



Designation: **F 3 – 02a**

Standard Specification for Nickel Strip for Electron Tubes¹

This standard is issued under the fixed designation F 3; 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 specification covers nickel strip for use as cathodes or other elements in electron tubes.
- 1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

2. Referenced Documents

- 2.1 *ASTM Standards:*
 - B 162 Specification for Nickel Plate, Sheet, and Strip²

¹ This specification is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.03 on Metallic Materials. Current edition approved Jan. Dec. 10, 2002. Published March 2002. February 2003. Originally published as F 3 – 57; approved in 1957. Last previous edition approved in 2002 as F 3 – 9900.

- E 39 Test Methods for Chemical Analysis of Nickel³
- E 107 Test Methods for Chemical Analysis of Electronic Nickel⁴
- E 129 Test Method for Spectrographic Analysis of Thermionic Nickel Alloys by the Powder Technique⁴
- F 1 Specification for Nickel-Clad and Nickel-Plated Steel Strip for Electron Tubes⁵
- F 16 Test Methods for Measuring Diameter or Thickness of Wire and Ribbon for Electronic Devices and Lamps⁵
- F 155 Test Method for Temper of Strip and Sheet Metals for Electronic Devices (Spring-Back Method)⁶
- F 239 Specification for Nickel Alloy Cathode Sleeves for Electron Devices⁷

3. Physical Requirements

3.1 *Temper*—The temper shall conform to limits agreed upon by the producer and consumer when determined in accordance with Test Method F 155.

3.2 *Finish*—The surface shall be as smooth and free of oxide, pits, scratches, seams, slivers, streaks, stains, scale, blisters, edge cracks, trimming burrs, and other defects or contaminants, as best commercial practice will permit when examined under 10× magnification.

4. Dimensions, Mass and Permissible Variations

- 4.1 Strip up to and including 0.020 in. (0.51 mm) is covered by this specification.
- 4.2 Strip over 0.020 in. (0.51 mm) is covered by Specification B 162.
- 4.3 *Thickness*—The thickness shall conform to the tolerances of Table 1.
- 4.4 *Width*—The width, as slit, shall conform to the tolerances of Table 2.
- 4.5 *Edgewise Bow*— The edgewise bow shall be no more than 0.5 in (13 mm) in 8 ft (2.4 m).
- 4.6 *Edge*—The edge shall be such as would result from a standard slitting operation.
- 4.7 *Burr*—The burr shall not exceed one half the strip thickness or 0.0025 in. (0.064 mm), whichever is smaller.

5. Chemical Requirements

5.1 The chemical composition of nickel strip used for cathodes shall be as prescribed in Specification F 239. For approved test methods, see 7.5.

5.2 Nickel strip used for elements other than cathodes shall conform to the requirements of Table 3 as to chemical composition, or as specified in Specification F 239, if desired.

5.3 The choice of grade for specific applications shall be agreed upon between the producer and consumer.

6. Sampling

6.1 Unwind required sample strip from each coil selected for inspection in such a manner that bending, twisting, and any other distortion is prevented.

6.2 If coil construction will permit, it is recommended that samples from coils of material be taken from both ends.

7. Test Methods

7.1 *Thickness*—On material 0.004 in. (0.10 mm) and under in thickness, make six measurements at least 1 m apart in accordance with Test Methods F 16 or with any equivalent method directly readable and accurate to ±0.5 % of strip thickness. On 1-in. (25-mm) or wider strip, or at any point on narrower strip, make all measurements about 0.4 in. (10 mm) from the edge.

² Annual Book of ASTM Standards, Vol 02.04.

³ Discontinued; see 1994 Annual Book of ASTM Standards, Vol 03.05.

⁴ Annual Book of ASTM Standards, Vol 03.05.

⁵ Annual Book of ASTM Standards, Vol 10.04.

⁶ Discontinued 1985, see 1983 Annual Book of ASTM Standards, Vol 10.04.

⁷ Discontinued 1992, see 1991 Annual Book of ASTM Standards, Vol 10.04.

TABLE 1 Thickness Tolerances

Thickness, in. (mm)	Thickness Tolerance, in. (mm)
Up to 0.004 ^A (0.10), incl	±5 % of over-all thickness, but not less than 0.0001 (0.0025) for average of six readings. A maximum of one reading may have a variation not over ±7.5 %.
Over 0.004 to 0.010 (0.10 to 0.25), incl	±0.0005 (0.013)
Over 0.010 to 0.020 (0.25 to 0.51), incl	±0.00075 (0.020)

^AOn material 0.004 (0.10) and under in thickness, produced in lots of approximately 50 lb (23 kg) or less, these tolerances may be difficult to hold throughout the roll. On such lots, tolerances should be agreed upon between the producer and consumer.

TABLE 2 Width Tolerances

Specified Width, in. (mm)	Thickness, in. (mm)	Width Tolerance, in. (mm)
Under 6.0 (153.0)	under 0.020 (0.50)	±0.005 (0.13)
6.0 (153.0) and over	under 0.020 (0.50)	±0.008 (0.20)
For cathode nickel only	under 0.004 (0.10)	±0.003 (0.08)

TABLE 3 Chemical Requirements

Element	Composition, %			
	UNS N02233 Grade 1 ^A	UNS N02205 Grade 2	UNS N02253 Grade 3 ^A	UNS N02270 Grade 4
Nickel, min	99.0	99.0	99.9	99.97
Carbon, max	0.10 ^B	0.15 ^C	0.02	-0.02
Carbon, max	0.10 ^B	0.10 ^C	0.02	0.02
Copper, max	0.10	0.15	0.04	-0.004
Copper, max	0.10	0.10	0.01	0.001
Iron, max	0.10	0.20	0.05	-0.005
Iron, max	0.10	0.10	0.05	0.005
Magnesium	0.10 max	0.01-0.08	0.005 max	0.001 max
Manganese, max	0.30	0.35	0.003	-0.004
Manganese, max	0.30	0.30	0.003	0.001
Silicon, max	0.10	0.15	0.005	-0.004
Silicon, max	0.10	0.10	0.005	0.001
Sulfur, max	0.005	0.008	0.003	-0.004
Sulfur, max	0.005	0.005	0.003	0.001
Titanium	0.005 max	0.01-0.05	0.005 max	-0.001 max
Titanium	0.005 max	0.005 max	0.005 max	0.001 max
Cobalt, max	0.10	0.001
Chromium, max	0.005	0.001

^A Duplicates chemistry of cathode Grade 23 in Specification F 239.

^B For rerolling, 0.15 max % carbon is allowed.

^C 0.02 % carbon available on request.

NOTE 1—An alternative method of determining strip thickness by weighing is suggested in Appendix X1.

7.2 *Width*—Determine width by removing a length of approximately 5 in. (130 mm) and forming it into a loop by bringing the ends together and measuring directly across bottom of loop with a screw micrometer.

7.3 *Edgewise Bow*—With material laid out on a flat surface, place an 8-ft (2.4-m) straightedge against one edge of the material. Measure any deviation from straightness at the maximum distance of the material from the straightedge by means of a scale graduated in 1/16 in. or 1 mm and read to the nearest scale division.

7.4 *Burr*—Measure burr in accordance with the Appendix of Specification F 1.

7.5 *Chemical Analysis*—Analyze in accordance with the following ASTM methods. Test Methods E 39 (wet method), E 107 (photometric method), or E 129.

8. Coiling and Spooling

8.1 Each coil or spool shall have only one continuous length of strip, free from joints of any kind, unless otherwise agreed upon.

8.2 Unless otherwise specified, the strip shall be so coiled that the normal curvature is not reversed.

9. Rejection

9.1 Any spools or coils not conforming to the specified requirements may be rejected. If 15 % of the spools or coils in any shipment do not conform to the specified requirements, the entire shipment may be rejected.

10. Product Marking

10.1 Each coil or spool shall be marked plainly, designating:

10.1.1 Name of material,

10.1.2 Name of manufacturer,

10.1.3 Lot of manufacturer's identification number,

10.1.4 Gross, tare, and net weight,

10.1.5 Thickness and width of strip,

10.1.6 Shipping date, and

10.1.7 Inspector's number or designation.

11. Packaging

11.1 Packaging shall be adequate to protect the spools or coils from contamination and damage during shipment. If a protective coating is used, it shall be completely removable by trichloroethylene degreasing.

12. Keywords

12.1 electron tubes; nickel strip; UNS N02233; UNS N02205; UNS N02253; UNS N02270

APPENDIX

(Nonmandatory Information)

X1. Method of Determining Thickness of Nickel Strip by Weighing

X1.1 The thickness of nickel strip may be determined indirectly by weighing a blank punched from the strip. The blank size has been calculated so that the thickness may be found by moving the decimal point in the milligram weight four places to the left.

X1.2 The following apparatus is required for making this check:

X1.2.1 A die having a tungsten carbide ring and punch designed to punch a clean blank of 0.2951 ± 0.0007 -in. (7.495 ± 0.018 -mm) diameter.

X1.2.2 A double-arm torsion balance with a range from 0 to 50 mg, equipped with a small weighing pan for holding the blank and a pan counterweight.

X1.3 *Determining Thickness:*

X1.3.1 Punch blanks from the strip at the same places where measurements would be normally made by a direct measuring method.

X1.3.2 Weight each blank separately on the torsion balance and record the weight to the nearest 0.1 mg.

X1.3.3 Move the decimal point in the recorded milligram weight four decimal places to the left. This gives the corresponding thickness to five decimal places.

NOTE X1.1—For example, a slug cut from a section of strip having a normal thickness of 0.002 in. (0.051 mm) and weighing 20.3 mg would have a thickness of 0.00203 in. (0.05156 mm).

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