



## Heat Shrink Tubes for Brake and Fuel Lines

### 1 Introduction

**Note:** Nothing in this standard supercedes applicable laws and regulations.

**Note:** In the event of conflict between the English and domestic language, the English language shall take precedence.

**1.1 Purpose.** This standard specifies dimensions, test methods and requirements single wall and dual wall heat shrinkable tubing use on metallic pipes, including Brake and Fuel Lines.

**1.2 Applicability.** This specification covers crosslinked polyolefin heat shrinkable tubing that is intended to be used as physical and corrosion protection for metallic pipe (brake and fuel lines). Surface is shiny black in appearance and abrasion resistant. Product yields a smooth surface on radii when formed.

**1.3 Remarks.** Shrink tube may also be used to protect other metallic lines such as Transmission Oil and Coolant (TOC) and Air Conditioning (A/C).

**1.4 Temperature Classes.** Two (2) temperature class ratings (3000 h) have been defined in Table 1 to respond to the various temperatures encountered on vehicles.

Table 1: Temperature Class Rating, 3000 h

| ISO Class | Operating Temperature<br>(°C) | Equivalent to Temperature<br>Class |
|-----------|-------------------------------|------------------------------------|
| B         | -40 to +100                   | T2                                 |
| C         | -40 to +125                   | T3                                 |

**Note:** °C = Degree Celsius.

**1.5 Heat Shrink Tube Designation.** It is recommended that the codes in Section 8 be used on drawings and purchase orders to designate tubing type, temperature class, and size.

### 2 References

**Note:** Only the latest approved standards are applicable unless otherwise specified.

#### 2.1 External Standards/Specifications.

|            |          |               |            |
|------------|----------|---------------|------------|
| ASTM D2671 | ISO 37   | ISO 4926      | JIS-C-3005 |
| ASTM D5374 | ISO 1817 | ISO/IEC 17025 | SAE J1703  |
| ASTM D5423 |          |               |            |

#### 2.2 GM Standards/Specifications.

|         |          |
|---------|----------|
| GMW3059 | GMW14658 |
|---------|----------|

## 2.3 Additional References.

- Bio-Diesel (GMPT-5-036) (ID)
- E85 Low pHe (GMPT-6-023) (ID)
- E100 (GMPT-6-037) (ID)
- No. 2 Diesel (GMPT-5-001) (ID)
- Oxidized Gasoline (GMPT-6-019) (ID)
- TF2 Gasoline-Methanol-Ethanol Blend (GMPT-6-006) (ID)

**Note:** For a list of approved suppliers for Test Fluids see Appendix C, Table C1.

(ID) = This document is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

## 3 Test Preparation and Evaluation

### 3.1 Resources.

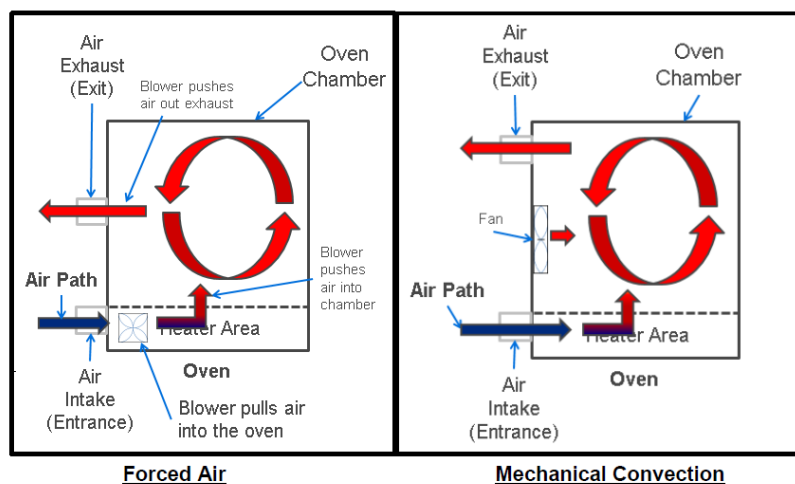
**3.1.1 Facilities.** Temperature controlled room with power outlets and internet connections.

**3.1.1.1 Calibration.** The test facilities and equipment shall be in good working order and shall have a valid calibration label.

**3.1.1.2 Alternatives.** Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

**3.1.1.3 Ovens.** Unless otherwise specified, when an oven is required, it shall be a hot air oven. The oven type shall either be a forced air or mechanical convection. See Figure 1. The air shall enter the oven in such a way that it flows over the surface of the test pieces and exits near the top of the oven. The oven shall have not less than eight (8) and not more than twenty (20) complete air changes per hour at the specified aging temperature. Reference ASTM D5423 and ASTM D5374 for temperature uniformity and air exchange measurements.

**Figure 1: Ovens**



**3.1.2 Equipment.** See each individual test in Section 4.

**3.1.3 Test Vehicle/Test Piece.** Table 2 defines the material codes for the shrink tube material.

Table 2: Material Code <sup>Note 1</sup>

| Material Code    | Material                                                                                                             |
|------------------|----------------------------------------------------------------------------------------------------------------------|
| Single Wall (SW) | Cross linked polyolefin, single wall <i>(recommended for pipes that have been pre-coated with polyamide coating)</i> |
| Dual Wall (DW)   | Cross linked polyolefin, single wall <i>(recommended for pipes that have been pre-coated with polyamide coating)</i> |

**Note 1:** The number of test samples is specified in each test. The shrink tube to be tested shall be manufactured under full production conditions. No parts out of prototype tools shall be used.

### 3.1.4 Test Time.

Calendar time: 125 d

Test time: 3000 h

Coordination time: 12 h

### 3.1.5 Test Required Information.

Not applicable.

### 3.1.6 Personnel/Skills.

Test personnel familiar with the test procedure.

### 3.2 Preparation.

See each individual test.

### 3.3 Conditions.

**3.3.1 Environmental Conditions.** Test samples for all tests shall be preconditioned for at least 16 h at a temperature of 23 °C ± 3 °C and a relative humidity of 45% to 75%. Unless otherwise specified, all tests other than "in process" tests shall be conducted at this temperature. Where no tolerance is specified, all values shall be considered approximately.

Deviations from the requirements of this standard shall have been agreed upon between General Motors and the supplier. Such requirements shall be specified on component drawings, test certificates, reports, etc.

**3.3.2 Test Conditions.** Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

### 3.4 Instructions.

See each individual test.

### 3.5 Data.

See 3.7.1.

**3.6 Safety.** This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

**3.7 Documentation.** Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

**3.7.1 Test Results.** Test results shall be reported in the format as shown in Appendix A, Data Sheet A1. The test report shall include as minimum:

- Name of the supplier

- GM and Supplier product code for the tested part
- Date of test report
- Part Designation/GM Spec Code
- IMDS\_ID and information. If the IMDS datasheet has been approved by the customer
- The result and interpretation of test result
- Test Report shall have the detail photos for each physical test result

**3.7.2 Approvals.** For Initial Certification, Periodic testing, and Secondary location approval of a heat shrink tube to this specification, see Appendix B, Table B1 for the list of tests required.

## 4 Requirements and Procedure

**4.1 Colors.** Standard color for heat shrink tubes is black. Other colors can be used and shall be agreed upon between GM and the supplier.

### 4.2 Dimensions.

#### 4.2.1 Inside Diameter (As Supplied).

**4.2.1.1 Test Samples.** Prepare three (3) test samples with a length of 150 mm each.

**4.2.1.2 Procedure.** Measure the Inside Diameter using a series of mandrels with diameter intervals of 0.1 mm being passed through a test section of tubes. The mandrel shall be inserted into the tube approximately 30 mm. The Inside Diameter is equal to the diameter of the mandrel that can be easily inserted into the tube. Measurement accuracy: 0.1 mm.

**4.2.1.3 Interpretation of Results.** As Supplied inside diameter values shall conform to Table 3 and Table 4.

**Table 3: Single Wall, Shrink Tubes without Adhesive** <sup>Note 1</sup>

| Size | For Use on the Following Outer Diameter Pipes<br>mm (in) | Minimum "as Supplied" Diameter, mm | Maximum Fully Recovered Inner Diameter, mm | Fully Recovered Wall Thickness, Nominal, mm |
|------|----------------------------------------------------------|------------------------------------|--------------------------------------------|---------------------------------------------|
| 6    | 4.76 (3/16)                                              | 6.0                                | 4.9                                        | 0.9                                         |
| 9    | 4.76 (3/16) or 6.35 (1/4)                                | 9.0                                | 4.5                                        | 1.2                                         |
| 11   | 9.53 (3/8)                                               | 11.0                               | 7.9                                        | 1.3                                         |
| 17   | 12.7 (1/2)                                               | 17.0                               | 11.5                                       | 0.8                                         |

**Note 1:** Deviations from these values can be agreed upon. A data sheet of the shrink tube, including the dimensions, shall be presented together with the test report (see 3.7.1).