Heat Shrink
Product Selection Guide

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unified business foundation

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Heat Shrink Frequently Asked Questions:

1. What are the main considerations when installing heat shrink?

- Pick the right diameter. (See Wire Size Chart on page 5)
- Consider the overlap between the tube and the cable insulation
- Heat evenly around the tube
- If using a flame, use a diffuser and keep it moving; start further away from the tube and move closer gradually
- If it's adhesive lined product, the adhesive will be pushed away from the recovery starting point; in general, start recovering at the center and work toward each end

2. What's the significance of a material being cross linked?

The majority of heat shrink is made from cross linked materials. Cross linked materials do not melt and flow; they soften and become rubbery but still hold their basic shape. The main benefit is improved thermal, physical and chemical resistance.

3. Why is shrink temperature important?

A tube with a lower shrink temperature will generally shrink faster. Products with higher shrink temperatures generally have higher performance. With any heat shrink tube, you can increase the shrink speed by using hotter temperatures, within reason. Be sure to consider the heat resistance of components under or around the heat shrink.

4. Can the tube be damaged by overheating and what are the signs of overheating?

Excessive temperatures and long exposure times cause damage faster. Most tubes will withstand 200°C to 250°C for a couple of hours without significant damage. Overheating can be difficult to detect since damage may not be obvious. If using a torch, use a flame diffuser, keep the flame at a proper distance, and keep the flame moving to apply heat gradually. Heat guns are easier to work with but can still cause damage. Charring, blistering, or cracking of the surface is a definite sign of overheating and damage.

5. How does operating temperature range relate to shrink temperature?

If the operating temperature is above the shrink temperature of the tube, the tube will be in a soft rubbery state, and it will have lower mechanical properties and abrasion resistance.

6. What is the significance of shelf life?

Per AMS-DTL-23053, all tubes have a defined minimum shelf life, dependent on the base material. The main consideration is expanded and recovered dimensions. If the product meets requirements, the shelf life can be extended up to 50% of the original value and this can be done multiple times.

7. What's the maximum voltage at which I can use Panduit heat shrink?

Unless noted otherwise, all the products have a 600V AC rating. They are "low voltage" products. Per NEMA, Low Voltage is 600V or less; Medium Voltage is 2,400 to 69,000 V; and High Voltage is 115k to 230kV.

Dry Locations:
A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.

Damp Locations:
Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Examples of such locations include partially protected locations under canopies, marquees, roofed pen porches, and like locations, and interior locations subject to moderated degrees of moisture, such as basements, some barns, and some cold storage buildings.

Wet Locations:
Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather.

Material Selection Criteria

Applications	Heat Shrink Product Type	Material	Key Characteristics	Typical Applications	Standard Sizes Expanded ID	Applicable Specifications	RoHS	Halogen-Free	Low Smoke/ Low Toxicity	Standard Colors	Packaging Available	Operating Temp Range	Shrink Temp	Shrink Ratio	Shelf Life	Flammability	Chemical Resistance	Dielectric Strength
DRY	**HSTT**	Polyolefin (Cross-Linked)	Flexible, Flame Retardant UV Resistant (Black only) Class 2 (Clear) is not flame retardant	General use, strain relief, insulate, protect, bundle, and color code wires, cables and electrical components in a wide variety of applications	3/64" to 4" (1.2mm to 101.6mm)	UL Recognized (except clear) CSA Certified (except clear) *Mil. Spec: AMS-DTL-23053/5 Class 1 (colors) Class 2 (clear)	Yes	No	No	Black Clear Brown Red Orange Yellow Green Blue White Yellow/Green	6" pieces 4' lengths, 25' to 1000' reels depending on diameter	-67°F to 275°F (-55°C to 135°C)	194°F (90°C)	2:1	5 Years	Class 1 Self Extinguishing ASTM D2671 Procedure B Class 2 N/A	Fluid Resistance per AMS-DTL-23053 1000 psi min tensile ASTM D638 400 V/mil min. ASTM D2671	500 V/MIL. (19.7 Kv/mm) min. ASTM D2671
	HSTTV	Polyolefin (Cross-Linked)	Flexible, highly flame retardant UV Resistant (Black only)	Strain relief, insulate, protect, and bundle cables and electrical components in a wide variety of applications	3/64" to 1 1/2" (1.2mm to 38.1mm)	UL Recognized (VW-1) CSA Certified *Mil. Spec: AMS-DTL-23053/5 Class 3	Yes	No	No	Black Red Yellow Green Blue White	6" pieces 4' lengths 25' to 1000' reels depending on diameter	-67°F to 275°F (-55°C to 135°C)	194°F (90°C)	2:1	5 Years	Self Extinguishing ASTM D2671 Procedure C VW-1 per UL224	Fluid Resistance per AMS-DTL-23053 1000 psi min tensile ASTM D638 400 V/mil min. ASTM D2671	500 V/MIL. (19.7 Kv/mm) min. ASTM D2671
	HSTTP	Polyvinylchloride-PVC (Cross-Linked)	Flexible, stronger than polyolefin, highly flame retardant, highly conformable, resistant to most fuels and oils UV Resistant	Applications with PVC wire and cable insulation, strain relief, bundling and protection from UV light, fading, harsh chemicals, chlorinated cleaners, dirt and abrasion	3/64" to 2" (1.2mm to 50.8mm)	UL Recognized (VW-1) CSA Certified Mil. Spec: AMS-DTL-23053/2 Class 1	Yes	No	No	Black	25' to 1000' reels depending on diameter	-4°F to 221°F (-20°C to 105°C)	212°F (100°C)	2:1	1 Year	Self Extinguishing ASTM D876 VW-1 per UL224	Fluid Resistance per AMS-DTL-23053 1800 psi min tensile ASTM D638 280 V/mil min. ASTM D2671	400 V/MIL. (15.8 Kv/mm) min. ASTM D2671
	HSTTPN	Crystal Clear Polyvinylchloride-PVC	Flexible, stronger than polyolefin, highly flame retardant, crystal clear, resistant to many chemicals and oils Highly UV Resistant	Applications with PVC wire and cable insulation, smooth clear cover, protecting wire and cable markers, continuous inspection of splices, and protection from UV fading	0.46" to 1.80" (11.7mm to 45.7mm)	UL Recognized (VW-1) CSA Certified Mil. Spec: AMS-DTL-23053/2 Class 2	Yes	No	No	Clear	4.38" to 100' lengths	-4°F to 221°F (-20°C to 105°C)	212°F (100°C)	2:1	1 Year	Self Extinguishing 15 sec, 3 in VW-1 per UL 224	Fluid Resistance per AMS-DTL-23053 1800 psi min tensile ASTM D638 280 V/mil min. ASTM D2671	400 V/MIL. (15.8 Kv/mm) min. ASTM D2671
	HSTTN	Elastomer Neoprene (Cross-Linked)	Highly flexible even at low temperatures, highly abrasion and tear resistant, excellent chemical resistance especially to fuels, oils, acids, hydraulic fluids, and solvents UV Resistant	Insulate, protect wires, cables and electrical components in rugged applications, including military, marine and aerospace	1/4" to 3" (6.4mm to 76.2mm)	Mil. Spec: AMS-DTL-23053/1 Class 1 & Class 2	Yes	No	No	Black	25' and 100' reels	-94°F to 250°F (-70°C to 121°C)	275°F (135°C)	2:1	5** Years	N/A	Fluid Resistance per AMS-DTL-23053 1000 psi tensile 250% Elongation min ASTM D638 250 V/mil min. ASTM D2671	300 V/MIL. (11.8 Kv/mm) min. ASTM D2671
	HSTTT	Polytetrafluorethylene (TFE / PTFE)	Semi-rigid, highly chemical resistant, non flammable, ETO and autoclave sterilizable, widest temperature range of any plastic material, UV Resistant, low outgassing, and low coefficient of friction	Insulate, protect wires, cables and electrical components requiring high insulation, high and low temperature resistance including cryogenic temperatures, clean rooms and aerospace, and resistance to corrosive atmospheres	30 to 0 AWG and 9/16" to 1 112" (0.9mm to 38.1mm)	Mil. Spec: AMS-DTL-23053/12 Class 3	Yes	Yes***	Low Smoke	Opaque	4' lengths	-88°F to 482°F (-67°C to 250°C)	644°F (340°C)	2:1	4 Years	Non-Flammable (Highest flame retardancy of any plastic)	Fluid Resistance per AMS-DTL-23053, No Change	800 V/MIL. (31.5 Kv/mm) min. ASTM D2671
	HSTTK	Fluoroplastic Kynar (Cross-Linked)	Semi-rigid, high temperature resistance, excellent abrasion, radiation, UV, and chemical resistance, highly flame retardant, low outgassing, transparent insulation	Protection and strain relief for wires or connectors in plenum applications and severe environments, including nuclear plants, automotive, and electrical component jacketing	3/64" to 1" (1.2mm to 25.4mm)	UL Recognized (VW-1) *Mil. Spec: AMS-DTL-23053/8 Class 1 & 2	Yes	Yes***	Low Smoke	Clear	4' lengths	-67°F to 347°F (-55°C to 175°C)	275°F (135°C)	2:1	5 Years	Self Extinguishing ASTM D2671 Procedure C VW-1 per UL 224	Fluid Resistance per AMS-DTL-23053 5000 psi min tensile ASTM D638 500 V/mil min. ASTM D2671	Size to 12.7mm 800 V/MIL. (31.5 Kv/mm) min Over 12.7mm 600 V/MIL. (23.6 Kv/mm) min ASTM D2671
DAMP	**HSTTVA**	Polyolefin, Adhesive Lined (Cross-Linked) Amid, 105C melt, Amber Adhesive	Flexible, adhesive lined, highly flame retardant outer wall	Seals and protects cables, components and splices from moisture and corrosion, including automotive, truck, and marine applications, where greater flexibility is needed	1/8" to 1 1/2" (3.2mm to 38.1mm)	UL Recognized *Mil. Spec: AMS-DTL-23053/4 Class 2	Yes	No	No	Black	6" pieces 4' lengths	-67°F to 230°F (-55°C to 110°C)	248°F (120°C)	2:1	5 Years	Self Extinguishing ASTM D2671 Procedure B, Outer Wall UL224 VW-1	Fluid Resistance per AMS-DTL-23053 1000 psi min tensile ASTM D638 400 V/mil min. ASTM D2671	500 V/MIL. (19.7 Kv/mm) min. ASTM D2671
	HSTTA	Polyolefin, Adhesive Lined (Cross-Linked) Amid, 105C melt, Amber Adhesive	Flexible, adhesive lined, wide shrink ratio, highly flame retardant outer wall	Seals and protects cables, components and splices from moisture and corrosion, including automotive, truck, and marine applications	3/16" to 1 1/2" (4.8mm to 38.1mm)	UL Recognized *Mil. Spec: AMS-DTL-23053/4 Class 3	Yes	No	No	Black	6" pieces 4' lengths	-67°F to 230°F (-55°C to 110°C)	248°F (120°C)	3:1	5 Years	Self Extinguishing ASTM D2671 Procedure B, Outer Wall UL224 VW-1	Fluid Resistance per AMS-DTL-23053 900 psi min tensile ASTM D638 200 V/mil min. ASTM D2671	300 V/MIL. (11.8 Kv/mm) min. ASTM D2671
	HSTT4A	Polyolefin, Adhesive Lined (Cross-Linked) Amid, 105C melt, Amber Adhesive	Flexible, adhesive lined, widest shrink ratio, highly flame retardant outer wall	Seals and protects cables, components and splices from moisture and corrosion, including automotive, truck, and marine applications, especially when working with large transitions	0.158" to 2.05" (4.0mm to 52.0mm)	UL Recognized *Mil. Spec: AMS-DTL-23053/4 Class 3	Yes	No	No	Black	4' lengths	-67°F to 257°F (-55°C to 125°C)	248°F (120°C)	4:1	5 Years	Self Extinguishing ASTM D2671 Procedure B, Outer Wall UL224 VW-1	Fluid Resistance per AMS-DTL-23053 900 psi min tensile ASTM D638 200 V/mil min. ASTM D2671	300 V/MIL. (11.8 Kv/mm) min. ASTM D2671
	HSTTRA	Polyolefin, Adhesive Lined (Cross-Linked) Amid, 105C melt, Amber Adhesive	Semi-rigid, tough, adhesive lined, flame retardant outer wall	Seals, protects and encapsulates cables, components and splices from moisture and corrosion. Heavy strain relief and rugged protection against vibration and flexing.	1/8" to 1" (3.2mm to 25.4mm)	UL Recognized *Mil. Spec: AMS-DTL-23053/4 Class 1	Yes	No	No	Black	4' lengths	-67°F to 230°F (-55°C to 110°C)	257°F (125°C)	2.5:1	5 Years	Outer Wall UL224 VW-1	Fluid Resistance per AMS-DTL-23053 1000 psi min tensile ASTM D638 400 V/mil min. ASTM D2671	500 V/MIL. (19.7 Kv/mm) min. ASTM D2671
WET	**HST**	Polyolefin, Adhesive Lined (Cross-Linked) EVA, 119C melt, Light Tan Adhesive	Rigid, thick wall, adhesive lined, highly flame retardant and sunlight resistant. UL and CSA surface markings.	Seals, encapsulates and protects electrical connections and splices above or below ground. Especially in harsh environments such as wind energy and solar applications. Can be used at 1kV.	0.4" to 3.5" (10.2mm to 88.9mm)	UL Recognized (VW-1 & Sunlight Resistant, black only) UL 486D Listed (Direct Burial) CSA Certified (except 3.0 & 3.5) Mil Spec: AMS-DTL-23053/15 Class 1	Yes	No	No	Black Red	3" pieces 6" pieces 9" pieces 12" pieces 4' lengths	-67°F to 230°F (-55°C to 110°C)	248°F (120°C)	3:1	10 Years	Self Extinguishing ASTM D2671 Procedure C VW-1 per UL 224	Fluid Resistance per AMS-DTL-23053 750 psi min tensile ASTM D638 200 V/mil min. ASTM D2671	200 V/MIL. (7.9 Kv/mm) min. ASTM D2671
	HSEC (End Cap)	Polyolefin, Adhesive Lined (Cross-Linked) EVA, 105C melt, Light Tan Adhesive	Semi-rigid, adhesive lined	Temporary or permanent watertight sealing of cable ends, pipe and conduit	0.47" to 3.92" (11.9mm to 99.6mm)	N/A	Yes	No	No	Black	Size dependent	-40°F - 257°F (-40°C - 125°C)	248°F (120°C)	2.5:1	5 Years	N/A	N/A	N/A
	HSECFR (End Cap)	Polyolefin, Adhesive Lined (Cross-Linked) EVA, 119C, Light Tan adhesive	Rigid, thick wall, adhesive lined, highly flame retardant, color changing lines for optimal recovery	Temporary or permanent watertight sealing of cable ends, pipe and conduit, in harsh environments	0.51" to 2.0" (13mm to 50.8mm)	UL Recognized	Yes	No	No	Black	Size dependent	-67°F to 230°F (-55°C to 110°C)	248°F (120°C)	3:1	5 Years	UL94 V-0 Material	N/A	N/A

*Material Performance only.

***Halogen Free as defined by IEC 61249-2-21
900 ppm max chlorine
900 ppm max bromine
1500 ppm max combined halogens
(Fluorine is excluded)

**Excluding HSTTN300 which is 2 years.

For more detailed information, visit the Panduit website at www.panduit.com/heatshrink

Wire Size Chart

THHW – Indicates a fine strand flexible wire with thermoplastic insulation. Moisture, oil and acid resistant. Rated 105°C wet or dry.

THW – Indicates a single conductor having flame-retardant, moisture and heat-resistant thermoplastic insulation. The wire is rated 75°C wet or dry.

TW – Indicates a single conductor having flame-retardant, moisture-resistant thermoplastic insulation. The wire is rated 60°C wet or dry.

TFN – Indicates a thermoplastic-insulated wire. The wire is rated at a 90°C maximum operating temperature.

THHN – Indicates a single conductor having flame-retardant and heat-resistant thermoplastic insulation with a jacket of extruded nylon or equivalent material. The wire is rated 90°C dry only.

	Approximate Wire Outside Diameter In. (mm)			
	With THW/ THHW/TW Insulation	WIth TFN/ THHN/THWN Insulation	Uninsulated Conductors, Range	
Size			Min.	Max.
24 AWG	0.059 (1.5)	0.088 (2.2)	0.020 (0.5)	0.024 (0.6)
22 AWG	0.066 (1.7)	0.094 (2.4)	0.025 (0.6)	0.031 (0.8)
20 AWG	0.071 (1.8)	0.101 (2.6)	0.032 (0.8)	0.038 (1.0)
18 AWG	0.084 (2.1)	0.111 (2.8)	0.040 (1.0)	0.049 (1.2)
16 AWG	0.096 (2.4)	0.124 (3.1)	0.051 (1.3)	0.060 (1.5)
14 AWG	0.111 (2.8)	0.133 (3.4)	0.064 (1.6)	0.073 (1.9)
12 AWG	0.130 (3.3)	0.152 (3.9)	0.081 (2.1)	0.095 (2.4)
10 AWG	0.164 (4.2)	0.176 (4.5)	0.102 (2.6)	0.116 (2.9)
8 AWG	0.216 (5.5)	0.236 (6.0)	0.128 (3.3)	0.146 (3.7)
6 AWG	0.254 (6.5)	0.304 (7.7)	0.162 (4.1)	0.184 (4.7)
4 AWG	0.324 (8.2)	0.352 (8.9)	0.204 (5.2)	0.232 (5.9)
3 AWG	0.352 (8.9)	0.380 (9.7)	0.229 (5.8)	0.260 (6.6)
2 AWG	0.384 (9.8)	0.420 (10.7)	0.258 (6.6)	0.292 (7.4)
1 AWG	0.446 (11.3)	0.492 (12.5)	0.289 (7.3)	0.332 (8.4)
1/0	0.486 (12.3)	0.532 (13.5)	0.325 (8.3)	0.373 (9.5)
2/0	0.532 (13.5)	0.578 (14.7)	0.365 (9.3)	0.418 (10.6)
3/0	0.584 (14.8)	0.630 (16.0)	0.410 (10.4)	0.470 (11.9)
4/0	0.642 (16.3)	0.688 (17.5)	0.460 (11.7)	0.528 (13.4)
250 MCM	0.711 (18.1)	0.765 (19.4)	0.500 (12.7)	0.575 (14.6)
300 MCM	0.766 (19.5)	0.820 (20.8)	0.548 (13.9)	0.630 (16.0)
350 MCM	0.817 (20.8)	0.871 (22.1)	0.592 (15.0)	0.681 (17.3)
400 MCM	0.864 (21.9)	0.918 (23.3)	0.633 (16.1)	0.728 (18.5)
500 MCM	0.949 (24.1)	1.003 (25.5)	0.707 (18.0)	0.813 (20.7)
600 MCM	1.051 (26.7)	1.113 (28.3)	0.775 (19.7)	0.893 (22.7)
700 MCM	1.122 (28.5)	1.184 (30.1)	0.837 (21.3)	0.964 (24.5)
750 MCM	1.156 (29.4)	1.218 (30.9)	0.866 (22.0)	0.998 (25.3)
800 MCM	1.188 (30.2)	1.250 (31.8)	0.894 (22.7)	1.031 (26.2)
900 MCM	1.252 (31.8)	1.314 (33.4)	0.949 (24.1)	1.093 (27.8)
1000 MCM	1.310 (33.3)	1.372 (34.8)	1.000 (25.4)	1.152 (29.3)
1250 MCM	—	1.539 (39.1)	1.121 (28.5)	1.289 (32.7)
1500 MCM	—	1.662 (42.2)	1.228 (31.2)	1.412 (35.9)
1750 MCM	—	1.776 (45.1)	1.327 (33.7)	1.526 (38.8)
2000 MCM	—	1.882 (47.8)	1.419 (36.0)	1.632 (41.5)

THWN – Indicates a single conductor having flame-retardant, moisture and heat-resistant thermoplastic insulation with a jacket of extruded nylon or equivalent material. The wire is rated 75°C wet or dry. THWN wire suitable for exposure to mineral oil and to liquid gasoline and gasoline vapors at ordinary ambient temperature is marked “Gasoline and Oil Resistant I” if suitable for exposure to mineral oil at 60°C, or “Gasoline and Oil Resistant II” if the compound is suitable for exposure to mineral oil at 75°C. Gasoline-resistant wire has been tested at 23°C when immersed in gasoline. It is considered inherently resistant to gasoline vapors within the limits of the temperature rating.

Heat Shrink Sizing Example

Generally, the largest tube that shrinks down tightly onto an object should be chosen. This allows the heat shrink tubing maximum stress relief and this will yield the longest service life.

Example:
A multi-conductor cable needs to be covered with HSTT Type Dry-Shrink™ Heat Shrink. The area to be covered has a measured outside diameter of .700" (17.8mm). The two possibilities are HSTT75-48-5 and HSTT100-48-5.

Part Number	Expanded I.D In. (mm)	Recovered I.D. In. (mm)
HSTT75-48-5	.750 (19.1)	.375 (9.5)
HSTT100-48-5	1.00 (25.4)	.500 (12.7)

The proper choice is HSTT100-48-5 since the tube will recover more than HSTT75-48-5. The HSTT75-48-5 will fit over the .700 inch (17.8mm) outside diameter; however, this is not the proper choice since it is smaller than the HSTT100-48-5. In general, heat shrink should recover at least 10% – 20% to reduce stress and yield the longest service life and thicker walls, resulting in thicker insulation, more abrasion protection, and more strain relief.

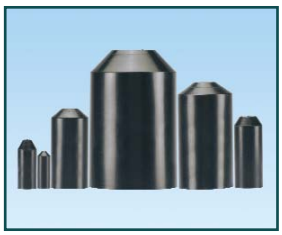
Related Products

Abrasion Protection:

- Variety of products ranging from Pan-Wrap™ to Non-Shrink Tubing
- Provides protection in various applications to protect wires/cables

Heat Gun and Accessories:

- Gun allows heating of the tubing without burning or charring
- Attachments reflect the heat around tubing to reduce shrink time



HSEC:

- Protects ends of wires/cables temporarily
- Adhesive lined to keep out moisture
- 2.5:1 Shrink ratio

HSECFR:

- Protects ends of wires/cables temporarily
- Adhesive lined to keep out moisture
- 3:1 shrink ratio flame retardant material

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