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Standard Specification for Iron-Nickel Sealing Alloys[1]

This standard is issued under the fixed designation F30; 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 iron-nickel alloys that are intended primarily for sealing to glass in electronic applications.

NOTE 1—Some of these alloys may be used for sealing to ceramics, but this specification in its present form is not intended to cover material for metal-to-ceramic seals.

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

1.3 *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* The hazard statement pertains only to the test method sections, Sections 10 and 12.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E18 Test Methods for Rockwell Hardness of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E112 Test Methods for Determining Average Grain Size

E228 Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer

F14 Practice for Making and Testing Reference Glass-Metal Bead-Seal

F140 Practice for Making Reference Glass-Metal Butt Seals and Testing for Expansion Characteristics by Polarimetric Methods

F144 Practice for Making Reference Glass-Metal Sandwich Seal and Testing for Expansion Characteristics by Polarimetric Methods

3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Size,

3.1.2 Temper (Section 6),

3.1.3 Surface finish (Section 8),

3.1.4 Marking and packaging (Section 16), and

3.1.5 Certification if required.

4. Chemical Composition

4.1 The material shall conform to the requirements as to chemical composition prescribed in Table 1.

5. Surface Lubricants

5.1 All lubricants used in processing shall be thoroughly removed. Protective coatings present on the material as shipped shall be readily removable by any of the common organic degreasing solvents.

6. Temper

6.1 The desired temper of the material shall be specified on the purchase order. Unless otherwise specified, wire, rod, bar, and tubing shall be given a final bright anneal by the manufacturer. Strip and sheet shall be annealed properly to develop deep drawing properties. For deep drawing the hardness shall not exceed Rockwell B82 for material 0.100 in. (2.54 mm) and less in thickness, and B85 for material over 0.100 in. thick when determined in accordance with Test Methods E18.

7. Grain Size

7.1 Strip and sheet for deep drawing applications shall have an average grain size not larger than ASTM No. 5 (Note 2) and no more than 10 % of the grains shall be larger than No. 5 when measured in accordance with Test Methods E112. For materials less than 0.005 in. (0.13 mm) in thickness the grain size shall be such that there are no less than 4 grains across the thickness.

NOTE 2—This corresponds to a grain size of 0.065 mm or 16 grains/in. of image of 100×.

[1] This specification is under the jurisdiction of ASTM Committtee F01 on Electronics and is the direct responsibility of Subcommittee F01.03 on Metallic Materials.

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[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.

TABLE 1 Chemical Requirements

	Composition, %				
	42 Alloy UNS K94100	46 Alloy UNS K94600	48 Alloy UNS K94800	51 Alloy	52 Alloy UNS N14052
Nickel,[A] nominal	41	46	48	51.5	50.5
Manganese, max	0.80	0.80	0.80	0.60	0.60
Silicon, max	0.30	0.30	0.30	0.30	0.30
Carbon, max	0.05	0.05	0.05	0.05	0.05
Chromium, max	0.25	0.25	0.25	0.25	0.25
Cobalt, max	[B]	[B]	[B]	[B]	[B]
Phosphorus, max	0.025	0.025	0.025	0.0250	0.025
Sulfur, max	0.025	0.025	0.025	0.0250	0.025
Aluminum, max	0.10	0.10	0.10	0.100	0.10
Iron	remainder	remainder	remainder	remainder	remainder

[A] The nickel contents listed are nominal. The nickel contents of the alloys shall be adjusted by the manufacturer so that the alloys meet the requirements for thermal expansion. The 52 Alloy is specifically intended to match lead (Pb) sealing glasses.
[B] Cobalt is present as an incidental element and shall be reported separately.

8. Surface Finish

8.1 The standard surface finishes available shall be those resulting from the following operations:

8.1.1 Hot-rolling,

8.1.2 Forging,

8.1.3 Centerless grinding (rod),

8.1.4 Belt polishing,

8.1.5 Cold rolling, and drawing, and

8.1.6 Wire drawing.

9. Thermal Expansion Characteristics

9.1 The average linear coefficients of thermal expansion shall be within the limits specified in Table 2.

10. Test for Thermal Expansion

10.1 Determine the thermal expansion characteristics with a precision dilatometer after heating the specimen as follows:

TABLE 2 Thermal Expansion Requirements [A]

UNS Number	Alloy No.	Temperature Range, °C	Average Linear Coefficient of Thermal Expansion,μ m/m·°C
K94100	42	30 to 300	4.0 to 4.7
		30 to 450	6.7 to 7.4
K94600	46	30 to 350	7.1 to 7.8
		30 to 500	8.2 to 8.9
K94800	48	30 to 400	8.2 to 9.2
		30 to 550	9.6 to 10.3
...	51	30 to 450	9.9 to 10.5
		30 to 550	10.0 to 10.7
N14052	52	30 to 450	9.7 to 10.2
		30 to 550	10.0 to 10.5

[A] Typical expansion data up to 1000°C are given in the Appendix.

10.1.1 Heat the specimen in a hydrogen atmosphere for 1 h at 900°C and then cool it from 900 to 200°C at a rate not exceeding 5°C/min.

10.1.2 The thermal expansion properties are determined in accordance with Test Method E228.

10.2 The thermal expansion match between the alloy and a glass may be evaluated by testing the assembly in accordance with Practices F14, F140, or F144.

11. Dimensions and Permissible Variations

11.1 *Cold-Rolled Strip*—Cold-rolled strip shall conform to the permissible variations in dimensions prescribed in Table 3, Table 4, and Table 5.

11.2 *Round Wire and Rod*—Wire and rod shall conform to the permissible variations in dimension prescribed in Table 6.

11.3 *Cold-Drawn Tubing*—Cold-drawn tubing, available either as seamless or welded, shall conform to the permissible variations prescribed in Table 7.

12. Rounding Results

12.1 Observed or calculated values obtained from analysis, measurements, or tests shall be rounded in accordance with Practice E29, to the nearest unit in the last right place of figures used in expressing the specified limit.

13. General Requirements

13.1 The material shall be commercially smooth, uniform in cross section, in composition, and in temper; it shall be free from scale, corrosion, porosity, cracks, seams, scratches, slivers, and other defects as best commercial practice will permit.

14. Packaging and Package Marking

14.1 Packaging shall be subject to agreement between the purchaser and the seller.

14.2 The material as furnished under this specification shall be identified by the name or symbol of the manufacturer and by melt number. The lot size for determining compliance with the requirements of this specification shall be one heat.

15. Investigation of Claims

15.1 Where any material fails to meet the requirements of this specification, the material so designated shall be handled in accordance with the agreement mutually agreed upon by the purchaser and the seller.

16. Keywords

16.1 glass-to-metal sealing applications; iron-nickel alloys; UNS K94600; UNS K94800; UNS N14052; vacuum electronics