~~Designation:B709–98~~ Designation: B 709 – 04 (Reapproved 2009)

Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloy (UNS N08028)* Plate, Sheet, and Strip[1]

This standard is issued under the fixed designation B 709; 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-chromium-molybdenum alloy (UNS N08028)* plate, sheet, and strip in the solution-annealed condition.

~~1.2The values stated in inch-pound units are to be regarded as the standard.~~

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 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 (MSDS) 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. Referenced Documents

2.1 *ASTM Standards:*[2]

B 880 ~~Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys~~

~~E8Test Methods for Tension Testing of Metallic Materials~~ Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys

~~E10Test Method for Brinell Hardness of Metallic Materials[3]~~ B 906 Specification for General Requirements for Flat-Rolled Nickel and Nickel Alloys Plate, Sheet, and Strip

~~E18Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials[3]~~

~~E29Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications~~

~~E38Methods for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys~~

~~E55Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition~~

~~E140Hardness Conversion Tables for Metals[3]~~

~~E1473Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys~~ 8/E 8M Test Methods for Tension Testing of Metallic Materials

3. ~~Terminology~~

~~3.1*Definitions of Terms Specific to This Standard:*~~

~~3.2The terms of plate, sheet, and strip as used in this specification are described as follows:~~

~~3.3*plate*—material 0.187 in. (4.76 mm) and over in thickness and over 10 in. (254 mm) in width.~~

~~3.4*sheet*—material under 0.187 in. (4.75 mm) in thickness and over 24 in. (610 mm) in width.~~

~~3.5*strip*—material under 0.187 in. (4.75 mm) in thickness and under 24 in. (610 mm) in width.~~

~~4.~~Ordering Information

~~4.1It is the responsibility of the purchaser to specify all requirements that are necessary for the safe and satisfactory performance of material ordered under this specification. Examples of such requirements include, but are not limited to the following:~~

~~4.1.1Quantity (weight or number of pieces),~~

~~4.1.2Name of material or UNS N08028,~~

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[1] This specification is under the jurisdiction of ASTM Committee ~~B-2~~B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.07 on Refined Nickel and Cobalt and Their Alloys.

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~~*New designation in accordance with ASTME 527 and SAEJ1086, Practice for Numbering Metals and Alloys (UNS).~~

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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* ~~, Vol 02.04.~~volume information, refer to the standard's Document Summary page on the ASTM website.

4.1.3Form (plate, sheet, or strip),
4.1.4Dimensions,
4.1.5Type of edge required (for strip only, see 8.4),
4.1.6*Finish (Section 9)*—For sheet ordered with No. 4 finish, specify whether one or both sides are to be polished,
4.1.7ASTM designation and year of issue,
4.1.8*Marking*—State if metal die identification is required on plate ¼ in. (6.35 mm) or thicker (Section 17),
4.1.9*Certification or Test Reports*—State if certification or test reports are required (Section 16), and
4.1.10*Source Inspection*—State if inspection is required (Section 14).

3.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Examples of such requirements include, but are not limited to those specified in Ordering Information Section in Specification B 906.

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 906, unless otherwise specified herein.

5. Materials and Manufacture

5.1 *Heat Treatment*—The final heat treatment shall be a solution-anneal. Minor cold working such as flattening or temper rolling may be performed after the final solution annealing treatment.

NOTE 1—This recommended solution-anneal consists of heating to a minimum temperature of 1975°F (1080°C) and cooling rapidly to room temperature.

6. Chemical Composition

6.1 The material sampled in accordance with 11.210.2 shall conform to the composition limits prescribed in Table 1.

6.2 If a product analysis is subsequently made, the material shall conform to the composition limits with the product analysis variation prescribed Specification B 880.

7. Mechanical Properties

7.1 The material shall conform to the requirements as to the mechanical property prescribed in Table 2.

8. Dimensions and Permissible Variations

8.1 *Sheet*—The material referred to as sheet shall conform to the variations in dimensions prescribed in Tables 3-8, inclusive.—Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 906, except as specified in Table 3 and Table 4.

8.2 *Cold-Rolled Strip*—The material referred to as cold-rolled strip shall conform to the permissible variations in dimensions prescribed in Tables 9-12 inclusive.—Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 906, except as specified in Tables 5-7.

8.3 *Plate*—The material referred to as plate shall conform to the permissible variations in dimensions prescribed in Tables 13-19, inclusive.

8.4*Edges for Cold-Rolled Strip*—The various types of edges procurable shall be as follows:
8.4.1*No. 1. Edge*— Rolled edge, contour as specified.
8.4.2*No. 3 Edge*—An edge produced by slitting.
8.4.3*No. 5 Edge*—Approximately square edge produced by rolling or filing, or both, after slitting.—Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 906.

9. Workmanship, Finish, and Appearance

9.1The material shall be free of injurious imperfections and shall correspond to the designated finish as described as follows:

TABLE 1 Chemical Requirements

Element	Composition, %
Ni	29.5 to 32.5
Fe	remainder[A]
Cr	26.0 to 28.0
Mo	3.0 to 4.0
C, max	0.030
Si, max	1.00
Mn, max	2.50
P, max	0.030
S, max	0.030
Cu	0.6 to 1.4

[A] Determined arithmetically by difference.

TABLE 2 Mechanical Property Requirements

Form	Tensile Strength, min, ksi (MPa)	Yield Strength (0.2 % offset), min, ksi (MPa)	Elongation in 2 in. or 50 mm, or 4D, min, %	Rockwell Hardness (or equivalent)[A]
Sheet	73 (500)	31 (214)	40	70–90 HRB
Strip	73 (500)	31 (214)	40	70–90 HRB
Plate	73 (500)	31 (214)	40	70–90 HRB

[A] Hardness values are shown for information only and shall not constitute a basis for acceptance or rejection as long as the other mechanical properties are met.

TABLE 2 3 MechFlatnicaess Tol Peropances for Hoty-Rollequird and Cold-Rollemd Shenets

Sheets not Specified to Stretcher Leveled Standard of Flatness

ForSpecified Thickness, in. (mm)	TensWile Sdtrength, m in, ksi . (MPamm)	YiFlatness Tolderance (max SDeviation freom a Horizongth- (0.2 % otal Flat Surff- sacet), m in, ksi. (MPamm)	
	Elonga- ti on in 2 in. or 50 mm,or 4D, m in, %	Rockwell½ Hardness ¾ (or equivalent)A	
0.062 (1.57) and over	to 60 (1524), incl	½ (12.7)	
	over 60 to 72 (1524 to 1829), incl	¾ (19.1)	
Sheet	73 (500)	31 (214)	
	over 72 (1829)	1 (25.4)	
	40	70–90 HRB	
Strip	7 3 (500)	31½ (214)	40 7
Under 0.062 (1.57)	to 36 (914), incl	½ (14)	40
	over 36 to 60 (914 to 1524), incl		
Plate	73 (500)	31 (214)40	70–90 HRB
	over 60 (1524)	1 (25.4)40	70–90 HRB

[A] Hardness values are shown for information only and shall not constitute a basis for acceptance or rejection as long as the other mechanical properties are met.

9.1.1*Sheet*—The various types of finish procurable on sheet products shall be as follows:

9.1.1.1*No. 1 Finish*— Hot-rolled, annealed, and descaled; produced by hot rolling to specified thicknesses followed by annealing and descaling (see 10.2).

9.1.1.2*No. 2D Finish*— Dull, cold-rolled finish; produced by cold rolling to the specified thickness, annealing and descaling. The dull finish results from the descaling and pickling operations.

9.1.1.3*No. 2B Finish*— Bright, cold-rolled finish; produced by giving a final light cold-rolled pass with polished rolls, to a sheet that has been annealed and descaled.

9.1.1.4*No. 4 Finish*— General-purpose polished finish. Following initial grinding with coarser abrasives, sheets are generally finished last with abrasives approximately 120 to 150 mesh. Sheets can be produced with one or two sides polished. When polished on one side only, the other side may be rough ground in order to obtain the necessary flatness.

9.1.1.5*Bright Annealed*— Bright finish produced by cold rolling to thickness, then annealing in a protective atmosphere.

9.1.2*Strip*—The type of finish procurable on cold-rolled strip shall be as follows:

9.1.2.1*No. 1 Finish*— Cold-rolled to specified thickness annealed and pickled (see 10.2). Appearance of this finish is a dull gray.

9.1.2.2*No. 2 Finish*— Same as No. 1 finish, followed by a final light cold-rolled pass, generally on highly polished rolls.

9.1.2.3*Bright-Annealed*— Bright finish produced by cold-rolling to thickness, then annealing in a protective atmosphere.

9.1.3*Plate*—The types of finish procurable on plates shall be as follows:

9.1.3.1*Hot- or Cold-Rolled, Annealed*—Scale not removed.

9.1.3.2*Hot- or Cold-Rolled, Annealed, Descaled*—Scale removed by a blast cleaning or pickling operation.

9.2Spot grinding to remove surface imperfections is permitted, provided such grinding does not reduce the thickness or width at any point beyond the permissible variations in dimensions.

10.Sampling

10.1*Lot for Chemical Analysis, Mechanical Testing, and Corrosion Testing*

9.1 *Sampling for Chemical Analysis, Mechanical Testing, and Corrosion Testing shall be performed in accordance with Specification B 906, except as specified herein*:

10.1.1A lot for chemical analysis shall consist of one heat.

10.1.2

TABLE 3 4 ThicknWessight Tolerances for Hot-Rolled and Cold-Cold-Rolled Sheets

Specified Thickness, In. (mm)		
Toler an ce,ov grand under, In. (mm)		
It is not practicable to produce hot-rolled and cold-rolled sheets to exact theoretical weight. Sheets of any one item of a specified thickness and size in any finish mm) ay be overweight to the following extent:		
O ver 0.145t o less th an0.187 (3.68 t o less th an 4.76)		
(*1*) An item of five sheets or less, or an item estimated to weigh 200 lb (90.7 kg) or less, may actually weigh as much as 10 % over the theoretical weight.76) 0.014 (0.36) may actually weigh as much as 7½ % over the theoretical weight.		
(*2*) An item of more than five sheets and estimated to weigh more than 200 lb (90.7 kg) may actually weigh as much as 7½ % over the theoretical weight.		
Ov er 0.130to 0.145 (3.30to 3.68),inclerances shown in Table 3 of Specification B 906.		
(*3*) The underweight variations for sheets are limited by the under thickness tolerances shown in Table 3 of Specification B 906.		
0.012 (0.30)		
Over 0.114 to 0.130 (2.90 to 3.30), incl	0.010 (0.25)	
Over 0.114 tFo 0.130 (2.90 to 3.30), incl	0.010 (0.25)	
Over 0.098to 0.114 (2.49 to 2.90), incl	0.009 (0.23)	
Over deto 0.114 (2.49 to 2.90), incl	0.009 (0.23)	
Over 0.083 to 0.098 (2.11 to 2.49),incl	0.008 (0.20)	
Overmincl	0.008 (0.20)	
Over 0.072 to 0.083 (1.83 to 2.11),incl	0.007 (0.18)	
Over 0.058to 0.072 (1.47 to 1.83),incl0.006 (0.15)		
Ovg theoretical0.006 (0.15)		
Over 0.040to 0.058 (1.02 to 1.47), incl	0.005 (0.13)	
Ov weight, incl	0.005 (0.13)	
Over 0.026to 0.0 40 (0.66 to 1.02), inc l0.004 (0.10)		
Ov the factor 42 l0.004 (0.10)		
Over 0.016to 0.026 (0.41 to 0.66),incl	0.003 (0.08)	
Over 0.016b/ft^2·incl	0. (0.08)	
Over0.007 to 0.016 (0.18 to 0.41), incl	0.002 (0.05)Over 0.005 to 0.007 (0.13 to 0.18),incl	0.0015
Over008 kg/cl	0.00m^2·mm) thicl	0kness may be u
0.005 (0.13)	0.001 (0.03)	

9.1.1 *Plate*—A lot of plate for testing and inspection purposes shall consist of the products resulting from the rolling of one heat of material in the same condition and specified thickness, solution annealed by the same practice, but in no case more than 25 000 lb (11 340 kg).

10.1.3

9.1.2 *Sheet and Strip*—A lot of sheet or strip for testing and inspection purposes shall consist of material from one heat in the same form (sheet or strip), condition, finish, and specified thickness, solution-annealed by the same practice but in no case more than 25 000 lb (11 340 kg).

10.2*Sampling of Chemical Analysis*:

10.2.1A representative sample shall be taken from each lot during pouring or subsequent processing.

10.2.2Product analysis, if performed, shall be wholly the responsibility of the purchaser.

10.3

9.2 *Sampling for Mechanical Tests*:

10.3.1A sample of the material to provide test specimens for mechanical tests shall be taken from such a location in each lot as to be representative of that lot.

10.3.2When samples are to be taken after delivery, the purchaser of material ordered to cut lengths may request on the purchase order additional material of adequate size to provide sample coupons for inspection purposes.

11.

9.2.1 When samples are to be taken after delivery, the purchaser of material ordered to cut lengths may request on the purchase order additional material of adequate size to provide sample coupons for inspection purposes.

10. Number of Tests and Retests

11.1In10.1 In the case of sheet or strip supplied in coil form, two or more tension tests (one from each end of each coil), and one or more hardness tests shall be made on specimens taken from each end of the coil. When material is supplied in flatsheet, flat strip, or plate, one tension and one or more hardness tests shall be made on each 100 or less sheets, strips, or plates of the same lot. When specified, one corrosion test shall be conducted for each lot.