



# CGPE-105 HEAT-SHRINK TUBING SPECIFICATION

TEC-108-120008

## Raychem CGPE-105 Tubing Brightly Colored, Shiny, Non-Flame-Retardant Polyolefin Tubing

CGPE-105 is a single wall 2:1 shrink ratio heat shrinkable tubing fabricated from crosslinked polyolefin. The tubing is available in a variety of colors and is intended to be used in applications where flame retardancy is not required.

RoHS and REACH compliant.

Continuous operating temperature: -70°C to 105°C (-94°F to 221°F).

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## 1. SCOPE

This specification covers the requirements for one type of flexible, non-flame resistant, electrical insulating, extruded tubing whose diameter will reduce to a predetermined size upon the application of heat in excess of 85°C (185°F). This tubing is intended to serve as an attractive covering for many automotive, appliance, and consumer-goods applications. Commercial grade tubing for applications where a flame-retardant product is not needed. Provides both insulation and protection of components and wires while also providing a smooth, glossy finish with a choice of seven colors as well as clear. Exceptional transparency of clear CGPE-105 makes it a well-suited choice for protecting marked surfaces. These special requirements are detailed in Table 3.

## 2. APPLICABLE DOCUMENTS

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issue of referenced documents applies. The following documents form a part of this specification to the extent specified herein.

### American Society for Testing and Materials (ASTM)

D2671 Standard Methods of Testing Heat-Shrinkable Tubing for Electrical Use

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103 or via the ASTM website at <http://www.astm.org>).

## 3. REQUIREMENTS

### 3.1. DIMENSIONS

The dimensions shall be in accordance with Tables 1 and 2.

### 3.2. MATERIALS

The tubing components shall be essentially free from pinholes, bubbles, cracks, defects and inclusions and shall be constructed as a single wall heat shrinkable tubing from an irradiated, modified polyolefin material.

### 3.3. COLOR

The standard colors are: Black, White, Clear, Red, Blue, Yellow, Green and Violet.

### 3.4. PROPERTIES

The tubing shall meet the requirements of Table 3.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1. CLASSIFICATION OF TESTS

#### 4.1.1. Qualification Tests

Qualification tests are those performed on tubing submitted for qualification as a satisfactory product and shall consist of all tests listed in this specification.



#### 4.1.2. Acceptance Tests

Acceptance tests are those performed on tubing submitted for acceptance under contract. Acceptance tests shall consist of:

Dimensions  
Tensile Strength  
Ultimate Elongation  
Heat Shock  
Longitudinal Change

### 4.2. SAMPLING INSTRUCTIONS

#### 4.2.1. Qualification Test Samples

Qualification test samples shall consist of 15 m (50 feet) of tubing of any single size. Both black and any other color will qualify all.

#### 4.2.2. Acceptance Test Samples

Acceptance test samples shall consist of not less than 5 m (16 feet) of tubing selected at random from each lot. A lot shall consist of all tubing of the same size from the same production run and offered for inspection at the same time.

#### 4.2.3. Lot Formation

A lot shall consist of all tubing of the same size, from the same production run, and offered for inspection at the same time.

### 4.3. TEST PROCEDURES

Unless otherwise specified, perform tests on specimens which have been recovered by heating for 3 minutes in a  $150 \pm 5^{\circ}\text{C}$  ( $302 \pm 9^{\circ}\text{F}$ ) oven. Condition the test specimens (and measurement gauges when applicable) for 3 hours at  $23 \pm 3^{\circ}\text{C}$  ( $73 \pm 5^{\circ}\text{F}$ ). For referee purposes, condition the test specimens at  $50 \pm 5$  percent relative humidity for 3 hours prior to testing. Use mechanical convection type ovens in which air passes the specimens at a velocity of 30 to 60 m (100 to 200 feet) per minute.

#### 4.3.1. Dimensions and Longitudinal Change

Measure three 150 mm (6 inch) specimens of tubing, as supplied, for length  $\pm 1$  mm ( $\pm 1/32$  inch) and inside diameter in accordance with ASTM D 2671. Condition the specimens for 3 minutes in a  $150 \pm 5^{\circ}\text{C}$  ( $302 \pm 9^{\circ}\text{F}$ ) oven, cool to  $23 \pm 3^{\circ}\text{C}$  ( $73 \pm 5^{\circ}\text{F}$ ), then re-measure. Prior to and after conditioning, the dimensions of the tubing shall be in accordance with Table 1 and the longitudinal change shall be in accordance with Table 3. Calculate the longitudinal change as follows:

$$C = ((L_1 - L_0) / L_0) \times 100$$

Where: C = Longitudinal Change [percent]

$L_0$  = Length Before Conditioning [inches (mm)]

$L_1$  = Length After Conditioning [inches (mm)]



#### 4.3.2. Tensile Strength and Ultimate Elongation

Perform the tests in accordance with ASTM D 2671 using 25 mm (*1 inch*) bench marks, 25 mm (*1 inch*) initial jaw separation and jaw separation speed of  $50 \pm 5$  mm ( $2.0 \pm 0.2$  inches) per minute. Calculate the tensile strength based on the wall thickness of the jacket only.

#### 4.3.3. Heat Shock

The test method shall be as specified in ASTM D2671. Five tubing specimens shall be prepared in accordance with Section 4.3.1. The specimens shall be suspended vertically in a fan assisted air-circulating oven and conditioned at  $200^{\circ}\text{C}$  ( $392^{\circ}\text{F}$ ) for 4 hours. After conditioning the specimens shall be allowed to cool naturally to room temperature and visually examined for signs of outer jacket cracking.

#### 4.3.4. Heat Aging

Ten tubing specimens shall be prepared in accordance with Section 4.3.1. The specimens shall be suspended vertically in two fan assisted air circulating ovens, conditioned at  $125 \pm 3^{\circ}\text{C}$  ( $257 \pm 5^{\circ}\text{F}$ ) for 168 hours. After conditioning, the specimens shall be allowed to cool naturally to room temperature and visually examined for signs of outer jacket cracking. The samples shall then be tested for Ultimate elongation in accordance with Section 4.3.1.2.

#### 4.4. REJECTION AND RETEST

Failure of any sample of tubing to conform to any one of the requirements of this specification shall be cause for rejection of the lot represented. Tubing which has been rejected may be replaced or reworked to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and action taken to correct the defects shall be furnished to the inspector.

### 5. PREPARATION FOR DELIVERY

#### 5.1. FORM

5.1.1. The tubing shall be supplied on spools or cut pieces.

#### 5.2. PACKAGING

5.2.1. Packaging shall be in accordance with good commercial practice.

#### 5.3. MARKING

5.3.1. Each container of tubing shall be permanently and legibly marked with the size, quantity, manufacturer's identification, part number and lot number.



## APPENDIX

**Table 1**  
**Tubing Dimensions**

Size	As Supplied		Recovered								
	Inside Diameter Minimum (D)		Inside Diameter Maximum (d)		Wall Thickness (W)						
	mm	<i>in.</i>	mm	<i>in.</i>	Minimum		Maximum		Nominal		
				mm	<i>in.</i>	mm	<i>in.</i>	mm	<i>in.</i>	mm	<i>in.</i>
3/64	1.17	.046	0.58	.023	0.33	.013	0.48	.019	0.40	.016	
1/16	1.60	.063	0.79	.031	0.35	.014	0.50	.020	0.43	.017	
3/32	2.36	.093	1.17	.046	0.43	.017	0.58	.023	0.50	.020	
1/8	3.17	.125	1.57	.062	0.43	.017	0.58	.023	0.50	.020	
3/16	4.74	.187	2.36	.093	0.43	.017	0.58	.023	0.50	.020	
1/4	6.35	.250	3.17	.125	0.56	.022	0.71	.028	0.64	.025	
3/8	9.50	.375	4.74	.187	0.56	.022	0.71	.028	0.64	.025	
1/2	12.70	.500	6.35	.250	0.56	.022	0.71	.028	0.64	.025	
3/4	19.05	.750	9.50	.375	0.69	.027	0.84	.033	0.76	.030	
1	25.40	1.000	12.70	.500	0.76	.030	1.01	.040	0.88	.035	
1-1/2	38.10	1.500	19.05	.750	0.86	.034	1.17	.046	1.01	.040	
2	50.80	2.000	25.40	1.000	0.96	.038	1.32	.052	1.14	.045	

**Table 2**  
**Special Sizes**

Size	As Supplied		Recovered								
	Inside Diameter (D)		Inside Diameter Maximum (d)		Wall Thickness (W)						
	mm	<i>in.</i>	mm	<i>in.</i>	Minimum		Maximum		Nominal		
				mm	<i>in.</i>	mm	<i>in.</i>	mm	<i>in.</i>	mm	<i>in.</i>
HW	12.70±0.750	0.500±0.030	7.50	0.300	1.90	0.075	2.10	0.083	2.00	0.079	



**Table 3  
Requirements**

Property	Unit	Requirement	Test Method
*Dimensions	mm ( <i>in</i> )	Table 1 and Table 2	ASTM D 2671
*Tensile Strength	MPa ( <i>psi</i> )	12.4 (1800) minimum	ASTM D 2671 20 in./min.
*Elongation	Percent	200 minimum	ASTM D 2671 20 in./min.
*Longitudinal Change	Percent	0 to -10	ASTM D 2671
Secant Modulus	MPa ( <i>psi</i> )	172.4 (25,000) maximum	ASTM D 2671
Specific Gravity	--	1.0 maximum	ASTM D 792
Low Temperature Flexibility 4 hr./-70°C Mandrel Dimensions in Table 4	--	No Cracking	ASTM D 2671 Procedure C
*Heat Shock 4 hr./200°C		No Dripping, Flowing or Cracking	ASTM D 2671
Corrosion, Copper Contact 16 hr./125°C	--	No Pitting or Blackening of Copper	ASTM D 2671 Procedure B
Heat Age, %E 168 hr./125°C	Percent	100 minimum	ASTM D 2671
Dielectric Strength Standard Wall Heavy Wall	V/mm ( <i>V/mil</i> )	19,700 (500) minimum 11,820 (300) minimum	ASTM D 2671

\*Acceptance Test

**Table 4  
Low Temp Flex Mandrel Sizes**

Recovered Tubing Diameter		Mandrel Size	
mm	<i>in</i>	mm	<i>in</i>
0.58 – 3.18	0.023 - 0.125	7.87 – 7.98	0.310 - 0.314
3.19 – 6.35	0.126 - 0.250	9.45 – 9.60	0.372 - 0.378
6.36 – 25.40	0.251 - 1.000	11.00 – 11.20	0.433 - 0.441