



Designation: D1603 – 11

## Standard Test Method for Carbon Black Content in Olefin Plastics<sup>1</sup>

This standard is issued under the fixed designation D1603; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope\*

1.1 This test method covers the determination of the carbon black content in polyethylene, polypropylene, and polybutylene plastics. Its use with acrylic or other polar monomer modifications which might affect the accuracy is not recommended. Determinations of carbon black content are made gravimetrically after pyrolysis of the sample under nitrogen. This test method is not applicable to compositions that contain nonvolatile pigments or fillers other than carbon black.

1.1.1 This test method is not applicable to materials containing brominated flame retardant additives at the end.

1.2 The values stated in SI units are to be regarded as standard. The values in parentheses are given for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This standard and ISO 6964-1986(E) address the same subject matter, but differ in technical content.

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

D883 Terminology Relating to Plastics

D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

#### 2.2 ISO Standard:

ISO 6964-1986(E) Polyolefin Pipes and Fittings—Determination of Carbon Black by Calcination and Pyrolysis—Test Method and Basic Specification<sup>3</sup>

### 3. Terminology

3.1 *Definitions*—For definitions of technical terms pertaining to plastics used in this specification, see Terminology D883.

### 4. Significance and Use

4.1 The information provided by this test method is useful for manufacturing quality control, technical service, and research purposes; and is required by various material specifications and for the calculation of optical absorptivity.

4.2 Test Method D4218 is available for determining the carbon black content of polyethylene compounds if so desired.

### 5. Apparatus

5.1 *Electric Furnace*, at least 20 cm (7.9 in.) long suitable for use with the tubing described in 5.2.

5.2 *High Temperature Glass Combustion Tube*,<sup>4</sup> of appropriate diameter and approximately twice as long as the furnace described in 5.1.

5.3 *Stoppers*—Two rubber or neoprene stoppers, to fit the tube described in 5.2, unless the tube is fitted with ground joints and mating connectors.

5.4 *Glass Tubing*, approximately 10 mm (0.39 in.) in diameter, of sufficient amount, and matching rubber or plastic tubing for connections.

5.5 *Combustion Boat*, approximately 8 by 1.9 by 1.3 cm (3.15 by 0.75 by 0.51 in.). Glazed porcelain, quartz high-silica glass, or platinum is suitable.

NOTE 2—A loose-fitting cover for the combustion boat is optional. If used, it shall be considered a part of the boat and handled and weighed with it.

<sup>3</sup> ISO/IEC Selected Standards for Testing Plastics, Second Edition, published by ASTM. Also available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

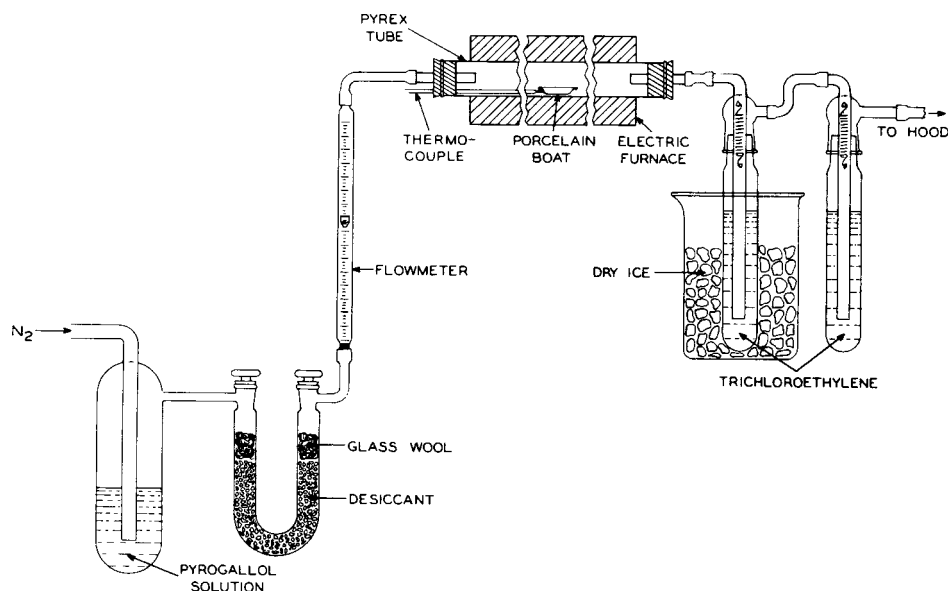
<sup>4</sup> Borosilicate, high-silica, or equivalent glass tubing has been found satisfactory for this purpose.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.70 on Analytical Methods (Section D20.70.01).

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard.



**FIG. 1 Assembly of Apparatus**

5.6 *Iron-Constantan Thermocouple*, and a potentiometer or millivoltmeter suitable for determining temperatures in the range 300 to 700°C (572 to 1292°F).

5.7 *Flow Meter*, suitable for measuring gas flow at rates of 1 to 10 L/min.

5.8 *Traps*, three glass traps with removable ground-glass connected heads and 10-mm (0.39-in.) diameter inner and connecting tubes.

NOTE 3—Only one trap is required if the entire apparatus train is placed in a fume hood. None is required if in addition, nitrogen of sufficient purity is used and produced by the alternative means provided in Section 6.

5.9 *Drying Tube*—A U-shaped drying tube, having an inside diameter of 20 mm (0.79 in.) or larger, fitted with ground glass or neoprene stoppers.

5.10 *Glass Wool*.

5.11 *Desiccator*, with desiccant.

5.12 *Bunsen Burner or Muffle Furnace*—Electric resistance-heated or microwave-heated furnace capable of heating the combustion boat to red heat.

NOTE 4—When an electric furnace is used, position it in a well-ventilated hood. When a microwave furnace is used, position it within or adjacent to a hood and the exhaust tube vented into the hood to prevent the breathing of byproducts of any combustion. An air flow rate of 2.8 m<sup>3</sup>/min through the microwave oven is recommended.

5.13 *Balance*—An analytical balance having a sensitivity of 0.0001 g.

## 6. Reagents and Materials

6.1 *Carbon Dioxide, Solid* (Dry Ice).

NOTE 5—The solid carbon dioxide and the trichloroethylene are not required if the entire apparatus train is placed in a fume hood.

6.2 *Desiccant*, such as anhydrous calcium chloride (CaCl<sub>2</sub>).

6.3 *Nitrogen*, prepurified, having oxygen content below 0.01 %. As a safeguard against accidental leakage, contamina-

tion, or inadequate purity, the gas shall be further purified by one of the following procedures:

6.3.1 Passage of the nitrogen through a glass trap inserted ahead of the drying tube (see Fig. 1), filled approximately one third full of potassium hydroxide - pyrogallol solution made to contain 5 g of pyrogallol and 50 g of KOH in 100 mL of water. Technical grade, or better, reagents are satisfactory.

6.3.2 Insertion of a plug, or roll, of clean copper tinsel, foil, or wire 7.5 to 10 cm (3 to 4 in.) long into the combustion tube ahead of the sample (see Fig. 1) so that it is completely within the heated region of the furnace. Take care to prevent channeling of the nitrogen through the plug. The extent of blackening of the copper may be taken as a guide for determining when the plug should be renewed.

6.3.3 Passage of the nitrogen through a combustion tube filled to a length of 15 cm (6 in.) or greater with clean copper tinsel, foil, or wire, and maintained in a furnace at a temperature around 500°C (932°F).

6.3.4 The need for the procedures described is eliminated if gas having an oxygen content of less than 0.002 % (20 ppm) is used.

6.4 *Trichloroethylene*, technical grade (Note 5).

## 7. Sampling and Test Specs

7.1 The test specimens can be in a variety of forms which fit in the combustion boat but must satisfy the requirements of 8.3. Soiled articles must be washed and printed articles are wiped clean with a suitable solvent.

## 8. Procedure

NOTE 6—The procedure below assumes that the combustion tube can be easily removed from the furnace. If this is not the case, alternate methods of inserting and removing sample boats are acceptable as long as the temperature, purge time, and flow rate requirements are met.

8.1 Assemble the apparatus as shown in Fig. 1. Both cold traps following the combustion tube shall contain trichloroethylene, but only the first need be cooled with solid carbon