



HEAT SHRINK TUBING

For Automotive Applications

TE CONNECTIVITY (TE) IS ONE OF THE WORLD'S LEADING COMPANIES IN DEVELOPING, SUPPLYING AND MANUFACTURING HIGH QUALITY, TECHNOLOGICALLY ADVANCED, HEAT SHRINK PROTECTION PRODUCTS. OUR PRODUCT PROVIDES A PERFECT SOLUTION FOR TOUGH ENGINEERING PROBLEMS.

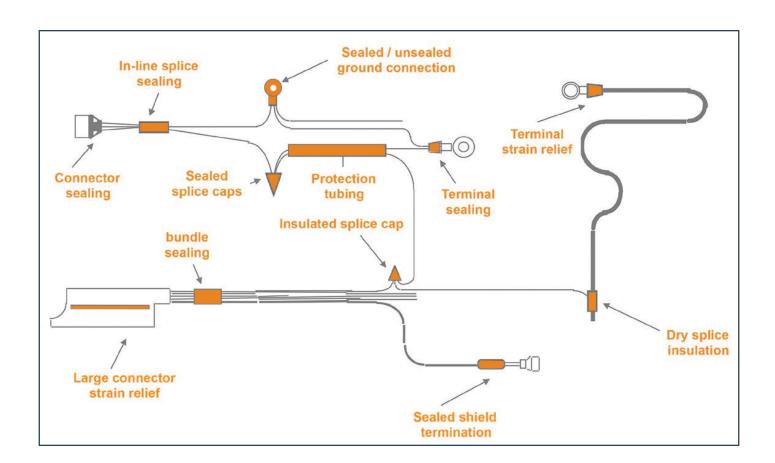
TE's Raychem heat-shrink products are in service throughout the world in automotive, telecommunications, power distribution, aerospace, defence, industrial and commercial applications.

Produced using Raychem state-of-the-art manufacturing facilities and processes, TE's Raychem tubing products are made from uniquely formulated materials that have been enhanced by radiation cross-linking, a technology that TE Connectivity under the brand of Raychem, famously pioneered.

These easy-to-use products provide cost effective, proven solutions in a wide range of automotive applications from sealing and protecting electrical splices to providing mechanical protection for fluid management systems in harsh environments.

The single wall tubing products have a wide range of characteristics. They can be used wherever reliable insulation, strain relief and protection from mechanical abrasion and chemical abuse is needed. They are an ideal way to identify or code components or simply use them to enhance aesthetics.

The adhesive-lined range shows its strength where sealing and encapsulation are critical requirements, as well as demonstrating many of the feature of the single wall products. The inner adhesive can deliver a true seal against moisture and fluid ingress.



Benefits | Features

- Simple and fast installation.
- Renowned for their unrivalled performance and reliability in demanding environments.
- Durable, provide long-term protection against moisture ingress, corrosion, mechanical damage and extremes of temperature.
- Engineered to be cost-effective.
- Product design ensures a repeatable, reliable, shrink to fit installation compatible with present day manufacturing processes.
- Available in a wide range of materials, polyolefins, fluoropolymers and elastomers.
- Different degrees of flexibility, from highly flexible to semi-rigid tubings.
- Designed for operation in high or low temperature environments.
- Halogen free and flame retardant to meet a range of industry standards.
- Available in many sizes, constructions, lengths and colours.
- Available with shrink ratios of 2:1 up to 4:1.
- Customer specific sizes on request.
- RoHS/ELV compliant
- Fully certified production plants according to TS16494 and ISO 14001



Technology

Polymer formulation

TE Connectivity's Raychem formulations are blends of polymers and additives that are carefully designed to meet the stringent customer demands and internal specification requirements. They meet international standards and OEM approvals in many electronics markets.

The selection of polymers, flame-retardants, anti-oxidants, UV-stabilisers and other additives is of great importance for products to meet requirements of properties such as tensile strength, elongation at break, flame retardancy, continuous operating temperature, heat shock, heat ageing, flexibility, chemical and solvent resistance and shrink temperature.

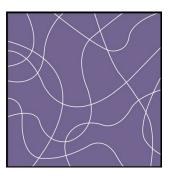
TE Connectivity's Raychem hot melt adhesives are specifically formulated to be compatible with individual heat-shrink tubing compounds. These adhesives include a balance of polymers and additives that allow the adhesive to melt, flow, seal and adhere to a range of substrates at the shrink temperature of the overall tubing.

Cross-linking

Radiation cross-linking enhances the polymer properties and provides heat-shrinkability or shape memory.

Polymeric tubing is extruded and in a separate process the chemical structure is modified to provide improved properties such as reduced deformation under load (creep), improved chemical and solvent resistance, increased abrasion resistance, improved impact properties and shape memory characteristics.

Due to the three dimensional cross-links which are formed during the cross-linking process, the tubing does not melt and obtains its perfect shape memory.



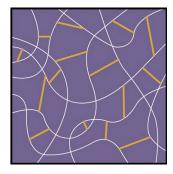
Unmodified Polymer

Manufacturing technology

Based on many years of experience Raychem tubing by TE Connectivity is produced using optimised manufacturing processes by the following steps: compounding, extrusion, radiation cross-linking and expansion.

Compounding processes are used to mix selected polymers and additives. The resulting compounds are then extruded using optimised screw and die designs to produce homogeneous and consistent tubing. The tubing is then cross-linked using electron beam radiation.

In the expansion process the diameter of the tubing is increased by forces at high temperature. Immediately after the tubing reaches its required expanded size, it is cooled down and retains its expanded dimensions.



Cross-linked Polymer

Protection: Chemical / Mechanical Abrasion

Products: Application Challenge facing manufacturers **Application Tooling** Features + Benefits Vehicle engine compartments are **HFT 5000** Model 105 Hoses • Closed-loop speed and becoming ever more crowded and • Highly flexible woven compact, often forcing cooling hoses to fabric construction for temperature control be routed in close proximity to high easy installation onto bent Continuous controlled temperature engine components and hoses process under-bonnet parts. This makes hoses Excellent mechanical and Adaptable for different highly vulnerable to abrasion and abrasion protection applications chafing. This same space considerations • Extremely tough meeting CE approved • Heater operation and over may require hoses to be designed with even demanding sharp bends and other radical shapes, automotive abrasion temperature alarm lights making difficult for manufacturers to fit specifications protective sleeves where damage is likely • Grips sustrates without additional fixing to occur. An added complication is the effect that any over-protection may have • Resists harsh engine on its surrounding components. Contacts compartment between two hoses or a hose and a environments harness are hard to avoid. Where over-• Safe installation with no protection is used to alleviate this hot knife cutting problem it needs to be non-abrasive equipment required itself and protect both components. • Resists hose pulsing effects · Protect only where protection is needed minimizing cost · Halogen free Diesel Manufacturers are constantly searching **ATUM** Model 105 Injection Closed-loop speed and for new ways to reduce engine noise, ATUM tubing provides Clusters particularly in diesel vehicles where excellent noise dampening temperature control higher mechanical noise levels are performance Continuous controlled perceived as a major disadvantage Reduced production times process compared to petrol engines. Research as tubes can be bent or Adaptable for different has shown that high pressure diesel fuel formed on the pipe applications injection clusters, which take fuel from • Moisture proof sealing - CE approved the fuel pump to the injector can emit a adhesive melts and flows • Heater operation and over significant "rushing" noise as fuel is to provide permanent temperature alarm lights transferred along the pipes. • High strength bonding to substrates *(black and colours only)











Fluid Resistant

Strain Relief

Products: Application Challenge facing manufacturers **Application Tooling** Features + Benefits **In-line Splices** All electrical splices in a wiring harness **RPPM RBK X1 Heat Shrink Machines** need to be insulated and protected from • Single component solution Automatic centering mechanical abuse. Effective protection is - to insulate and protect (standard on select models. becoming even more critical as ultrasonic almost all dry area splices but also available as an welding is increasingly being used to · Low profile protection upgrade for earlier models) make the electrical connection. reducing diameter of enhances product quality Ultrasonic welding, while providing a conduit required by automatically centering much better electrical connection than • Flexible while providing tubing over the splice prior traditional crimping, is mechanically superior strain relief than to heating. weak, especially in peel and tear, so PVC tape • Stand-alone operation additional mechanical protection and · Rapid installation mode allows operator to set strain relief must be provided. • Repeatable process time and temperature. • High shrink ratio - allow one Sequenced operation mode size to cover a wide range lets preset times and of splice combinations temperatures be sequenced automatically (and also randomly selected from stored sequence) Communication with upstream ultrasonic welder allows time and Following the trend to reduce cost, **Miniature QSZH** temperature to be weight and space, wire is being replaced **Splices** • Adhesive liner that melts automatically set without by smaller cross-sections and the splices to provide strong operator intervention. are particularly fragile requiring mechanical bond Compact format with mechanical protection and strain relief. Mechanical protection touchscreen interface Given the very low profile of these against flexing, abrasion • Traceability with optional splices, the use of conventional PVC and cut-through bar code scanner and data tapes might become an increasingly • Small cross-sectional profile collection software unsatisfactory solution. · Quick installation · Suited for low volume/high • Zero halogen mix production. • Long life heating elements • Operator key lock/ password protection levels and individual selections for installation times Temperature and product size information.

Challenge facing **Products: Application Application Tooling** Features + Benefits manufacturers **In-line Splice** An automotive **QSZH XB 17 Belt Heater** • Closed-loop time and temperature control. wiring harness Excellent · Continuous controlled process is only as strong environmental • Integrated multi-language touchscreen interface with as its weakest sealing programmable logic system can adjust belt speed, temperature link. In many • Inspectable after settings, and offers users the ability to create hundreds of unique instances that installation weakest link is Mechanical Belt automatically reverses direction to prevent wire from where wires are protection against entering into chamber before reaching desired temperature. • Connection ports support several functions such as a bar-code spliced flexing, abrasion scanner, automatic temperature calibration, and remote access to together. Nonand cut-through an upstream welder. sealed splices · Small cross-• Emergency stop-switch exposed to sectional profile · Slim profile design for easy production layout water, salt spray Quick installation · CE approved. and other fluids Zero halogen in wet areas of Applications **XB 19 Belt Heater** the vehicle can versatility - one • Closed-loop time and temperature control. Continuous controlled process rapidly corrode. size covers a broad • Integrated multi-language touchscreen interface with degrading both range of ground programmable logic system can adjust belt speed, temperature the electrical wire sizes and wire settings, and offers users the ability to create hundreds of unique and mechanical combinations properties of Belt automatically reverses direction to prevent wire from the harness. In entering into chamber before reaching desired temperature addition, splice Connection ports support several functions such as a bar-code joints are scanner, automatic temperature calibration, and remote access to an upstream welder mechanically **RPPM** • Emergency stop-switch weak. Welded Single component • Slim profile design for easy production layout splices, in solution - to All models are CE approved particular, are insulate and highly · An adjustable belt distance feature on the protect almost all susceptible to XB 19 allows operators to extend the processing dry area splices range of tubing products from 100 mm up to 160 mm. peel and tear Low profile loading, and protection -**RBK X1 Heat Shrink Machines** must be reducing diameter • Automatic centering (standard on select models, but also provided with of conduit required available as an upgrade for earlier models) enhances product effective strain Flexible while quality by automatically centering tubing over the splice prior to relief. heating. providing superior • Stand-alone operation mode allows operator to set time and strain relief than temperature. PVC tape • Sequenced operation mode lets preset times and temperatures Rapid installation be sequenced automatically (and also randomly selected from • Repeatable stored sequence) process • Communication with upstream ultrasonic welder allows time and High shrink ratio temperature to be automatically set without operator allow one size to intervention. · Compact format with touchscreen interface cover a wide range • Traceability with optional bar code scanner and data collection of splice combinations • Suited for low volume/high mix production. Long life heating elements Operator key lock/password protection levels and individual selections for installation times Temperature and product size information. XS-D1 Shuttle Heater • Innovative fork movement of heating elements for accuracy and flexible operation Machine includes two separate workstations for higher and quicker output of product · Automatic heating height adjustment with programmable functionality for wider scope of projects · Manual heating height adjustment for application where automatic in not necessary

CE approved

Challenge facing **Products: Product Name Application Tooling** Features + Benefits manufacturers ES2000 Specially designed for • 4:1 shrink ratio allows a **Model 105 Tunnel Oven** environmental sealing and few sizes to cover a wide Closed-loop speed and temperature control electrical insulation of wire range of splice and • Continuous controlled splices, terminations, and component diameters process components • Flame-retardant and • Adaptable for different mechanically tough, the applications tubing provides strain CE approved for relief and abrasion worldwide use protection of wire splices, • Heater operation and terminals, and other over-temperature alarm components liahts • Thick adhesive liner forms an effective barrier against fluids and moisture and performs well at an extended temperature range UL recognized RoHS compliant Tough flame-retardant • 4:1 shrink ratio allows a XS-D1 workbook FL2500 polyolefin tubing lined with a few sizes to cover a wide • XB 17 Belt Heater flame-retardant adhesive range of wire terminations • XB 19 Belt Heater provides the optimum and components • RBK X1 Heat Shrink solution for applications • Flame-retardant tubing **Machines** • Model 105 Tunnel Oven where full flame-retardancy is jacket and adhesive preferred or specified. Rated provide full flame-• XS-D1 Shuttle Heater to 135°C [275°F] for 3000 retardancy hours, FL2500 is suitable for • Fully flame-retardant and use in the automotive harness mechanically tough, the market and other harsh tubing provides strain environments. As the tubing relief and abrasion shrinks, the adhesive lining protection of wire splices, melts and flows to fill all terminals and other voids and create a complete components seal against moisture, oils, • Thick high-performance chemicals and other fluids. adhesive lining offers permanent sealing of splices, fusible links, terminals and in-line components RoHS compliant

Products: Challenge facing **Application Application Tooling** Features + Benefits manufacturers **End Splice** Many automotive ES-CA XS-D1 Shuttle Heater harness suppliers • Mechanically tough • Innovative fork movement of heating elements for accuracy and flexible operation produce a basic jacket provides strain • Machine includes two separate workstations for higher harness after which relief and abrasion and quicker output of product the harness is protection · Automatic heating height adjustment with modified to meet Adhesive lined product programmable functionality for wider scope of projects the requested to environmentally seal · Manual heating height adjustment for specification of the stub splices application where automatic in not vehicle. Sub · Highly resistant to necessary harnesses are automotive fluids and CE approved added which solvents • High srink ratio - three requires electrical **XB 17 Belt Heater** connections being sizes cover a broad • Closed-loop time and temperature control. realised on the range of stub splices · Continuous controlled process assembly line. • Integrated multi-language touchscreen interface with Ultrasonic and programmable logic system can adjust belt speed, crimped temperature settings, and offers users the ability to create hundreds of unique profiles connections require • Belt automatically reverses direction to prevent wire sealing. ES Caps from entering into chamber before reaching desired can provide an ontemperature. board solution to • Connection ports support several functions such as a this requirement bar-code scanner, automatic temperature calibration, and they can be and remote access to an upstream welder. installed using Emergency stop-switch especially designed · Slim profile design for equipment. easy production layout · CE approved. XB 19 Belt Heater • Closed-loop time and temperature control. Continuous controlled process • Integrated multi-language touchscreen interface with programmable logic system can adjust belt speed, temperature settings, and offers users the ability to create hundreds of unique profiles • Belt automatically reverses direction to prevent wire from entering into chamber before reaching desired temperature • Connection ports support several functions such as a bar-code scanner, automatic temperature calibration, and remote access to an upstream welder • Emergency stop-switch · Slim profile design for easy production layout • All models are CE approved • An adjustable belt distance feature on the XB 19 allows operators to extend the processing range of tubing products from 100 mm up to 160 mm. Model 105 • Closed-loop speed and temperature • Continuous controlled process · Adaptable for different applications CE approved • Heater operation and over-temperature alarm lights

Products: Application Challenge facing manufacturers **Application Tooling** Features + Benefits 2 to way 18 connectors are frequently Model 105 Connector used on cars, often in wet and high • Low profile mechanical • Closed-loop speed and temperature areas such as engine protection, strain relief and temperature control compartments. Manufacturers need Continuous controlled simple, versatile sealing systems with a • Seals a wide range or process minimum number of components that different number/gauge Adaptable for different provide connector sealing even when not sizes of wires into the applications all of the contact cavities are in use. same connector housing CE approved • Heater operation and over • Semi-flexible, dual-wall moisture proof temperature alarm lights • Environmental sealing • Ideal for connector sealing covering large diameter differences · High strength bonding **XS-D1 Shuttle Heater** • Innovative fork movement of • Excellent environmental heating elements for accuracy sealing and flexible operation Mechanical protection · Machine includes two against flexing, abrasion separate workstations for and cut-through higher and quicker output of • Small cross-sectional product profile • Automatic heating height • High shrink ratio allows a adjustment with few sizes to cover a wide programmable functionality range of splices for wider scope of projects Strain relief Manual heating height adjustment for application where automatic in not necessary CE approved Ring Maintaining the electrical quality of ring **QSZH** XS-D1 Shuttle Heater Innovative fork movement of terminal connections has always been See page 9 **Terminal** heating elements for accuracy critical. In today's cars it is even more and flexible operation important as manufacturers are SCT • Machine includes two increasingly using ring terminals to See above separate workstations for ground low current 'quiet' and 'logic' higher and quicker output of signal circuits. Any increase in resistance, RBK-RTP product usually caused by corrosion as a result of • Environmental protection Automatic heating height moisture entering the wire terminal Mechanical protection adjustment with against flexing, abrasion connection, can critically impair these programmable functionality electrically sensitive circuits. and cut-through for wider scope of projects Mechanical damage can also reduce Small cross-sectional • Manual heating height electrical performance, so protection adjustment for application during handling is important, as well as where automatic in not effective strain relief when in use. necessary CE approved

Application	Challenge facing manufacturers	Products: Features + Benefits	Application Tooling
Wire Bundle	Low cost, but reliable sealing of multi-wire bundles of up to 20 wires is becoming increasingly important as vehicle harnesses grow in size and complexity. Typically, sealing is needed to provide a water block where the wire bundle passes through a moulded rubber boot into the back of a connector, or at a grommet between a wet and dry area, such as the engine to passenger compartment. Ideally, this seal should not add significantly to the overall diameter of the bundle, allowing easy positioning of grommets and other components during the harness assembly.	RayBlock Sealing Kit RayBlock sealing kit provides ultra low profile seals only marginally larger than the cable bundle itself Excellent resistance to automotive fluids and solvents Excellent electrical insulation Outstanding vibration resistance RayBlock 85 RayBlock 105	XB 17 Belt Heater Closed-loop time and temperature control. Continuous controlled process Integrated multi-language touchscreen interface with programmable logic system can adjust belt speed, temperature settings, and offers users the ability to create hundreds of unique profiles Belt automatically reverses direction to prevent wire from entering into chamber before reaching desired temperature. Connection ports support several functions such as a bar-code scanner, automatic temperature calibration, and remote access to an upstream welder. Emergency stop-switch Slim profile design for easy production layout CE approved. XB 19 Belt Heater Closed-loop time and temperature control. Continuous controlled process Integrated multi-language touchscreen interface with programmable logic system can adjust belt speed, temperature settings, and offers users the ability to create hundreds of unique profiles Belt automatically reverses direction to prevent wire from entering into chamber before reaching desired temperature Connection ports support several functions such as a bar-code scanner, automatic temperature calibration, and remote access to an upstream welder Emergency stop-switch Slim profile design for easy production layout All models are CE approved Lrdays An adjustable belt distance feature on the XB 19 allows operators to extend the processing range of tubing products from 100 mm up to 160 mm.

Sealing Matrix

Products									
Application	QSZH	RBK-ILS	RBK-VWS	ES-CAP	SCT	RBK-RTP	НТАТ	RBK-105-KIT	RBK-85-KIT
Splice Sealing - Inline	√	✓	✓		√				
Splice Sealing - Stub				✓					
Ring Terminal Sealing	✓	✓	✓		√	✓			
Connector Sealing					√		√		
Bundle Wire Sealing								✓	✓

Identification / Beautification

Products: Application Challenge facing manufacturers **Application Tooling** Features + Benefits **Gas Pipes** Vehicle manufacturers need to improve **LSTT** Model 105 on the environmental impact of materials. • Rapid recovery at low • Closed-loop speed and Replacing paint with heat shrink tubing is temperature control temperatures an effective way of reducing the use of • Can be used with • Continuous controlled solvents and chemicals. temperature sensitive process materials Adaptable for different • Excellent physical and applications electrical performance • CE approved Heater operation and Flexible overtemperature alarm liahts • Very good chemical and solvent resistance • Wide range of colours • Flexible • Excellent physical and electrical performance Identification of voltage, ground and **CGPT XS-D1 Shuttle Heater** Ring • Innovative fork movement of signal wires is increasingly required • Very good chemical and **Terminal** heating elements for accuracy within automotive harnesses to prevent solvent resistance and flexible operation incorrect connections during the lifetime • Wide range of colours • Machine includes two of the vehicle. More electrical aparatus Flexible separate workstations for results in an increased need to • Excellent physical and higher and quicker output of distinguish individual circuitry. electrical performance product • Automatic heating height adjustment with programmable functionality for wider scope of projects · Manual heating height adjustment for application where automatic in not necessary • CE approved

Cosmetic: Appearance / Beautification

Application	Challenge facing manufacturers	Products: Features + Benefits	Application Tooling
Seat Belt Stalks	Metal fixtures within the vehicle require finishing which is both aesthetically pleasing and functional.	• Rapid recovery at low temperatures • Can be used with temperature sensitive materials • Excellent physical and electrical performance • Flexible • Flexible	XB 17 Belt Heater Closed-loop time and temperature control. Continuous controlled process Integrated multi-language touchscreen interface with programmable logic system can adjust belt speed, temperature settings, and offers users the ability to create hundreds of unique profiles Belt automatically reverses direction to prevent wire from entering into chamber before reaching desired temperature. Connection ports support several functions such as a bar-code scanner, automatic temperature calibration, and remote access to an upstream welder. Emergency stop-switch Slim profile design for easy production layout CE approved. XB 19 Belt Heater Closed-loop time and temperature control. Continuous controlled process Integrated multi-language touchscreen interface with programmable logic system can adjust belt speed, temperature settings, and offers users the ability to create hundreds of unique profiles Belt automatically reverses direction to prevent wire from entering into chamber before reaching desired temperature Connection ports support several functions such as a bar-code scanner, automatic temperature calibration, and remote access to an upstream welder Emergency stop-switch Slim profile design for easy production layout All models are CE approved Lrdays An adjustable belt distance feature on the XB 19 allows operators to extend the processing range of tubing products from 100 mm up to 160 mm. Model 105 Closed-loop speed and temperature control Continuous controlled process Adaptable for different applications CE approved Heater operation and over temperature alarm lights

Cosmetic: Appearance / Beautification

Products: Application Challenge facing manufacturers **Application Tooling** Features + Benefits Car radio and cellular antennas need a **CGPT** Model 105 Antenna protective coating to protect the antenna • Very good chemical and • Closed-loop speed and from mechanical abuse, abrasion and solvent resistance temperature control corrosion. The majority of antennas are • Wide range of colours Continuous controlled straight and smooth and are typically • Flexible process painted or dip-coated. However, some Excellent physical and Adaptable for different antennas have a glas or fibre winding electrical performance applications that extends around part or all of the • CE approved antenna. In these cases a different • Heater operation and over protective covering is needed to hold the temperature alarm lights winding in place over the antenna base and provide abrasion protection to the entire assembly. Eliminating wind noise is also a critical factor in antenna design.

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