



Designation: F 2203 – 02

Standard Test Method for Linear Measurement Using Precision Steel Rule¹

This standard is issued under the fixed designation F 2203; 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 ($\frac{1}{8}$ in.) or greater based on gage repeatability and reproducibility presented in the Precision and Bias section.

2. Referenced Documents

2.1 ASTM Standards:

D 1898 Practice for Sampling of Plastics²

D 4332 Practice for Conditioning Containers, Packages or Packaging Components for Testing³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁴

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 ($\frac{1}{8}$ 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.

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.

5. Apparatus

5.1 Precision Steel Rule:

5.1.1 Tempered steel rule in increments of $\frac{1}{64}$ in., 100ths, or $\frac{1}{2}$ 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.

6.2 See Practice D 1898 for guidance on sampling practices.

7. Conditioning

7.1 Conditioning of the samples will depend on the material under evaluation. If conditioning before testing is appropriate, normal, and desirable, then condition the test specimens at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) and $50 \pm 5\%$ relative humidity for not less than 24 h prior to test.

7.2 See Practice D 4332 for guidance on conditioning practices.

8. Procedure

8.1 Review applicable specifications, drawings, or procedures. Specify unit of measure to be used and directions related

¹ This test method is under the jurisdiction of ASTM Committee F02 on Flexible Barrier Materials and is the direct responsibility of Subcommittee F02.60 on Medical Packaging.

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² Discontinued, see 1997 *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 15.09.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

TABLE 2 Summary of Interlaboratory Results by Measurement Set

Measurement Set	Average mm	Repeatability Standard Deviation S_r	Reproducibility Standard Deviation S_R	95 % Repeatability Limit r	95 % Reproducibility Limit R
A	266.85	0.162	0.204	0.459	0.576
B	777.30	0.324	0.424	0.917	1.200
C	826.25	0.167	0.267	0.472	0.756
D	82.42	0.132	0.199	0.374	0.564
E	279.47	0.000	0.162	0.000	0.459
F	379.78	0.204	0.319	0.578	0.903
G	326.78	0.204	0.387	0.578	1.094
H	133.57	0.162	0.253	0.459	0.717
I	253.65	0.094	0.284	0.265	0.803
J	9.97	0.162	0.280	0.459	0.791
K	18.10	0.162	0.204	0.459	0.576
L	114.41	0.229	0.339	0.648	0.959
M	225.91	0.229	0.298	0.648	0.843

TABLE 3 Summary of Interlaboratory Averaged Results

Average Test Value	284.2 mm (11.19 in.)
Repeatability (within a laboratory) standard deviation (s_r)	0.187 mm (0.0074 in.)
95 % repeatability limit (r)	0.528 mm (0.0208 in.)
Reproducibility (between laboratories) standard deviation (s_R)	0.288 mm (0.0113 in.)
95 % reproducibility limit (R)	0.815 mm (0.0321 in.)

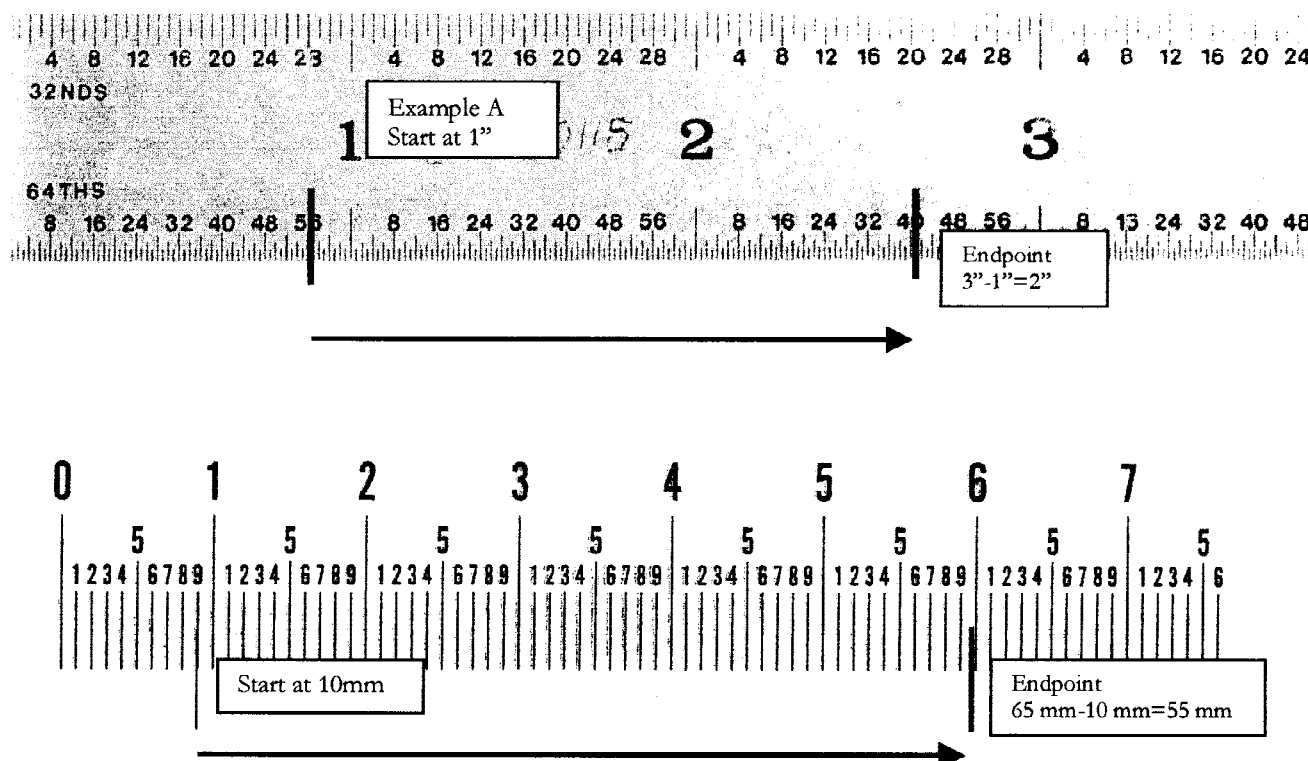
to precision requirements (for example, measure to nearest 0.5 mm, round up or down to nearest 0.5 mm, to $\frac{1}{64}$ in., etc.). Depending upon the level of accuracy and visual acuity, image magnification may be an aid.

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 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



NOTE—Example A and Example B begin at the leading edge of fixed scale division on rule at a point within the scale, at 1 in. or 10 mm, for example.

FIG. 1 Proper Alignment to Ruler Scale Divisions