Designation: A1030/A1030M – 21

Standard Practice for Measuring Flatness Characteristics of Steel Sheet Products[1]

This standard is issued under the fixed designation A1030/A1030M; 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 practice covers definitions and procedures for measuring flatness characteristics of uncoated steel sheet and nonmetallic and metallic-coated steel sheet. The methods described are designed and intended to be used in mill situations and environments.

1.2 The sheet shall conform to all the requirements of the appropriate specifications as follows: Specifications A568/A568M or A924/A924M.

1.3 Quantitative limits are not addressed and are established in the general requirements, or individual product specifications, or both; or when applicable, as agreed to between supplier and user.

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

A924/A924M Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

3. Significance and Use

3.1 This practice provides definitions and procedures commonly used for measuring flatness characteristics of steel sheet products under the jurisdiction of ASTM Committees A01 and A05 and their subcommittees as designated by a purchaser in a purchase order or contract.

3.2 Sheet flatness is affected by mill process factors plus the grade, thickness, and width of the material supplied. These measuring methods provide purchasers and suppliers with common definitions and procedures for flatness characteristics. The intention of these definitions and measuring methods is not to provide dimensional specifications for flatness characteristics, but rather common procedures for quantifying flatness anomalies. For determining compliance with flatness specifications, references are provided to appropriate ASTM standards.

3.3 This practice may be used by other ASTM Committees and other standards writing bodies for the purpose of measuring flatness characteristics of metal sheet products.

4. Interferences

4.1 Measurement of flatness often has been subjective, at best. Successful measurement of various flatness anomalies on quantitative terms requires recognition of several factors that can interfere with accurate measurements.

4.1.1 Flat surfaces are required. Measurement of several anomalies requires laying of a cut sheet sample, or a sheet area still attached to a coil, on a recognized flat surface. In most cases, laying of a cut sheet sample, or a sheet area still attached to a coil, on a floor will produce satisfactory results, as long as the floor is recognized as being flat. The flatness of sheet areas still attached to a coil is also measured on the flat tables of coil processing lines, with the sheet line tension released. If the measuring surface is not recognized as being flat, a machined flat surface is recommended.

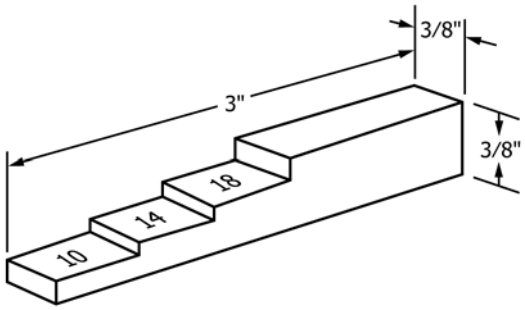
4.1.2 Stepblock gauges or tapered gauges should be checked regularly with a calibrated hand micrometer. Wear or dirt build up will affect accuracy.

[1] This practice is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.07 on Methods of Testing.

Current edition approved May 1, 2021. Published May 2021. Originally approved in 2003. Last previous edition approved in 2016 as A1030/A1030M – 16. DOI: 10.1520/A1030_A1030M-21.

[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**



NOTE 1—Stepblock gauge for all thicknesses and sizes of cut sheets.
NOTE 2—Dimensions given are approximate overall dimensions.

FIG. 1 Flatness Stepblock Gauge

4.1.3 The flat tables of shape gauges capable of measuring flatness characteristics must be clean and the sensors must be in good condition.

4.1.4 The sheet sample must be damage free.

5. Apparatus

5.1 Appropriate tools to measure flatness anomalies are described along with drawings as indicated.

5.1.1 *Flat Surfaces*—Accurate measurements of flatness anomalies require a flat surface, machined flat preferred.

5.1.2 *Machined Stepblock Gauge*—See Fig. 1. Typically steps are in 1⁄16 in. [1 mm] increments.

5.1.3 *Tapered Gauge*—See Fig. 2.

5.1.4 *Standard Ruler or Tape Measure.*

5.1.5 *Hand Micrometer.*

5.1.6 *Lightweight Straightedge*—Rigid, but light enough not to affect the test result.

6. Procedure

6.1 *Wavy Edge (see Fig. 3):*

6.1.1 *Definition*—A series of rolling direction edge deviations or undulations of the sheet from a recognized flat surface, having a height (H) and a measurable cycle length (L).

6.1.2 *Measuring Methods:*

6.1.2.1 With a cut sheet sample, or sheet area still attached to a coil, of at least 4 ft [1.2 m] in length by coil width on a recognized flat surface, measure the height (H) at the peak point of each wave from the recognized flat surface with a ruler, tape measure, tapered gauge, or stepblock gauge. Also measure the cycle length (L) from peak to peak of each wave with a ruler or tape measure.

6.1.3 *Permissible Variations*

6.1.3.1 The height (H) of the highest peak measured in accordance with 6.1.2.1 shall comply with applicable limits, such as found in the tables on flatness tolerances of Specifications A568/A568M or A924/A924M. Note that the referenced tables apply to cut sheet that has received adequate flattening. While wavy edge height evident in a sheet area still attached to a coil is a reasonable indication of flatness, it is not bound by the limits of the referenced tables.

6.1.3.2 As stated in the section on flatness tolerances of Specifications A568/A568M or A924/A924M, I-Unit and % Steepness rejection limits are subject to agreement between producer and purchaser. Using the procedures of Appendix X1, and the readings from 6.1.2.1, determine the I-Unit and % Steepness values, first using the distance between the two highest peaks, and second using the distance between two adjacent peaks. The highest I-Unit and % Steepness values obtained from these two situations shall be used to determine if the specification has been met.

6.1.3.3 If the I-Unit and % Steepness values are supplied directly using a shape gauge, determine if the results are within the maximum specified values.

6.2 *Ridge Buckle, Quarter Buckle, Center Buckle (see Fig. 4):*

6.2.1 *Definition*—Buckles are continuous deviations from a recognized flat surface, having a height (H) and a measurable cycle (L), and usually occur in narrow width areas parallel to the rolling direction other than at the sheet edges.

6.2.2 *Measuring Methods:*

6.2.2.1 With a cut sheet sample, or sheet area still attached to a coil, of at least 4 ft [1.2 m] by coil width resting on a recognized flat surface, place a lightweight straightedge on the highest portion of a buckle and on the highest portion of the next repeating buckle. Measure the height (H) between the straightedge and the sheet using a ruler, tape measure, tapered gauge, or stepblock gauge. Measure the cycle length (L) from peak to peak of each buckle with a ruler or tape measure.

6.2.2.2 In the case of a cut sheet sample, it is permissible to shear through the centerline of the flatness anomaly and measure as an edge wave (see 6.1.2.1) using a ruler, tape measure, tapered gauge, or stepblock gauge.

6.2.3 *Permissible Variations*

6.2.3.1 The height (H) of the highest peak measured in accordance with 6.2.2.1 or 6.2.2.2 shall comply with applicable limits, such as found in the tables on flatness tolerances of Specifications A568/A568M or A924/A924M. Note that the referenced tables apply to cut sheet that has received adequate flattening. While buckle height evident in a sheet area still attached to a coil is a reasonable indication of flatness, it is not bound by the limits of the referenced tables.

6.2.3.2 As stated in the section on flatness tolerances of Specifications A568/A568M or A924/A924M, I-Unit and % Steepness rejection limits are subject to agreement between producer and purchaser. Using the procedures of Appendix X1, and the readings from 6.2.2.1 or 6.2.2.2, determine the I-Unit and % Steepness values, first using the distance between the

NOTE 1—Tapered gauge for all thicknesses and sizes of cut sheets.

FIG. 2 Flatness Tapered Gauge

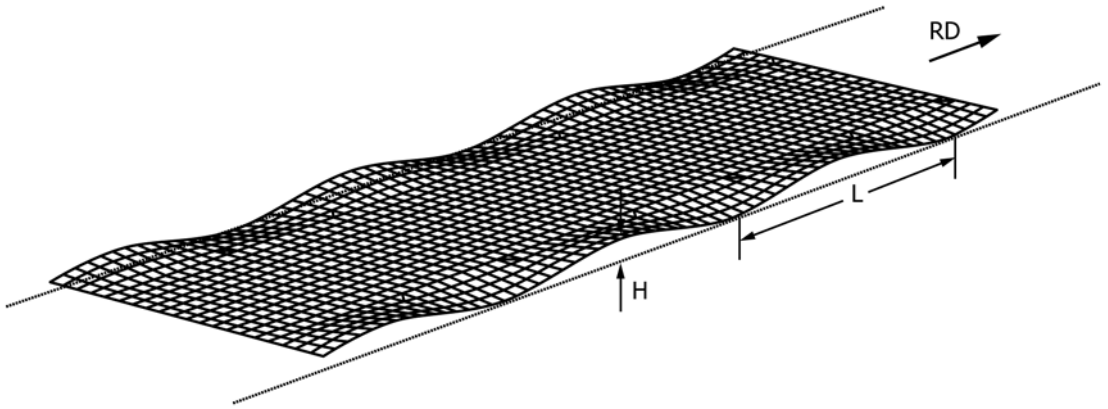


FIG. 3 Wavy Edge

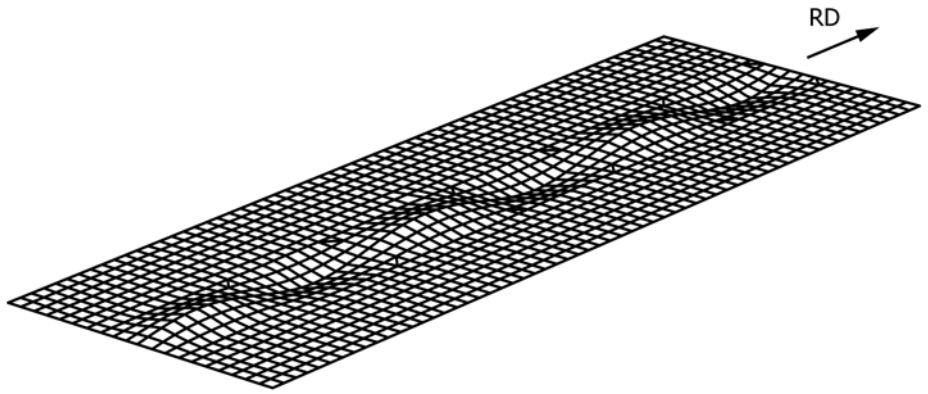


FIG. 4 Ridge Buckle, Quarter Buckle, Center Buckle

two highest peaks, and second using the distance between two adjacent peaks. The highest I-Unit and % Steepness values obtained from these two situations shall be used to determine if the specification has been met.

6.2.3.3 If the I-Unit and % Steepness values are supplied directly using a shape gauge, determine if the results are within the maximum specified values.

6.3 *Full Center (see Fig. 5):*

6.3.1 *Definition*—Any overall deviation of a sheet from a recognized flat surface, having a height (H) and a measurable cycle (L), and occurring over a major portion of the sheet width parallel to the rolling direction other than at the sheet edges.

6.3.2 *Measuring Methods:*

6.3.2.1 With a cut sheet sample, or a sheet area still attached to a coil, of at least 4 ft [1.2 m] by coil width resting on a recognized flat surface, place a lightweight straightedge on the highest portion of a full center region and on the highest portion of the next repeating region of full center. Measure the height (H) between the straightedge and the sheet using a ruler, tape measure, tapered gauge, or stepblock gauge. Measure the cycle length (L) from peak to peak of a full center region with a ruler or tape measure.

6.3.2.2 In the case of a cut sheet sample, it is permissible to shear through the centerline of the flatness anomaly and measure as an edge wave (see 6.1.2.1) using a ruler, tape measure, tapered gauge, or stepblock gauge.

6.3.3 *Permissible Variations*

6.3.3.1 The height (H) of the highest peak measured in accordance with 6.3.2.1 or 6.3.2.2 shall comply with applicable limits, such as found in the tables on flatness tolerances of Specifications A568/A568M and A924/A924M. Note that the referenced tables apply to cut sheet that has received adequate flattening. While buckle height evident in a sheet area still attached to a coil is a reasonable indication of flatness, it is not bound by the limits of the referenced tables.

6.3.3.2 As stated in the section on flatness tolerances of Specifications A568/A568M or A924/A924M, I-Unit and % Steepness rejection limits are subject to agreement between producer and purchaser. Using the procedures of Appendix X1, and the readings from 6.3.2.1 or 6.3.2.2, determine the I-Unit