

HEAT SHRINK TUBING: AN UNDERLYING SOLUTION TO COMPLEX ICT DESIGN REQUIREMENTS

PROVIDES INSULATION, SEALING AND PROTECTION FOR
CRITICAL COMPONENTS WITHIN INDUSTRIAL AND COMMERCIAL
TRANSPORTATION (ICT) APPLICATIONS

ICT applications often require manufacturers to design robust and resilient vehicles that meet the performance demands of harsh and rugged environments — whether tractor-trailers climbing steep hills or farm equipment toiling hard land. This is further compounded by the need to operate in harsh conditions such as heavy rain, snow and extreme temperature change on a daily, if not 24/7 basis.

Designing ICT machinery to handle these performance demands requires equally rugged and reliable component parts. But that's not all. Major market needs around safety, connectivity and efficiency are also impacting manufacturing specifications in the ICT space.



The focus on data and connectivity, including the next generation of GPS technologies, is increasingly being used to enhance functionalities and enable preventive maintenance to help improve safety and efficiency. Data and connectivity are also among the driving forces behind automation and the introduction of autonomous trucks. This greater use of data and connectivity in ICT designs creates more complexities and in turn, the need for more component parts.

An increased focus on environmental standards has also impacted ICT manufacturing. Regulations over emissions standards, e.g. China 6 and Euro 6, have intensified the interest in hybrid vehicles, impacting everything from transmissions to fuel systems. There is also pressure to improve heating ventilation and air conditioning (HVAC) systems to enhance air quality and thermal comfort for truckers. Looking into the future, current research and development (R&D) teams are focused on solid-state batteries which are expected to usher in fully electric trucks and large-scale transport. Collectively, these issues are serving to redefine ICT manufacturing requirements and the components needed.

Common Denominators

Looking together at these various performance demands, as well as current and emerging market trends, there remains fundamental common denominators that cut across the ICT manufacturing landscape:

Design engineers must address the sealing, vibration and temperature challenges associated with manufacturing all types of ICT vehicles. This means choosing protective products that can work within increasingly complex designs, as well as withstand the harsh environments inherent to ICT vehicle operation.

Increasingly, it also means ICT manufacturers must choose a component provider that not only understands current and future market demands

but offers a breadth of products that address a range of needs and are backed by decades of superior performance and reliability.

Heat shrink tubing is a solution to support these performance challenges—TE Connectivity is the choice provider.

Heat shrink tubing has proven to be the optimal solution for insulating components against heat and electric current, providing strain relief for connectors and splices, and protecting and sealing against water ingress, chemicals and abrasions. Versatile in solving design challenges efficiently, heat shrink tubing has also shown to outperform tape, glue and glass alternatives, particularly when it comes to impact resistance and operating in harsh environments.



TE Connectivity is a leading provider of heat shrink tubing, offering a wide portfolio of products to address an array of ICT manufacturing related needs. This leadership is based on TE's Raychem brand of tubing, which has been a market force for more than 50 years. Following the design of select products for the US military and aerospace industry—efforts which exact the highest and most rigorous of engineering protocols—this became the standard by which TE tubing products are developed.

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



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.

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).

Applications

- Trucks
- Buses
- Two Wheelers
- Farm Machinery and Equipment
- Construction Equipment
- Material Handling Equipment
- UTVs and ATVs
- Mobile Homes and Campers
- Recreational Marine
- Transportation Wire Harnesses

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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

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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

Conclusions

Industrial and Commercial Transportation (ICT) manufacturers face countless design requirements to meet the most rugged of performance demands, as well as new challenges brought on by ever-changing market trends and evolving market needs. TE Connectivity's heat shrink tubing solutions are designed to help ICT manufacturers meet a wide range of needs and conditions. Through deep engineering capabilities and a commitment to testing, specific design requirements and certifications are achieved with reliability and dependability. With three major manufacturing sites to cover key regions globally, TE offers strong global sales services for heat shrink tubing solutions, including great channel partner support.

TE Connectivity

TE Connectivity is a global technology leader offering complete product portfolios across a wide-range of industry applications. 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.

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