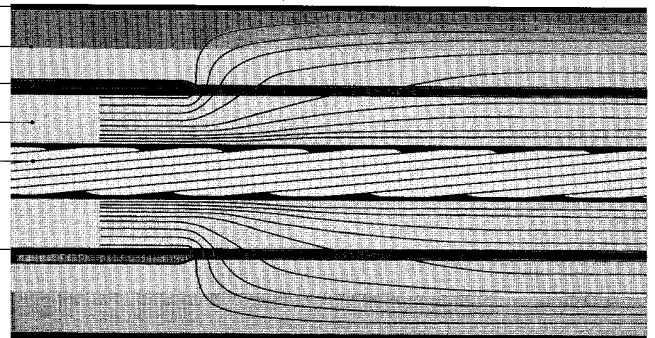
joint insulation

field control tubing

cable insulation

conductor

cable screen



### Insulation screen

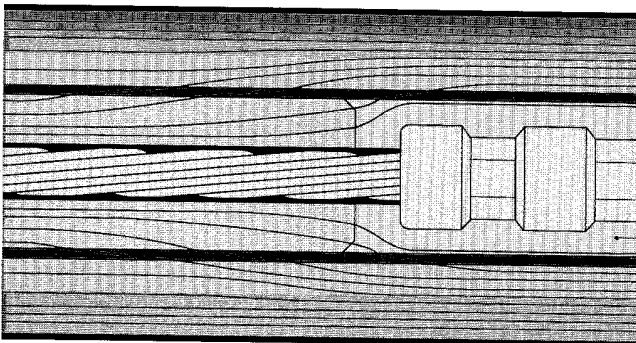
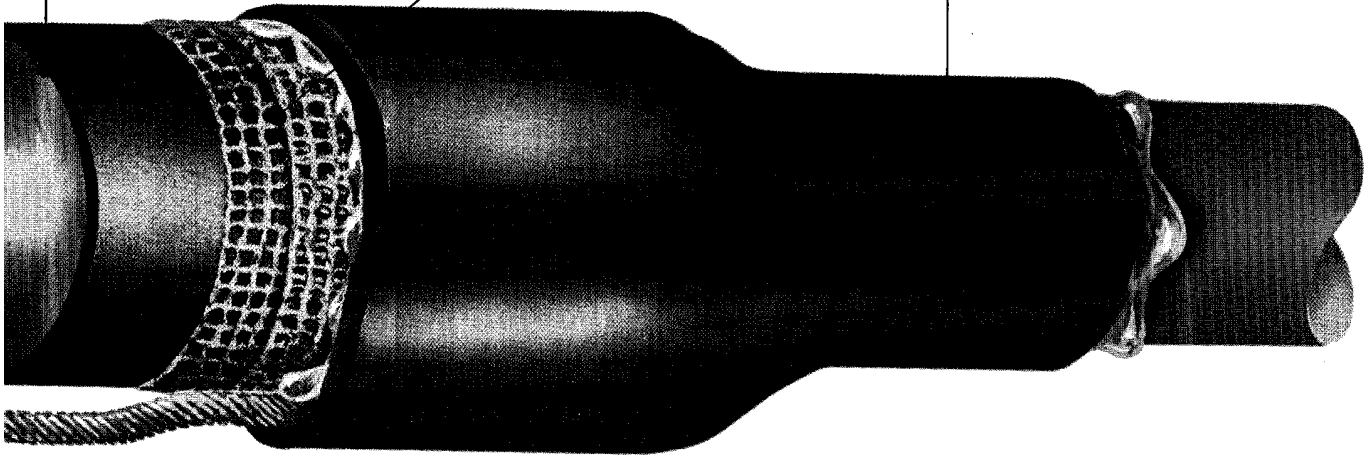
A single dual-wall tubing enables the final insulating layer (red) to be installed complete with a conductive polymeric screen (black). This technique saves time and ensures a flawless bond between insulation and screen.

### Metallic shielding

Copper mesh continues the correct shield cross-section across the connection area and makes electrical contact with the outer screen of the joint.

### Outer sealing

Joints for both armoured and unarmoured cables are sealed with heavy-wall heat-shrinkable sleeves, internally pre-coated with adhesive. The heat used to shrink the tubing causes the specially developed adhesive to melt and flow, resulting in a lasting moisture and corrosion barrier on the cable oversheath.



void filler

## Minimum performance of Raychem joints for screened plastic and rubber insulated cables for up to 36 kV

Test sequence		Test Voltage					Result
		7.2	12	17.5	24	36	
		Highest voltage for Cable $U_m$ (kV)					
		7.2	12	17.5	24	36	
<b>Impact</b>	4 kg wedge dropped 6 times from 2 m armoured cables only						no functional damage
<b>A.C. Voltage Withstand</b>	1 min	27	35	45	55	75	no breakdown and no flashover
<b>Partial Discharge</b>		4.5 7.2	7.5 12	10.9 17.5	15 24	22.5 36	$\leq 3$ pC $\leq 20$ pC
<b>Impulse Voltage Withstand</b>	10 positive and 10 negative, 1.2/50 $\mu$ s, between conductor and grounded screen	70	95	110	150	200	no breakdown and no flashover
<b>Load Cycling</b>	63 cycles, 5 h heating, 3 h cooling Conductor temperature: PE, PVC cables: 75 °C XPE cables: 95 °C	9	15	22	30	45	no breakdown and no flashover
<b>Partial Discharge</b>		4.5 7.2	7.5 12	10.9 17.5	15 24	22.5 36	$\leq 3$ pC $\leq 20$ pC
<b>Thermal Short Circuit</b>	1 s symmetrical fault with conductor temperature as for cable specification  1 s earth fault with armour temperature as for cable specification						no visible signs of damage
<b>Load Cycling</b>	as above, with cable in 1 m water, oversheath removed	9	15	22	30	45	no breakdown and no flashover
<b>Partial Discharge</b>		4.5 7.2	7.5 12	10.9 17.5	15 24	22.5 36	$\leq 3$ pC $\leq 20$ pC
<b>A.C. Voltage Withstand</b>	4 h	14	24	36	48	72	no breakdown and no flashover
<b>Impulse Voltage Withstand</b>	repeat	70	95	110	150	200	no breakdown and no flashover
<b>D.C. Voltage Withstand</b>	30 min	28	48	72	96	144	no breakdown and no flashover
<b>Notes:</b>		1. $U_m$ is the highest phase to phase voltage. All other voltages are stated as phase to ground values.				2. Further details are given in Raychem specification PPS 3013.	

### Ordering information

Raychem joint kits are available for single core and 3-core plastic insulated cables with and without armour up to 36 kV and for all standard cross-sections. A full selection table is available on request.

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For further details on this or any other Raychem products please contact your local Raychem sales engineer.

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**At Raychem we are committed to continuous quality improvement in every aspect of our business.**

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