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AMERICAN NATIONAL STANDARD **ANSI/ASTM F 49 – 68 (Reapproved 1972)**

Standard Specification for MOLYBDENUM STRIP FOR ELECTRON TUBES[1]

This Standard is issued under the fixed designation F 49; 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.

The committee responsible for this standard has voted its withdrawal. In the absence of substantial reasons that it should be continued, the Society will approve withdrawal from publication in October 1978.

1. Scope

1.1 This specification covers molybdenum strip from 0.001 in. (0.03 mm) to 0.080 in. (2.0 mm) thick and up to approximately 6 in. (150 mm) wide specifically for use in electron tubes. This material is made either by powder metallurgy or by arc-casting methods. The difference is that carbon is used as a deoxidizer for the arc-cast material.

NOTE—The values stated in U.S. customary units are to be regarded as the standard. The metric equivalents of U.S. customary units may be approximate.

2. Chemical Requirements

2.1 The molybdenum strip shall conform to the requirements as to chemical composition as shown in Table 1.

2.2 The material shall be analyzed in accordance with appropriate ASTM methods.[2] When such methods are not available, methods of analysis as mutually agreed upon by manufacturer and purchaser shall be employed.

3. Physical Requirements

3.1 *Temper*—Temper of material shall be classified as follows:

3.1.1 *Hard*—As rolled, not annealed, suitable for spring applications.

3.1.2 *Soft*—Stress relieved, suitable for forming, bending or drawing. Recrystallization may exist up to 10 percent, max. It is usually estimated from a metallographic specimen prepared in the longitudinal direction. Comparative microstructure standards as agreed upon by manufacturer and purchaser are recommended.

3.2 *Tensile Strength*—Tension test specimens are to be prepared and tested in conformity with Methods E 8, for Tension Testing of Metallic Materials.[3] Tensile properties shall be determined using a strain rate of 0.005 ± 0.002 in./in. (0.13 ± 0.05 mm/25 mm)·min[4] up to 0.6 percent offset and 0.05 ± 0.02 in./in. (1.25 mm ± 0.5 mm/25 mm)·min for tensile strength or fracture. All tensile testing shall be done at a temperature between 18 C (65 F) and 30 C (86 F).

3.3 *Hardness*—Not necessarily correlated with tensile properties.

3.3.1 When determining microhardness using light loads, the best correlation and reproducibility can be obtained by use of Table 4.

3.4 *Bend and Delamination*—Bend testing shall be performed at a temperature between 18 C (65 F) and 30 C (86 F) by bending the sample through an angle of 180 deg, without fracture. The bend shall be made on a radius equal to that shown for soft temper, t being the thickness.

	Bend Test Radius
Up to 0.040 in. (1 mm)	$1t$
0.041 in. to 0.080 in. (1 to 2 mm)	$2t$

3.4.1 These values shall apply to tests taken both longitudinal and transverse to the direction of rolling. The specimen shall be deburred and shall have a width of 0.5 in. (13 mm) min.

[1] This specification is under the jurisdiction of ASTM Committee F-1 on Electronics.
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[2] *Annual Book of ASTM Standards*, Part 12.

[3] *Annual Book of ASTM Standards*, Parts 6, 7, and 10.

3.4.2 The material shall not show delaminations at the bends. If deburring is necessary, care shall be taken to preserve the edges for visual inspection after bending.

3.5 *Springback*—This test is applicable to strip 0.020 in. (0.51 mm) or less in thickness and shall be performed in accordance with ASTM Method F 155, Test for Temper of Strip and Sheet Metals for Electronic Devices,[4] with limits as agreed upon by producer and consumer.

4. Finish

4.1 Unless otherwise requested, the molybdenum finish shall be bright in thicknesses up to 0.005 in. (0.13 mm), bright or matte between 0.005 in. (0.13 mm) and 0.060 in. (1.5 mm), and matte finish over 0.060 in. (1.5 mm) in thickness. The surface shall be smooth and free from dirt, oxide, pits, scratches, seams, stains, scale, delaminations (including edges), heavy burrs, or other defects not considered good commercial finish.

5. Product Shapes

5.1 Unless otherwise specified, strip in thickness over 0.020 in. (0.51 mm) shall be supplied in flat lengths. Thicknesses 0.020 in. (0.51 mm) or less may be supplied in either flat lengths or in coils as requested.

6. Dimensions and Tolerances

6.1 The dimensional tolerances shall be in accordance with Table 5.

6.1.1 *Other Tolerances and Limitations:*

6.1.1.1 Shearing tolerance on length, ± 0.094 in. (2.4 mm).

6.1.1.2 Edge camber, 0.0625 in. (1.6 mm) max in 1 ft (300 mm).

6.1.1.3 Strip flatness for flat lengths shall be determined by the following equation and as shown in Fig. 1.

$$(H/L) \times 100 = \text{percent out-of-flatness}$$

where:

H = maximum vertical distance between a flat reference surface and the lower surface of the sheet, and

L = minimum horizontal distance between the highest point on the sheet and the point of contact with a flat reference surface.

6.1.1.4 The maximum percent out-of-flatness shall be 4 percent for 0.020 in. (0.51 mm) thickness and over and 5 percent for material less than 0.020 in. (0.51 mm) thick.

7. Packaging

7.1 Packaging shall be adequate to protect the flat lengths or coils from contamination or damage during shipment.

8. Marking

8.1 Each coil or container of flat lengths shall be legibly marked with the:

8.1.1 Type of material,

8.1.2 Name of manufacturer,

8.1.3 Heat, lot, or manufacturer's identification number,

8.1.4 Purchaser's specification number,

8.1.5 Gross, tare, and net weight,

8.1.6 Thickness and width of sheet or strip,

8.1.7 Shipping date, and

8.1.8 Inspector's number or designation.

9. Rejection

9.1 Any coil or flat not conforming to the specified requirements may be rejected. If 15 percent or more of the coils or flats in any shipment do not conform to the specified requirements, the shipment does not conform to this specification.

[4] *Annual Book of ASTM Standards*, Part 43.