



Tyco Electronics

We develop, manufacture and market innovative products that benefit from our advanced know-how in the field of material science. All products are designed to help our customers to improve the reliability and economy of their electrical networks and equipment. Our broad portfolio of products offered for the electrical power industry include cable accessories, surge arresters, insulators, insulation enhancement products, components for electrical equipment, as well as connectors and fittings for up to 800 kV.

This catalogue contains terminations, joints and accessories for cable types most commonly used in the electrical distribution and industrial networks of New Zealand. As one of the largest suppliers of cable accessories in the world, Raychem products are offered for nearly all special constructions. Please contact the Raychem products representative for technical support and additional information about cable accessories or the other product lines.

Raychem cable accessories



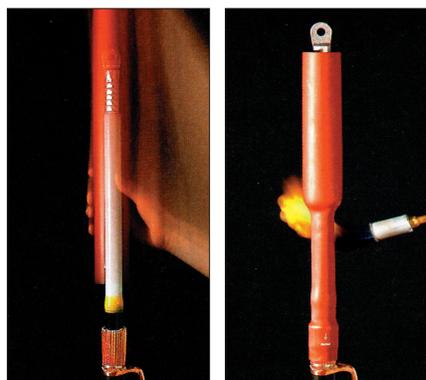
As a result of sustained and extensive research and long experience in technical support work, Raychem products have been developed during the last 3 decades to become a complete system of cable accessories up to 170 kV.

The long-term performance of Raychem heat-shrinkable materials has been demonstrated by the well-proven Raychem accessory system. Millions of installations in some of the most severe service conditions have confirmed the reliability of the Raychem heat-shrinkable technique under high electrical, thermal and environmental stress.

The technology that is common to all Raychem heat-shrinkable cable accessories is based on radiation crosslinked polymers with an elastomeric shape memory. They provide a significantly improved mechanical, chemical and thermal resistance compared to non-crosslinked products.

Raychem cable accessories are distinguished by their good insulating and sealing characteristics, high mechanical toughness and resistance to weathering and chemicals such as UV radiation and alkaline soils. Because of the large shrink area of the individual parts, it is possible to use a few standard accessories to cover a large range of different cable types and cross sections. This means that warehousing is simple and economical. In addition, Raychem cable accessories can be stored for an unlimited length of time under normal conditions.

The product line includes indoor and outdoor terminations, in-line and transition joints as well as universal insulation, sealing and repair systems for use in the cable network. All medium voltage accessories include a stress control system either as separate stress control tubing, or integrated as stress control coating in an insulating tubing. In terminations, the insulating tubing ensures a non-tracking and erosion resistant surface and provides an environmental seal to the cable lug and the oversheath. The connection area of joints is covered by an elastomeric dual-wall tubing which provides an interface free insulation and an outer screening.



Installation

No special tools are required for the cable preparation. The installation of the heat-shrinkable parts is performed with a propane gas torch which is usually used for the preparation of paper and plastic cables. When delivered, all individual parts are provided so that they can easily be slid over the prepared cable end. When sufficiently heated, they shrink and firmly enclose the cable and protect it against moisture, while the adhesive melts and fills all grooves and voids. Raychem cable accessories are constructed in a similar way to the cables themselves and can, like these, be bent in narrow spaces. Upside-down installations of terminations are possible simply by turning the heat-shrinkable sheds. The accessories can immediately be put into operation after installation.

Test process and qualification

Raychem cable accessories are designed and fully tested to meet Raychem specification PPS 3013 which encompasses the requirements of major national and international standards, e.g.: IEC, CENELEC, GOST, BS CSN, MSZ, PN, STN, STR, VDE, etc. Test reports are available which document the tests performed in test institutes and in Raychem laboratories on the long-term electrical and environmental behaviour of cable accessories and materials.

The currently relevant CENELEC standards tested to are:

- HD623.S1:1995 – Specifications for joints, stop ends and outdoor terminations for distribution cables of rated voltage 0,6/1,0 (1.2) kV
- HD629.1.S1:1996 – Test requirements on accessories for use on power cables of rated voltages from 3,6/6 (7,2) kV up to 20,8/36 (42) kV. Part 1: Cables with extruded insulation.
- HD629.2.S1:1997 – Test requirements on accessories for use on power cables of rated voltages from 3,6/6 (7,2) kV up to 20,8/36 (42) kV. Part 2: Cables with impregnated paper insulation.

For product testing and selection we follow the classifications for rated voltages U_0/U (U_m) as referred to in IEC and Cenelec standards:

U_0 is the rated power-frequency voltage between phase conductor and earth or metallic screen for which the cable accessory is designed.

U is the rated power-frequency voltage between phase conductors for which the cable accessory is designed.

U_m is the maximum value of the 'highest system voltage' for which the cable accessory may be used.

To cover all typical voltages in distribution networks, Tyco Electronics Energy Division tests cable accessories to the highest sets of rated voltages: 3,8/6,6 (7,2) kV 6,35/11 (12) kV, 8,7/15 (17,5) kV, 12,7/22 (24) kV, 19/33 (36) kV and 20,8/36 (42).

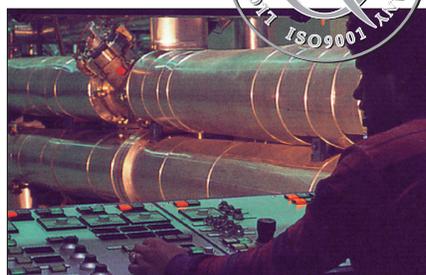
The quality standards of all materials throughout the entire manufacturing process beginning with the raw materials and continuing through to the packaged product are continuously monitored and documented. Materials as well as complete accessories are regularly requalified. As a result of our well established Quality Management System including quality assurance, Tyco Electronics Energy Division was one of the first in the industry to achieve a certification according to ISO 9001.

Service

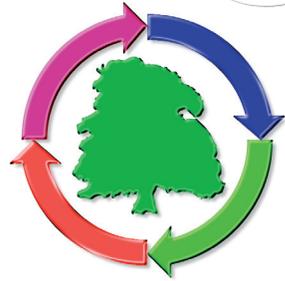
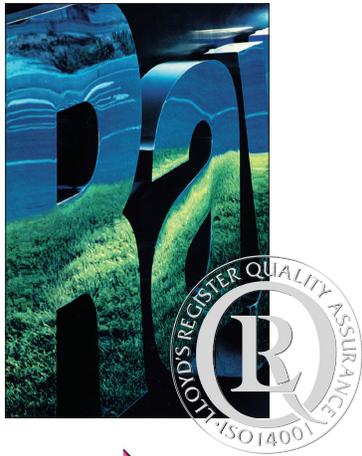
Even the best technology can be applied in the wrong way. To avoid such situations, we have established a technical support service to provide technical information and application guidelines for our customers, such as cable fitters, project and maintenance engineers, constructors, equipment manufacturers and specification and purchasing engineers.

A sound and practice oriented range of services is provided:

- Presentations and Seminars
- Technical papers focusing on new industry trends and products
- Training in cable preparation, installation techniques and product selection for engineers and installers
- Practical demonstrations and field installations
- Solutions to specific customer problems



Quality Standards, Environment, Health and Safety



The quality standards of all materials throughout the entire manufacturing process beginning with the raw materials and continuing through to the packaged product are continuously monitored and documented. Materials as well as complete accessories are regularly requalified. As a result of our well established Quality Management System including quality assurance, Tyco Electronics Energy Division continuously achieves re-certification according to ISO 9001.

Regular installations of Raychem heat-shrinkable cable accessories are considered to present no risk to health based on investigations by independent test institutes and customer evaluations. Moreover, hazards typically associated with cable accessory installations can be eliminated by avoiding any soldering or handling of conventional 2 component or bitumen fillers. No messy or harmful residues requiring special or costly disposal are left over after installation.

Only ecologically sound and recyclable components are used and packaging materials are continuously reduced. Our efforts and investments over the years in improving the environment led not only to the elimination of ozone-depleting materials and substantial reductions of waste materials and water consumption but also to new processes allowing crosslinked materials to be recycled. As a result of these efforts, we have successfully completed the environmental assessment in accordance with ISO 14001 and received a certification as one of the first companies in the industry.



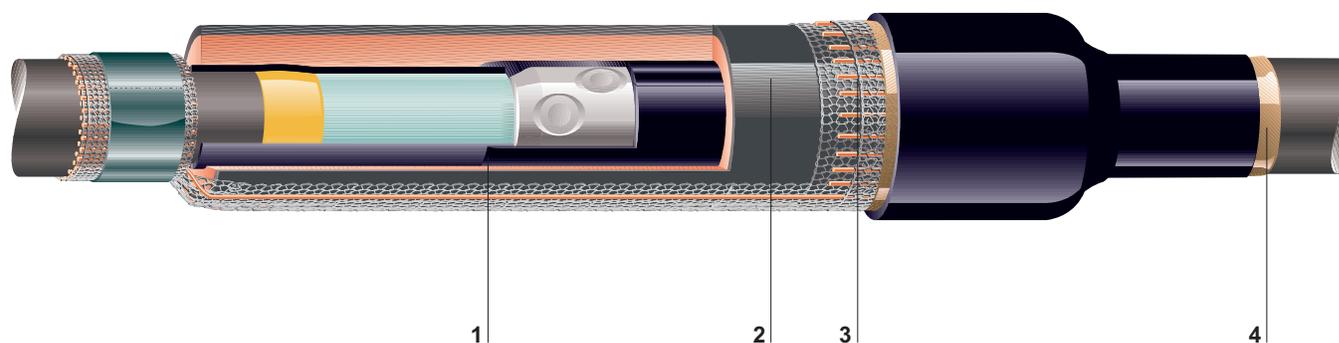
Ordering and delivery

All cable accessories come complete with the necessary electrical insulation materials installation instructions. Solderless earth connections can be ordered separately. Cable lugs and connectors are only included if specifically stated. Medium voltage termination kits and joint kits for 3-core cables include materials for all 3 phases and joint kits for single core cables including material for one phase.

We continuously monitor delivery performance and lead times and look for opportunities to shorten cycle times and improve service. We also analyse our responsiveness throughout our distribution network to customers. This is not static, but rather a constantly improving process directed towards our goal: complete customer satisfaction.



Raychem Medium Voltage Jointing System



Product design

The design of a single-core joint for a polymeric insulated cable is described here. The same design principles are used for 3-core cables. For transition joints, special oil barrier tubings are used to transform draining oil (MI) as well as non draining oil (MIND) paper insulated cable into a quasi polymeric insulated cable with a radial field.

Installation procedure

The elastomeric joint component and the outer sealing sleeve are slid over the prepared cable end. The screen ends are electrically smoothed with a void filling compound and stress control tubings are shrunk over the cable ends. By simply tightening the bolts of the mechanical connector, the conductors are jointed and then covered with a stress control patch. The elastomeric component is quickly shrunk over the connection area. Roll springs and copper mesh rebuild the cable shield and the oversheath is replaced by an adhesive-coated sealing sleeve. All kits are supplied with illustrated step by step instructions.

1 Electrical stress control

The stress control tubing and the patch have a precisely defined impedance characteristic which smoothes the electrical field over the connector and cable screen ends. During installation of the tubings, its shrinking action compresses the special void filler (yellow) and the patch into position around the screen ends and the connector. Penciling of the insulation at the connector is not necessary.

2 Insulation and screen

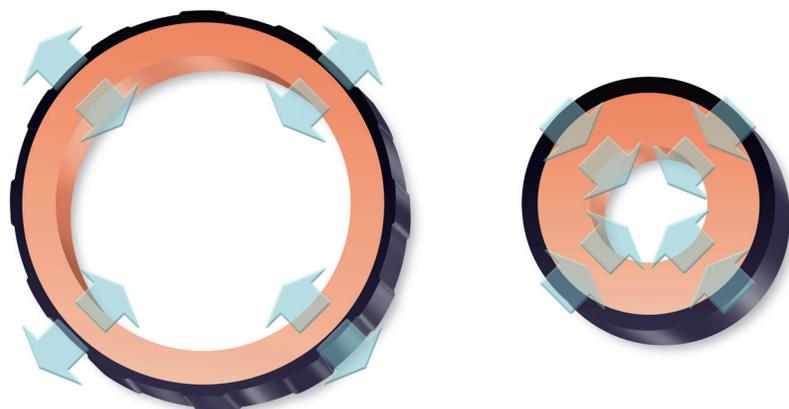
The elastomeric sleeve provides the correct thickness of insulation (red) in one step. The insulation screen is provided by the outer wall of the sleeve, which is made of heat-shrinkable conductive polymer (black). This technique saves installation time and ensures a flawless bond between joint insulation and screen.

3 Metallic shielding

Copper mesh and roll springs ensure the correct screen connection across the joint area and make electrical contact with the outer screen of the joint.

4 Outer sealing and protection

The heat used to shrink the outer sleeve causes the pre-coated adhesive to melt and flow, resulting in a lasting moisture and corrosion barrier on the cable oversheath. The outer sleeve provides mechanical impact and chemical resistance as expected from cable oversheaths. For armoured cables, Raychem joints incorporate a quick to install galvanised steel joint case or steel tape.



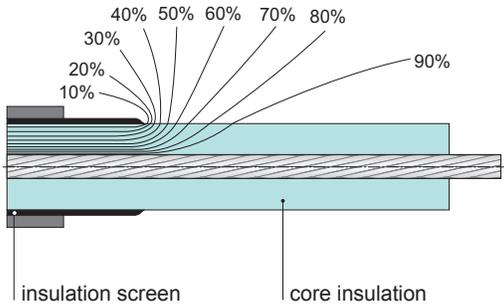
Elastomeric technology – ERIC

The elastomeric joint component is supplied in an expanded form, in which the heat-shrinkable outer wall holds the insulation at a wide diameter. Application of heat causes the outer wall to shrink, allowing the elastomeric, insulating layer to contract at the same time and closely fit the joint. Elastomers typically experience a reducing of the contraction force after storage and at cold temperatures. By applying heat this effect is overcome thus allowing an unlimited storage time and installations at low temperatures.

The rubber-like characteristics of the insulation material combined with the rigid outer heat-shrinkable wall enable the joint to follow the thermally induced dimensional changes of the cable insulation.

Electrical Stress Control in Cable Accessories

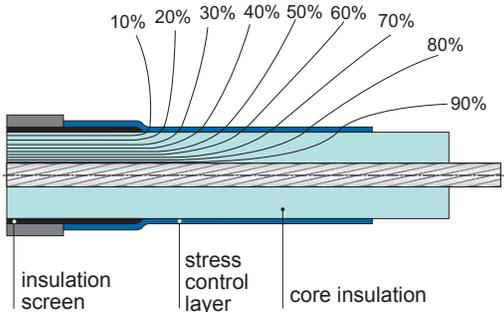
Without stress control



Uncontrolled electrical field at the end of a cable

At the end of medium voltage cables where the insulation screen is removed, the equipotential lines are very close indicating high electric stresses. This stress is high enough to ionise the air at the cable surface causing discharges. The temperature and by-products of this ionisation will, over a period of time, degrade the insulation surface. In addition, the stress at the screen end is that high that even the smallest notch would cause a breakdown.

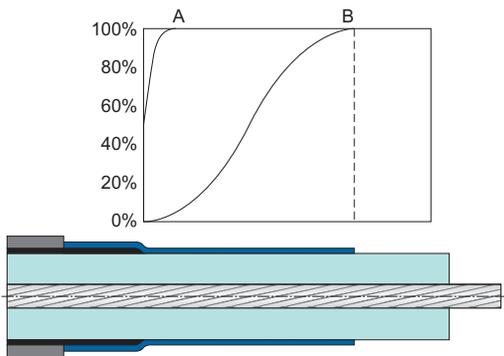
With stress control



Electrical field with a stress control system (tubing or coating)

Raychem terminations include stress control coatings or tubings with a carefully controlled volume resistivity and permittivity to smooth out the high stress areas. The electrical field strength at the end of the screen cut is reduced to a level well below the upper limit for long term operation. This slim stress control system can be used on a variety of cable types, including paper cables, and accommodates variations of cable dimensions.

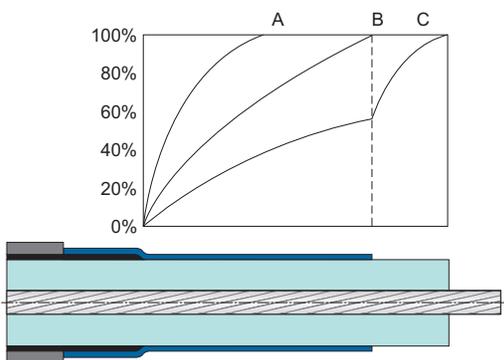
A – without stress control
B – stress control coating



Non-linear stress distribution

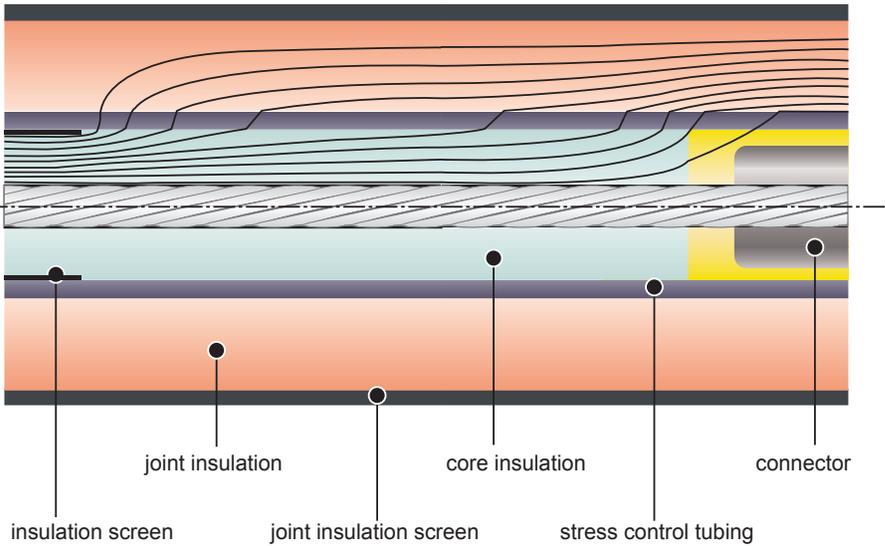
The stress control coatings are made of a material which behaves similar to a varistor. The resulting voltage distribution is non-linear and allows a short termination length while the electrical stress at the screen end area is kept low. In addition, the stress control coating is pressed into small surface irregularities by the shrinking action of the tubing. The result is a perfect interface fit over the insulation which prevents any discharge during operation. Most of the Raychem terminations include this stress control system.

A – improper impedance
B – stress control tubing
C – short length



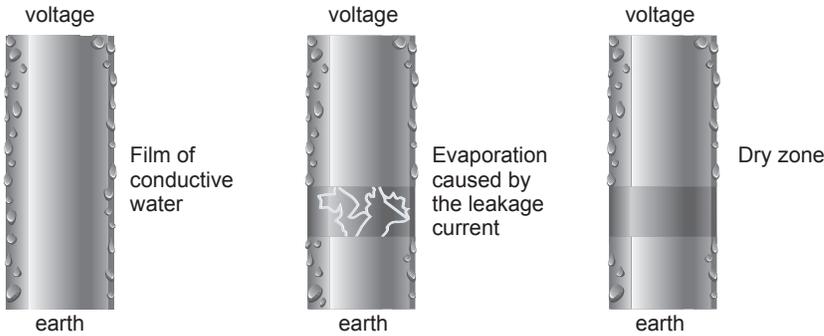
Linear stress distribution

The non-linear impedance of the stress control tubing leads to a linear stress distribution (B). The resulting field depends on correct selection of material properties and length of the tubing. Improper selection of the materials impedance would lead to an unacceptable steep voltage rise at the screen end (A). Reducing the length or wrong positioning would result in discharge at the tubing end (C). All Raychem designed accessories take these effects into account.



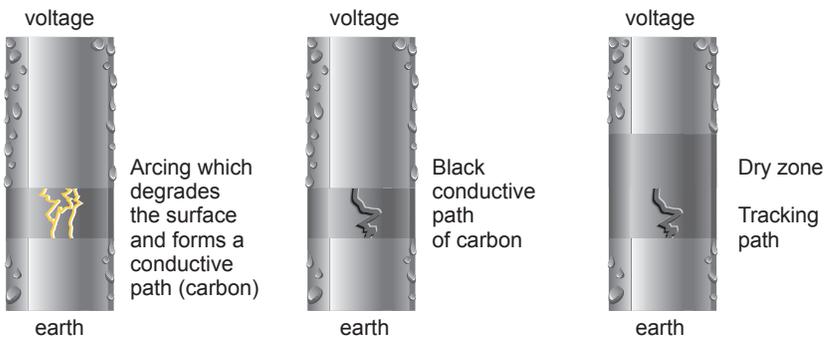
Stress distribution inside a joint

The stress control tubing contacts and overlaps the screen at each end of the joint and controls the stress at these areas in the same way as in terminations. Together with the high permittivity yellow void filler, the stress control tubing separates the equipotentials thus reducing the electrical stresses at the end of the connector. The single layer of insulation bonded to the outer conductive layer has a thickness designed to the rated voltage of the joint and prevents any interfacial discharge. The stress control system of this joint makes it unnecessary to chamfer the cable insulation or to use a connector with a specially profiled shape.



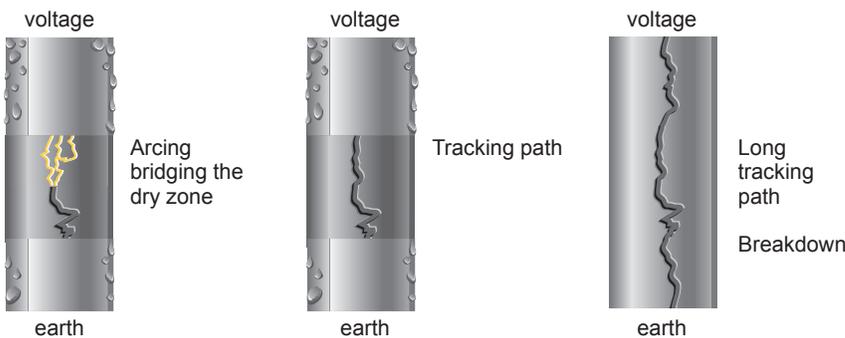
Weathering and ageing resistivity

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



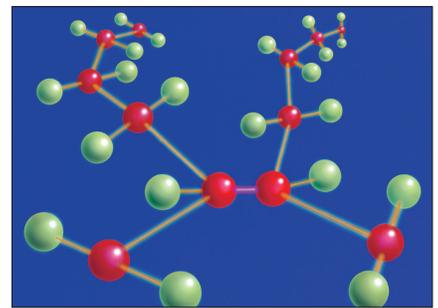
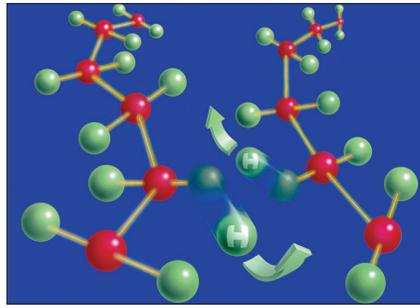
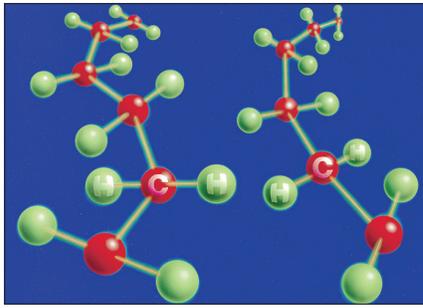
Phenomenon of tracking and erosion

Naturally over time, 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.



We have developed specially formulated Raychem 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.

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.

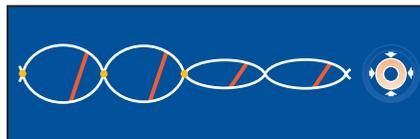
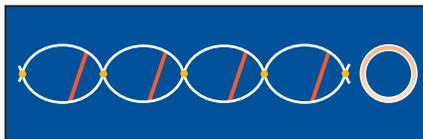
Manufacture and Installation of heat-shrinkable tubing



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.

Advantage of Raychem Heat-Shrinkable Products

Properties	Advantages	Benefits
Crosslinked material	No shelf life	No warehouse losses
	Mechanical resistance	Long lifetime
	Chemical resistance	Long lifetime
	Can be put into service immediately after installation	Reduced outage time
Heat-shrinkable	Excellent range taking	Less stock required
	Independent of large cable tolerances	Installation and operation reliability
	Use of hot melt adhesives	Excellent sealing and operational reliability
	No reduction of shrink strength	Installation reliability
	Possible to install at low temperatures	Universal use
Raychem design	Exceeding specifications	Operational reliability in demanding environments
	Fits on different cable types and sizes of different manufacturers	Universal use
	Consistent installation procedures	Installation reliability
	Tolerates typical variations of cable preparation in the field	Installation reliability
Non toxic and environmentally friendly	No health hazards	Health and safety
	Minor waste, environmentally friendly	Low disposal cost
Complete kits with factory tested installation	Simple installation	Operational reliability
	Fast installation	Reduced outage time
Dual wall tubing: elastomeric insulation / heat-shrinkable screen	Improved interfaces	Operational reliability
	Reduced partial discharges	Operational reliability
Stress control tubing, coating or patch	Single piece, less risk of misplacement	Operational reliability
	Improved level of partial discharge	Operational reliability

