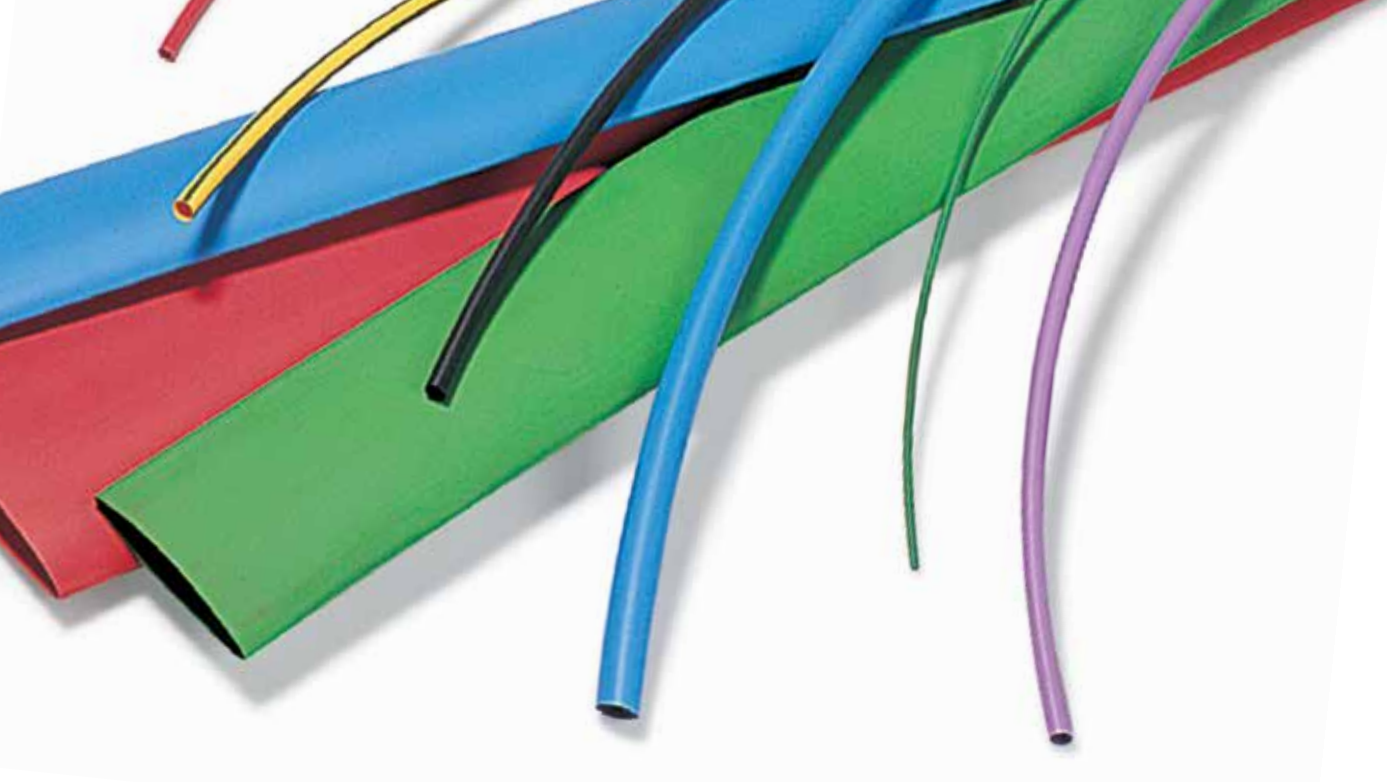


Routing, Protection and Insulation

Heat Shrink Tubing

Protection and insulation of wires and cables

HellermannTyton



Heat Shrink Tubing

Heat shrink tubing is an excellent solution for providing strain relief, insulation and protection of wires and cables. Robust and flexible, a wide range of industries use heat shrink tubing for splice and termination applications.

HellermannTyton's non-printable heat shrink tubing product range consists of cross linked polyolefin materials in an array of shrink ratios and package configurations, including mini reels, sticks, bulk reels, convenience bags and assortment kits. Whatever the size or scale of the project, HellermannTyton has a heat shrink tubing solution designed to meet the most challenging of conditions.

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2:1 SHRINK RATIO – THIN WALL

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Market Applications

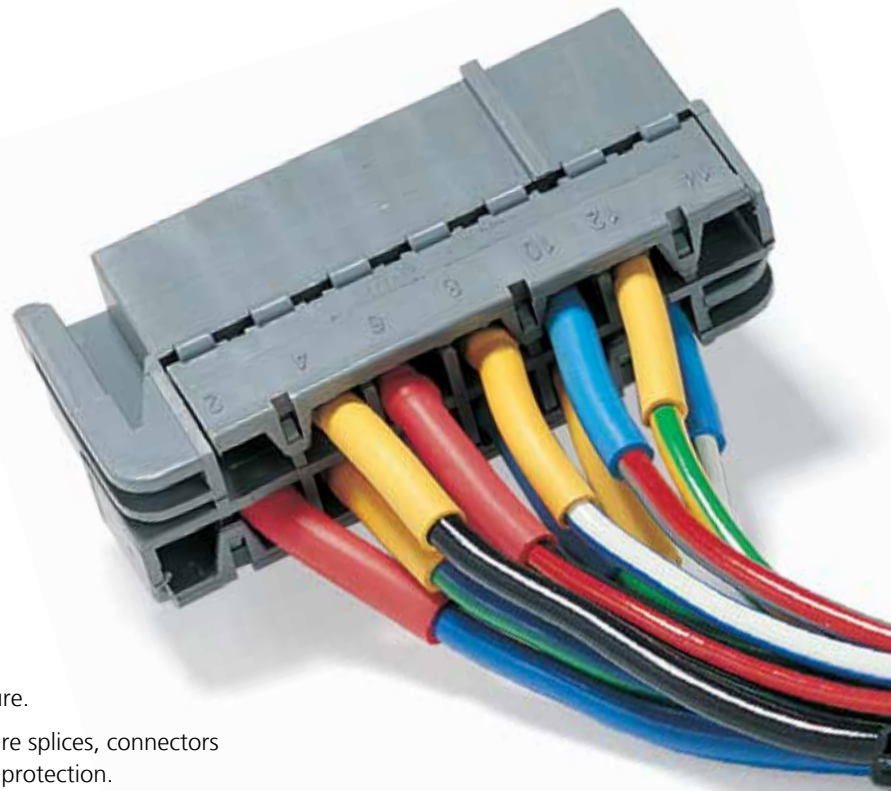
- White Goods / Appliances
- Mass Transit
- Renewable Energy
- Telecommunications
- Automotive
- Electrical
- Electronics

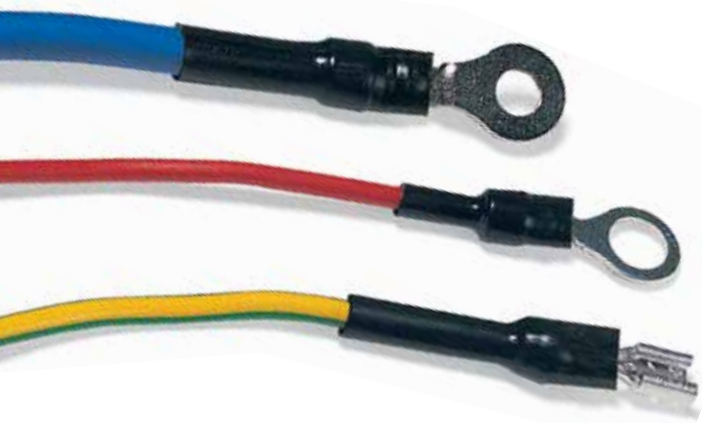
Product Applications

- **Insulation / Sealing:** Provides a high level of protection against the ingress of dirt and moisture.
- **Protection:** Offers mechanical strain relief of wire splices, connectors and cable jacketing; provides excellent abrasion protection.
- **Identification:** Color options allow for color coding and wire and cable marking.

Key Features & Benefits

- **Flexible Material:** Polyolefin allows for quick and easy installations for OEM and maintenance operations, reducing installation and assembly costs.
- **Flame Retardant:** All thin walled heat shrink tubing by HellermannTyton is highly flame retardant, meeting the requirements of UL224 VW-1.
- **Chemical Resistance:** Polyolefin demonstrates good resistance against common chemicals, fluids and acids.
- **Insulation:** Heat shrink tubing blocks out moisture and humidity. Adhesive-lined heat shrink tubing provides a superior level of protection against environmental elements as it melts and encapsulates the substrate.





Selecting the Right Heat Shrink Tubing

When selecting heat shrink tubing, it is important to consider several factors; the application and the cable/wire's diameter are primary considerations. Another important factor is the 80:20 Rule.

Determine the type of heat shrink tubing needed for the application.

- **2:1 Shrink Ratio:** Faster shrink time reduces installation time and potential damage to heat sensitive components.
- **3:1 Shrink Ratio:** Covers a broader range of substrates and irregular shapes. Greater recovered wall thickness versus 2:1 tubing. Offers better abrasion resistance and protection than 2:1 tubing.
- **Thin Wall:** Most flexible of the polyolefin tubing materials. Shrinks quickly. Easily fits over uneven components during shrink/recovery state.
- **Medium Wall and Thick Wall:** Semi-rigid material provides a more robust solution with greater durability and mechanical strength; often required in exposed or buried applications. Offers greater protection than thin wall tubing.
- **Adhesive-lined:** Also referred to as dual walled. The adhesive typically begins to melt at a temperature lower than the outer wall, allowing it to flow into voids and spaces to create a more secure seal.

Consider the wire/cable size.

Let's say you have a cable with a diameter size of 0.118" (3.0 mm) that requires heat shrink tubing. You will need to find tubing that has a larger Supplied Diameter (D) than the cable.

Look for a smaller Recovered Diameter than the cable/wire.

When selecting heat shrink tubing from the product charts in this catalog, a good place to start is by looking at the Recovered Diameter (d). The Recovered Diameter is the most the tubing will shrink (the smallest size it will shrink to) when heat is applied. For heat shrink tubing to work properly it needs to fit snugly on the cable/wire, so choose tubing with a Recovered Diameter that is smaller than the diameter of your cable/wire.

For instance, if you have a 0.118" (3.0 mm) cable to cover, a reasonable choice would be tubing with a Recovered Diameter of 0.079" (2.0 mm), which is slightly smaller than your cable. TFN31 tubing part number 333-41501 (listed on page 11) has a Recovered Diameter of 0.079" (2.0 mm). And, the Supplied Diameter for this tubing (333-41501) happens to be 0.24" (6.0 mm), which also meets the preceding criterion by being larger than our cable size.

Calculate the 80:20 shrinkage.

For best performance and results, heat shrink tubing has an optimal shrink range. It should shrink by a maximum of 80% and a minimum of 20%. Therefore, it is important to factor in the 80:20 Rule when selecting heat shrink tubing.

To identify the optimal 80:20 shrink range for any heat shrink tubing, all you need is the tubing's Supplied Diameter (D) and Recovered Diameter (d). The shrink ratio (2:1, 3:1, etc.) does not enter into this equation.

The optimal 80:20 range for any heat shrink tubing can be calculated using 5 simple steps on the next page. The measurements are from the OUR EXAMPLE box.

IMPERIAL TO METRIC CONVERSIONS

IMPERIAL TO METRIC CONVERSIONS FOR 3:1 SHRINK RATIO TUBING

in	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
mm	1.5	2	2.5	3	4.5	6	9	12	15	18	24	32	40

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

How to Calculate the 80:20 Shrinkage

OUR EXAMPLE:

For this example, we are using Metric measurements (mm) for calculations, but Imperial measurements (in.) could also be used.

Cable Diameter: 0.118" (3.0 mm)

Heat Shrink Tubing Trade Size: ¼"

Supplied Diameter: (D): 0.24" (6.0 mm)

Recovered Diameter: (d): 0.079" (2.0 mm)

STEP 1: Calculate the Net Diameter.

Subtract the Recovered Diameter of the heat shrink tubing from the Supplied Diameter. This will give you the Net Diameter.

Supplied Diameter (D) - Recovered Diameter (d) = Net Diameter

$$6 - 2 = 4$$

STEP 2: Calculate the Minimum Variable.

Multiply the Net Diameter by .20 to get the Minimum Variable.

$$4 \times .20 = .8$$

STEP 3: Calculate the Maximum Variable.

Multiply the Net Diameter by .80 to get the Maximum Variable.

$$4 \times .80 = 3.2$$

STEP 4: Calculate the Minimum Bundle Size.

Add the Recovered Diameter (d) and the Minimum Variable to get the Minimum Bundle Size.

$$2 + .8 = 2.8$$

STEP 5: Calculate the Maximum Bundle Size.

Add the Recovered Diameter (d) and the Maximum Variable to get the Maximum Bundle Size.

$$2 + 3.2 = 5.2$$

THE RESULTS:

Given the calculations using the 80:20 Rule, the heat shrink tubing in our example would be appropriate for our **3.0 mm** cable because the size falls within the optimal shrink range.

To put it another way:

The **Minimum Bundle Size** for this tubing would be 2.8 mm (0.11"). 2.8 mm is the smallest cable/wire diameter that should be used with this tubing.



The **Maximum Bundle Size** for this tubing would be 5.2 mm (0.20"). 5.2 mm is the largest cable/wire diameter that should be used with this tubing.



80:20 REFERENCE CHARTS

For convenience, we have created the reference charts below that factor in the 80:20 Rule range for many common wire/cable sizes.

2:1 Shrink Ratio		
Cable / Wire Diameter	Heat Shrink Tubing Trade Sizes	
.002" (0.07 mm)	1.2 mm/0.6 mm	
.043" (1.1 mm)	3/64"	
.055" (1.4 mm)		2.4 mm/1.2 mm 3/32"
.074" (1.9 mm)	3.2 mm/1.6 mm 1/8"	4.8 mm/2.4 mm 3/16"
.086" (2.2 mm)		
.114" (2.9 mm)	6.4 mm/3.2 mm 1/4"	9.5 mm/4.7 mm 3/8"
.149" (3.8 mm)		
.169" (4.3 mm)	12.7 mm/6.4 mm 1/2"	19.1 mm/9.5 mm 3/4"
.224" (5.7 mm)		
.228" (5.8 mm)	25.4 mm/12.7 mm 1"	38.1 mm/19.1 mm 1.5"
.303" (7.7 mm)		
.338" (8.6 mm)	50.8 mm/25.4 mm 2"	
.448" (11.4 mm)		
.598" (15.2 mm)		
.677" (17.2 mm)		
.901" (22.9 mm)		
1.20" (30.5 mm)		
1.35" (34.3 mm)		
1.79" (45.7 mm)		

3:1 Shrink Ratio		
Cable / Wire Diameter	Heat Shrink Tubing Trade Sizes	
0.002" (0.7 mm)	1.5 mm/0.5 mm	
0.051" (1.3 mm)	1/16"	
0.055" (1.4 mm)		3 mm/1 mm 1/8"
0.102" (2.6 mm)		
0.110" (2.8 mm)	6 mm/2 mm 3/16"	9 mm/3 mm 3/8"
0.165" (4.2 mm)		
0.189" (4.8 mm)	12 mm/4 mm 1/2"	18 mm/6 mm 3/4"
0.204" (5.2 mm)		
0.220" (5.6 mm)	24 mm/8 mm 1"	9 mm/13 mm 1 1/4"
0.307" (7.8 mm)		
0.330" (8.4 mm)		
0.409" (10.4 mm)		
0.440" (11.2 mm)		
0.614" (15.6 mm)		
0.716" (18.2 mm)		
0.819" (20.8 mm)		
1.33" (33.8 mm)		

NOTE ON TRADE SIZES

For quick reference, heat shrink tubing is often identified by nominal Trade Size. Trade Sizes are approximations of the tubing's Supplied Diameter (D) and Recovered Diameter (d), and can be listed in both Metric and Imperial measurements (fractional and decimal), as such: 6/2 (mm) or ¼" or 0.24".

Heat Shrink Tubing Selection Guide

Properties	Silicone Free	Copper Compatibility Non-corrosive	Solvents	UV Light	Acids & Bases	Flammability Rating	Fuels	Shrink Ratio	Electrical Insulation	Strain Relief	Protection Against Moisture	Shrink Temp (Minimum Full Recovery)	Operating Range
TFN31 Basic Kit	X	X	O	•	•	Self Extinguishing	O	3:1	X	X		212° F / 100° C	-67° F to 275° F (-55° C to 135° C)
TFN31 Universal Kit	X	X	O	•	•	Self Extinguishing	O	3:1	X	X		212° F / 100° C	-67° F to 275° F (-55° C to 135° C)
HIS-3 BAGS	X	X	O	•	•	UL224 VW-1**	•	3:1	X	X		212° F / 100° C	-67° F to 275° F (-55° C to 135° C)
TFN31 Reels & Sticks	X	X	O	•	•	UL224 VW-1	•	3:1	X	X		212° F / 100° C	-67° F to 275° F (-55° C to 135° C)
TAN33 Sticks	X	X	•	•	•	UL224 VW-1*	O	3:1	X	X	X	230° F / 110° C	-67° F to 257° F (-55° C to 125° C)
TFN21 Reels & Sticks	X	X	•	•	•	UL224 VW-1**	•	2:1	X	X		212° F / 100° C	-67° F to 275° F (-55° C to 135° C)
TCN20 Reels	X	X	O	•	•	UL224 VW-1	O	2:1	X			212° F / 100° C	-67° F to 257° F (-55° C to 125° C)
MA47 Sticks	X	X	O	•	•		•	4:1	X	X	X	248° F / 120° C	-67° F to 230° F (-55° C to 110° C)
HA47 Sticks	X	X	O	•	•		•	3.5:1	X	X	X	248° F / 120° C	-67° F to 230° F (-55° C to 110° C)

KEY:

X	Yes
•	Good
O	Limited
*	Outer wall only
**	Except clear

All heat shrink tubing in this catalog is cross linked using E-Beam technology.

An E-Beam is an electron beam that is used to cross link the molecular structure of the polymer. Traditional methods can include chemical cross linking, but HellermannTyton uses E-Beam technology which is the preferred process, providing the highest quality levels.

HellermannTyton offers retail merchandiser displays for heat shrink sticks.

For more information, contact your HellermannTyton sales representative or call 800-537-1512.

Heat Shrink Tubing - 3:1 Shrink Ratio

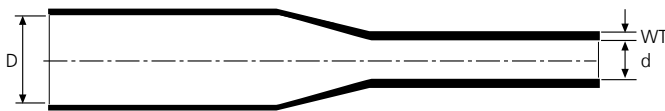
TFN31 Basic Kit Non-adhesive Thin Wall

The TFN31 basic kit contains an assortment of black 3 to 1 tubing in a variety of diameter sizes and lengths.

Heat shrink kits are a convenient solution for “on-the-job” projects. This 3 to 1 shrink ratio tubing features a flexible, thin wall to cover a wide range of components, sizes and shapes. The polyolefin material has a higher operating temperature range than general-use heat shrink tubing.

Features and Benefits

- The basic kit contains 220 pieces of black polyolefin heat shrink tubing in assorted diameter sizes and lengths.
- The 3 to 1 shrink ratio covers a wide range of components, sizes and shapes.
- Material is self-extinguishing, for use in applications in which non-flammable materials are required.
- Case included for easy storage and transport.



Material Data	
Material	Polyolefin, cross linked (POX)
Shrink Ratio	3:1
Longitudinal Change After Shrinkage	+5% / -10% max
Minimum Shrink Temperature	194° F (90° C)
Operating Temperatures	-67° F to 275° F (-55° C to 135° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 2671
Flammability	Self Extinguishing



Product Selection													
Part No.	Type	Compartment	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Length		Color	Number of Tubes
				in.	mm	in.	mm	in.	mm	in.	mm		
380-03001	321-KIT-BASIC	1	1/16	0.06	1.5	0.02	0.5	0.018	0.45	1.38	35.0	Black	50
		2	1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	Black	30
		3	1/8	0.12	3.0	0.04	1.0	0.022	0.55	1.38	35.0	Black	25
		4	1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	Black	15
		5	1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	Black	15
		6	1/8	0.12	3.0	0.04	1.0	0.022	0.55	1.38	35.0	Black	25
		7	1/16	0.06	1.5	0.02	0.5	0.018	0.45	1.38	35.0	Black	50
		8	3/4	0.71	18.0	0.24	6.0	0.031	0.80	3.15	80.0	Black	5
		8	1/2	0.47	12.0	0.16	4.0	0.028	0.70	3.15	80.0	Black	5

IMPERIAL TO METRIC CONVERSIONS FOR 3:1 SHRINK RATIO TUBING

in	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
mm	1.5	2	2.5	3	4.5	6	9	12	15	18	24	32	40

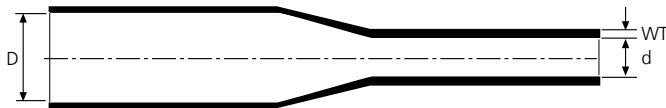
TFN31 Universal Kit Non-adhesive Thin Wall

The TFN31 universal kit contains an assortment of 3 to 1 tubing in different diameter sizes, colors and lengths.

Heat shrink kits are a convenient solution for “on-the-job” projects. This 3 to 1 shrink ratio tubing features a flexible, thin wall to cover a wide range of components, sizes and shapes. The polyolefin material has a higher operating temperature range than general-use heat shrink tubing

Features and Benefits

- The universal kit contains 177 pieces of tubing in assorted colors, diameter sizes and lengths.
- The 3 to 1 shrink ratio covers a wide range of components, sizes and shapes.
- Material is self-extinguishing, for use in applications in which non-flammable materials are required.
- Case included for easy storage and transport.



Material Data	
Material	Polyolefin, cross linked (POX)
Shrink Ratio	3:1
Longitudinal Change After Shrinkage	+5% / -10% max
Minimum Shrink Temperature	194° F (90° C)
Operating Temperatures	-67° F to 275° F (-55° C to 135° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 2671
Flammability	Self Extinguishing



Heat Shrink Tubing – 3:1 Shrink Ratio

Product Selection													
Part No.	Type	Compartment	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Length		Color	Number of Tubes
				in.	mm	in.	mm	in.	mm	in.	mm		
380-03005	321-KIT-ASST	1	1/2	0.47	12.0	0.16	4.0	0.028	0.70	1.38	35.0	Black	12
		2	1/4	0.24	6.0	0.08	2.0	0.028	0.70	3.15	80.0	Blue	5
			1/4	0.24	6.0	0.08	2.0	0.028	0.70	3.15	80.0	Red	5
			1/4	0.24	6.0	0.08	2.0	0.028	0.70	3.15	80.0	White	5
			1/2	0.47	12.0	0.16	4.0	0.028	0.70	3.15	80.0	Black	2
			1/2	0.47	12.0	0.16	4.0	0.028	0.70	3.15	80.0	Blue	2
			1/2	0.47	12.0	0.16	4.0	0.028	0.70	3.15	80.0	Red	2
		3	1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	Blue	10
			1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	White	10
			1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	Red	10
		4	3/8	0.35	9.0	0.12	3.0	0.028	0.70	1.38	35.0	Green-Yellow	15
		5	3/8	0.35	9.0	0.12	3.0	0.028	0.70	1.38	35.0	Black	20
		6	1/8	0.12	3.0	0.04	1.0	0.022	0.55	1.38	35.0	Black	10
			1/8	0.12	3.0	0.04	1.0	0.022	0.55	1.38	35.0	Red	10
			1/8	0.12	3.0	0.04	1.0	0.022	0.55	1.38	35.0	White	10
			1/8	0.12	3.0	0.04	1.0	0.022	0.55	1.38	35.0	Blue	10
		7	1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	Black	20
			1/4	0.24	6.0	0.08	2.0	0.028	0.70	1.38	35.0	Green-Yellow	10
		8	3/4	0.71	18.0	0.24	6.0	0.031	0.80	6.30	160.0	Black	3
			3/4	0.71	18.0	0.24	6.0	0.031	0.80	6.30	160.0	White	3
			3/4	0.71	18.0	0.24	6.0	0.031	0.80	6.30	160.0	Green-Yellow	3

IMPERIAL TO METRIC CONVERSIONS FOR 3:1 SHRINK RATIO TUBING

in	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
mm	1.5	2	2.5	3	4.5	6	9	12	15	18	24	32	40

Heat Shrink Tubing – 3:1 Shrink Ratio

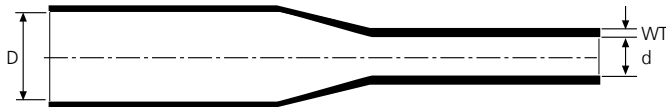
TFN31 HIS-3 Bags Non-adhesive Thin Wall

TFN31 HIS-3 bags are packaged in smaller lengths, in a convenient bag for small projects and easy merchandising.

TFN31 series tubing features a flexible, thin wall and highly flame retardant material with a higher operating temperature range than general-use heat shrink tubing. The 3 to 1 shrink ratio accommodates a variety of component shapes and sizes.

Features and Benefits

- Thin wall 3 to 1 shrink material is extremely flexible and accommodates a wide range of component shapes and diameters.
- Meets UL224 VW-1 specifications for flame retardancy, for use in high heat applications (excludes clear tubing).
- Polyolefin material provides excellent insulation and mechanical strength with good resistance to solvents, oils and fuels.
- Packaged in a printed plastic bag with hang hole for easy merchandising.



Material Data	
Material	Polyolefin, cross linked (POX)
Shrink Ratio	3:1
Longitudinal Change After Shrinkage	+5%
Minimum Shrink Temperature	212° F (100° C)
Operating Temperatures	-67° F to 275° F (-55° C to 135° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 150
Flammability	UL224 VW-1 600V (except clear)
Standards	Meets SAE-AMS-DTL-23053/5 Class 1 & 3



Product Selection

Part No.	Type	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Length		Quantity per Pack
		in.	in.	mm	in.	mm	in.	mm		in.	mm	
308-30320	HIS-3-BAG-3/1 BK	1/8	0.13	3.2	0.039	1.0	0.022	0.55	Black	6.0	153.0	10
308-30420	HIS-3-BAG-4.5/1.5 BK	3/16	0.188	4.8	0.059	1.5	0.024	0.6	Black	6.0	153.0	10
308-30620	HIS-3-BAG-6/2 BK	1/4	0.25	6.4	0.079	2.0	0.026	0.65	Black	6.0	153.0	10
308-30920	HIS-3-BAG-9/3 BK	3/8	0.38	9.5	0.118	3.0	0.029	0.75	Black	6.0	153.0	10
308-31220	HIS-3-BAG-12/4 BK	1/2	0.5	12.7	0.157	4.0	0.031	0.8	Black	6.0	153.0	10
308-30321	HIS-3-BAG-3/1 CL	1/8	0.13	3.2	0.039	1.0	0.022	0.55	Clear	6.0	153.0	10
308-30421	HIS-3-BAG-4.5/1.5 CL	3/16	0.188	4.8	0.059	1.5	0.024	0.6	Clear	6.0	153.0	10
308-30621	HIS-3-BAG-6/2 CL	1/4	0.25	6.4	0.079	2.0	0.026	0.65	Clear	6.0	153.0	10
308-30921	HIS-3-BAG-9/3 CL	3/8	0.38	9.5	0.118	3.0	0.029	0.75	Clear	6.0	153.0	10
308-31221	HIS-3-BAG-12/4 CL	1/2	0.5	12.7	0.157	4.0	0.031	0.8	Clear	6.0	153.0	10

IMPERIAL TO METRIC CONVERSIONS FOR 3:1 SHRINK RATIO TUBING

in	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
mm	1.5	2	2.5	3	4.5	6	9	12	15	18	24	32	40

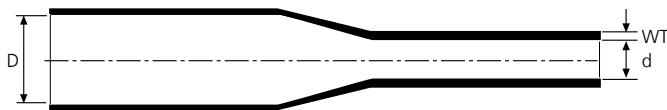
Heat Shrink Tubing – 3:1 Shrink Ratio

TFN31 Reels Non-adhesive Thin Wall

TFN31 heat shrink tubing has a flexible, thin wall and a 3 to 1 shrink ratio to accommodate a variety of component shapes and diameters. Made of a highly flame retardant material, this tubing offers abrasion and insulation protection for wires and cables. The polyolefin material also offers good resistance to solvents, oils and fuels.

Features and Benefits

- Thin wall, flexible 3 to 1 shrink ratio material accommodates a wide range of component shapes and diameters.
- Meets UL224 VW-1 specifications, making it ideal for high heat applications.
- Polyolefin material provides excellent insulation and mechanical strength with good resistance to solvents, oils and fuels.
- Available in mini or bulk reels, for small to large volume applications.



Material Data	
Material	Polyolefin, cross linked (POX)
Shrink Ratio	3:1
Longitudinal Change After Shrinkage	+5%
Minimum Shrink Temperature	212° F (100° C)
Operating Temperatures	-67° F to 275° F (-55° C to 135° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 150
Flammability	UL224 VW-1 600V (except clear)
Standards	Meets SAE-AMS-DTL-23053/5 Class 1 & 3



Product Selection		Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity		
Part No.	Type		in.	mm	in.	mm	in.	mm		ft.	m	
333-41500	TFN31-3/1 BK	1/8	3.2	0.13	3.2	0.039	1.0	0.022	0.55	Black	1000	304.8
333-41501	TFN31-6/2 BK	1/4	6.4	0.25	6.4	0.079	2.0	0.026	0.65	Black	1000	304.8
333-41502	TFN31-9/3 BK	3/8	9.5	0.38	9.5	0.118	3.0	0.029	0.75	Black	500	152.4
333-41503	TFN31-12/4 BK	1/2	12.7	0.5	12.7	0.157	4.0	0.031	0.8	Black	300	91.4
333-41504	TFN31-18/6 BK	3/4	19.1	0.75	19.1	0.236	6.0	0.035	0.9	Black	200	61.0
333-41505	TFN31-24/8 BK	1	25.4	1.0	25.4	0.315	8.0	0.047	1.2	Black	200	61.0
333-41506	TFN31-39/13 BK	1-1/2	39.0	1.5	39.0	0.512	13.0	0.049	1.25	Black	100	30.5

IMPERIAL TO METRIC CONVERSIONS FOR 3:1 SHRINK RATIO TUBING

in	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
mm	1.5	2	2.5	3	4.5	6	9	12	15	18	24	32	40

Heat Shrink Tubing – 3:1 Shrink Ratio

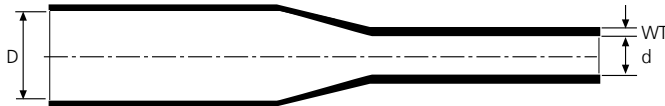
TFN31 Sticks Non-adhesive Thin Wall

TFN31 heat shrink tubing has a flexible, thin wall and a 3 to 1 shrink ratio to accommodate a variety of component shapes and diameters. Made of a highly flame retardant material, this tubing offers abrasion and insulation protection for wires and cables. The polyolefin material also offers good resistance to solvents, oils and fuels.



Features and Benefits

- Thin wall 3 to 1 shrink material is extremely flexible and accommodates a wide range of component shapes and diameters.
- Meets UL224 VW-1 specifications, making it ideal for high heat applications.
- Polyolefin material provides excellent insulation and mechanical strength with good resistance to solvents, oils and fuels.
- 4-foot sticks are individually tagged for retail.



Material Data	
Material	Polyolefin, cross linked (POX)
Shrink Ratio	3:1
Longitudinal Change After Shrinkage	+5%
Minimum Shrink Temperature	212° F (100° C)
Operating Temperatures	-67° F to 275° F (-55° C to 135° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 150
Flammability	UL224 VW-1 600V (except clear)
Standards	Meets SAE-AMS-DTL-23053/5 Class 1 & 3



Product Selection		Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity <i>(sticks per pack)</i>
Part No.	Type		in.	in.	mm	in.	mm	in.		
333-41507	TFN31-ST-1.5/0.5 BK	1/16	0.063	1.6	0.02	0.5	0.018	0.45	Black	20
333-41508	TFN31-ST-3/1 BK	1/8	0.125	3.2	0.039	1.0	0.022	0.55	Black	20
333-41509	TFN31-ST-4.5/1.5 BK	3/16	0.188	4.8	0.059	1.5	0.024	0.64	Black	20
333-41510	TFN31-ST-6/2 BK	1/4	0.25	6.4	0.079	2.0	0.026	0.65	Black	15
333-41511	TFN31-ST-9/3 BK	3/8	0.375	9.5	0.118	3.0	0.029	0.75	Black	15
333-41512	TFN31-ST-12/4 BK	1/2	0.5	12.7	0.157	4.0	0.031	0.80	Black	10
333-41513	TFN31-ST-18/6 BK	3/4	0.75	19.1	0.236	6.0	0.035	0.90	Black	5
333-41514	TFN31-ST-24/8 BK	1	1.0	25.4	0.315	8.0	0.047	1.20	Black	5

Sticks are individually tagged in a retail box.

IMPERIAL TO METRIC CONVERSIONS FOR 3:1 SHRINK RATIO TUBING

in	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
mm	1.5	2	2.5	3	4.5	6	9	12	15	18	24	32	40

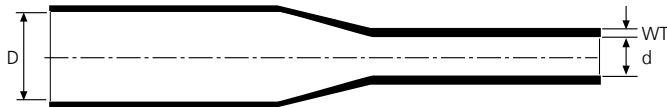
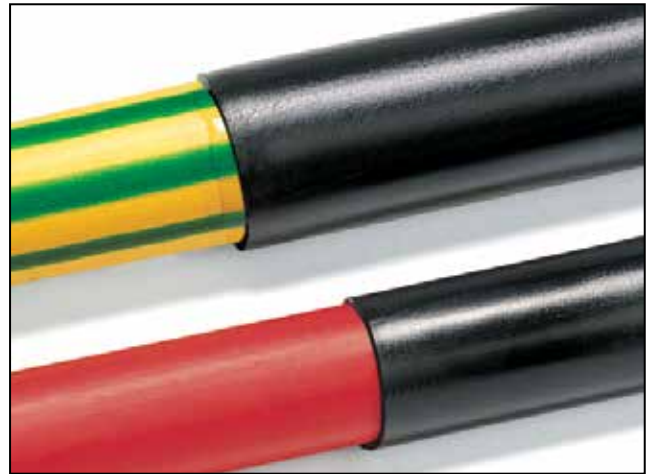
Heat Shrink Tubing – 3:1 Shrink Ratio

TAN33 Sticks Adhesive-lined Thin Wall

TAN33 is a flexible, thin wall adhesive-lined heat shrink tubing with highly flame retardant properties. The 3 to 1 shrink ratio accommodates a wide range of component shapes and diameters. The adhesive lining begins to activate as the temperature reaches 176° F (80° C), to create a strong seal against moisture and humidity.

Features and Benefits

- Adhesive lining provides an excellent seal against moisture and humidity.
- Thin exterior wall is very flexible, while providing superior insulation of cables and components.
- 3 to 1 shrink ratio accommodates a wide range of component shapes and diameters.
- Meets UL224 VW-1 specifications, making it ideal for high heat applications (excludes clear tubing).
- Polyolefin material provides mechanical strength with good resistance to solvents, oils and fuels.
- 4-foot sticks are individually tagged and come in a retail box.



Material Data	
Material	Polyolefin, adhesive-lined cross linked (POX)
Shrink Ratio	3:1
Longitudinal Change After Shrinkage	- 10%
Minimum Shrink Temperature	230° F (110° C)
Operating Temperatures	-67° F to 257° F (-55° C to 125° C)
Softening Point Adhesive	176° F (80° C)
Flammability	UL224 VW-1 600V
Standards	Meets SAE-AMS-DTL-23053/4



Product Selection		Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity <i>(sticks per box)</i>
Part No.	Type		in.	in.	mm	in.	mm	in.		
318-60150	TAN33-ST-3/1 BK	1/8	0.112	3.0	0.039	1.0	0.039	1.0	Black	20
318-60151	TAN33-ST-4.8/1.5 BK	3/16	0.189	4.8	0.059	1.5	0.039	1.0	Black	20
318-60152	TAN33-ST-6/2 BK	1/4	0.236	6.0	0.079	2.0	0.039	1.0	Black	15
318-60153	TAN33-ST-9/3 BK	3/8	0.354	9.0	0.118	3.0	0.056	1.4	Black	15
318-60154	TAN33-ST-12/4 BK	1/2	0.472	12.0	0.158	4.0	0.063	1.6	Black	10
318-60155	TAN33-ST-19/6 BK	3/4	0.748	19.0	0.236	6.0	0.085	2.15	Black	15
318-60156	TAN33-ST-24/8 BK	1	0.945	24.0	0.315	8.0	0.094	2.4	Black	10
318-60158	TAN33-ST-40/13 BK	1-1/2	1.58	40.0	0.512	13.0	0.094	2.4	Black	6

Sticks are individually tagged in a retail box.

IMPERIAL TO METRIC CONVERSIONS FOR 3:1 SHRINK RATIO TUBING

in	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
mm	1.5	2	2.5	3	4.5	6	9	12	15	18	24	32	40

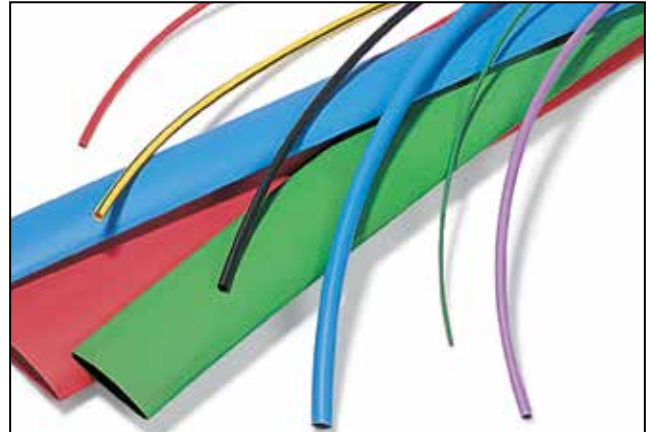
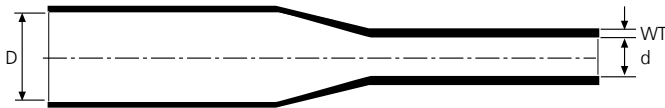
Heat Shrink Tubing – 2:1 Shrink Ratio

TFN21 Reels Non-adhesive Thin Wall

TFN21 is a highly flexible thin wall 2 to 1 heat shrink tubing with excellent flame retardant properties. In addition to providing insulation and abrasion protection for wires and cables, the polyolefin material also offers resistance to oils, solvents and chemicals.

Features and Benefits

- Thin, 2 to 1 shrink ratio tubing provides insulation and abrasion protection for wires and cables.
- Flammability rating of UL224 VW-1 for use in applications requiring the highest degree of flame protection (excludes clear tubing).
- Flexible-yet-durable material resists most common oils, chemicals and fluids.
- Offered in a variety of diameters and colors for identifying and marking wires and cables.
- Available in mini or bulk reels, for small to large volume applications.



Material Data	
Material	Polyolefin, cross linked (POX)
Shrink Ratio	2:1
Longitudinal Change After Shrinkage	± 5%
Minimum Shrink Temperature	212° F (100° C)
Operating Temperatures	-67° F to 275° F (-55° C to 135° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 150
Flammability	UL224 VW-1 600V (except clear)
Standards	Meets SAE-AMS-DTL-23053/5 Class 1 & 3



Heat Shrink Tubing – 2:1 Shrink Ratio

Product Selection										
Part No.	Type	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity
		in.	in.	mm	in.	mm	in.	mm		ft.
MINI REELS										
309-60107	TFN21-1.6/0.8 CL	1/16	0.063	1.6	0.032	0.8	0.016	0.4	Clear	100
309-60108	TFN21-1.6/0.8 BK	1/16	0.063	1.6	0.032	0.8	0.016	0.4	Black	100
309-60280	TFN21-1.6/0.8 RD	1/16	0.063	1.6	0.032	0.8	0.016	0.4	Red	100
309-60281	TFN21-1.6/0.8 BU	1/16	0.063	1.6	0.032	0.8	0.016	0.4	Blue	100
309-60282	TFN21-1.6/0.8 WH	1/16	0.063	1.6	0.032	0.8	0.016	0.4	White	100
309-60283	TFN21-1.6/0.8 YE	1/16	0.063	1.6	0.032	0.8	0.016	0.4	Yellow	100
309-60284	TFN21-1.6/0.8 GN	1/16	0.063	1.6	0.032	0.8	0.016	0.4	Green	100
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309-65111	TFN21-2.4/1.2 CL	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Clear	100
309-65112	TFN21-2.4/1.2 BK	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Black	100
309-60285	TFN21-2.4/1.2 RD	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Red	100
309-60286	TFN21-2.4/1.2 BU	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Blue	100
309-60287	TFN21-2.4/1.2 WH	3/32	0.094	2.4	0.047	1.2	0.019	0.48	White	100
309-60288	TFN21-2.4/1.2 YE	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Yellow	100
309-60289	TFN21-2.4/1.2 GN	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Green	100
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309-65120	TFN21-3.2/1.6 CL	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Clear	100
309-60290	TFN21-3.2/1.6 BK	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Black	100
309-65121	TFN21-3.2/1.6 RD	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Red	100
309-65122	TFN21-3.2/1.6 BU	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Blue	100
309-60291	TFN21-3.2/1.6 WH	1/8	0.125	3.2	0.063	1.6	0.019	0.48	White	100
309-60292	TFN21-3.2/1.6 YE	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Yellow	100
309-60293	TFN21-3.2/1.6 GN	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Green	100
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309-65130	TFN21-4.8/2.4 CL	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Clear	50
309-60294	TFN21-4.8/2.4 BK	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Black	50
309-65131	TFN21-4.8/2.4 RD	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Red	50
309-65132	TFN21-4.8/2.4 BU	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Blue	50
309-60295	TFN21-4.8/2.4 WH	3/16	0.188	4.8	0.094	2.4	0.019	0.48	White	50
309-60296	TFN21-4.8/2.4 YE	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Yellow	50
309-60297	TFN21-4.8/2.4 GN	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Green	50

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

Heat Shrink Tubing - 2:1 Shrink Ratio

Product Selection										
Part No.	Type	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity
		in.	in.	mm	in.	mm	in.	mm		ft.
MINI REELS										
309-65140	TFN21-6.4/3.2 CL	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Clear	50
309-60298	TFN21 6.4/3.2 BK	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Black	50
309-65141	TFN21-6.4/3.2 RD	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Red	50
309-65142	TFN21-6.4/3.2 BU	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Blue	50
309-60299	TFN21 6.4/3.2 WH	1/4	0.25	6.4	0.125	3.2	0.022	0.56	White	50
309-60300	TFN21 6.4/3.2 YE	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Yellow	50
309-60301	TFN21 6.4/3.2 GN	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Green	50
309-65150	TFN21-9.5/4.8 CL	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Clear	50
309-60302	TFN21 9.5 /4.8 BK	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Black	50
309-65151	TFN21-9.5/4.8 RD	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Red	50
309-65152	TFN21-9.5/4.8 BU	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Blue	50
309-60303	TFN21 9.5 /4.8 WH	3/8	0.375	9.5	0.188	4.8	0.024	0.62	White	50
309-60304	TFN21 9.5 /4.8 YE	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Yellow	50
309-60305	TFN21 9.5 /4.8 GN	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Green	50
309-65160	TFN21-12.7/6.4 CL	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Clear	25
309-60306	TFN21 12.7/6.4 BK	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Black	25
309-65161	TFN21-12.7/6.4 RD	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Red	25
309-65162	TFN21-12.7/6.4 BU	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Blue	25
309-60307	TFN21 12.7/6.4 WH	1/2	0.5	12.7	0.25	6.4	0.024	0.62	White	25
309-60308	TFN21 12.7/6.4 YE	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Yellow	25
309-60309	TFN21 12.7/6.4 GN	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Green	25
309-60310	TFN21 - 16.0/8.0	5/8	0.63	15.9	0.315	8	0.027	0.68	Black	25
309-65170	TFN21-19.1/9.5 CL	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Clear	25
309-60311	TFN21-19.1/9.5 BK	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Black	25
309-65171	TFN21-19.1/9.5 RD	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Red	25
309-65172	TFN21-19.1/9.5 BU	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Blue	25
309-60312	TFN21-19.1/9.5 WH	3/4	0.75	19.1	0.375	9.5	0.027	0.68	White	25
309-60313	TFN21-19.1/9.5 YE	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Yellow	25
309-60314	TFN21-19.1/9.5 GN	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Green	25
309-65180	TFN21-25.4/12.7 CL	1	1.00	25.4	0.5	12.7	0.034	0.87	Clear	25
309-60315	TFN21-25.4 /12.7 BK	1	1.00	25.4	0.5	12.7	0.034	0.87	Black	25
309-65181	TFN21-25.4/12.7 RD	1	1.00	25.4	0.5	12.7	0.034	0.87	Red	25
309-65182	TFN21-25.4/12.7 BU	1	1.00	25.4	0.5	12.7	0.034	0.87	Blue	25
309-60316	TFN21-25.4 /12.7 WH	1	1.00	25.4	0.5	12.7	0.034	0.87	White	25
309-60317	TFN21-25.4 /12.7 YE	1	1.00	25.4	0.5	12.7	0.034	0.87	Yellow	25
309-60318	TFN21-25.4 /12.7 GN	1	1.00	25.4	0.5	12.7	0.034	0.87	Green	25

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

Heat Shrink Tubing - 2:1 Shrink Ratio

Product Selection										
Part No.	Type	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity
		in.	in.	mm	in.	mm	in.	mm		ft.
BULK REELS										
309-60197	TFN21 1.2/0.6 BK	3/64	0.047	1.2	0.024	0.6	0.016	0.4	Black	1000
309-60109	TFN21 1.6/0.8 BK	1/16	0.063	1.6	0.032	0.8	0.016	0.4	Black	1000
309-60118	TFN21 2.4/1.2 BK	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Black	1000
309-65123	TFN21-3.2/1.6 BK	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Black	1000
309-65133	TFN21-4.8/2.4 BK	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Black	1000
309-65143	TFN21-6.4/3.2 BK	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Black	1000
309-65153	TFN21-9.5/4.8 BK	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Black	500
309-65163	TFN21-12.7/6.4 BK	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Black	300
309-65313	TFN21 12.7/6.4	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Red	300
309-65173	TFN21-19.1/9.5 BK	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Black	200
309-65310	TFN21 19.1/9.5	3/4	0.75	19.1	0.38	9.5	0.027	0.68	Red	200
309-65183	TFN21-25.4/12.7 BK	1	1.00	25.4	0.5	12.7	0.034	0.87	Black	200
309-65311	TFN21 25.4/12.7	1	1	25.4	0.5	12.7	0.034	0.87	Red	200
309-60320	TFN21-31.8/15.9 CL	1-1/4	1.25	31.8	0.625	15.9	0.039	1.00	Clear	100
309-60319	TFN21-31.8/15.9 BK	1-1/4	1.25	31.8	0.625	15.9	0.039	1.00	Black	100
309-60321	TFN21-31.8/15.9 RD	1-1/4	1.25	31.8	0.625	15.9	0.039	1.00	Red	100
309-60322	TFN21-31.8/15.9 BU	1-1/4	1.25	31.8	0.625	15.9	0.039	1.00	Blue	100
309-60323	TFN21-31.8/15.9 WH	1-1/4	1.25	31.8	0.625	15.9	0.039	1.00	White	100
309-60324	TFN21-31.8/15.9 YE	1-1/4	1.25	31.8	0.625	15.9	0.039	1.00	Yellow	100
309-60325	TFN21-31.8/15.9 GN	1-1/4	1.25	31.8	0.625	15.9	0.039	1.00	Green	100
309-60326	TFN21-38.1/19.1 CL	1-1/2	1.50	31.8	0.752	19.1	0.039	1.00	Clear	100
309-65192	TFN21-38.1/19.1 BK	1-1/2	1.50	31.8	0.752	19.1	0.039	1.00	Black	100
309-60327	TFN21-38.1/19.1 RD	1-1/2	1.50	31.8	0.752	19.1	0.039	1.00	Red	100
309-60328	TFN21-38.1/19.1 BU	1-1/2	1.50	31.8	0.752	19.1	0.039	1.00	Blue	100
309-60329	TFN21-38.1/19.1 WH	1-1/2	1.50	31.8	0.752	19.1	0.039	1.00	White	100
309-60330	TFN21-38.1/19.1 YE	1-1/2	1.50	31.8	0.752	19.1	0.039	1.00	Yellow	100
309-60331	TFN21-38.1/19.1 GN	1-1/2	1.50	31.8	0.752	19.1	0.039	1.00	Green	100
309-60333	TFN21-50.8/25.4 CL	2	2.00	50.8	1.00	25.4	0.043	1.1	Clear	100
309-60332	TFN21-50.8/25.4 BK	2	2.00	50.8	1.00	25.4	0.043	1.1	Black	100
309-60334	TFN21-50.8/25.4 RD	2	2.00	50.8	1.00	25.4	0.043	1.1	Red	100
309-60335	TFN21-50.8/25.4 BU	2	2.00	50.8	1.00	25.4	0.043	1.1	Blue	100
309-60336	TFN21-50.8/25.4 WH	2	2.00	50.8	1.00	25.4	0.043	1.1	White	100
309-60337	TFN21-50.8/25.4 YE	2	2.00	50.8	1.00	25.4	0.043	1.1	Yellow	100
309-60338	TFN21-50.8/25.4 GN	2	2.00	50.8	1.00	25.4	0.043	1.1	Green	100
309-65227	TFN21 76.2/38.1 BK	3	3.00	76.2	1.50	38.1	0.047	1.2	Black	50
309-65237	TFN21 102.0/50.8 BK	4	4.00	102	2.00	50.8	0.053	1.35	Black	50

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

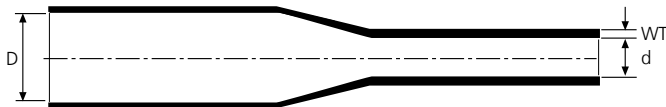
Heat Shrink Tubing – 2:1 Shrink Ratio

TFN21 Sticks Non-adhesive Thin Wall

TFN21 is a highly flexible thin wall heat shrink tubing with a 2 to 1 shrink ratio and excellent flame retardant properties. In addition to providing insulation and abrasion protection for wires and cables, the polyolefin material also offers resistance to oils, solvents and chemicals.

Features and Benefits

- Thin, 2 to 1 shrink ratio tubing provides insulation and abrasion protection for wires and cables.
- Flammability rating of UL224 VW-1 for use in applications requiring the highest degree of flame protection.
- Flexible-yet-durable material resists most common oils, chemicals and fluids.
- 4-foot sticks are individually tagged for retail.



Material Data

Material	Polyolefin, cross linked (POX)
Shrink Ratio	2:1
Longitudinal Change After Shrinkage	± 5%
Minimum Shrink Temperature	212° F (100° C)
Operating Temperatures	-67° F to 275° F (-55° C to 135° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 150
Flammability	UL224 VW-1 600V (except clear)
Standards	Meets SAE-AMS-DTL-23053/5 Class 1 & 3

Product Selection

Part No.	Type	Trade Size	Supplied Diameter (D)			Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity <i>(sticks per box)</i>
		in.	in.	mm	in.	mm	in.	mm			
309-65100	TFN21-ST 1.6/0.8 CL	1/16	0.063	1.6	0.031	0.8	0.016	0.4	Clear	20	
309-65101	TFN21-ST 1.6/0.8 BK	1/16	0.063	1.6	0.031	0.8	0.016	0.4	Black	20	
309-65102	TFN21-ST 1.6/0.8 RD	1/16	0.063	1.6	0.031	0.8	0.016	0.4	Red	20	
309-65103	TFN21-ST 1.6/0.8 BU	1/16	0.063	1.6	0.031	0.8	0.016	0.4	Blue	20	
309-65104	TFN21-ST 1.6/0.8 WH	1/16	0.063	1.6	0.031	0.8	0.016	0.4	White	20	
309-65105	TFN21-ST 1.6/0.8 YE	1/16	0.063	1.6	0.031	0.8	0.016	0.4	Yellow	20	
309-65106	TFN21-ST 1.6/0.8 GN	1/16	0.063	1.6	0.031	0.8	0.016	0.4	Green	20	
309-65113	TFN21-ST 2.4/1.2 CL	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Clear	20	
309-65110	TFN21-ST 2.4/1.2 BK	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Black	20	
309-65114	TFN21-ST 2.4/1.2 RD	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Red	20	
309-65115	TFN21-ST 2.4/1.2 BU	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Blue	20	
309-65116	TFN21-ST 2.4/1.2 WH	3/32	0.094	2.4	0.047	1.2	0.019	0.48	White	20	
309-65117	TFN21-ST 2.4/1.2 YE	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Yellow	20	
309-65118	TFN21-ST 2.4/1.2 GN	3/32	0.094	2.4	0.047	1.2	0.019	0.48	Green	20	

Sticks are individually tagged in a retail box.

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

Heat Shrink Tubing - 2:1 Shrink Ratio

Product Selection

Part No.	Type	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity <i>(sticks per box)</i>
		in.	in.	mm	in.	mm	in.	mm		
309-65125	TFN21-ST 3.2/1.6 CL	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Clear	20
309-65124	TFN21-ST-3.2/1.6 BK	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Black	20
309-65126	TFN21-ST 3.2/1.6 RD	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Red	20
309-65127	TFN21-ST 3.2/1.6 BU	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Blue	20
309-65128	TFN21-ST 3.2/1.6 WH	1/8	0.125	3.2	0.063	1.6	0.019	0.48	White	20
309-65129	TFN21-ST 3.2/1.6 YE	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Yellow	20
309-65195	TFN21-ST 3.2/1.6 GN	1/8	0.125	3.2	0.063	1.6	0.019	0.48	Green	20
309-65135	TFN21-ST 4.8/2.4 CL	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Clear	20
309-65134	TFN21-ST-4.8/2.4 BK	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Black	20
309-65136	TFN21-ST 4.8/2.4 RD	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Red	20
309-65137	TFN21-ST 4.8/2.4 BU	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Blue	20
309-65138	TFN21-ST 4.8/2.4 WH	3/16	0.188	4.8	0.094	2.4	0.019	0.48	White	20
309-65139	TFN21-ST 4.8/2.4 YE	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Yellow	20
309-65290	TFN21-ST 4.8/2.4 GN	3/16	0.188	4.8	0.094	2.4	0.019	0.48	Green	20
309-65145	TFN21-ST 6.4/3.2 CL	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Clear	15
309-65144	TFN21-ST-6.4/3.2 BK	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Black	15
309-65147	TFN21-ST 6.4/3.2 RD	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Red	15
309-65148	TFN21-ST 6.4/3.2 BU	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Blue	15
309-65149	TFN21-ST 6.4/3.2 WH	1/4	0.25	6.4	0.125	3.2	0.022	0.56	White	15
309-65291	TFN21-ST 6.4/3.2 YE	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Yellow	15
309-65292	TFN21-ST 6.4/3.2 GN	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Green	15
309-65166	TFN21-ST 6.4/3.2 GNYE	1/4	0.25	6.4	0.125	3.2	0.022	0.56	Green-Yellow	15
309-65155	TFN21-ST 9.5/4.7 CL	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Clear	15
309-65154	TFN21-ST-9.5/4.8 BK	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Black	15
309-65156	TFN21-ST 9.5/4.8 RD	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Red	15
309-65157	TFN21-ST 9.5/4.8 BU	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Blue	15
309-65158	TFN21-ST 9.5/4.8 WH	3/8	0.375	9.5	0.188	4.8	0.024	0.62	White	15
309-65159	TFN21-ST 9.5/4.8 YE	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Yellow	15
309-65293	TFN21-ST 9.5/4.8 GN	3/8	0.375	9.5	0.188	4.8	0.024	0.62	Green	15
309-65165	TFN21-ST 12.7/6.4 CL	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Clear	10
309-65164	TFN21-ST-12.7/6.4 BK	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Black	10
309-65167	TFN21-ST 12.7/6.4 RD	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Red	10
309-65168	TFN21-ST 12.7/6.4 BU	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Blue	10
309-65169	TFN21-ST 12.7/6.4 WH	1/2	0.5	12.7	0.25	6.4	0.024	0.62	White	10
309-65294	TFN21-ST 12.7/6.4 YE	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Yellow	10
309-65295	TFN21-ST 12.7/6.4 GN	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Green	10
309-65146	TFN21-ST 12.7/6.4 GNYE	1/2	0.5	12.7	0.25	6.4	0.024	0.62	Green-Yellow	10
309-65175	TFN21-ST 19.1/9.5 CL	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Clear	5
309-65174	TFN21-ST-19.1/9.5 BK	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Black	5
309-65176	TFN21-ST 19.1/9.5 RD	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Red	5
309-65177	TFN21-ST 19.1/9.5 BU	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Blue	5
309-65178	TFN21-ST 19.1/9.5 WH	3/4	0.75	19.1	0.375	9.5	0.027	0.68	White	5
309-65179	TFN21-ST 19.1/9.5 YE	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Yellow	5
309-65296	TFN21-ST 19.1/9.5 GN	3/4	0.75	19.1	0.375	9.5	0.027	0.68	Green	5

Sticks are individually tagged in a retail box.

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

Heat Shrink Tubing – 2:1 Shrink Ratio

Product Selection		Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity <i>(sticks per box)</i>
Part No.	Type		in.	mm	in.	mm	in.	mm		
309-65280	TFN21-ST 25.4/12.7 CL	1	1.0	25.4	0.5	12.7	0.034	0.87	Clear	5
309-65184	TFN21-ST-25.4/12.7 BK	1	1.0	19.1	0.5	12.7	0.027	0.68	Black	5
309-65297	TFN21-ST 25.4/12.7 RD	1	1.0	25.4	0.5	12.7	0.034	0.87	Red	5
309-65298	TFN21-ST 25.4/12.7 BU	1	1.0	25.4	0.5	12.7	0.034	0.87	Blue	5
309-65299	TFN21-ST 25.4/12.7 WH	1	1.0	25.4	0.5	12.7	0.034	0.87	White	5
309-65300	TFN21-ST 25.4/12.7 YE	1	1.0	25.4	0.5	12.7	0.034	0.87	Yellow	5
309-65301	TFN21-ST 25.4/12.7 GN	1	1.0	25.4	0.5	12.7	0.034	0.87	Green	5
309-65270	TFN21-ST 31.8/15.9 CL	1-1/4	1.25	31.8	0.625	15.9	0.039	1.0	Clear	10
309-65271	TFN21-ST 31.8/15.9 BK	1-1/4	1.25	31.8	0.625	15.9	0.039	1.0	Black	10
309-65272	TFN21-ST 31.8/15.9 RD	1-1/4	1.25	31.8	0.625	15.9	0.039	1.0	Red	10
309-65273	TFN21-ST 31.8/15.9 BU	1-1/4	1.25	31.8	0.625	15.9	0.039	1.0	Blue	10
309-65274	TFN21-ST 31.8/15.9 WH	1-1/4	1.25	31.8	0.625	15.9	0.039	1.0	White	10
309-65275	TFN21-ST 31.8/15.9 YE	1-1/4	1.25	31.8	0.625	15.9	0.039	1.0	Yellow	10
309-65276	TFN21-ST 31.8/15.9 GN	1-1/4	1.25	31.8	0.625	15.9	0.039	1.0	Green	10
309-65193	TFN21-ST 38.1/19.1 CL	1-1/2	1.5	38.1	0.75	19.1	0.039	1.0	Clear	6
309-65194	TFN21-ST 38.1/19.1 BK	1-1/2	1.5	38.1	0.75	19.1	0.039	1.0	Black	6
309-65302	TFN21-ST 38.1/19.1 RD	1-1/2	1.5	38.1	0.75	19.1	0.039	1.0	Red	6
309-65303	TFN21-ST 38.1/19.1 BU	1-1/2	1.5	38.1	0.75	19.1	0.039	1.0	Blue	6
309-65304	TFN21-ST 38.1/19.1 WH	1-1/2	1.5	38.1	0.75	19.1	0.039	1.0	White	6
309-65305	TFN21-ST 38.1/19.1 YE	1-1/2	1.5	38.1	0.75	19.1	0.039	1.0	Yellow	6
309-65306	TFN21-ST 38.1/19.1 GN	1-1/2	1.5	38.1	0.75	19.1	0.039	1.0	Green	6
309-65210	TFN21-ST 50.8/25.4 CL	2	2.0	50.8	1.0	25.4	0.043	1.1	Clear	6
309-65211	TFN21-ST 50.8/25.4 BK	2	2.0	50.8	1.0	25.4	0.043	1.1	Black	6
309-65212	TFN21-ST 50.8/25.4 RD	2	2.0	50.8	1.0	25.4	0.043	1.1	Red	6
309-65213	TFN21-ST 50.8/25.4 BU	2	2.0	50.8	1.0	25.4	0.043	1.1	Blue	6
309-65214	TFN21-ST 50.8/25.4 WH	2	2.0	50.8	1.0	25.4	0.043	1.1	White	6
309-65215	TFN21-ST 50.8/25.4 YE	2	2.0	50.8	1.0	25.4	0.043	1.1	Yellow	6
309-65216	TFN21-ST 50.8/25.4 GN	2	2.0	50.8	1.0	25.4	0.043	1.1	Green	6
309-65220	TFN21-ST 76.2/38.1 CL	3	3.0	76.2	1.5	38.1	0.047	1.2	Clear	3
309-65221	TFN21-ST 76.2/38.1 BK	3	3.0	76.2	1.5	38.1	0.047	1.2	Black	3
309-65222	TFN21-ST 76.2/38.1 RD	3	3.0	76.2	1.5	38.1	0.047	1.2	Red	3
309-65223	TFN21-ST 76.2/38.1 BU	3	3.0	76.2	1.5	38.1	0.047	1.2	Blue	3
309-65224	TFN21-ST 76.2/38.1 WH	3	3.0	76.2	1.5	38.1	0.047	1.2	White	3
309-65225	TFN21-ST 76.2/38.1 YE	3	3.0	76.2	1.5	38.1	0.047	1.2	Yellow	3
309-65226	TFN21-ST 76.2/38.1 GN	3	3.0	76.2	1.5	38.1	0.047	1.2	Green	3
309-65230	TFN21-ST 102/50.8 CL	4	4.0	102	2.0	50.8	0.053	1.35	Clear	2
309-65231	TFN21-ST 102/50.8 BK	4	4.0	102	2.0	50.8	0.053	1.35	Black	2
309-65232	TFN21-ST 102/50.8 RD	4	4.0	102	2.0	50.8	0.053	1.35	Red	2
309-65233	TFN21-ST 102/50.8 BU	4	4.0	102	2.0	50.8	0.053	1.35	Blue	2
309-65234	TFN21-ST 102/50.8 WH	4	4.0	102	2.0	50.8	0.053	1.35	White	2
309-65235	TFN21-ST 102/50.8 YE	4	4.0	102	2.0	50.8	0.053	1.35	Yellow	2
309-65236	TFN21-ST 102/50.8 GN	4	4.0	102	2.0	50.8	0.053	1.35	Green	2

Sticks are individually tagged in a retail box.

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

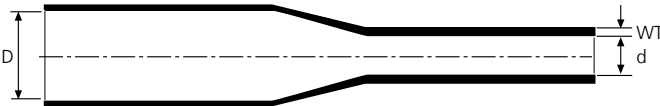
Heat Shrink Tubing – 2:1 Shrink Ratio

TCN20 Reels Non-adhesive Thin Wall

TCN20 is a general purpose, thin wall heat shrink tubing used to protect electrical and mechanical wiring. In addition to having a 2 to 1 shrink ratio, the polyolefin material is self-extinguishing and resists common fluids and solvents. The low shrink temperature and mechanical strength make this tubing ideal for use in electronic and automotive harness applications.

Features and Benefits

- Thin wall heat shrink tubing with a 2 to 1 shrink ratio to fit a variety of component shapes and diameters.
- Provides abrasion and insulation protection and resists fluids and solvents.
- Meets UL224 VW-1 specifications for flame retardancy.
- Low 212° F (100° C) shrink temperature is well suited for electronic and harness making applications.
- Available in a wide range of diameters and lengths.



Material Data		
Material	Polyolefin, cross linked (POX)	
Shrink Ratio	2:1	
Longitudinal Change After Shrinkage	± 5%	
Minimum Shrink Temperature	212° F (100° C)	
Operating Temperatures	-67° F to 257° F (-55° C to 125° C)	
Dielectric Strength	> 20 kV / mm according to ASTM D2671	
Flammability	UL224 125°C 600V VW-1	



Product Selection

Part No.	Type	Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity	
		in.	in.	mm	in.	mm	in.	mm		ft.	m
300-73600	TCN20 1.2/0.6	3/64	0.047	1.2	0.023	.6	0.011	0.3	Black	1000	304.8
300-73601	TCN20 1.6/0.8	1/16	0.062	1.6	0.032	.8	0.013	0.35	Black	1000	304.8
300-73602	TCN20 2.4/1.2	3/32	0.094	2.4	0.047	1.2	0.017	0.45	Black	1000	304.8
300-73603	TCN20 3.2/1.6	1/8	0.12	3.2	0.062	1.6	0.017	0.45	Black	1000	304.8
300-73604	TCN20 4.8/2.4	3/16	0.189	4.8	0.094	2.4	0.019	0.5	Black	1000	304.8
300-73605	TCN20 6.4/3.2	1/4	0.25	6.4	0.12	3.2	0.021	0.55	Black	500	152.4
300-73606	TCN20 9.5/4.8	3/8	0.375	9.5	0.189	4.8	0.021	0.55	Black	500	152.4
300-73607	TCN20 12.7/6.4	1/2	0.5	12.7	0.25	6.4	0.025	0.65	Black	500	152.4
300-73608	TCN20 19.1/9.5	3/4	0.75	19.1	0.375	9.5	0.031	0.80	Black	200	61.0
300-73609	TCN20 25.4/12.7	1	1.0	25.4	0.5	12.7	0.035	0.90	Black	200	61.0
300-73610	TCN20 38.1/19.1	1-1/2	1.5	38.1	0.75	19.1	0.04	1.02	Black	100	30.5
300-73611	TCN20 50.8/25.4	2	2.0	50.8	1.0	25.4	0.045	1.15	Black	100	30.5

IMPERIAL TO METRIC CONVERSIONS FOR 2:1 SHRINK RATIO TUBING

in	1/32	3/64	1/16	5/64	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2	3	4
mm	0.8	1.2	1.6	2	2.4	3.2	4.8	6.4	9.5	12.7	15.9	19.1	25.4	31.8	38.1	50.8	76.2	101.6

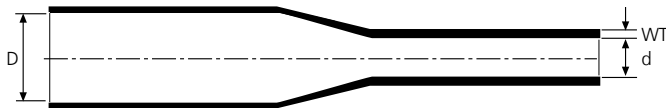
Heat Shrink Tubing – 4:1 Shrink Ratio

MA47 Sticks Adhesive-lined Medium Wall

MA47 is a medium wall heat shrink tubing with an adhesive lining for use in low voltage applications. The thermoplastic adhesive liner provides excellent moisture sealing and insulation protection of cable joints and terminations. Made of a polyolefin outer material, this tubing has a shrink ratio of up to 4 to 1. The adhesive lining begins to activate as the temperature approaches 185° F (85° C).

Features and Benefits

- Medium wall tubing resists solvents, acids and alkaline solutions while providing good mechanical strength.
- Features robust insulation characteristics designed for low voltage power applications.
- Adhesive liner provides excellent insulation against moisture and humidity.
- Individually tagged 4-foot sticks come in a retail box.
- RoHS compliant and Halogen-free.



Material Data	
Material	Polyolefin, adhesive-lined cross linked (POX)
Shrink Ratio	up to 4:1
Longitudinal Change After Shrinkage	-10% max
Minimum Shrink Temperature	248° F (120° C)
Operating Temperatures	-67° F to 230° F (-55° C to 110° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 150
Softening Point Adhesive	185° F (85° C)



Product Selection		Trade Size	Supplied Diameter (D)			Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity <i>(sticks per box)</i>
Part No.	Type		in.	in.	mm	in.	mm	in.	mm		
323-50010	TREDUX MA47-48ST-12/3	1/2	0.47	12.0	0.118	3.0	0.08	2.0	Black	6	
323-50011	TREDUX MA47-48ST-19/6	3/4	0.748	19.0	0.236	6.0	0.09	2.5	Black	10	
323-50012	TREDUX MA47-48ST-30/8	1-1/4	1.181	30.0	0.314	8.0	0.09	2.5	Black	6	
323-50013	TREDUX MA47-48ST-40/12	1-1/2	1.57	40.0	0.47	12.0	0.09	2.5	Black	4	
323-50014	TREDUX MA47-48ST-50/16	2	1.969	50.0	0.62	16.0	0.1	2.7	Black	2	
323-50015	TREDUX MA47-48ST-63/19	2-1/2	2.48	63.0	0.75	19.0	0.11	2.8	Black	2	
323-50016	TREDUX MA47-48ST-75/22	3	2.95	75.0	0.86	22.0	0.12	3.0	Black	2	
323-50017	TREDUX MA47-48ST-95/30	3-3/4	3.74	95.0	1.181	30.0	0.12	3.0	Black	1	

Sticks are individually tagged in a retail box.

IMPERIAL TO METRIC CONVERSIONS FOR 4:1 SHRINK RATIO TUBING

in	1/2	3/4	1 1/4	1 1/2	2	2 1/2	3	3 3/4
mm	12.7	19.1	31.8	38.1	50.8	63.5	76.2	95.3

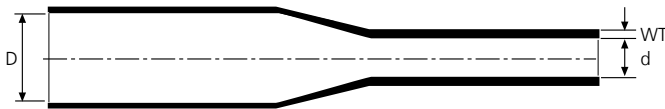
Heat Shrink Tubing – 3.5:1 Shrink Ratio

HA47 Sticks Adhesive-lined Thick Wall

HA47 is a thick wall adhesive-lined heat shrink tubing for use in low and medium voltage applications. The adhesive lining provides excellent moisture sealing and weathering protection, making it suitable for above and below ground applications. Made of a polyolefin outer material, this tubing has a shrink ratio up to 3.5 to 1. The adhesive lining begins to activate as the temperature approaches 185° F (85° C).

Features and Benefits

- Thick, semi-flexible exterior wall is well-suited for low and medium voltage power applications, above or below ground.
- Adhesive lining provides excellent insulation against moisture and humidity.
- Individually tagged 4-foot sticks come in a retail box.
- RoHS compliant and Halogen-free.



Material Data	
Material	Polyolefin, adhesive-lined cross linked (POX)
Shrink Ratio	up to 3.5:1
Longitudinal Change After Shrinkage	-10% max
Minimum Shrink Temperature	248° F (120° C)
Operating Temperatures	-67° F to 230° F (-55° C to 110° C)
Dielectric Strength	> 20 kV / mm according to ASTM D 150
Softening Point Adhesive	185° F (85° C)



Product Selection		Trade Size	Supplied Diameter (D)		Recovered Diameter (d)		Wall Thickness Recovered (WT)		Color	Package Quantity <i>(sticks per box)</i>
Part No.	Type		in.	in.	mm	in.	mm	in.		
321-50010	TREDUX HA47-48ST-13/4	1/2	0.512	13.0	0.157	4.0	0.094	2.4	Black	6
321-50011	TREDUX HA47-48ST-19/6	3/4	0.748	19.0	0.236	6.0	0.106	2.7	Black	10
321-50012	TREDUX HA47-48ST-33/8	1-1/4	1.3	33.0	0.315	8.0	0.126	3.2	Black	5
321-50013	TREDUX HA47-48ST-45/12	1-3/4	1.772	45.0	0.472	12.0	0.161	4.1	Black	4
321-50014	TREDUX HA47-48ST-51/16	2	2.008	51.0	0.63	16.0	0.161	4.1	Black	2
321-50015	TREDUX HA47-48ST-68/22	2-3/4	2.677	68.0	0.866	22.0	0.161	4.1	Black	1
321-50016	TREDUX HA47-48ST-85/25	3-1/4	3.346	85.0	1.0	25.4	0.169	4.3	Black	1

Sticks are individually tagged in a retail box.

IMPERIAL TO METRIC CONVERSIONS FOR 4:1 SHRINK RATIO TUBING

in	1/2	3/4	1 1/4	1 3/4	2	2 3/4	3 1/4
mm	12.7	19.1	31.8	44.5	50.8	69.8	82.5

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HellermannTyton

HellermannTyton North American Corporate Headquarters

7930 N. Faulkner Rd, PO Box 245017
Milwaukee, WI 53224-9517
Phone: (414) 355-1130, (800) 537-1512
Fax: (414) 355-7341, (800) 848-9866
email: corp@htamericas.com
www.hellermann.tyton.com

TS16949, ISO 9001, and ISO 14001 certified

HellermannTyton Canada

Unit #4, 205 Industrial Parkway North
Aurora, Ontario L4G 4C4 Canada
Phone: (800) 661-2461
Fax: (800) 390-3904
email: sales@hellermanntyton.ca

HellermannTyton Mexico

Anillo Periferico Sur 7980 Edificio 6A
Parque Industrial Tecnologico II
Santa María Tequepexpan
Tlaquepaque, Jalisco, Mexico 45601
Phone: 011-52-33-3-133-9880
Fax: 011-52-33-3-133-9861
email: info@htamericas.com.mx

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