



Designation: D 4272 – 99

Standard Test Method for Total Energy Impact of Plastic Films By Dart Drop¹

This standard is issued under the fixed designation D 4272; 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.

1. Scope *

1.1 This test method describes the determination of the total energy impact of plastic films by measuring the kinetic energy lost by a free-falling dart that passes through the film.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are 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—The ISO reference for this test method is ISO 7765-2; however, this test method is not equivalent to Test Method D 4272. The ISO test method calls for a direct readout of energy by using a load cell as part of the impactor head, while Test Method D 4272 calls for a constant weight impactor, then measuring the time of travel through a given distance to get energy values. Therefore, the two are not equivalent in this respect.

2. Referenced Documents

2.1 ASTM Standards:

- D 374 Test Methods for Thickness of Solid Electrical Insulation²
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing³
- D 1709 Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method³
- D 3420 Test Method for Dynamic Ball Burst (Pendulum) Impact Resistance of Plastic Film⁴
- E 171 Specification for Standard Atmospheres for Conditioning and Testing Flexible Barrier Materials⁵
- E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁶

¹ This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D 20.19 on Film and Sheeting. Current edition approved Aug. 10, 1999. Published September 1999. Originally published as D 4272 – 83. Last previous edition D 4272 – 96.

² *Annual Book of ASTM Standards*, Vol 10.01.

³ *Annual Book of ASTM Standards*, Vol 08.01.

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

⁵ *Annual Book of ASTM Standards*, Vol 15.09.

⁶ *Annual Book of ASTM Standards*, Vol 14.02.

2.2 *ISO Standard:*
ISO 7765-2⁷

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *free-fall time*—the measured time required for the dart to travel through the sensing area with no film specimen in the clamp.

3.1.2 *missile weight*—the weight of the dart plus the total value of incremental weights attached, including the locking collar.

3.1.3 *test-fall time*—the measured time for the dart to travel through the sensing area with a film specimen in the clamp.

4. Summary of Test Method

4.1 The velocity of a freely falling dart of specified shape that has passed through a sheet of plastic film is determined by means of a photoelectric speed trap. The kinetic energy corresponding to this velocity is calculated and compared with the kinetic energy of the same dart measured without a plastic film in place. The loss in kinetic energy, suffered by the dart that ruptured the film, is used as an index of impact resistance.

5. Significance and Use

5.1 Evaluation of the impact toughness of film is important in predicting the performance of a material in applications such as packaging, construction, and other uses. The test simulates the action encountered in applications where moderate-velocity blunt impacts occur in relatively small areas of film.

5.2 The values obtained by this test method are highly dependent on the method and conditions of film fabrication as well as the type and grade of resin.

5.3 Test methods employing different missile velocities, impinging surface diameters, or effective specimen diameters will most likely produce different results. Data obtained by this test method cannot necessarily be compared directly with those obtained by the other test methods.

5.4 The impact resistance of a film, while partly dependent on thickness, does not have a simple correlation with sample thickness. Hence, impact values expressed in joules (ft-lbf)

⁷ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

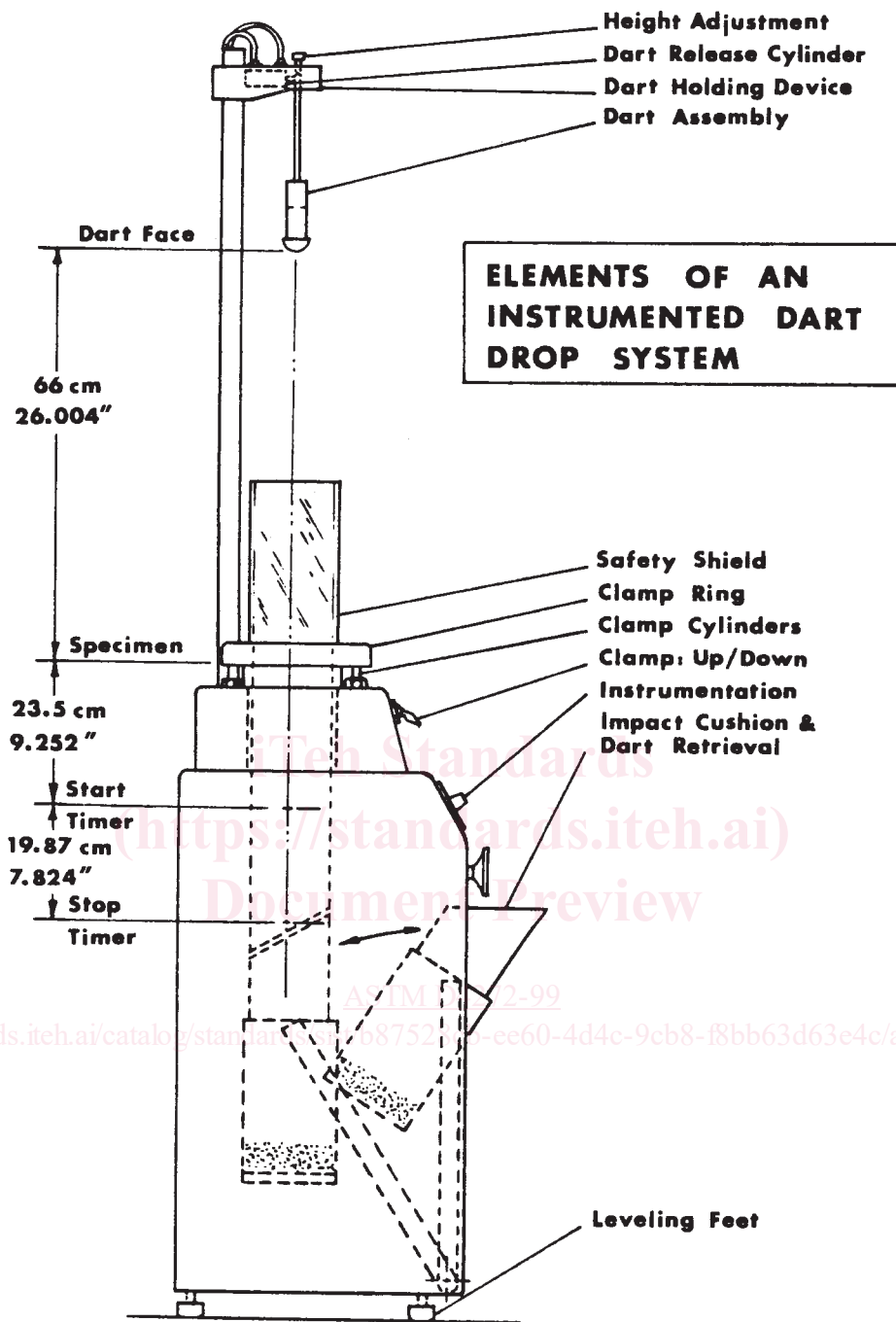


FIG. 1 Elements of an Instrumented Dart Drop System

normalized over a range of thickness will not necessarily be linear with thickness. Data from this test method are comparable only for specimens that vary by no more than $\pm 15\%$ from the nominal or average thickness of the specimens tested.

5.5 The test results obtained by this test method are greatly influenced by the quality of film under test. The influence of variability of data obtained by this procedure will, therefore, depend strongly on the sample quality, uniformity of film gage, the presence of die marks, contaminants, etc.

5.6 Several impact test methods are used for film. It is sometimes desirable to know the relationships among test

results derived by different test methods. A study was conducted in which four films made from two resins (polypropylene and linear low-density polyethylene), with two film thicknesses for each resin, were impacted using Test Methods D 1709 (Test Method A), Test Method D 3420 (Procedures A and B), and Test Method D 4272. The test results are shown in Appendix X2. Differences in results between Test Methods D 1709 and D 4272 are expected since Test Methods D 1709 represents failure-initiated energy, while Test Method D 4272 is initiation plus completion energy. Some films may show consistency when the initiation energy is the same as the total