Designation: D 1042 – 01a

An American National Standard

Standard Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions[1]

This standard is issued under the fixed designation D 1042; 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 is designed to provide a means for measuring in plastic specimens the dimensional changes resulting from exposure to service conditions. In particular, this test method is suitable for measuring shrinkage or elongation developed ~~in accordance with the procedures described in Practice D 756.~~

~~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~~ under specific oven and water conditionings.

1.2 *This standard does not purport to address all of the safety ~~problems,~~ 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—There is no similar or comparable ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*

[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.50 on ~~Permanence Properties.~~ Durability of Plastics.

Current edition approved ~~March~~ April 10, 2001. Published ~~May~~ June 2001. Originally published as D 1042 – 49 T. Last previous edition D 1042 – ~~93~~01.

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

D 756 Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions[2]
D 883 Terminology 883 Terminology Relating to Plastics
D 1898 Practice for Sampling of Plastics[3,2]

3. Terminology

3.1 *Definitions:* Definitions of terms applying to this test method appear in Terminology D 883.

4. Significance and Use

4.1 This test method is intended only as a convenient test method for measurement of linear dimensional changes in plastics subjected to defined conditions of test as outlined in Practice D 756. Section 8. When all precautions are observed, measurements are reproducible to ±0.02 %.

5. Apparatus

5.1 *Scriber*, so constructed that two sharp needle points are rigidly separated by 100 ± 0.2 mm. A very satisfactory The scriber, as shown in Fig. 1, consists of two sharp steel phonograph needles (approximately needles, approximately 1.5 mm in diameter). The needles are to be inserted in holes drilled holes with their axes parallel to each other and perpendicular to and intersecting the long axis of a stainless steel rod, 7.9 8.0 ± 0.1 mm (5/16 in.) in diameter by 125 mm (5 in.) ± 5 mm in length. The needles' points shall extend 6 ± 1 mm beyond the supporting rod and are held in position by two set screws inserted through the ends of the rod. Thickness of arc lines should not exceed 0.02 mm.

NOTE 2—Phonograph needles may be used as a satisfactory scriber.
NOTE 3—For calibration of the scriber, a A stainless steel gage with reference points consisting of a center and two short concentric arcs (R_1= 99.80 ± 0.02 mm, and R_2= 100.20 ± 0.02 mm) shall be used for calibration of the scriber. Thickness of arc lines shall not exceed 0.02 mm.
NOTE 2—Phonograph needles may be used as a satisfactory scriber.

5.2 *Measuring Microscope*, having a magnification of at least 20× and graduated to read to have a resolution of 0.1 mm or better. (A Brinell microscope 20×, for measuring Brinell hardness, is very satisfactory.) For mm.

NOTE 3—For more precise measurements, a micrometer microscope may should be used.

5.3 *Beaker*, having a suitable size for the number of specimens to be evaluated and is constructed of a material that is stable under the test conditions.

5.4 *Room or Conditioning Chamber*, capable of being maintained at 23 ± 2°C.

5.5 *Conditioning Oven*, full draft air-circulating oven, capable of being maintained within ±2°C of the set temperature.

5.6 *Absorbent Material*, cloth or paper suitable for drying.

6. Sampling

6.1 Sampling shall be in accordance with the present considerations outlined in Practice D 1898.

7. Test Specimens

7.1 The test specimens

6.1 Specimens shall not be similar to those prescribed less than 110 mm in Practice D 756 with the additional requirement that length in the direction of test t. The preferred specimen size is 125 ± 5 mm in length should be not less than 110 mm. In practice, specimens 150 by 25 13 ± 0.5 mm and of the full thickness of the material are desirable. These wide by 3.0 (-0.0 + 0.2) mm thick.

6.2 Three specimens may shall be tesuspted for each conditioning.

6.3 Individual specimens shall be positioned vertically in the specified environment by.

NOTE 4—A wire hooks inserted in a hole punched drilled in one end of the specimen. W has been found acceptable.

7. Conditioning and Exposure

7.1 *Preconditioning*

[2] *Annual Book of ASTM Standards*, Vol 08.01.
Annual Book
[3] To participate in the development of precision and bias data, contact the staff manager of ASTM Standards, Vol 08.02. Committee D20 at ASTM Headquarters.

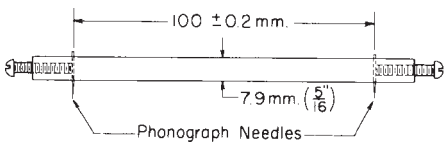


FIG. 1 Scriber

7.1.1 Precondition ~~type~~ specimens at 23 ± 2°C and 50 ± 5 % relative humidity for a minimum of ~~plastic~~ 40 h prior to initial scribing.

NOTE 5—If moisture equilibrium is required prior to preconditioning, refer to the specific material specifications.

7.1.2 After removal from the conditioning environment, specimens shall be ~~e~~ tested within 30 min.

7.2 *Method A—Water Immersion*

7.2.1 Specimens shall be immersed in water maintained at 23 ± 2°C for 168 ± 1 h.

7.2.2 The specimens shall be wiped dry with the absorbent cloth after removal from t~~y~~he water and tested within 3 min.

7.3 *Method B—Oven Conditioning*

7.3.1 Specimens shall be conditioned in an oven at 70 ± 2°C for 25 ± 1 h.

7.3.2 After removal from the oven, the specimens shall be tested within 3 min.

7.4 Other conditionings for specific service conditions can be used if agreed upon by all parties.

7.5 Conduct tests in a standard ~~thickness~~ laboratory atmosphere of ~~3.2 mm (0.125 in.) is preferred.~~ 23 ± 2°C and 50 ± 5 % relative humidity.

8. Procedure

8.1 Immediately following the ~~preconditioning period of the test,~~ preconditioning, scribe an arc of 100-mm radius on the surface of the test specimen. Press one needle firmly into the specimen to form a center for this and subsequent measurements. The other needle scribes the arc which is used as a reference for all subsequent measurements (see Fig. 2). Draw the arcs smoothly, using a pressure consistent with the surface hardness and test conditions to which the specimen is subjected. It is desirable to ~~depress rather than~~ lightly scratch ~~or tear~~ the surface with the ~~needle, although harder surfaced materials and those subjected to extreme test conditions~~ needle so that a sharp, clear arc is defined.

NOTE 6—A contrasting colored, permanent type marker may ~~require deeper scratching~~ be used on the surface of the ~~surface.~~

~~8.2 At each phase~~ specimen, in the area of the ~~test where it is desirable~~ scribe to ~~measure linear changes,~~ aid in defining a sharp, clear arc.

8.2 After conditioning, reinsert one needle in the original center and draw a short arc with the other. Measure the distance between the original arc and the new arc with the microscope. Measure the separation of the arcs between corresponding positions, for example, center to center.

8.3 If the test specimen is not flat, flatten it by pressing or clamping it against a plane surface before scribing the arcs and making the measurements. In no case shall the specimen be clamped or otherwise confined during the period of exposure to accelerated service conditions.

9. Calculation and ~~Precision~~ Measurement

9.1 Measure the distance between arcs to ~~0.1 mm and estimate to~~ the nearest ~~0.01 mm (0.01 mm corresponds to a linear change~~ 0.1 mm.

9.2 Determine the amount of ~~0.0 %). Measurements made on materials not moisture sensitive at other than constant temperature will be corrected for differential thermal~~ linear expansion or shrinkage by the ~~following amount:~~ following:

~~(1) $C = (\alpha p - \alpha s)(Tf - Ti) \times 100$~~ $L_C = D_B / D_I \times 100$

DB~~Tf~~ DI

where:

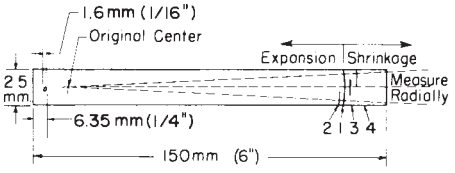
L_C = ~~correction to add to calculated percent shrinkage or subtract from calculated percent expansion,~~ percent of linear change,

~~α_{pD_B}~~ = ~~coefficient of linear thermal expansion of~~distance between the ~~plastic specimen,~~ scribed arcs, and

~~α_{sD_I}~~ = ~~coefficient~~initial scribed distance.

10. Precision and Bias [3]

10.1 This test method is in use by a limited number of ~~linear thermal expansion~~ D20.50 members. Subcommittee D20.50 was not able to locate a sufficient number of laboratories willing to conduct a round robin, for the purpos~~e~~ of developing an acceptable



1—Original arc
2—After 37.7°C (100°F) and 100 % humidity
3—After 60°C (140°F)
4—Final conditioning~~Note 1—The ar~~

FIG. 2 Scsrin thbing Tes st Specimen illustrate the steps to use for Proc Medasure VI of Practieme D 756.nt

Precision and Bias statement. However, Repeatability conducted on six materials was developed by one laboratory. Results are as follows:

TABLE Method A—Water Conditioning

Material	Thick. (mm)	Exp. or Shr.	Spec. 1 (mm)	Spec. 2 (mm)	Spec. 3 (mm)	AVG (mm)	STD DEV	% CH (Lc)
~~T_f~~	~~=~~	~~temperature when final arc is scribed, and Expansion~~	~~0.108~~	~~0.114~~	~~0.091~~	~~0.104~~	~~0.012~~	~~0.104~~
PA 66	3.10	Expansion	0.108	0.114	0.091	0.104	0.012	0.104
~~T_i~~	~~=~~	~~temperature when initial arc is scribed.Shrinkage~~	~~0.059~~	~~0.064~~	~~0.072~~	~~0.065~~	~~0.007~~	~~0.065~~
PP	3.00	Shrinkage	0.059	0.064	0.072	0.065	0.007	0.065
ABS	2.98	Expansion	0.119	0.308	0.131	0.186	0.106	0.186
PC	3.15	Shrinkage	0.051	0.067	0.138	0.085	0.046	0.085
PS	3.10	Shrinkage	0.054	0.072	0.065	0.064	0.009	0.064
PMMA	2.98	Expansion	0.056	0.032	0.076	0.055	0.022	0.055

~~**10. Precision and Bias**~~

~~10.1 A meaningful precision and bias statement cannot be developed at this time because of the small number of laboratories presently known to be using this test method.[4]~~

TABLE Method B—Oven Conditioning

Material	Thick. (mm)	Exp. or Shr.	Spec. 1 (mm)	Spec. 2 (mm)	Spec. 3 (mm)	AVG (mm)	STD DEV	% CH (Lc)
PA 66	3.10	Shrinkage	0.059	0.064	0.078	0.067	0.010	0.067
PP	3.00	Shrinkage	0.169	0.171	0.158	0.166	0.007	0.166
ABS	2.98	Shrinkage	0.150	0.185	0.128	0.154	0.029	0.154
PC	3.15	Shrinkage	0.250	0.222	0.232	0.235	0.014	0.235
PS	3.10	Shrinkage	0.223	0.268	0.321	0.271	0.049	0.271
PMMA	2.98	Shrinkage	0.170	0.189	0.147	0.169	0.021	0.169

11. Report

11.1 The test report shall include the following information:

11.1.1 A reference to this standard;

11.1.2 Date of testing;

11.1.3 A statement that test results relate only to the behavior of the test specimens under the conditions of this test;

11.1.4 Identification of the material tested, including the manufacturer, designation, type of material, the specimen orientation with respect to any anisotropy, and anything unique to the material;

11.1.5 Dimensions of the specimen;

11.1.6 Method of conditioning: A, B, or other;

11.1.7 Distance between the arcs after each conditioning; and

11.1.8 Percent linear expansion or shrinkage (L_C).

12. Keywords

1~~1~~2.1 accelerated service conditions; linear dimensional changes; plastics

SUMMARY OF CHANGES

~~This section identifies~~

Committee D20 has identified the location of selected changes to this ~~test method. For the convenience of the user, Committee D20 has highlighted those changes~~ standard since its last issue, on March 10, 2001, that may impact the use of this ~~test method. This section may also include descriptions of the changes or reasons for the changes, or both.~~

~~*D 1042–01:*~~ standard.

(*1*) ~~Notes 2~~ Removed references to D 576 and ~~3~~ D 1898, which have~~r~~ been withdrawn.

(*2*) Added Section 7 on Conditioning.~~ N~~

(*3*) Added appropriate equipment to condition samples (5.3-5.6).

(*4*) Removed re~~p~~ference to inch units and added tolerance~~d ws~~ to critical dimensions (5.1, Figs. 1 and 2).

(*5*) Changed recommended specimen size (6.1).

(*6*) Added requirement for number of specimens to test (6.2).

(7) Added specific times to test after conditioning (7.1.2, 7.2.2, and 7.3.2).
(8) Added a Repeatability statement (10.1).
(9) Added a Report section (11).