



Designation: B754 – 22

# Standard Test Method for Measuring and Recording the Deviations from Flatness in Copper and Copper Alloy Strip<sup>1</sup>

This standard is issued under the fixed designation B754; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This test method establishes a procedure for the measurement of distortions in thin metal strip and the application of these measurements to an equation that will indicate the deviation from flatness.

1.2 The distortions to be measured in this test method are dish, wavy edges, buckle, longitudinal corrugation, coil set, and herringbone.

1.3 This test method is not intended to include the measurement of longitudinal curl, camber, or edgewise curvature, or twist.

1.4 This test method is limited to metal strip 0.003 in. to 0.020 in. (0.08 mm to 0.50 mm) thick and not more than 6.0 in. (150.0 mm) wide.

1.5 Units—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units which are provided for information only and are not considered standard.

1.6 The following safety hazard caveat pertains only to the test method(s) described in this test method:

1.6.1 *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.*

1.7 *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.*

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.06 on Methods of Test.

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## 2. Referenced Documents

2.1 *ASTM Standard:*<sup>2</sup>  
**B846 Terminology for Copper and Copper Alloys**

## 3. Terminology

3.1 For determination of terms relating to copper and copper alloys, refer to Terminology **B846**.

## 4. Summary of Test Method

4.1 A prepared test specimen of a specific wrought copper or copper alloy sheet or strip of a predetermined thickness is placed on a surface plate. The relative flatness of the sample is determined by measuring the length and height of the irregularity and calculating the percent of deviation.

4.2 In the case of coil set, it is measured by hanging the strip against a vertical wall or post and measuring the distance of the unrestrained hanging strip end from the wall or post. That measured distance is an indication of the amount of coil set that exists in the strip as a result of processing.

## 5. Significance and Use

5.1 This test method is intended for measuring distortion in strip used for making close tolerance parts. Since distortion in this strip would influence the shape of the part being produced and cause difficulties in feeding through close-fitting dies and other manufacturing equipment, it is important that this material be flat.

5.2 This test method provides a universal procedure for measuring the irregularities that cause the deviation from flatness.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

5.3 This test method allows the purchaser and manufacturer to inspect strip with a standard technique to a mutually agreed upon and acceptable percentage deviation from flatness, and in the case of coil set, acceptable distance deviation from flatness.

## 6. Apparatus

6.1 *Surface Plate*, to be used as a reference flat. It must have a large enough surface area to accommodate the maximum size test specimen. It shall be flat within 0.0002 in. (0.005 mm) per 1 in. (25 mm).

6.2 *Micrometer*, for measuring metal thickness. It shall be graduated in 0.0001 in. (0.0025 mm) increments.

6.3 *Height Gage*, for measuring the height of irregularities. The arm of this gage must be long enough to extend beyond the center of the widest strip to be measured. It shall be graduated in 0.001 in. (0.025 mm) increments.<sup>3</sup>

6.4 *Steel Rule*, for measuring the lengths of the irregularities, and length of distance from a straight vertical surface for coil set measurement. It shall be graduated in 0.02 in. (0.50 mm) increments.

6.5 *Vertical Surface*, for measuring coil set of hanging strip. Vertical, perpendicular to a flat surface; measured  $90^\circ \pm 2.5^\circ$  from flat.

## 7. Test Specimens

7.1 The test specimen shall be the full-finished slit width of the strip and cut long enough so that measurement will not be influenced by the distortions referred to in 1.3. It also must be long enough to measure coil set as defined in the procedure included. In any case, a minimum length of 12 in. (300 mm) is required.

7.2 When cutting specimens, caution must be taken to prevent additional distortion.

## 8. Procedure

8.1 Measure the thickness of the specimen at six locations, near each corner and at midwidth at each end, to the nearest 0.001 in. (0.03 mm) using the micrometer. The average of these six readings will be used as  $T$  (see Fig. 1).

8.2 Place the test strip unrestrained on the surface plate. If the specimen is not flat, compare the irregularities observed with the illustrations shown in Figs. 1-5 to determine the type of distortion and how it should be measured.

<sup>3</sup> An electronic touch sensitive system, which will not distort the sample, has been found to be acceptable.

8.3 Using the height gage, measure the highest point,  $H$ , of each of the irregularities to the nearest 0.001 in. (0.03 mm). See Figs. 1-6.

8.4 Using the steel rule, measure the length,  $L$ , between the points where the outer radii of the most significant irregularity touches the surface plate, to the nearest 0.02 in. (0.50 mm). See Figs. 1-7.

8.5 Repeat this procedure as often as necessary to satisfy quality level requirements, recording each measurement.

8.6 In the case of coil set, hang the strip of the prescribed length against a vertical wall as shown in Fig. 8. Measure the distance from the vertical wall to the strip end at the bottom (refer to Fig. 8). The material is considered acceptable if it falls within the maximum prescribed deviation distance ( $D$ ) from the wall.

## 9. Calculation or Interpretation of Results

9.1 Apply the values for  $T$ ,  $H$ , and  $L$  obtained for each irregularity to the following equation to determine the percentage of deviation from flat.

$$\text{Deviation from flat, \%} = \frac{H - T}{L} \times 100 \quad (1)$$

Compare the results to the agreed-upon limits. The larger the percentage, the greater the deviation from flat.

9.2 *Coil Set - Deviation from Vertical*—Measure Distance  $D$  as depicted in Fig. 8. Compare results against agreed-upon limits.

## 10. Test Report

10.1 The nominal thickness, width, temper, alloy number, and form of product should be reported.

10.2 The number and type of distortions measured and the thickness, height, length, and percent deviation from flatness for each should be reported.

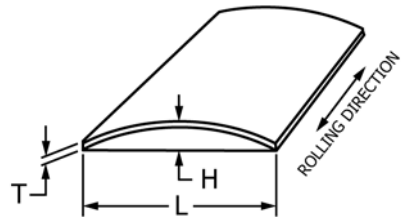
## 11. Precision and Bias

11.1 The precision of this test method is dependent upon the sensitivity of the measuring apparatus.

11.2 This test method has no bias because the values of deviation from flatness are direct measurements based on the accuracy of the test apparatus and the observations of the inspector.

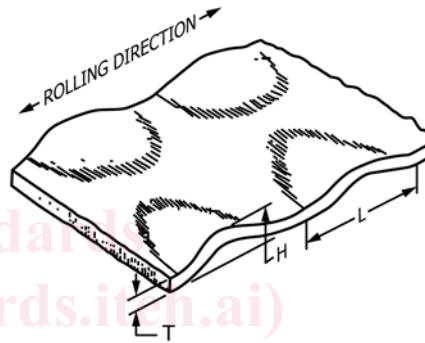
## 12. Keywords

12.1 coil set; edge wave; flatness measurement; strip distortion; strip flatness; wavy edge



$T$  = Thickness of Material  
 $H$  = Highest Point of Irregularities  
 $L$  = Measurement Length

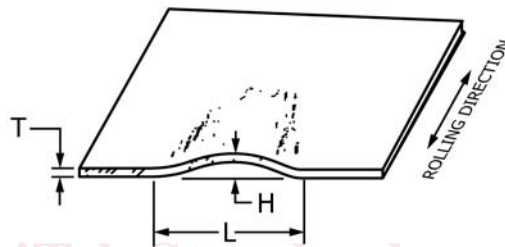
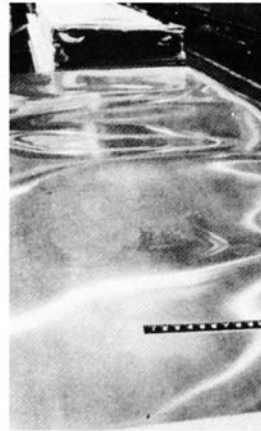
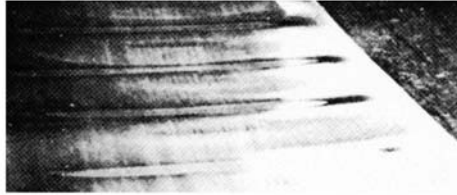
FIG. 1 Dish



$T$  = Thickness of Material  
 $H$  = Highest Point of Irregularities  
 $L$  = Measurement Length

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 FIG. 2 Wavy Edges

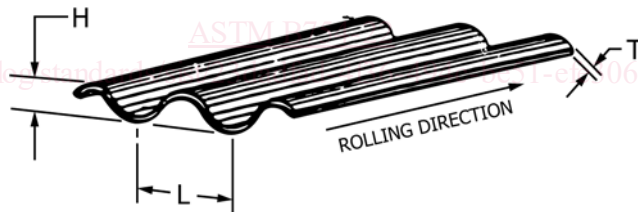
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- $T$  = Thickness of Material
- $H$  = Highest Point of Irregularities
- $L$  = Measurement Length

NOTE 1—For illustration only. Section to show measuring.

FIG. 3 Buckle



- $T$  = Thickness of Material
- $H$  = Highest Point of Irregularities
- $L$  = Measurement Length

FIG. 4 Longitudinal Corrugation