Designation: F2203 – 13

Standard Test Method for Linear Measurement Using Precision Steel Rule[1]

This standard is issued under the fixed designation F2203; 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 measurement of linear dimension of flexible packages and packaging materials. It is recommended for use with an allowable tolerance range of 3 mm (⅛ in.) or greater based on gage repeatability and reproducibility presented in the Precision and Bias section.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E171 Practice for Conditioning and Testing Flexible Barrier Packaging

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:*

3.1.1 *linear dimension*—the measurement of length, width or relative positions.

3.1.2 *parallax error*—the error resulting from a change in observational relationship to a fixed position. For example, looking at a measurement gage from different angles can cause variation in the reporting of that measurement.

4. Significance and Use

4.1 This test method provides a means for measuring linear dimensions. Accurate measurement of dimensions can be critical to meeting specifications and characterizing process performance.

4.2 This test method should not be applied to tolerance ranges of less than 3 mm (⅛ in.) when it is preferable that test error does not exceed 30 % of tolerance range. See Precision and Bias Section for gage repeatability and reproducibility results.

4.3 This test method does not address acceptability criteria. These need to be jointly determined by the user and producer of the product.

5. Apparatus

5.1 *Precision Steel Rule:*

5.1.1 Tempered steel rule in increments of 1/64 in., 100ths, or ½ mm.

5.1.2 Steel rule should be of sufficient length to measure full dimension of interest.

5.1.3 It is recommended that a calibration be performed on the apparatus used and it is certified to a recognized industry standard.

6. Sampling

6.1 The number of samples tested should be adequate to be predictive of performance. Caution should be taken when eliminating samples with defects as this can bias results.

7. Conditioning

7.1 Conditioning of the samples will depend on the material under evaluation. If conditioning before testing is appropriate, normal, and desirable, refer to Specification E171.

8. Procedure

8.1 Review applicable specifications, drawings, or procedures. Specify unit of measure to be used and directions related to precision requirements (for example, measure to nearest 0.5 mm, round up or down to nearest 0.5 mm, to 1/64 in., etc.). Depending upon the level of accuracy and visual acuity, image magnification may be an aid.

8.2 Lay sample to be measured on flat surface with sufficient color contrast to distinguish the edge of the sample. Sample should lay flat and smooth without wrinkles, creases or folds. Material should not be under tension when measured.

8.3 Lay ruler over product or place product on top of ruler so that the characteristic to be measured can be clearly viewed and referenced to the ruler. Care should be taken to properly

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[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.

TABLE 1 Description of Materials Measured in Round Robin Studies

Measurement Set	Material Type	Measurement Characteristic	Ruler Scaling Applied
A	Foil Web	Web Width	in.
B	Paper Web	Web Width	in.
C	Spunbonded Olefin Web	Web Width	mm
D	Printed Foil Web	Print Repeat Length	in.
E	Printed Paper Web	Print Repeat Length	in.
F	Printed Spunbonded Olefin Web	Print Repeat Length	mm
G	Forming Film Web	Web Width	mm
H	Finished Pouch	Dimension A	in.
I	Finished Pouch	Dimension B	in.
J	Finished Pouch	Dimension C	in.
K	Finished Pouch	Dimension D	in.
L	Finished Pouch	Dimension E	in.
M	Finished Pouch	Dimension F	in.

align sample to avoid skewing errors. A ruler may be set on edge along the surface rather than laid flat if the risk of parallax error is apparent.

8.4 Carefully align the starting point of the measurement to the leading edge of fixed scale division on rule (Fig. 1, Example A). Then measure to the end point of the characteristic. Note the scale division on the ruler that corresponds to the end point of the measurement. Determine the measurement by subtracting the start point measurement from the end point. Record the number in the unit of measure and precision required by specification.

9. Report

9.1 Report the following information:

9.1.1 Lot number and source of material, date, time, location and operator of test and complete identification of materials being tested,

9.1.2 Any conditioning of the materials,

9.1.3 Any and all deviations from standard, and

9.1.4 The sampling plan and number of specimens tested along with test results.

10. Precision and Bias

10.1 *Precision*—A research report[3] describes a round robin conducted in 2001 in accordance with Practice E691, involving seven laboratories measuring 13 dimensional attributes of five packaging materials. Materials and measurement attributes are listed in Table 1. Measurements taken included use of steel rules scaled in inch and millimetre divisions. Statistical summaries of repeatability (within a laboratory) and reproducibility (between laboratories) are listed in Tables 2 and 3. All test results are expressed in SI millimetre (mm) units of measure.

10.2 *Concept of "r" and "R" in* Tables 1 and 2—If S_r and S_R have been calculated from a large enough body of data, and for test results that are averages from testing 3 specimens for each test result, then the following applies:

10.3 Repeatability "*r*" is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory. Two test results shall be judged to be not equivalent if they differ by more than the "*r*" value for that material, in this instance approximately 0.528 mm. That is, it can be expected that the same operator measuring the same sample may obtain a reading that varies by up to 0.528 mm (0.0208 or approximately 1⁄64 in.).

10.4 Reproducibility "*R*" is the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories, not necessarily on the same day. Two test results shall be judged to be not equivalent if they differ by more than the "*R*" value for that material, in this instance approximately 0.815 mm. That is, it can be expected that different operators using different equipment in different laboratories may obtain readings that vary by up to 0.815 mm (0.0320 or approximately 1⁄32 in.).

10.5 Any judgment in accordance with 10.3 or 10.4 will have approximately 95 % (0.95) probability of being correct.

10.6 *Bias*—There are no recognized standards by which to estimate the bias of this test method.

11. Keywords

11.1 dimension; linear measurement; rule; scale

[3] A research report is available from ASTM International Headquarters. Request RR:F02-1017.