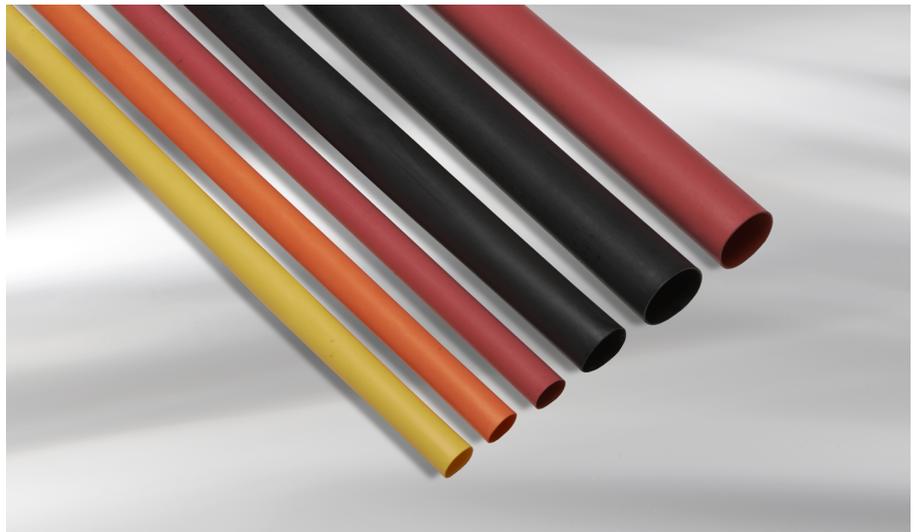


SEALED & PROTECTED WITH HEAT SHRINK TUBING

TE Connectivity's Heat Shrink Tubing Offers a Superior Alternative to Tape, Glues and Glass

By John Sandwell, Sr. Manager, Product Management



SEALED & PROTECTED WITH HEAT SHRINK TUBING

TE Connectivity's Heat Shrink Tubing Offers a Superior Alternative to Tape, Glues and Glass

TE CONNECTIVITY'S HEAT SHRINK TUBING PROVES TO BE A SUPERIOR ALTERNATIVE TO TAPE, GLUES AND GLASS

Whether designing for harsh outdoor environments or the home, design engineers across industries need ways to insulate components against heat and electric current, provide strain relief for connectors and splices, and protect and seal against water ingress, chemicals and abrasions. Heat shrink tubing can be the versatile choice to solve all these design challenges efficiently. It can also provide cosmetic improvement and organize and identify different wires and components quickly. Many design engineers and manufacturers may not realize that tubing can be used just as effectively—and often more effectively—as a protective cover, insulator, noise reducer and more in many applications and industries.



TE's heat shrink tubing is a high-tech, low-cost solution that can be used in place of taping, molding, potting, gluing and glass. Tubing has a quicker application time and can help improve performance. Potting, for example, because it involves liquid resin, can be tougher to keep consistent and repeatable throughout manufacturing. Gluing can present the same challenges and taping also has its shortcomings. TE Connectivity (TE) showed a customer who was using mastic tape around terminals how using tubing shortened application time (from 180 seconds to 45 seconds), improved yield (from less than 90% to over 98%) and provided a higher temperature rating—125 degrees Celsius (C) compared to 105 C with the tape.

Versatility and durability are key traits of heat shrink tubing. TE's tubing portfolio provides benefits for strain relief, electrical insulation, mechanical protection and environmental sealing for applications such as back-end connector sealing, breakouts and connector-to-cable transitions, and is especially useful in cable harnesses. When heated, the tubing conforms to the size and shape of the substrate beneath, enabling quick and easy installation. Its high expansion ratio of up to 8:1 can enable users and technicians to repair most damaged cable jackets without removing connectors.

By keeping out moisture, harsh chemicals and mechanical interference, heat shrink tubing can improve the performance of equipment. It can even be used to organize wires and small pipes, as it's available in a wide range of sizes, materials and colors including clear, which enables inspection of covered components and excellent light transmittal.

Cross-Linking Technology Enables Use within Harsh Environments

TE's heat shrink tubing can be used for a wide range of applications across many industries and environments because it is reliable, robust and easy to use. One of the reasons for this is cross-linking technology. Cross-linking technology modifies the molecular structure of a polymer, allowing the tubing to withstand high temperatures without adding bulk.

Heat shrink tubing can provide a complete seal. It can be used for repairs and for:

- Insulating and protecting components and wiring
- Sealing and protecting splices
- Corrosion protection for wire-ends
- Identifying and sealing battery terminals
- Mechanical protection for hoses, lighting components, etc.
- Strain relief for fine gauge wires, fiber-optic cables and electric hand tools
- Noise reduction, due to vibration or moving assemblies
- Moisture, fungus, weather and ultraviolet light resistance for outdoor applications
- Thermal insulation of substrates, pipes, hoses and cables
- Electrical insulation of electrosurgical instruments
- Fluorescent & LED light covers
- Color-coding of wiring and circuits
- Bundling wires together for organization, protection and easier assembly

SEALED & PROTECTED WITH HEAT SHRINK TUBING

TE Connectivity's Heat Shrink Tubing Offers a Superior Alternative to Tape, Glues and Glass

When compared to using tape, glues or glass, tubing with cross-linking technology offers outstanding benefits. It can operate at higher temperatures without melting. Its high mechanical strength means it is more resistant to impacts and abrasions. Cross-linked heat shrink tubing can also be used to bundle or collate different wires and small pipes for easy organization and identification. Other benefits include:

- Fluid resistance
- Up to 600 V electrical insulation rating
- Maximum temperature rating of 150°C to 200°C
- Mechanical interference protection

The Difference Between Single Wall & Dual Wall Heat Shrink Tubing

Single Wall Heat Shrink Tubing for Quick Insulation and Protection

Single wall heat shrink tubing provides superior insulation, strain relief, and protection against mechanical damage and abrasion versus taping and molding in place. This high-performance alternative has reliably consistent dimensions and physical properties, with shrink ratios of 2:1 to 4:1. When heated, the single-wall tubing shrinks to conform to the size and shape of the underlying material, making installation fast and easy. Single-wall tubing offers optimum flexibility and space savings along with mechanical protection and chemical resistance.

Across appliance designs, single-wall heat shrink tubing is also useful for noise reduction, identification and organization—for example, for bundling wires or assembling cable harnesses. TE products also come in a wide range of sizes, colors, and materials, and many products are offered in flame retardant versions. Most of our products are UL recognized/CSA certified and some meet SAE 23053, MIL-PRF-46846 and VG95343 standards.

Dual Wall Heat Shrink Tubing: Ideal for Sealing and Protecting Against Fluids and Corrosion

Nearly anywhere corrosion protection and sealing are required, dual-wall heat shrink tubing should be considered as a top choice over taping, molding and potting. Dual-wall tubing uses engineered adhesives to protect against moisture, chemicals, and corrosive conditions and provide electrical insulation and mechanical protection.

TE's Raychem dual-wall tubing products have a cross-linked outer jacket and an inner layer of adhesive or encapsulant. The highly engineered adhesives can bond with many different types of materials. During installation, the adhesive lining melts and flows, creating a moisture-resistant protective barrier that seals and protects against dust and fluid ingress. This provides more consistent results for the user during assembly due to the controlled amounts of adhesive within, and tubing can be applied quicker and easier than potting, for example.

TE's dual-wall heat shrink tubing products offer shrink ratios ranging from 2:1 to 6:1, and are resistant to flame, heat, chemicals and mechanical damage. Depending on the intended use, different products are certified in compliance with SAE 23053 standards, UL and CSA, and RoHS. Select tubing products are also type-approved by the American Bureau of Shipping (ABS) and Lloyd's Registry of Shipping.



SEALED & PROTECTED WITH HEAT SHRINK TUBING

TE Connectivity's Heat Shrink Tubing Offers a Superior Alternative to Tape, Glues and Glass

TE's Heat Shrink Tubing Outperforms Alternatives When it Comes to Impact Resistance and Harsh Environments

Glass, glues and even PVC were not going to work to protect the rugged, lighting application that one of TE's customers relied on for sealing out water ingress and protection against UV light effects, chemicals, oils and solvents. For this customer, manufacturing applications for power sports, racing, construction, mining, military and government applications required high demands for performance in the harsh off-road environment.

Before working with TE, the only solutions the customer could find were to encase their product in glass or plastic, which would be very expensive and not impact resistant. TE provided a simple custom tubing solution that had the thickness required to provide the impact resistance needed to support the harsh off-road environment and exceeded their requirements, while also simplifying their production.

In addition to appliances and lighting applications, single wall and dual wall tubing, specialty and heavy-duty tubing can be used for automotive, commercial trucking, industrial, medical, military and energy, aerospace and marine. It is time to look beyond taping, molding, potting, PVC, gluing and glass. The cost-saving, versatile and durable solution has been within reach without many designers and manufacturers even realizing.

WHY CHOOSE TE'S HEAT SHRINK TUBING PRODUCTS: DESIGNED FOR HARSH AND RUGGED ENVIRONMENTS

As design engineers address the sealing, vibration and temperature challenges associated with manufacturing ICT vehicles, it's important to understand the benefits of heat shrink tubing:

Versatility and Durability: Heat shrink tubing is designed to improve the ability to keep out moisture, harsh chemicals and mechanical interference. It also provides strain relief, electrical insulation, mechanical protection and environmental sealing for applications such as back-end connector sealing, breakouts, connector-to-cable transitions, and is especially useful in cable harnesses.

Quick Installation/High-Tech Performance: Heat shrink tubing has a faster application time than other products resulting in better performance. For example, when compared to tape, heat shrink tubing has been shown to shorten application time (from 180 seconds to 45 seconds), improve yield (from less than 90% to over 98%) and provide a higher operational temperature rating (125°C compared to 105°C.)

Easy Installation: When heated, heat shrink tubing conforms to the size and shape of the substrate beneath, enabling quick and easy installation. Its high expansion ratio of up to 8:1 can also enable users and technicians to repair most damaged cable jackets without removing other components such as connectors.

Safety: Heat shrink tubing products are designed to maximize safety. This can include variables such as thick-tubing to secure extra protection, various colors for easy identification and various levels of flame-retardancy to meet UL VW-1 flammability standards.

Reliable, Robust Cross-linking Technology: Cross-linking technology modifies the molecular structure of a polymer, allowing the tubing to withstand high temperatures without melting — a critical factor in harsh ICT environments. Heat shrink tubing can provide a complete seal and its high mechanical strength makes it more resistant to impacts and abrasions.

Offered in Single Wall and Dual Wall Heat Shrink Tubing: Single wall shrink tubing provides superior insulation strain relief and protection against mechanical damage and abrasion versus taping and molding in place. Dual wall tubing should be considered the top choice over taping, molding and potting for any circumstance where corrosion protection and sealing are required.



SEALING



VIBRATION



TEMPERATURE

SEALED & PROTECTED WITH HEAT SHRINK TUBING

TE Connectivity's Heat Shrink Tubing Offers a Superior Alternative to Tape, Glues and Glass



CONNECTED

Data and connectivity is being used to enhance functionalities and enable preventive maintenance to help improve safety and efficiency and facilitate the introduction of autonomous trucks.



SUSTAINABLE

There is an increased focus on environmental sustainability across the ICT space including hybrid and electrical vehicles, regenerative energy, electric vs. hydraulic systems CO2 and lower emissions.



PRODUCTIVE

Engineers are designing more productive applications by enabling weight reduction, automated manual transmission, engine control and low power consumption.



POWERFUL

The focus on solid-state batteries for transportation vehicles will allow for faster charging, energy density, and longer life cycles.

Innovation is Central to All Heat Shrink Tubing Efforts

TE engineers embark on in-depth engineering approaches to design, combining premium R&D efforts, strict process controls and deep industry knowledge to inform product development and meet ICT customer needs. For example, TE pioneered the use of radiation cross-linking technology for its Raychem tubing portfolio and developed heat-shrinkable polymer products which set industry standards in heat shrink tubing. In addition, TE's extensive work with automakers around the world has translated into valuable tubing now available to ICT manufacturers.

For unique customer applications, TE's heat shrink tubing solutions can be customized to address the exact specifications required—regardless of the market the application is being designed for or the customer's footprint. These solutions are then fully tested to ensure performance specifications are met.

It is this journey with the customer, from the research lab to field-service operations, that distinguishes TE's product development approach. Equally important, it defines why TE Connectivity successfully brings solutions to market both quickly and efficiently.



SEALED & PROTECTED WITH HEAT SHRINK TUBING

TE Connectivity's Heat Shrink Tubing Offers a Superior Alternative to Tape, Glues and Glass

TE CONNECTIVITY'S PORTFOLIO OF PRODUCTS

TE provides an extensive portfolio of heat shrink tubing solutions—ten families of products—each of which offers unique values and functionalities to address a number of needs, specifically within the ICT space, specifically.

BATTU Heat Shrink Tubing: Designed specifically for the ICT market; color differentiation allows for easy identification of battery poles and vehicle power types; quick installation allows for faster production time.

SCT Heat Shrink Tubing: Flame-retardant, adhesive-lined, semirigid polyolefin heat-shrinkable tubing covers a wide range of splice sealing constructions with a few sizes of tubing; prevents ingress of moisture to prevent corrosion. Operating temp of 150°C.

ES1000 and ES2000 Heat Shrink Tubing; RBK-ILS and RBK-VWS Heat Shrink Tubing: High-shrink-ratio, adhesive-lined, semirigid polyolefin tubing covers a wide range of splice constructions with a few sizes of tubing; prevents ingress of moisture to prevent corrosion. Operating temp of 130°C.

RNF-100 and RNF-3000 Heat Shrink Tubing: Military grade, flexible, flame-retardant, 3:1 shrink ratio polyolefin tubing for general purpose bundles and strain relief; thick tubing for extra protection; including bright orange in color to identify battery poles and vehicle power types in distinguishing safety hazards. UL and CSA certifications.

VERSAFIT Heat Shrink Tubing: Highly flame-retardant, very flexible, low-shrink-temperature, polyolefin tubing for general purposes and strain relief; color differentiated for safety. UL and CSA certifications; UL VW-1 flammability rating.

DWFR Heat Shrink Tubing: Highly flame-retardant, high shrink ratio, adhesive lined, polyolefin tubing provides moisture protection and strain relief. Operating temp of 125°C. UL VW-1 flammability rating.

SWFR Heat Shrink Tubing: Cost-effective, highly flame-retardant, 2:1 shrink ratio tubing made of irradiated, cross-linked polyolefin tubing to provide high temperature stability; zero halogen. UL and CSA certifications; UL VW-1 flammability rating.

HFT5000 Heat Shrink Tubing: Heat-shrinkable fabric tubing designed for superior abrasion resistance; it is also anti-fungal resistant to stop buildup of mold for halogen free environment. Operating temp range of 125°C to 150°C.

Rayblock Heat Shrink Tubing: Heat-shrinkable water-blocking sealing kit environmentally seals up to 20 wires in a bundle to prevent moisture and noise transmission (climate protection). Operating temp range of 85°C to 110°C with excursions up to 120°C.

CGPE-105 Heat Shrink Tubing: Brightly colored, shiny, non-flame-retardant polyolefin tubing conforms to substrate variation; improves aesthetics. UV stable.

ATUM Heat Shrink Tubing: Highly flame-retardant, high shrink ratio, adhesive lined, polyolefin tubing is moisture resistant and provides strain relief. Operating temp of 125°C.

AP-2000 Heat Shrink Tubing: Flexible, adhesive-lined, non-flame-retardant tubing is corrosion resistant and provides environment and mechanical protection (climate protection).

Single Wall Heat Shrink Tubing is Used for Quick Insulation and Protection

- Reliably consistent dimensions and physical properties, with shrink ratios of 2:1 to 4:1
- Optimum flexibility and space savings along with mechanical protection and chemical resistance
- Available in a wide range of sizes, colors, and materials, and many products are offered in flame retardant versions
- Within our portfolio we offer products that are UL recognized/CSA certified and some meet SAE 23053, MIL-PRF-46846 and VG95343 standards

SEALED & PROTECTED WITH HEAT SHRINK TUBING

TE Connectivity's Heat Shrink Tubing Offers a Superior Alternative to Tape, Glues and Glass

Dual Wall Heat Shrink Tubing is the Ideal Choice for Sealing and Protecting Against Fluids and Corrosion

- Engineered adhesives protect against moisture, chemicals, and corrosive conditions and provide electrical insulation and mechanical protection
- Shrink ratios range from 2:1 to 6:1, and are resistant to flame, heat, chemicals and mechanical damage
- Depending on the intended use, different products are certified in compliance with SAE 23053 standards, UL and CSA, and RoHS
- Select tubing products are also type-approved by the American Bureau of Shipping (ABS) and Lloyd's Registry of Shipping
- Dual Wall Heat Shrink Tubing is the choice of many Automotive OEMs

THE TE ADVANTAGE

TE's Raychem brand of tubing has been the market leader for over 50 years—beginning when Raychem scientists pioneered the application of radiation cross-linking and developed heat-shrinkable polymer products and continuing over half a century, innovating product designs and setting the standard for the industry. After acquiring Raychem in 1999, TE upheld Raychem's strong legacy and continues to be on the cutting edge of heat shrink tubing technology today. As a global leading brand, TE offers:

- Complete product portfolios covering many industry applications
- Premium product quality from abundant R&D and application experience, as well as excellent process controls
- Ability to meet various specs and certifications (including clean rooms for medical and military specs such as SAE 23053 and MIL-PRF-46846)
- Design capability to meet specific needs and solutions
- 3 manufacturing sites to cover key regions globally
- Strong global sales services, including great channel partner support

TE remains committed to meeting the needs of our customers, delivering quality products and identifying opportunities for more efficiencies, cost-savings and innovations in design. Finding ways to solve customer problems and increase reliability and performance in harsh environments are just some of the ways TE lives up to its purpose of creating a safer, sustainable, productive and connected future.



Heat Shrink Tubing Installation Do's and Don'ts:

- Do not force the supplied tube over something by stretching it. This can cause it to tear during recovery
- Since heat shrink tubing is supplied at a minimum expanded diameter, always use the specified Expanded ID dimension. Do not assume that the tube will be delivered at exactly the same dimension every time. However, it will always meet the specified minimum expanded ID dimension
- Do not assume the tube will always shrink to the same fully- recovered dimensions. Always use the specified dimensions for the recovered internal diameter of the tube. Sometimes the tube will shrink a little more than the Recovered ID specified, but it will always meet the maximum specified dimension
- Do not cut the tube length to be the final installed length required. The tube will change length during recovery. The more you shrink it the greater the longitudinal change. The long change is noted in the product specification. Use it when calculating the cut length
- Do not recover the tubing over something with sharp edges, they can cut the tubing or puncture it which results in the tubing splitting during installation
- Follow the installation guidelines, especially the guideline on temperature. At too low a temperature the tubing may not fully recover. At too high a temperature it may show burn marks or split
- If you use a heat gun to recover the tubing, expect to see some wrinkles. This is caused by non-uniform heating of the tubing (chill marks). However continued heating of the chill marks will make them disappear, but generally chill marks have no effect on the performance of the tube
- Recommended recovery is in an oven to give uniform recovery around the entire circumference of the piece, or with a heat gun that allows the substrate to come up to temperature and assists in full recovery
- If you have any questions when selecting which size tubing is appropriate for your application, please consult with one of

TE Technical Support Center

USA:	1.800.522.6752
Canada:	1.905.475.6222
Mexico:	52.0.55.1106.0800
Latin/S. America:	54.0.11.4733.2200
Germany:	49.0.6251.133.1999
UK:	44.0.800.267666
France:	33.0.1.3420.8686
Netherlands:	31.0.73.6246.999
China:	86.0.400.820.6015

te.com

TE Connectivity, TE Connectivity (logo) and Every Connection Counts are trademarks. All other logos, products and/or company names referred to herein might be trademarks of their respective owners.

The information given herein, including drawings, illustrations and schematics which are intended for illustration purposes only, is believed to be reliable. However, TE Connectivity makes no warranties as to its accuracy or completeness and disclaims any liability in connection with its use. TE Connectivity's obligations shall only be as set forth in TE Connectivity's Standard Terms and Conditions of Sale for this product and in no case will TE Connectivity be liable for any incidental, indirect or consequential damages arising out of the sale, resale, use or misuse of the product. Users of TE Connectivity products should make their own evaluation to determine the suitability of each such product for the specific application.

©2023 TE Connectivity. All Rights Reserved.

02/23 Original