



Standard Specification for Compostable Plastics¹

This standard is issued under the fixed designation D 6400; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

^{ε1} NOTE—Editorially corrected standard listed under 2.3 in April 2002.

1. Scope

1.1 This specification covers plastics and products made from plastics that are designed to be composted in municipal and industrial aerobic composting facilities.

1.2 This specification is intended to establish the requirements for labeling of materials and products, including packaging made from plastics, as “compostable in municipal and industrial composting facilities.”

1.3 The properties in this specification are those required to determine if plastics and products made from plastics will compost satisfactorily, including biodegrading at a rate comparable to known compostable materials. Further, the properties in the specification are required to assure that the degradation of these materials will not diminish the value or utility of the compost resulting from the composting process.

1.4 The following safety hazards caveat pertains to the test methods portion of this standard: *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 health and safety practices and to determine the applicability of regulatory limitations prior to use.*

NOTE 1—No equivalent ISO specifications exist for this standard.

2. Referenced Documents

2.1 ASTM Standards:

D 883 Terminology Relating to Plastics²

D 5338 Test Method for Determining Aerobic Biodegradation of Plastic Materials Under Controlled Composting Conditions³

D 6002 Guide for Assessing the Compostability of Environmentally Degradable Plastics³

2.2 Organization for Economic Development (OECD) Standard:⁴

OECD Guideline 208 Terrestrial Plants, Growth Test

2.3 *Comite Europeen de Normalisation (CEN) Draft:*⁵

CEN/TC 261/SC 4 N 99 Packaging—Requirements for Packaging Recoverable through Composting and Biodegradation—Test Scheme and Evaluation Criteria for the Final Acceptance of Packaging (prEN 13432)

2.4 *ISO Standard:*⁵

ISO 14855 Evaluation of the Ultimate Aerobic Biodegradability and Disintegration of Plastics under Controlled Composting Conditions—Method by Analysis of Evolved Carbon Dioxide

2.5 *Government Standard:*⁶

40 CFR Part 503.13 Standards for the Use or Disposal of Sewage Sludge

3. Terminology

3.1 *Definitions*—Definitions appearing in this specification are found in Terminology D 883, unless otherwise noted.

3.1.1 *biodegradable plastic*—a degradable plastic in which the degradation results from the action of naturally occurring microorganisms such as bacteria, fungi, and algae.

3.1.2 *compostable plastic*—a plastic that undergoes degradation by biological processes during composting to yield CO₂, water, inorganic compounds, and biomass at a rate consistent with other known compostable materials and leave no visible, distinguishable or toxic residue.

3.1.3 *composting*⁷—a managed process that controls the biological decomposition and transformation of biodegradable materials into a humus-like substance called compost: the aerobic mesophilic and thermophilic degradation of organic matter to make compost; the transformation of biologically decomposable material through a controlled process of biooxidation that proceed through mesophilic and thermophilic phases and results in the production of carbon dioxide, water, minerals, and stabilized organic matter (compost or humus).

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

Current edition approved April 10, 1999. Published May 1999.

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

³ *Annual Book of ASTM Standards*, Vol 08.03.

⁴ Available from Organization for Economic Development, Director of Information, 2 rue Andre' Pascal, 75775 Paris Cedex 16, France.

⁵ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

⁶ *Code of Federal Regulations*, available from U.S. Government Printing Office, Washington, DC 20402.

⁷ *Compost Facility Operating Guide*, Composting Council, Alexandria, VA, 1995.

3.1.3.1 *Discussion*—Composting uses a natural process to stabilize mixed decomposable organic material recovered from municipal solid waste, yard trimmings, biosolids (digested sewage sludge), certain industrial residues and commercial residues.

3.1.4 *degradable plastic*—a plastic designed to undergo a significant change in its chemical structure under specific environmental conditions, resulting in a loss of some properties that may be measured by standard test methods appropriate to the plastic and the application in a period of time that determines its classification.

3.1.5 *plastic*—a material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or processing into finished articles, can be shaped by flow.

3.1.6 *polymer*—a substance consisting of molecules characterized by the repetition (neglecting ends, branch junctions, other minor irregularities) of one or more types of monomeric units.

4. Classification

4.1 The purpose of this specification is to establish standards for identifying products and materials that will compost satisfactorily in commercial and municipal composting facilities. Products meeting the requirements outlined below are appropriate for labeling as “compostable” in accordance with the guidelines issued by the Federal Trade Commission.⁸

5. Basic Requirements

5.1 In order to compost satisfactorily, a product or material must demonstrate each of the characteristics found in 5.1.1-5.1.3, and which are quantified in Section 6.

5.1.1 *Disintegration During Composting*—A plastic product or material will disintegrate during composting such that any remaining plastic residuals are not readily distinguishable from the other organic materials in the finished product. Additionally, the material or product must not be found in significant quantities during screening prior to final distribution of the compost.

5.1.2 *Inherent Biodegradation*—A level of inherent biodegradation shall be established by tests under controlled conditions, that are comparable to known compostable materials.

5.1.3 *No Adverse Impacts on Ability of Compost to Support Plant Growth*—The tested materials shall not adversely impact on the ability of composts to support plant growth, when compared to composts using cellulose as a control, once the finished compost is placed in soil. Additionally, the polymeric products or materials must not introduce unacceptable levels of heavy metals or other toxic substances into the environment, upon sample decomposition.

NOTE 2—For a better understanding of why these criteria are important, the reader should consult Guide D 6002 *Compost Facility Operating Guide*,⁷ and CEN/TC 261/SC 4 N 99.

⁸ *Guidelines for the Use of Environmental Marketing Claims*, Federal Trade Commission, Washington, DC, 1992.

6. Detailed Requirements

6.1 In order to be identified as compostable, products must pass the requirements of 6.2, 6.3, and 6.4 using the appropriate laboratory tests, representative of the conditions found in aerobic composting facilities. Products and finished articles should be tested in the same form as they are intended to be used. For products that are made in multiple thicknesses or densities, such as films, containers and foams, only the thickest or most dense products need to be tested as long as the chemical composition and structure remains otherwise the same. It is assumed that thinner gages and lower densities will also compost satisfactorily. Similarly, if additives are present in test samples that pass testing, lower levels of the same additives are similarly passed.

6.2 A plastic product is considered to have demonstrated satisfactory disintegration if after controlled laboratory-scale composting, found in 7.2.1 of Guide D 6002, no more than 10 % of its original dry weight remains after sieving on a 2.0-mm sieve.

6.3 A plastic product must demonstrate a satisfactory rate of biodegradation by achieving one of the following ratios of conversion to carbon dioxide found in 6.3.1, 6.3.2 or 6.3.3, within the time periods specified in 6.3.3.1 or 6.3.3.2, using Test Method D 5338 as outlined in 7.3.1 and 7.3.3 of Guide D 6002:

6.3.1 For products consisting of a single polymer (homopolymers or random copolymers), 60 % of the organic carbon must be converted to carbon dioxide by the end of the test period (see 6.3.4), when compared to a known reference material as outlined in 7.3.2 of Guide D 6002.

6.3.2 For products consisting of more than one polymer (block copolymers, segmented copolymers, blends, or addition of low molecular weight additives), 90 % of the organic carbon must be converted to carbon dioxide by the end of the test period (see 6.3.4), when compared to a known reference material as outlined in 7.3.2 of Guide D 6002.

6.3.3 For products consisting of more than one polymer, each individual polymer component, present at more than 1 % concentration, must achieve the 60 % specification for homopolymers, as described in 6.3.1.

6.3.3.1 For materials that are not radiolabeled, the test period shall be no greater than 180 days.

6.3.3.2 If radiolabeled materials are used, then the test period may be as long as 365 days.

NOTE 3—While the end points of biodegradation may include incorporation into biomass or humic substances as well as carbon dioxide, no recognized standard test methods and specifications exist to quantify these outcomes. When these tests and specifications become available, this standard will be revised.

6.4 A plastic product can demonstrate satisfactory terrestrial and aquatic safety if it fulfills the following requirements:

6.4.1 The plastic or product shall have concentrations of heavy metals less than 50 % of those prescribed in 40 CFR Part 503.13, and

6.4.2 The plastic or product shall fulfill the requirements of the tests found in 7.5.2.2 and 7.5.2.3 of Guide D 6002, including the cress seed test for plant germination and a plant growth test following OECD Guideline 208.

7. Sampling

7.1 Sampling shall be conducted as indicated in the specified test method.

8. Specimen Preparation

8.1 Specimen preparation shall be in accordance with the specified test method.

9. Marking and Labeling

9.1 Marking and labeling shall conform to national and local regulations.

10. Keywords

10.1 biodegradable; compostable plastic; composting; degradable plastics; labeling

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).