Shin-Etsu

Shin-Etsu Silicone

Heat-Shrink Rubber Tubing

ST Series

A diverse product lineup for a wide range of industrial applications.

The ST Series are heat-shrinkable rubber tubings made of silicone. Simply heating shrinks the inner diameter of the tubing by about 50%. These silicone rubber tubings are used for electrical insulation, protection and sheathing.

The products in the ST Series offer the fine properties typical of silicone, including heat- and cold-resistance, chemical-resistance, excellent weatherability and fine electrical properties. This makes them ideal for a wide range of applications ranging from roller covers, paint masking and consumer electronics to applications in the transport industry and the light and heavy electric industries.

Our heat-shrink tubings offer advantages in saved labor and reduced work time, and exhibit stable performance in even the harshest conditions.

■Contents

Main Applications

Heavy and Light Electric

- Heat protection for heaters & sensors in semiconductor devices
- Heat protection for wiring in copiers
- Insulative coating of risers and bus bars in train car motors and electric generators
- Lead wires and coil joints of transformers
- Connections (incl. PE fusion) of power and telecommunications cables
- Preventing shorts to the bus bars (caused by birds, snakes, etc.) at power plants and substations
- Heat-resistant and electrical insulative protection for resistors, thermistors and dielectric heater coils
- Protection and terminal treatment of the lead wires of temperature sensors

Heat protection of wiring

Insulative sheathing of large motor ground wires

Bus bar coating

Exterior sheathing for fiber optic cables

Consumer Electronics

- Protective sheathing of the ends of heater wires in microwave ovens and electric rice cookers
- Protection of the thermistor wiring in air conditioners
- Protective sheathing for fuses

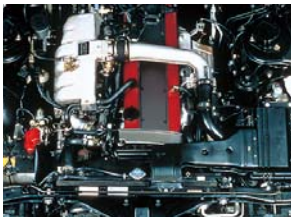
Protecting lead wires of temperature sensors in air conditioners

Protecting lead wires of temperature sensors in electric rice cookers

Transport Vehicles

- Heat-resistant coating for onboard sensors (oxygen, temperature, etc.) in automobiles
- Automotive spark plug applications
- Heater hose applications
- Treating harness terminals
- Treating wiring terminals in transport vehicles
- Cushioning material for turbo pipe joints
- Damping vibration of motorcycle silencer fastener springs

Insulative sheathing of power harness terminals



Insulative sheathing of harness

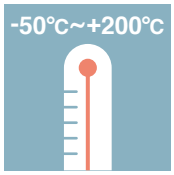
Other Applications

- For rollers
- Masking for painting and other coatings
- Covers for the arms of eyeglasses
- Grip covers for dental grinders
- Securing shafts in prepreg fabrication

Covering for rollers in shrink tunnels

Features

The ST Series includes a variety of silicone rubber tubing whose inner diameter shrinks by 50% just by heating.
They are used for covering in places where users require properties of high- and low-temperature resistance, weatherability and favorable electrical properties.



Outstanding high- & low-temperature resistance and flame retardancy.

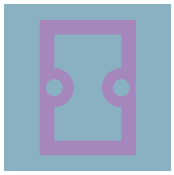
Can be used over a wide temperature range (-50°C to +200°C).
All ST-DG VW-1 tubings have high flame retardancy and are UL certified.

Excellent electrical properties.

Our products exhibit stable electrical properties in even the harshest conditions.

They stay suitably flexible.

Even after heat shrinking, our products retain the flexibility typical of silicone rubber,
and they exhibit little degradation over time.



Excellent releasability.

Our tubing can also be used for masking and as jigs for resin molds,
thanks to the excellent release properties typical of silicone rubber.

They form highly airtight coverings.

With the contractile stress of rubbers, the tubing shrinks tight
to the object being covered to form a highly airtight cover.
In addition, you can form a watertight seal by injecting RTV rubber.

A wide assortment of sizes.

Our lineup includes tubing in a wide variety of wall thicknesses and bore diameters, from small to large.

Product lineup arranged by type

ST-DG Type

Flame retardant grade

UL certified product (UL-224). The entire length is covered with marking indicating size and grade.

*Not including ST-8/10 DG

ST-HT Type

Transparent grade

This tubing is transparent even after shrinking. Text and figures on the surface of the covered object can be read, so marking is unnecessary.

ST-DG Type

General purpose grade

Standard product is light gray (DG). For products in special colors, with special diameters, wall thicknesses & physical properties (eg. enhanced oil resistance), talk to our Sales Department.

General Properties

Item \ Type	ST-DG	ST-DG	ST-HT
Feature	Flame retardant	Thin wall	Transparent
Standard colors	Light gray	Light gray	Colorless translucent
Density g/cm^3	1.2	1.2	1.3
Hardness Durometer A	70	70	65
Tensile strength MPa	6.0	6.0	5.4
Elongation %	350	350	350
Tear strength kN/m	15	15	24.5
Volume resistivity Ω·m	2 x 10^{12}	2 x 10^{12}	2 x 10^{12}
Breakdown strength kV (1mm)	25	25	20
Dielectric constant (ε) 50Hz	3.2	3.2	4.3
Dielectric dissipation factor (tanδ) 50Hz	0.001	0.001	0.017
Flame retardancy UL-224	VW-1	—	—
Usage temperature range °C	-50 to +200	-50 to +200	-50 to +200
Shrinkage (in direction of diameter) %	about 50	about 50	about 40
Shrinkage temp. °C	80-250	80-250	> 170

(Not specified values)

- UL-224 Certification no.: E49996(S)
- Rated temp.: 200°C / rated voltage: 600V / flame retardancy: passes VW-1
- Method used to measure flame retardancy:
  - A flame is applied for 15 seconds, then the time (sec) is measured until flaming or glowing ceases. This cycle is repeated 5 times.
  - 5 test strips are used (flame applications: 25 total), and the material passes only if the flame/glow time per any single flame application never exceeds 60 seconds.

Reading the product number: ST- ○○ □□ (○.○)

Size: post-shrink bore diameter x 10 (mm) — Grade — Post-shrink wall thickness (mm)

Product List

ST-DG UL Type/ST-DG Type

Product Name	Pre-shrink bore diameter (mm)	Post-shrink bore diameter (mm)	Post-shrink wall thickness (mm)	Standard packaging				Minimum packing unit (m)
				1m	3m	5m	50m*	
ST-5DG (0.3)	0.9-1.2	0.4-0.75	0.2-0.4	●	●			30
ST-8DG (0.3)	1.8-2.4	0.7-1.1	0.2-0.5	●	●			
ST-8DG UL	0.9-1.2	0.4-0.75	0.8-1.2	●		●		25
ST-10DG (0.5)	2.2-3.0	0.8-1.3	0.3-0.7	●		●		
ST-10DG UL	1.8-2.8	0.8-1.2	0.8-1.2	●			●	
ST-15DG (0.5)	2.9-3.8	1.3-1.8	0.3-0.7	●		●		
ST-15DG (1.0)	3.0-4.2	1.3-1.8	0.8-1.2	●		●		20
ST-15DG UL	3.0-4.2	1.3-1.8	0.8-1.2	●			●	
ST-20DG (0.5)	4.0-5.6	1.7-2.3	0.3-0.7	●		●		
ST-20DG (1.0)	3.8-5.2	1.7-2.3	0.8-1.2	●		●		
ST-20DG UL	3.8-5.2	1.7-2.3	0.8-1.2	●			●	
ST-25DG (0.5)	4.8-6.5	2.3-3.0	0.3-0.7	●		●		
ST-25DG (1.0)	5.0-6.7	2.2-2.9	0.8-1.2	●		●		
ST-25DG UL	5.0-6.7	2.2-2.9	0.8-1.2	●			●	
ST-30DG (0.5)	5.5-7.3	2.8-3.5	0.3-0.7	●		●		
ST-30DG (1.0)	6.2-8.0	2.7-3.5	0.8-1.2	●		●		
ST-30DG UL	6.2-8.0	2.7-3.4	0.8-1.2	●			●	
ST-40DG (0.5)	7.5-9.5	3.7-4.5	0.3-0.7	●		●		
ST-40DG (1.0)	7.8-10.0	3.5-4.4	0.8-1.2	●		●		
ST-40DG UL	7.8-10.0	3.5-4.4	0.8-1.2	●			●	
ST-55DG (1.5)	10.0-13.0	5.0-6.2	1.2-1.8	●		●		10
ST-55DG UL	10.0-13.0	5.0-6.2	1.2-1.8	●			●	
ST-65DG (0.6)	11.0-14.0	6.1-7.5	0.4-0.8	●		●		
ST-80DG (1.5)	15.0-19.0	7.3-9.0	1.2-1.8	●		●		
ST-80DG UL	15.0-19.0	7.3-9.0	1.2-1.8	●		●		
ST-110DG (2.0)	20.0-25.0	10.2-12.5	1.7-2.3	●		●		
ST-110DG UL	20.0-25.0	10.2-12.5	1.7-2.3	●		●		
ST-140DG (1.3)	24.0-29.0	13.5-16.0	1.0-1.6	●		●		5
ST-140DG UL	24.0-29.5	13.0-15.5	1.7-2.3	●		●		

* Tubing is not sold in amounts smaller than 50 m (1 reel).
● Please place orders in multiples of the packing unit.
● Bore and wall thickness are not specified values.

Product Name	Pre-shrink bore diameter (mm)	Post-shrink bore diameter (mm)	Post-shrink wall thickness (mm)	Standard packaging			Minimum packing unit (m)
				1m	3m	5m	
ST-170DG (1.5)	29.0-35.0	15.0-20.0	1.2-1.8	●		●	5
ST-170DG (2.0)	29.0-35.0	15.0-19.0	1.7-2.3	●		●	
ST-170DG	29.0-35.0	15.0-19.0	1.7-2.3	●		●	
ST-230DG (1.5)	43.0-52.0	21.0-28.0	1.2-1.8	●		●	
ST-230DG (3.0)	41.0-49.0	20.0-26.0	2.7-3.3	●		●	
ST-230DG	41.0-49.0	20.0-26.0	2.7-3.3	●		●	
ST-290DG	50.0-60.0	27.0-34.0	2.7-3.3	●		●	
ST-350DG (1.5)	62.0-75.0	34.0-43.0	1.2-1.8	●		●	
ST-350DG (3.0)	60.0-73.0	31.0-40.0	2.7-3.3	●		●	
ST-350DG	60.0-73.0	31.0-40.0	2.7-3.3	●		●	
ST-400DG (3.0)	67.0-84.0	37.0-49.0	2.5-3.5	●		●	1
ST-400DG	67.0-84.0	37.0-49.0	2.5-3.5	●		●	
ST-500DG (3.0)	78.0-98.0	45.0-60.0	2.5-3.5	●		●	
ST-500DG	78.0-98.0	45.0-60.0	2.5-3.5	●		●	
ST-600DG (3.0)	95.0-118.0	55.0-70.0	2.5-3.5	●		●	
ST-600DG	95.0-118.0	55.0-70.0	2.5-3.5	●		●	
ST-800DG (3.0)	130.0-160.0	75.0-95.0	2.5-3.5	●		●	
ST-800DG	130.0-160.0	75.0-95.0	2.5-3.5	●		●	
ST-1000DG (3.0)	158.0-193.0	90.0-115.0	2.5-3.5	●		●	
ST-1000DG	158.0-193.0	90.0-115.0	2.5-3.5	●		●	
ST-1200DG (3.0)	190.0-230.0	110.0-140.0	2.5-3.5	●		●	
ST-1200DG	190.0-230.0	110.0-140.0	2.5-3.5	●		●	
ST-1500DG (3.0)	235.0-285.0	135.0-170.0	2.5-3.5	●		●	
ST-1500DG	235.0-285.0	135.0-170.0	2.5-3.5	●		●	

● Please place orders in multiples of the packing unit. ● Bore and wall thickness are not specified values.

Product List

ST-HT Type

Product Name		Pre-shrink bore diameter (mm)	Post-shrink bore diameter (mm)	Post-shrink wall thickness (mm)	Standard packaging			Minimum packing unit (m)
					1m	3m	5m	
ST-8HT	(0.15)	1.15-1.45	0.7-1.0	0.1-0.3	●	●		30
ST-10HT	(0.3)	1.7-2.4	0.9-1.3	0.2-0.45	●	●		
ST-15HT	(0.3)	2.2-3.0	1.2-1.8	0.2-0.45	●		●	25
ST-20HT	(0.3)	3.1-3.9	1.7-2.3	0.2-0.45	●		●	20
ST-30HT	(0.5)	5.1-6.0	2.7-3.4	0.3-0.7	●		●	
ST-50HT	(0.5)	7.8-9.2	4.3-5.5	0.3-0.7	●		●	10
ST-75HT	(0.5)	11.5-13.2	6.7-8.2	0.3-0.7	●		●	
ST-100HT	(0.75)	16.0-18.2	9.0-10.7	0.6-1.0	●		●	
ST-140HT	(0.75)	23.0-26.0	12.0-15.0	0.6-1.0	●		●	5
ST-190HT	(1.0)	31.5-35.5	17.5-22.0	0.8-1.2	●		●	
ST-230HT	(1.5)	44.0-49.5	22.0-26.5	1.3-1.8	●		●	
ST-270HT	(1.0)	45.0-51.5	24.0-32.0	0.8-1.3	●		●	
ST-290HT	(1.5)	54.0-61.0	28.0-36.0	1.3-1.8	●		●	
ST-380HT	(1.5)	60.0-73.0	34.0-44.0	1.2-1.8	●		●	
ST-520HT	(1.5)	83.0-98.0	46.0-60.0	1.2-1.8	●		●	1
ST-650HT	(2.0)	100.0-117.0	58.0-75.0	1.5-2.5	●		●	
ST-800HT	(3.0)	135.0-160.0	74.0-89.0	2.5-3.5	●		●	
ST-1000HT	(3.0)	160.0-190.0	92.0-115.0	2.5-3.5	●		●	

● Please place orders in multiples of the packing unit. ● Bore and wall thickness are not specified values.

Instructions for Use

Work Procedure

1 Size selection

Select a size, type, color, and wall thickness suitable for the application.
As a rule of thumb, select a tubing whose post-shrink bore diameter is slightly smaller than that of the object to be covered.

2 Fitting

Cut the tubing to the appropriate length for the object being covered.

✻ Our heat-shrink tubing can be cut easily with a utility knife or scissors. Take care to cut the end cleanly and evenly.
✻ Tubing may shrink or elongate slightly lengthwise. The customer should consider this carefully before use.

3 Heating

Slip the tubing over the object being covered, then heat evenly to shrink.
Tubing should be heated to between 80°C - 250°C.

✻ If the heating temperature is too high (over 250°C), the tube surface may crack or split.

Possible heating equipment: hot-air oven, hot-air gun, gas burner, infrared heater, electric heater, etc.

Precautions during Heating

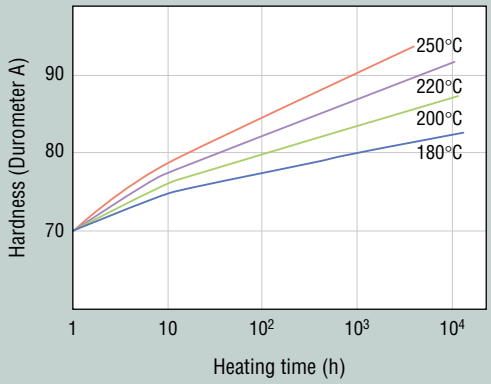
Using a hot-air oven is the easiest way to ensure even shrinking.
When using a hot-air gun or other device, please observe the following precautions:

1. When the object being covered is long and thin,
   start shrinking in the center and work outward to the ends.
2. To ensure even rubber thickness, rotate the tubing and heat evenly around the full circumference.
3. Take care not to trap air pockets: apply heat first to any concave sections.
4. When covering a polygonal bar, start shrinking at the angles first.
   Work should proceed in the order listed above.

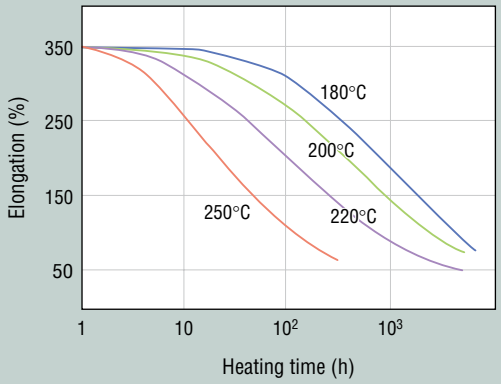
High-/low-temperature resistance: ST-DG/ST-DG Types

Like common silicone rubber, ST-DG and ST-DG heat-shrink tubing retain their rubber properties over a wide temperature range (-50°C to +200°C).
The graphs show changes in hardness, elongation and tensile strength at high temperatures, and changes in rigidity at low temperatures.

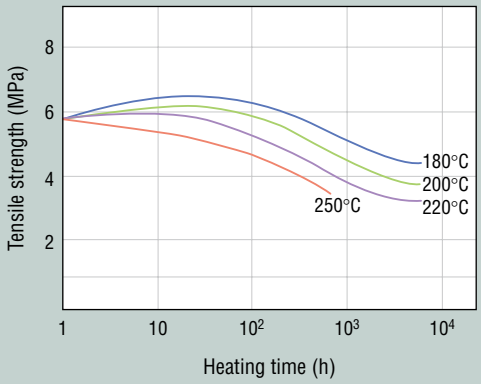
Change in hardness at high temperatures



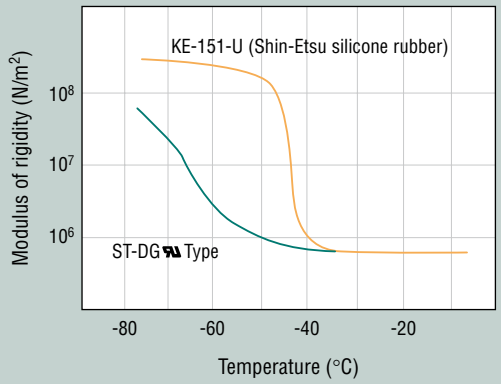
Change in elongation at high temperatures



Change in tensile strength at high temperatures



Change in rigidity at low temperatures



- Low-temperature flexibility test (ASTM-D-2671)
  ST-DG Type -75°C PASSED
- Gehman torsional stiffness (ASTM-D-1053)

Oil resistance: ST-DG/ST-DG Types

The table shows the change in elongation, tensile strength, tear strength and volume resistivity when ST-DG/ST-DG heat-shrink tubing is immersed in various oils.

	Immersion conditions	Elongation change (%)	Tensile strength change (%)	Tear strength change (%)	Volume resistivity change (%)
Soybean oil	60°C / 150h	-16	-4	-59	-1
Rapeseed oil	60°C / 150h	-21	-4	-42	+6
Sesame oil	60°C / 150h	-16	-4	-42	+3
Lard	60°C / 150h	-33	-11	-46	0
Blended cooking oil*	60°C / 150h	-21	-6	-48	+2
Brake fluid	60°C / 150h	-7	-16	-40	+5
Motor oil	60°C / 150h	-21	-4	-45	+5
Insulating oil (low voltage)	60°C / 150h	-47	-55	-75	+53
ASTM oil No. 1	60°C / 150h	-22	-4	-42	+2

✻ Based on JIS K 6249 ✻ Blended cooking oil is a blend of equal parts (by weight) of soybean oil, rapeseed oil and lard. (Not specified values)

	Immersion conditions	Volumetric change (%)
Benzene	25°C / 1h	130
Toluene	25°C / 1h	160
Xylene	25°C / 1h	160
Gasoline	25°C / 1h	170
Solvent naphtha	25°C / 1h	190
Ethyl ether	25°C / 1h	170
Acetone	25°C / 1h	45
Methyl ethyl ketone	25°C / 1h	90
Ethyl acetate	25°C / 1h	95
Methanol	25°C / 1h	> 1
Water	100°C / 24h	> 1

✻ Based on JIS K 6249 (Not specified values)

Solvent resistance: ST-DG/ST-DG Types

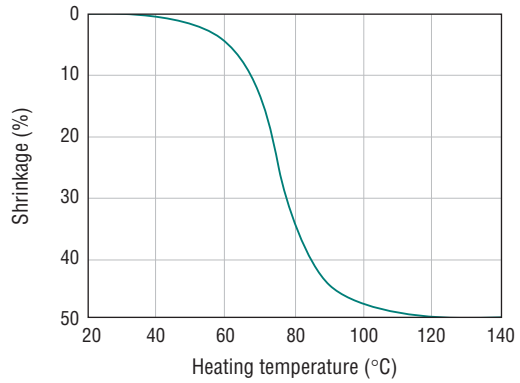
The solvent resistance of ST-DG and ST-DG heat-shrink rubber tubing is the same as that of ordinary silicone rubber. They have strong resistance against water and polar solvents; though they are affected by non-polar solvents, aromatic solvents and chlorinated solvents, resulting in swelling and reduced strength. However, when the swell-inducing solvent dries and is removed, the rubber's properties return nearly to their initial state. The table shows the change in volume when ST-DG and ST-DG tubings are immersed in various solvents.

Shrinkage properties: ST Series

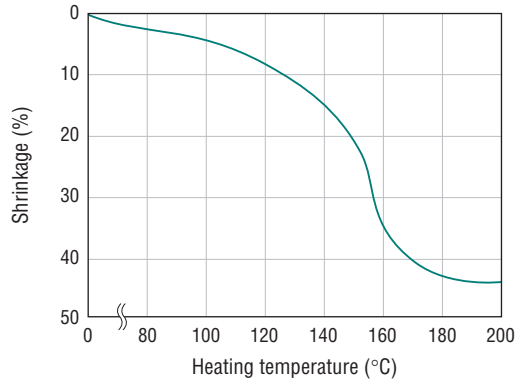
● Heating temperature and shrinkage

The shrinkage of our ST Series of heat-shrink rubber tubing is most affected by temperature, and shrinkage is greater as heating time increases. The graph shows the rate of shrinkage after 5 minutes at various temperatures.

ST-DG/ST-DG Types



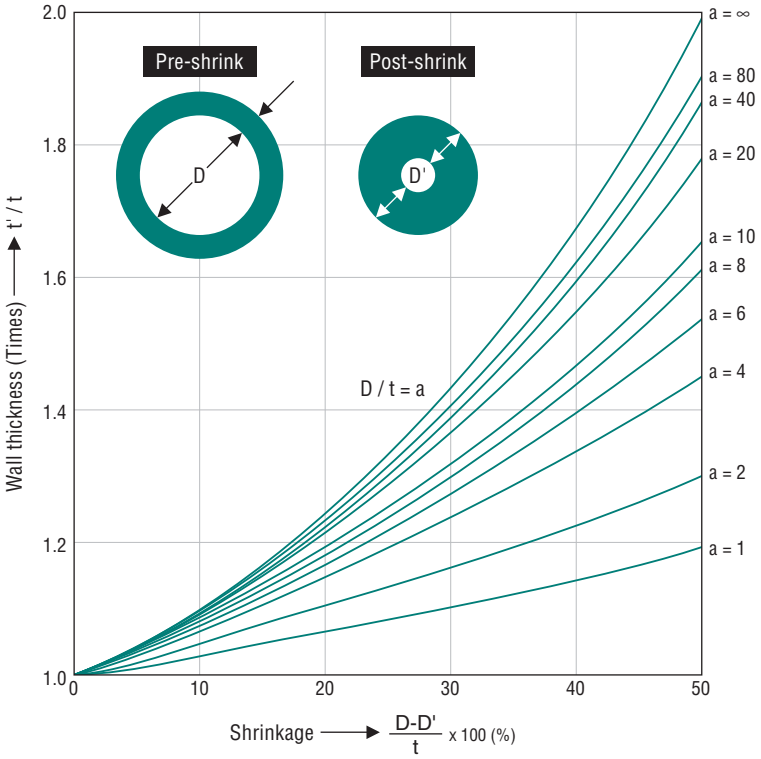
ST-HT Type



● Shrinkage and wall thickness

As it shrinks, the wall thickness of our ST tubing always increases. The correlation between shrinkage and wall thickness is shown in the figure below; this assumes the Poisson ratio of silicone rubber to be μ=0.5, and that the cross section of the tubing is geometrically constant. When the ratio of tubing diameter to wall thickness is about 10:1, shrinkage and wall thickness change in a nearly linear fashion. Furthermore, keep in mind that when the bore is small and the wall is thick, there will be less change in wall thickness.

Fig. Shrinkage and wall thickness



✻ Example of calculation formula

$$\left(\frac{t'}{t}\right)^2 + \frac{D}{t}\left(1 - \frac{D-D'}{t}\right)\left(\frac{t'}{t}\right) - \frac{D}{t} - 1 = 0$$

● Contractile force

When our ST tubings are heated, they shrink due to the tensile force stored within them.
The contractile force exerted during shrinking is shown in the table below.

Sample	Pre-shrink thickness (mm)	Contractile force at 0% shrinkage (per 1-m width: g)	Force/section area (kg/cm²)	Contractile force at 25% shrinkage (per 1-m width: g)	Force/section area (kg/cm²)
ST-170DG	0.85	350	4.1	170	2

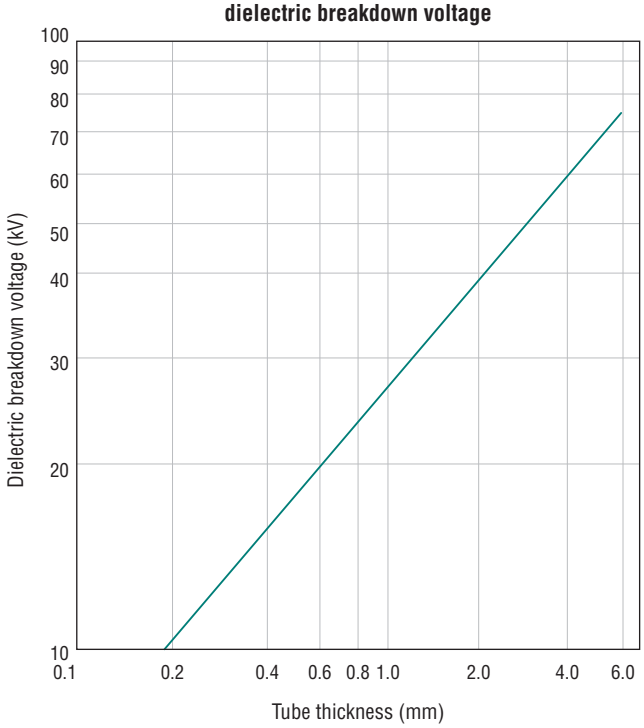
(Not specified values)

Electrical properties: ST-DG/ST-DG Types

ST-DG and ST-DG heat-shrink tubings perform well as electrical insulators, with no change in properties caused by fluctuations in frequency or temperature. The correlation between tube wall thickness and dielectric breakdown strength (for AC current) is shown in the graph at right. Generally speaking, dielectric breakdown voltage is proportional to thickness to the 2/3 power. The correlation between tube thickness (on a flat plate) and dielectric breakdown voltage is plotted on the log-log graph shown at right, where it appears as a nearly straight line.

* Keep in mind that the wall thickness of heat-shrink rubber tubing changes during the shrinking process.

Correlation between wall thickness and dielectric breakdown voltage



Light transmissivity: ST-HT Type

	Wavelength	Wall thickness	
		0.5 mm	1.0 mm
Light transmissivity	800 nm	90%	70%
	600 nm	80%	60%
	400 nm	60%	35%

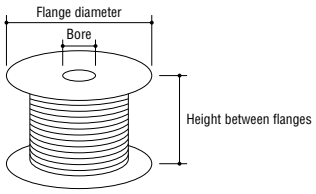
(Not specified values)

Packaging

Samples of 1-, 3-, 5-meter packaging

Samples of 50-meter packaging

✻ Box No. 6-9 50 m reels Part names



Reel size

Flange diameter 250mm: 10DGUL-30DGUL / Height between flanges 85mm
290mm: 40DGUL / Height between flanges 110mm
340mm: 55DGUL / Height between flanges 110mm

Bore is 30 mm for all.

Sizes of shipping boxes

Uses	Packaging	Type	Size (long side x short side x height)/weight	Brief description
Standard for domestic shipping	1-, 3-, 5-meter packaging	❶ Box No.1	1,120×110×110mm/0.38kg	1-, 3-, 5-meter
		❷ Box No.2	1,105×200×110mm/0.75kg	1-, 3-, 5-meter
		❸ Box No.3	1,105×430×175mm/1.51kg	1-, 3-, 5-meter
		❹ Box No.4	1,115×80×80mm/0.19kg	1-, 3-, 5-meter
		❺ Box No.5	1,105×280×160mm/0.98kg	1-, 3-, 5-meter
	50-meter packaging	Box No. 6	260×260×120mm/0.245kg	For 50 m reels (1 reel, 250 mm in diameter)
		Box No.7	515×260×215mm/0.46kg	For 50 m reels (4 reel, 250 mm in diameter)
		Box No.8	300×300×145mm/0.335kg	For 50 m reels (1 reel, 290 mm in diameter)
		Box No.9	595×300×265mm/0.585kg	For 50 m reels (4 reel, 290 mm in diameter)
		Box No.10	350×350×145mm/0.6kg	For 50 m reels (1 reel, 340 mm in diameter)
		Box No.11	695×350×265mm/0.8kg	For 50 m reels (4 reel, 340 mm in diameter)
Standard for export	1-, 3-, 5-meter packaging	Export box K	1,110×485×365mm/4.06kg	1-, 3-, 5-meter
	50-meter packaging	Export box L	1,050×280×460mm/2.3kg	Shipping unit: 4 No. 7 Boxes
		Export box M	1,230×320×580mm/3.92kg	Shipping unit: 4 No. 9 Boxes
		Export box N	1,430×370×580mm/5kg	Shipping unit: 4 No. 11 Boxes

Storage and Handling Precautions

1. Store out of direct sunlight in a cool, dry place.
2. Do not allow product to come in contact with solvents or oils. Prolonged contact may deteriorate the product resulting in a decline in properties.
3. Before use, be sure to clean the surface of the object being covered to remove any dirt, debris, moisture or oil.
4. Please read the Material Safety Data Sheet (MSDS) before use. MSDS can be obtained from our Sales Department.

Sample Order Form

If you would like a sample of products in our ST Series,
make a copy of this page and fill in the required information. Fax the completed form to the following number:

FAX (+81) 3-3246-5364

Shin-Etsu Chemical Co., Ltd Attn: ST Sample

Model no. of desired sample

Size Grade Thickness

ST- ☐☐☐☐ ☐☐ **(.)**

✻ Select sizes from those in the product lists on pp. 6-8.

For requests regarding colors & other specs, enter info here:

( )

Desired delivery

____ / ____ / 20__ (mm / dd / yyyy)

Outer diameter of object being covered

ϕ **mm**

Intended application

Send sample to

Address

Company name	Department name
Your name	Contact us Phone: Fax: Email:

✻ Please keep in mind that certain grades and sizes may take longer to deliver.

Shin-Etsu

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