Designation: ~~D2659 – 11~~ D2659 – 16

Standard Test Method for Column Crush Properties of Blown Thermoplastic Containers[1]

This standard is issued under the fixed designation D2659; 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 test method covers the determination of mechanical properties of blown thermoplastic containers, whether blown commercially or in the laboratory, loaded under columnar crush conditions at a constant rate of compressive deflection.

NOTE 1—Although this test method was developed specifically for blow-molded containers, the general procedure can also be applied to containers of suitable geometries produced by other means, for example, thermoforming, injection molding, etc.

1.2 The values stated in SI units are to be regarded as the standard.

NOTE 2—There is no known ISO equivalent to this standard.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing

D883 Terminology Relating to Plastics

D4976 Specification for Polyethylene Plastics Molding and Extrusion Materials

E4 Practices for Force Verification of Testing Machines

E83 Practice for Verification and Classification of Extensometer Systems

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method and associated with plastics issues refer to the terminology contained in ASTM D883.

3.2 ~~*Definitions:*~~*Definitions of Terms Specific to This Standard:*

3.2.1 *apparent crushing stiffness*—the ratio of the crushing load to the corresponding deflection at a point on the linear portion of the crushing load deflection curve (expressed in newtons per metre (or pounds per inch)).

3.2.2 *column*—a compression member that is axially loaded.

3.2.3 *crushing load at failure*—the crushing load applied to a blown thermoplastic container that produces a failure by fracture or parting of the material in any portion of said container (expressed in kilograms (or pounds)).

3.2.4 *crushing yield load*—the first load at which an increase of deflection occurs with no increase in load in a compressive crushing test (expressed in units of kilograms (or pounds) of load).

NOTE 3—In some cases, usually as a result of design or styling features, or both, of a specific container, multiple values of the crushing yield load are be observed, that is, a small deflection occurs with no increase or with a decrease in the crush load, followed by resumption of the normal crush load change with deflection. This phenomenon cannot be ignored in the evaluation of the column crush properties of a blown thermoplastic container, since it can be a very useful designated failure point for the application under consideration. The load at which this abrupt change occurs can be chosen as a crushing yield load for study. In such a case, the report of results should be accompanied by a proper description of the crushing yield load selected.

---

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.19 on Film, Sheeting, and Molded Products.

Current edition approved ~~Sept. 1, 2011~~May 1, 2016. Published ~~September 2011~~May 2016. Originally approved in 1967. Last previous edition approved in ~~2005~~2011 as ~~D2659 - 1995 (2005).~~D2659 - 11. DOI: ~~10.1520/D2659-11.~~10.1520/D2659-16.

[2] 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**

~~3.1.2 *crushing load at failure*—the crushing load applied to a blown thermoplastic container that produces a failure by fracture or parting of the material in any portion of said container (expressed in kilograms (or pounds)).~~

3.2.5 *deflection at crushing yield load*—the decrease in length of the container specimen produced at the crushing yield load along the center line of testing (axis of crushing, see Fig. 1) (expressed in millimetres (or inches)).

3.2.6 ~~*apparent crushing stiffness*~~—*gage length*—the ~~ratio of the crushing load to the corresponding deflection at a point on the linear~~ original length of that portion of the ~~crushing load deflection curve (expressed in newtons per metre (or pounds per inch)).~~specimen over which strain or change in length is determined.

4. Significance and Use

4.1 Column crush tests only provide information about the crush properties of blown thermoplastic containers when employed under conditions approximating those under which the tests are conducted.

4.2 The column crush properties include the crushing yield load, deflection at crushing yield load, crushing load at failure, and apparent crushing stiffness. Blown thermoplastic containers made from materials that possess a low order of ductility can fail in crushing by brittle fracture. In such cases, the crushing yield load is equivalent to the crushing load at failure. Blown thermoplastic containers made of ductile materials do not always exhibit a crushing load at failure although they will normally provide a crushing yield load value.

4.3 Column crush tests provide a standard method of obtaining data for research and development, applications, design, quality control, acceptance or rejection under specifications, and special purposes. The tests cannot be considered significant for engineering design in applications differing widely from the load - time scale of the standard test. Such applications require additional tests such as impact, creep, and fatigue.

5. Apparatus

5.1 *Testing Machine*—Any suitable testing machine capable of control of constant-rate-of-crosshead movement and comprising essentially the following:

5.1.1 *Drive Mechanism*—A drive mechanism imparting the crosshead movable member of a uniform, controlled velocity with respect to the fixed member, this velocity to be regulated as specified in Section 9.

5.1.2 *Load Indicator*—A load-indicating mechanism capable of showing the total crushing load carried by the test specimen. The mechanism shall be essentially free from inertia-lag at the specified rate of testing and shall indicate the crushing load with an accuracy of ±1 %. The accuracy of the testing machine shall be verified at least once a year, in accordance with Practices E4.

5.2 *Extensometer*—A suitable instrument for determining the distance between the two surfaces of load application on the test specimen at any time during the test. It is desirable that this instrument automatically record this distance, or any change in it as a function of the crushing load on the test specimen. The instrument shall be essentially free of inertia-lag at the specified rate of loading and shall conform to the requirements for a Class B-2 extensometer, as defined in Practice E83.

5.3 *Load Application Fixtures*—A means shall be provided to apply the crushing load to the specimen such as a stationary and moveable parallel platens. The fixtures shall be of sufficient rigidity to prevent fixture deformation due to the applied crushing load.

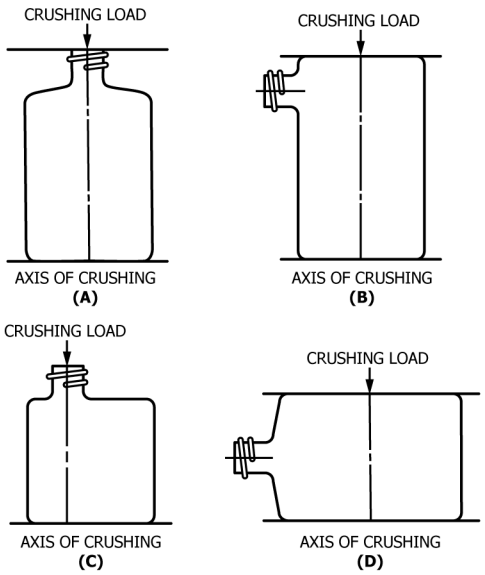

FIG. 1 Typical Crushing Axes