



AEROSPACE MATERIAL SPECIFICATION

AMS-I-23011™**REV. C**

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Superseding AMS-I-23011B

Iron-Nickel Alloys for Sealing
to Glasses and Ceramic

RATIONALE

AMS-I-23011C stabilizes this specification because it is no longer state of the art and similar requirements are contained in other specifications.

STABILIZED NOTICE

AMS-I-23011C has been declared "STABILIZED" by the SAE AMS F Corrosion Heat Resistant Alloys Committee. This document will no longer be updated and may no longer represent standard industry practice. This document was stabilized because it contains requirements that are no longer state of the art and are also contained in alternate documents that contain similar requirements. This document has been designated as Noncurrent since August 2007. This document has never been technically updated. Users of this document should refer any certification issues (e.g., exceptions listed on the certification report) to the cognizant engineering organization for their disposition.

CAUTION: In many cases the purchaser is not the cognizant engineering organization (i.e., purchaser may be a sub tier supplier). AMS Committee F recommends that the following similar specifications be considered.

This listing does not constitute authority to substitute these specifications for the "STABILIZED" specification.

AMS-I-23011 Class	Similar Specification
1	ASTM F15
2	ASTM F30
3	ASTM F30
4	ASTM F30
5	ASTM F30
6	ASTM F31
7	ASTM F753, ASTM F1684

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Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this technical report.

1. SCOPE:

1.1 Scope:

This specification covers a series of iron-nickel, iron-nickel-cobalt, and iron-nickel-chromium alloys used for sealing to glasses and ceramics in electronic applications (see 6.1).

1.2 Classification:

The alloys shall be of the following classes, forms, finishes, and conditions, as specified (see 6.2):

1.2.1 Classes: Classes shall be as follows:

Class 1	Iron-nickel-cobalt alloy (29% Ni, 17% Co, remainder Fe)
Class 2	Iron-nickel-alloy (50.5% Ni, remainder Fe)
Class 3	Iron-nickel-alloy (48% Ni, remainder Fe)
Class 4	Iron-nickel-alloy (46% Ni, remainder Fe)
Class 5	Iron-nickel-alloy (41% Ni, remainder Fe)
Class 6	Iron-nickel-chromium alloy (41% Ni, 5.5% Cr, remainder Fe)
Class 7	Iron-nickel alloy (36% Ni, remainder Fe)

1.2.2 Forms: Alloys shall be in the form specified in Table I.

TABLE I. Availability of forms

Forms	Class						
	1	2	3	4	5	6	7
Bar	X	X	X	X	X	---	X
Rods	X	X	X	X	X	---	X
Ribbon	X	X	---	X	X	X	---
Strip	X	X	X	X	X	---	X
Tubing	X	---	---	---	---	---	---
Wire	X	X	X	X	X	X	X

1.2.3 Finishes: Finishes shall be as follows:

Hot rolled or forged
Centerless ground

Cold drawn or rolled
Belt polished

1.2.4 Condition and temper: Condition and temper shall be as follows (see Tables IV and V):

Annealed
1/4 Hard (one quarter hard temper)
1/2 Hard (one half hard temper)
Hard (full hard temper)

2. APPLICABLE DOCUMENTS:

The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-C-16173	Corrosion Preventive Compound, Solvent Cutback, Cold-Application
FED-STD-48	Tolerances for Steel and Iron Wrought Products
FED-STD-151	Metal; Test Methods
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-163	Steel Mill Products; Preparation for Shipment and Storage

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 8	Methods of Tension Testing of Metallic Material
ASTM E 18	Methods of Test for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 112	Methods for Estimating the Average Grain Size of Metals
ASTM E 228	Method of Test for Linear Thermal Expansion of Rigid Solids with a Vitreous Silica Dilatometer

3. REQUIREMENTS:

3.1 Condition and temper:

Unless otherwise specified in the contract or purchase order, rod, ribbon, tubing, and wire shall be bright annealed. Strip shall be annealed properly to have deep drawing or spinning properties (see 6.2).

3.1.1 Drawing and forming: Compounds and lubricants used in drawing and forming operations and during cold working shall be capable of being completely removed by vapor degreasing.

3.2 Chemical composition:

The chemical composition of the iron-nickel alloys shall be as specified in Table II (see 4.5.1).

3.3 Linear coefficient of thermal expansion:

The linear coefficient of thermal expansion shall conform to the values for the applicable class as listed in Table III (see 4.5.2).

3.4 Tensile strength or hardness:

The tensile strength for the applicable class of materials in the finished form and in the specified condition and temper shall conform to Table IV (see 4.5.3). If the size of product prevents the cutting of tensile specimens as defined by ASTM E 8, conformance to hardness requirements of Table V may be substituted.

3.5 Grain size:

The average grain size of annealed strip materials to be used for deep drawing or spinning purposes shall be no larger than No. 5 and no more than 10 percent of the individual grains may be larger than No. 5 (see 4.5.5). However, for material of Classes 2 to 6, inclusive, which are less than 0.005 inch in thickness, the grain size shall be such that there are no less than 9 grains across the thickness in the short transverse direction.

3.6 Phase transformation:

No phase transformation shall occur in the finished forms of the Class 1 alloy from 1,100°C to -80°C (see 4.5.6), except that material having a thickness or diameter exceeding 0.75 inch, some localized transformation may be tolerated if it does not exceed 1 percent of the cross section.

3.7 Porosity:

When specified in the contract or order (see 6.2), material shall show no leakage, when tested with a helium leak detector (see 4.5.7).

3.8 Permissible variations in dimensions:

The permissible variations in dimensions shall be as shown in applicable paragraph and table for the various forms of material (see 4.4.1).

3.8.1 Bars, rods, and wire diameter, thickness, or width: Bars, rods, and wire, measured on their diameters or between parallel faces, shall not vary at any point from the specified dimensions by more than the amounts shown in Tables VI, VII, VIII, and IX.

3.8.1.1 Straightness: The permissible variation in straightness of rods and bars as determined by the departure from true straightness (thrown in one revolution for rods or depth of chord for bars) shall be as specified in Table X.

3.8.2 Ribbon width: The permissible variation in width of ribbon shall be as specified in Table XI.

TABLE II. Chemical compositions

Elements (percent)	Class						
	1	2	3	4	5	6	7
Nickel (Ni)	2/ 29	2/ 50.5	2/ 48	2/ 46	2/ 41	2/ 42.0	2/ 35.5 - 36.5
Cobalt (Co)	2/ 17	0.50	0.50	0.50	0.50	---	---
Chromium (Cr)	---	0.10	0.10	0.10	0.10	2/ 5.6	0.25
Manganese (Mn)	0.50	0.60	0.80	0.80	0.80	0.25	0.50
Silicon (Si)	0.20	0.30	0.30	0.30	0.30	0.30	0.25
Carbon (C)	0.06	0.05	0.05	0.05	0.05	0.07	0.05
Aluminum (Al)	3/ 0.10	0.10	0.10	0.10	0.10	0.20	3/ 0.10
Magnesium (Mg)	3/ 0.10	---	---	---	---	---	3/ 0.10
Zirconium (Zr)	3/ 0.10	---	---	---	---	---	3/ 0.10
Titanium (Ti)	3/ 0.10	---	---	---	---	---	3/ 0.10
Phosphorus (P)	---	0.025	0.025	0.025	0.025	0.025	0.020
Sulfur (S)	---	0.025	0.025	0.025	0.025	0.025	0.020
Iron (Fe)	Remainder	Remainder	Remainder	Remainder	Remainder	Remainder	Remainder

1/ All percentages are maximum, unless otherwise indicated.

2/ Nominal contents. The nominal contents of the alloys shall be adjusted by the supplier so that the alloys meet the requirements for thermal expansion (see 3.4).

3/ Total permissible contents of aluminum, magnesium, zirconium, and titanium shall not exceed 0.20 percent.