



Standard Practice for Exposing Plastics to a Simulated Compost Environment Using an Externally Heated Reactor¹

This standard is issued under the fixed designation D 5512; 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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers the exposure of plastics to a specific test environment. The test environment is an externally heated laboratory-scale reactor that simulates a composting system. Plastic exposure occurs in the presence of a media undergoing aerobic composting. The standard media simulates a municipal solid waste from which inert materials have been removed. This practice allows for the use of other media to represent particular waste streams. This practice provides exposed specimens for further testing and for comparison with controls. This test environment does not necessarily reproduce conditions that could occur in a particular full-scale composting process.

1.2 Changes in the material properties of the plastic and controls should be determined using appropriate ASTM test procedures. Changes could encompass physical and chemical changes such as disintegration and degradation.

1.3 This practice may be used for different purposes. Therefore, the interested parties must select: exposure conditions from those allowed by this practice; criteria for a valid exposure, that is, minimum or maximum change requirements for the compost and controls; and the magnitudes of material properties changes required for the plastic specimens.

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

1.5 *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.* Specific hazard statements are given in Section 8.

NOTE 1—There is no similar or equivalent ISO standard.

2. Referenced Documents

2.1 ASTM Standards:

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing²

¹ This practice is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.96 on Environmentally Degradable Plastics.

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² *Annual Book of ASTM Standards*, Vol 08.01.

D 638 Test Method for Tensile Properties of Plastics²

D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting²

D 883 Terminology Relating to Plastics²

D 1898 Practice for Sampling of Plastics²

D 1922 Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method²

D 3593 Test Method for Molecular Weight Averages Distribution of Certain Polymers by Liquid Size-Exclusion Chromatography (Gel Permeation Chromatography (GPC)) Using Universal Calibration³

D 3826 Practice for Determining Degradation End Point in Degradable Polyolefins Using a Tensile Test⁴

2.2 *American Public Health Association Standard:*

5210 B. 5-Day BOD Test, Standard Methods for the Examination of Water and Wastewater⁵

3. Terminology

3.1 *Definitions*—Definitions of terms applying to this practice appear in Terminology D 883. Definitions in Terminology D 883 supersede definitions in this section.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *aerobic*—a life process that occurs in the presence of oxygen **(1)**.⁶

3.2.2 *biological reactor*—a vessel in which living organisms, usually microorganisms, catalyze a reaction.

3.2.3 *compost*—a relatively stabilized and sanitized product of composting.

3.2.4 *compost environment*—a biological reactor containing a solid-organic-waste matrix in which aerobic degradation occurs due to the action of microorganisms and other mechanisms.

3.2.5 *degradation*—the process by which a chemical is reduced to a less complex form **(1)**.

3.2.6 *disintegration*—physical breakup of a solid material.

3.2.7 *inoculum*—microorganisms placed in compost to start or accelerate biological action **(1)**.

³ *Discontinued*—See 1992 *Annual Book of ASTM Standards*, Vol 08.02.

⁴ *Annual Book of ASTM Standards*, Vol 08.02.

⁵ *Standard Methods for the Examination of Water and Wastewater*, 18th ed, 1992, published by the American Public Health Assn., 1015 Fifteenth St., NW, Washington, DC 20005.

⁶ The boldface numbers in parentheses refer to the list of references at the end of this standard.

3.2.8 *simulated solid waste*—a media representing a typical waste stream. Although every item found in an actual stream is not included, it includes representative items which establish a consistent and easily reproduced waste matrix.

4. Summary of Practice

4.1 This practice consists of: preparing a representative simulated-solid-waste mixture; loading the biological reactor with controls, test specimens, simulated solid waste, and inoculum; operating and monitoring the biological reactor to ensure active biological degradation; and removing the specimens for cleaning (if desired), conditioning, testing, and reporting.

5. Significance and Use

5.1 Changes to the material properties of a plastic within a compost unit by various mechanisms, such as biodegradation or hydrolysis, are important. Such changes can affect the degradation of other materials enclosed by the plastic and the resulting composition and appearance of the composted material. This practice allows screening of the stability of plastics exposed to an externally heated compost process. ASTM test methods run on plastic products or specimens before and after exposure in accordance with this practice can determine the degree to which material properties of the plastic have changed.

5.2 This practice also allows the determination of the effect of the plastic on the composting process. This is done by comparing extents of compost dry weight or carbon loss.

5.3 This practice does not preclude the pre-exposure of the test specimens to other environments.

5.4 Limitations:

5.4.1 Due to the wide variation in the construction, operation, and content of composting systems and due to variations in regulatory requirements for composting systems, this practice does not simulate the environment of all composting systems. However, it is expected to simulate the environment of a compost process operated under near-optimum conditions.

5.4.2 Appropriate post-exposure testing is not included in this practice, but it is addressed by other ASTM test methods.

5.4.3 Predicting the long-term fate or effects of a plastic from the results of short-term exposure in accordance with this practice could be difficult. Use caution when considering such extrapolations.

5.4.4 A specimen that becomes indistinguishable from other materials within the system could be not fully mineralized. Determination of degradation products and their toxicity requires further testing.

5.4.5 This practice does not address effects occurring after the compost process, such as effects of the compost on soil.

6. Apparatus

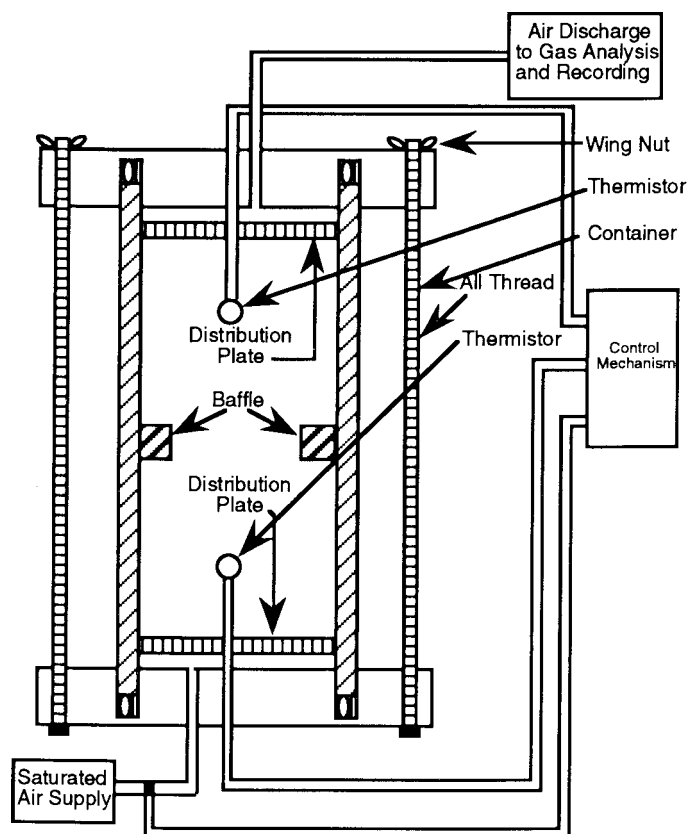
6.1 *Biological Reactor*, for containing the simulated solid waste and plastic specimens in a suitable environment. This may consist of a 12-cm (5-in.) diameter by 25-cm (10-in.) long column. Reactor size may be decreased or slightly increased as long as it is small enough to allow the temperature to be controlled by external heating, and the diameter-to-length ratio is in the range from 1:1 to 1:3. The reactor size should not be

so small that it prevents an even distribution of waste components throughout the column. Fit the reactor with temperature-measuring devices. Extend these devices into the compost to between one fourth and three fourths the depth and width of the compost. There shall be entrance and exit ports for air feed and discharge, and there shall be a distribution plate-baffle or other device to ensure that the airflow through, or air contact with, the compost is distributed as evenly as possible. For example, in the cylindrical reactor shown in Fig. 1, the identical top and bottom distribution plates have 15 uniformly spaced 3.2-mm ($\frac{1}{8}$ -in.) diameter holes and 1.2-cm ($\frac{1}{2}$ -in.) perimeters, without holes. The perimeter acts as a baffle. The pictured reactor also has a second baffle extending 1.2 cm ($\frac{1}{2}$ in.) inward from the chamber walls positioned at the midpoint. These baffles help prevent air from leaking around instead of passing through the compost matrix. The reactor openings shall be attached by a method that provides a hermetic seal. The container and appurtenances shall be constructed of a noncorrosive chemically inert material. The tubing attached to the vessel should be flexible so that the chamber can be inverted.

6.2 *Environmental Chamber*, or other temperature-controlling device capable of regulating the temperature at between 35 and 60 $\pm$ 2°C, or other temperature range required to simulate regulatory requirements.

6.3 *Filtered-Air Supply*, that introduces no contaminants and is measured and controllable.

6.4 *Saturating Device*, for saturating the air with water such



NOTE 1—Not to scale.

FIG. 1 Typical Apparatus