Standard Test Method for Cross Curvature of Thermostat Metals[1]

This standard is issued under the fixed designation B 478; 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 determination of cross curvature of thermostat metals.

NOTE 1—This test method is not limited to thermostat metals and can be used for other materials for which the cross curvature must be measured accurately.

NOTE 2—This standard includes means for calculating cross curvature for widths other than that of the specimen having the same radius of curvature.

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of the inch-pound units may be approximate.

1.3 *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 become familiar with all hazards including those identified in the appropriate Material Safety Data Sheet for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *thermostat metal*—a composite material, usually in the form of sheet or strip, comprising two or more materials of any appropriate nature, metallic or otherwise, which by virtue of the differing expansivities of the components, tends to alter its curvature when its temperature is changed.

2.2 *cross curvature*—the deviation from flat across the width, measured as a chord height. It is expressed in inches or millimetres.

3. Summary of Test Method

3.1 The test method for cross curvature consists of measuring the chord height deviation from flat across the width of a specimen of thermostat metal (Fig. 1).

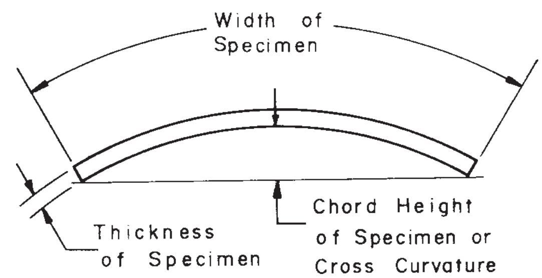

FIG. 1 Specimen Relationships

NOTE 3—The highest point will normally be at or near the center of the specimen.

4. Significance and Use

4.1 This procedure provides the means for defining the magnitude and direction of cross curvature (an inherent property in thermostat metal).

5. Apparatus

5.1 *Fixture*—A typical cross curvature fixture is shown in Fig. 2. It consists of a base which has a flat ground surface on its top side. For convenience a granite surface plate, as is pictured, can be used. To it are attached side frames to support rod or bar tracks which are parallel to the top surface of the base. On the tracks is assembled a movable carriage for mounting a micrometer depth gage.

5.2 *Micrometer Depth Gage*, for measuring the position of the specimen to the nearest 0.0001 in. (0.0025 mm). The tip of the gage rod shall be radiused.

5.3 *Electronic Contact Indicator*, sensitive, low-current, to give a signal when the micrometer depth-gage rod completes the electrical circuit across the indicator terminals by touching the specimen or the parallel.

5.4 *Parallel*, hardened and ground steel, ¼ by ⅜ by 6 in. (6 by 10 by 150 mm).

NOTE 4—Parallelism of the rods, on which the micrometer carriage traverses, to the steel parallel when laid on the surface plate shall be such that when the carriage is traversed and micrometer readings are taken along the length of the parallel, no reading shall be different from any other reading by more than 0.0002 in. (0.005 mm).

[1] This test method is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.10 on Thermostat Metals and Electrical Resistance Heating Materials.

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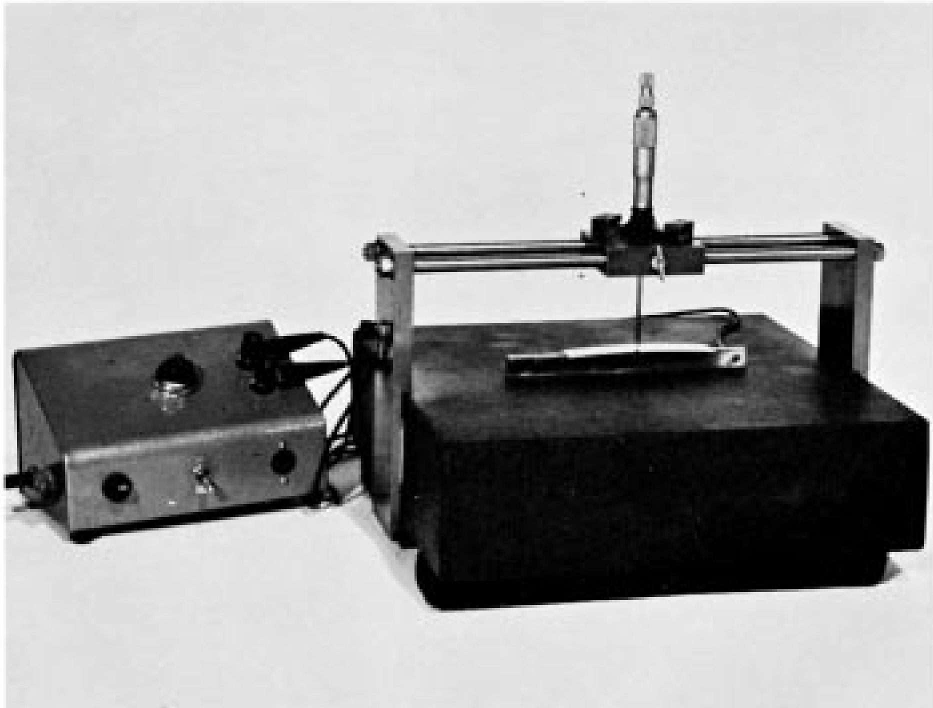

FIG. 2 A Typical Design of Apparatus

6. Sampling

6.1 The method of sampling shall be mutually agreed upon between the manufacturer and the purchaser.

7. Preparation of Sample for Measurement

7.1 The most important step in preparing the specimen for measurement is cutting it to length. The length shall be approximately equal to the width. The minimum length of a specimen shall be ¾ in. (20 mm). It must be cut in a manner that will not tend to alter the inherent cross curvature. It is recommended that a shear with sharp blades and the proper clearance be used. The shearing should impart no burrs to the specimen. It is recommended that after shearing the specimen to length the specimen be allowed to set for 10 min before testing so that it can stabilize its shape. The specimen shall be flat longitudinally.

8. Procedure

8.1 Lay the steel parallel on the surface plate with the ¼ -in. (6-mm) face down and its length parallel to the travel of the micrometer and directly under the tip of micrometer gage rod. Take a base reading of the micrometer depth gage by sliding the micrometer carriage over the parallel and turning the micrometer thimble down until contact of the tip of the rod is made with the parallel as is indicated by the electronic contact indicator. Back off the micrometer thimble and move the carriage away. Lay the specimen on the parallel so that the two side edges of the specimen contact the parallel, the convex side of the specimen is up, and the specimen is centered to avoid tilting or uneven contact to the parallel. Then move the micrometer carriage over the sample and take a micrometer reading at the highest point on the specimen. Remove the specimen and determine its thickness within ±0.0001 in. (±0.0025 mm) by means of micrometer calipers having radiused anvils. Take all measurements at a temperature of 75 ± 1°F (24 ± 0.5°C) with sufficient time allowed for the sample to have reached temperature stabilization.

NOTE 5—When low expansion side of the thermostat metal is convex, the results obtained shall be referred to as positive (+) and when the high expansion side is convex, the results obtained shall be referred to as negative (−).

9. Calculation

9.1 Calculation of cross curvature is as follows:

$$C = B - H - t$$

where:

C = cross curvature, in. (or mm)
B = base reading of micrometer depth gage, in. (or mm),
H = micrometer depth gage reading at highest point of specimen, in. (or mm),
t = specimen thickness, in. (or mm).

NOTE 6—Cross curvature varies by the square of the width for the same radius of curvature. For example, if the cross curvature of a strip 3.00 in. (76.2 mm) is 0.09 in. (2.3 mm), the cross curvature of a strip 1.00 in. (25.4 mm) wide having the same radius of curvature would be 0.01 in. (0.3 mm). This relationship may be influenced by mechanical distortion of the edges in slitting or trimming to width for strips of low width-thickness ratio.

10. Report

10.1 The report shall include the following:
10.1.1 Type of material,
10.1.2 Thickness of specimen,
10.1.3 Width of specimen,

10.1.4 Percentage reduction of specimen,

10.1.5 Test temperature,

10.1.6 Base reading of micrometer depth gage,

10.1.7 Micrometer depth gage reading at highest point on specimen, and

10.1.8 Cross curvature (including positive or negative sign).

11. Precision and Bias

11.1 The reliability of the results of the measurement of cross-curvature depends primarily on the method of sample preparation and the test conditions. The most common sources of variation in the test results relate to the quality of the sheared edge of the test specimen, and the uniformity of the test temperature.

11.2 Quantitative determination of precision and bias is in progress.

12. Keywords

12.1 chord height; cross curvature; thermostat metal