



# Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloy (UNS N08028)\* Plate, Sheet, and Strip<sup>1</sup>

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.

1.2 The values stated in inch-pound units are to be regarded as the 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 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:<sup>2</sup>

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

B 906 Specification for General Requirements for Flat-Rolled Nickel and Nickel Alloy Plate, Sheet, and Strip

E 8 Test Methods for Tension Testing of Metallic Materials

## 3. Ordering Information

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.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## 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 10.2 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*—Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 906, except as specified in Tables 3 and 4.

8.2 *Cold-Rolled Strip*—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*—Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification B 906.

**TABLE 1 Chemical Requirements**

Element	Composition, %
Ni	29.5 to 32.5
Fe	remainder <sup>A</sup>
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

<sup>A</sup>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) <sup>A</sup>
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

<sup>A</sup>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 3 Flatness Tolerances for Hot-Rolled and Cold-Rolled Sheets**

Sheets not Specified to Stretcher Levelled Standard of Flatness		
Specified Thickness, in. (mm)	Width, in. (mm)	Flatness Tolerance (max Deviation from a Horizontal Flat Surface), in. (mm)
0.062 (1.57) and over	to 60 (1524), incl	½ (12.7)
	over 60 to 72 (1524 to 1829), incl	¾ (19.1)
	over 72 (1829)	1 (25.4)
Under 0.062 (1.57)	to 36 (914), incl	½ (12.7)
	over 36 to 60 (914 to 1524), incl	¾ (19.1)
	over 60 (1524)	1 (25.4)

**TABLE 4 Weight Tolerances for Hot-Rolled and Cold-Rolled Sheets**

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 may be overweight to the following extent:

(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.

(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.

(3) The underweight variations for sheets are limited by the under thickness tolerances shown in Table 3 of Specification B 906.

For determining theoretical weight, the factor 42 lb/ft<sup>2</sup>-in. (0.0008 kg/cm<sup>2</sup>-mm) thickness may be used.

## 9. Sampling

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

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).

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).

### 9.2 Sampling for Mechanical Tests:

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

10.1 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

**TABLE 5 Thickness Tolerance<sup>A,B,C</sup> for Cold-Rolled Strip for the Thicknesses and Widths Given, Over and Under**

Specified Thickness	Width, in.							
	0.187 to 1, incl	Over 1 to 3, incl	Over 3 to 6, incl	Over 6 to 9, incl	Over 9 to 12, incl	Over 12 to 16, incl	Over 16 to 20, incl	Over 20 to 24, incl
	Thickness Tolerance, in.							
Over 0.160 to less than 0.187	0.002	0.003	0.004	0.004	0.004	0.005	0.006	0.006
Over 0.099 to 0.160, incl	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.005
Over 0.068 to 0.099, incl	0.002	0.002	0.003	0.003	0.003	0.004	0.004	0.004
Over 0.049 to 0.068, incl	0.002	0.002	0.003	0.003	0.003	0.003	0.004	0.004
Over 0.039 to 0.049, incl	0.002	0.002	0.0025	0.003	0.003	0.003	0.004	0.004
Over 0.034 to 0.039, incl	0.002	0.002	0.0025	0.0025	0.003	0.003	0.003	0.003
Over 0.028 to 0.034, incl	0.0015	0.0015	0.002	0.002	0.0025	0.0025	0.003	0.003
Over 0.025 to 0.028, incl	0.001	0.0015	0.0015	0.002	0.002	0.002	0.0025	0.003
Over 0.019 to 0.025, incl	0.001	0.001	0.0015	0.0015	0.002	0.002	0.0025	0.0025
Over 0.016 to 0.019, incl	0.001	0.001	0.001	0.0015	0.0015	0.002	0.002	0.002
Over 0.012 to 0.016, incl	0.001	0.001	0.001	0.001	0.0015	0.0015	0.002	0.002
Over 0.011 to 0.012, incl	0.001	0.001	0.001	0.001	0.0015	0.0015	0.0015	0.0015
Over 0.010 to 0.011, incl	0.001	0.001	0.001	0.001	0.001	0.0015	0.0015	0.0015
0.010	0.001	0.001	0.001	0.001	0.001	0.001	0.0015	0.0015

  

Specified Thickness, mm	Width, mm							
	4.76 to 25.4, incl	Over 25.4 to 76.2, incl	Over 76.2 to 152.4, incl	Over 152.4 to 228.6, incl	Over 228.6 to 304.8, incl	Over 304.8 to 406.4, incl	Over 406.4 to 508, incl	Over 508 to 609.6, incl
	Thickness Tolerance, mm							
Over 4.06 to less than 4.76	0.05	0.08	0.10	0.10	0.10	0.13	0.15	0.15
Over 2.51 to 4.06, incl	0.05	0.05	0.08	0.08	0.10	0.10	0.13	0.13
Over 1.73 to 2.51, incl	0.05	0.05	0.08	0.08	0.08	0.10	0.10	0.10
Over 1.25 to 1.73, incl	0.05	0.05	0.08	0.08	0.08	0.08	0.10	0.10
Over 0.99 to 1.24, incl	0.05	0.05	0.06	0.08	0.08	0.08	0.10	0.10
Over 0.86 to 0.99, incl	0.05	0.05	0.06	0.06	0.08	0.08	0.08	0.08
Over 0.71 to 0.86, incl	0.04	0.04	0.05	0.05	0.06	0.06	0.08	0.08
Over 0.64 to 0.71, incl	0.02	0.04	0.04	0.05	0.05	0.05	0.06	0.08
Over 0.48 to 0.64, incl	0.02	0.02	0.04	0.04	0.05	0.05	0.06	0.06
Over 0.41 to 0.48, incl	0.02	0.02	0.02	0.04	0.04	0.05	0.05	0.05
Over 0.38 to 0.41, incl	0.02	0.02	0.02	0.02	0.04	0.04	0.05	0.05
Over 0.28 to 0.30, incl	0.02	0.02	0.02	0.02	0.04	0.04	0.04	0.04
Over 0.25 to 0.28, incl	0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.04
0.25	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.04

<sup>A</sup>For thickness under 0.010 to 0.005 in. (0.254 to 0.127 mm), inclusive, in widths up to and including 16 in. (406 mm), a tolerance of  $\pm 10\%$  of the thickness applies. For thicknesses under 0.010 to 0.005 in. (0.254 to 0.127 mm), inclusive, in widths over 16 to 24 in. (406 to 610 mm), exclusive, a tolerance of  $\pm 15\%$  of the thickness applies. For thickness tolerances on thicknesses under 0.005 in. (0.127 mm) in widths up to 24 in. (610 mm), exclusive, the producer should be consulted.

<sup>B</sup>Thickness measurements are taken  $\frac{3}{8}$  in. (9.5 mm) in from the edge of the strip, except that on widths less than 1 in. (25.4 mm) the tolerances are applicable for measurements at all locations.

<sup>C</sup>The tolerances in this table do not include crown tolerances.

**TABLE 6 Crown Tolerances for Cold-Rolled Strip**

Specified Thickness, in. (mm)	Additional Thickness, at Middle of Strip over That Shown in Table 5 for Edge Measurement, for Widths and Thicknesses Given, in. (mm)		
	Width, in. (mm)		
	To 5 (127), incl	Over 5 to 12 (127 to 305), incl	Over 12 to 24 (305 to 610), excl
0.005 to 0.010 (0.127 to 0.254), incl	0.0075 (0.19)	0.001 (0.02)	0.0015 (0.04)
Over 0.010 to 0.025 (0.254 to 0.635), incl	0.001 (0.02)	0.0015 (0.04)	0.002 (0.05)
Over 0.025 to 0.065 (0.635 to 1.65), incl	0.0015 (0.04)	0.002 (0.05)	0.0025 (0.06)
Over 0.065 to 0.187 (1.65 to 4.76), excl	0.002 (0.05)	0.0025 (0.06)	0.003 (0.08)

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.

10.2 If any specimens selected to represent any lot fail to meet any of the test requirements, the material represented by

such specimens may be retested. If there is valid reason to believe the result is not representative, the material may be re-annealed and retested.

## 11. Specimen Preparation

11.1 Tension test specimens from material under  $\frac{1}{2}$  in. (12.7 mm) in thickness shall be of the full thickness of the material

**TABLE 7 Length and Camber Tolerances for Cold-Rolled Strip**

Length Tolerances	
Specified Length, ft (mm)	Tolerance Over Specified Length (No Under Tolerance), in. (mm)
To 5 (1524), incl	3/8 (9.5)
Over 5 to 10 (1520 to 3050), incl	1/2 (12.7)
Over 10 to 20 (3050 to 6100), incl	5/8 (15.9)

and machined to the form and dimensions shown for the sheet-type specimen in Test Methods E 8. Tension test specimens from material 1/2 in. (12.7 mm) and over shall be of the full thickness of the material, machined to the form and dimensions shown for the plate-type specimen in Test Methods E 8. Tension test specimens shall be taken from material after

final heat treatment and shall be selected in the transverse direction unless prohibited by width.

**12. Keywords**

12.1 N08028; plate; sheet; strip

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