



AEROSPACE RECOMMENDED PRACTICE

ARP1153™

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Superseding ARP1153A

Method for Determining Relative Specific Gravity Polytetrafluoroethylene Tubing

RATIONALE

Added the displacement method per ASTM D792 for measuring the specific gravity.

1. SCOPE

This document describes a method for determining the specific gravity of tubing, fabricated from polytetrafluoroethylene, after a controlled heating and cooling cycle. The specific gravity obtained by this method is a measure of relative molecular weight of the resin. The measure, termed relative specific gravity (RSG), increases with decreasing molecular weight (refer to Sperati and Starkweather, 1961).

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

ASTM D1505-85 Standard Method of Test for Density of Plastics by the Density-Gradient Technique

2.2 Other Publications

Sperati, C.A. and Starkweather, H.W. (1961). *Advances in polymer science - Fluorine containing polymers II polytetrafluoroethylene* (pp. 465-495).

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3. THE METHOD

3.1 The Sample

The sample shall be a representative cross section of the size, thickness, and construction of the tubing under test. The size and shape of the sample is not critical but shall be large enough to provide sufficient specimen material for specific gravity measurements in a density gradient tube (refer to ASTM D1505-85).

3.2 Heating and Cooling Cycle

The air circulating oven is to be preheated at $716^{\circ}\text{F} \pm 5^{\circ}\text{F}$. The specimen shall be placed in the oven and held at $716^{\circ}\text{F} \pm 5^{\circ}\text{F}$ for 30 ± 5 minutes. The oven air temperature shall reach 716°F within 5 minutes after insertion of the sample.

The sample is then cooled in the oven at an average rate of $2.2^{\circ}\text{F} \pm 0.1^{\circ}\text{F}$ per minute to $572^{\circ}\text{F} \pm 10$ with a minimum cooling time of 63 minutes and maximum time of 68 minutes. Deviations in oven temperature should not exceed $\pm 5^{\circ}\text{F}$ from the average temperature indicated on a plot of temperature versus time for the cooling rate actually achieved as shown in Figure 1. The sample is then removed from the oven and allowed to cool to room temperature.

3.3 Measuring Relative Specific Gravity

The primary method for measuring relative specific gravity shall be per Test Method A for Testing Solid Plastics in Water per ASTM D792. An alternate method is described in detail in ASTM D1505-85. It involves determining the level a specimen sinks in a vertical tube in which a continuous gradient has been established by partially mixing liquids of different densities. A diagram of the equipment is shown in Figure 2.

Glass floats of calibrated specific gravity are employed to determine the liquid gradient produced in relation to their positions on a linear scale adjacent to the vertical tube. The sample is introduced to the tube and sinks to an equilibrium position equivalent to its own specific gravity. The position of the sample along the linear scale is read at its estimated center of gravity.

3.3.1 Liquids

Suggested liquids for use in preparing the gradient tubes are listed below:

Tetrachloroethylene, density 1.62 g/mL - tribromomethane, density 2.89 g/mL

Bromobenzene, density 1.50 g/mL - tribromomethane, density 2.89 g/mL

Chlorobenzene, density 1.11 g/mL - tribromomethane, density 2.89 g/mL

1,3-Dibromopropane, density 1.98 g/mL - Bromoform, density 2.88 g/mL

3.3.2 Gradient Tube Specimen Size

The specimens of fabricated polytetrafluoroethylene resins should be quite small, a perimeter of 3/8 to 5/8 inch being adequate. In order to differentiate between specimens, they may be cut in a variety of simple geometric shapes. Holes or cracks in the specimens will entrap air and cause bubbles. This will influence the specific gravity and should be avoided. Also, the specimens should be cut with a sharp knife or razor to prevent ragged edges.

3.3.3 Gradient Tube Testing Procedure

The temperature of the tube should be maintained at $73.5^{\circ}\text{F} \pm 0.5^{\circ}\text{F}$. The specimen should be placed in the liquid with long tweezers and should be agitated slightly to eliminate any air bubbles that may cause erroneous readings. When the specimen is bubble-free, it should be released and allowed to sink to an equilibrium position. If the specimen clings to the walls of the tube or lodges on a float, gentle tapping on the side of the tube will dislodge it.