



Designation: B575 – 17

# Standard Specification for Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten, and Low-Carbon Nickel-Molybdenum-Chromium Alloy Plate, Sheet, and Strip<sup>1</sup>

This standard is issued under the fixed designation B575; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification<sup>2</sup> covers plate, sheet, and strip of low-carbon nickel-chromium-molybdenum alloys (UNS N10276, N06022, N06455, N06035, N06044, UNS N06058, UNS N06059),<sup>3</sup> low-carbon nickel-chromium-molybdenum-copper alloy (UNS N06200), low-carbon nickel-molybdenum-chromium (UNS N10362), low-carbon nickel-chromium-molybdenum-tantalum alloy (UNS N06210), and low-carbon nickel-chromium-molybdenum-tungsten alloy (UNS N06686) as shown in **Table 1**, for use in general corrosive service.

1.2 The following products are covered under this specification:

1.2.1 *Sheet and Strip*—Hot or cold rolled, solution annealed, and descaled unless solution anneal is performed in an atmosphere yielding a bright finish.

1.2.2 *Plate*—Hot or cold rolled, solution annealed, and descaled.

1.3 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.

1.4 *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 Safety Data Sheet (SDS) for this product/material as provided*

<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 ASME Boiler and Pressure Vessel Code applications, see related Specification SB-575 in Section II of that Code.

<sup>3</sup> Designation established in accordance with Practice E527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

*by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>4</sup>

B906 Specification for General Requirements for Flat-Rolled Nickel and Nickel Alloys Plate, Sheet, and Strip

E112 Test Methods for Determining Average Grain Size

E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *cold-rolled plate, n*—material  $\frac{3}{16}$  to  $\frac{3}{8}$  in. (4.76 to 9.52 mm), inclusive, in thickness.

3.1.2 *hot-rolled plate, n*—material  $\frac{3}{16}$  in. (4.76 mm) and over in thickness.

3.1.3 *plate, n*—material  $\frac{3}{16}$  in. (4.76 mm) and over in thickness.

3.1.4 *sheet and strip, n*—material under  $\frac{3}{16}$  in. (4.76 mm) in thickness.

<sup>4</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.

\*A Summary of Changes section appears at the end of this standard

**TABLE 1 Chemical Requirements**

Element	Composition Limits, %												
	Alloy N06035	Alloy N06044	Alloy N10276	Alloy N06022	Alloy N06455	Alloy N06059	Alloy N06058	Alloy N06200	Alloy N06210	Alloy N10362	Alloy N06686		
Molybdenum	7.60-9.00	0.80-1.20	15.0-17.0	12.5-14.5	14.0-17.0	15.0-16.5	18.5-21.0	15.0-17.0	18.0-20.0	21.5-23.0	15.0-17.0		
Chromium	32.25-34.25	43.5-45.3	14.5-16.5	20.0-22.5	14.0-18.0	22.0-24.0	20.0-23.0	22.0-24.0	18.0-20.0	13.8-15.6	19.0-23.0		
Iron	2.00 max	0.3 max	4.0-7.0	2.0-6.0	3.0 max	1.5, max	1.5, max	3.0 max	1.0 max	1.25 max	5.0 max		
Tungsten	0.60 max	...	3.0-4.5	2.5-3.5	...	...	0.3 max	...	...	...	3.0-4.4		
Cobalt, max	1.00	...	2.5	2.5	2.0	0.3	0.3	2.0 max	1.0	...	...		
Carbon, max	0.050	0.02	0.010	0.015	0.015	0.010	0.010	0.010	0.015	0.010	0.010		
Silicon, max	0.60	0.20	0.08	0.08	0.08	0.10	0.10	0.08	0.08	0.08	0.08		
Manganese, max	0.50	0.07-0.30	1.0	0.50	1.0	0.5	0.5	0.50	0.5	0.60	0.75		
Vanadium, max	0.20	...	0.35	0.35	...	...	...	...	0.35	...	...		
Phosphorus, max	0.030	0.020	0.04	0.02	0.04	0.015	0.015	0.025	0.02	0.025	0.04		
Sulfur, max	0.015	0.020	0.03	0.02	0.03	0.010	0.010	0.010	0.02	0.010	0.02		
Titanium	...	0.10-0.30	...	...	0.7 max	...	...	...	...	...	...		
Nickel	remainder <sup>A</sup>	Bal	remainder <sup>A</sup>	remainder <sup>A</sup>	remainder <sup>A</sup>	Bal	Bal	remainder <sup>A</sup>	remainder <sup>A</sup>	remainder <sup>A</sup>	remainder <sup>A</sup>		
Aluminum	0.40 max	0.30 max	...	...	...	0.1-0.4	0.40 max	0.50 max	...	0.50 max	0.02-0.25		
Copper	0.30 max	...	...	...	...	0.50 max	0.50 max	1.3-1.9	...	0.50 max	...		
Tantalum	...	...	...	...	...	...	...	...	1.5-2.2	...	...		
Nitrogen	...	...	...	...	...	...	0.02-0.15	...	...	...	...		

<sup>A</sup> Shall be determined arithmetically by difference.

**TABLE 2 Mechanical Property Requirements**

Alloy	Tensile Strength, min, psi (MPa)	Yield Strength (0.2 % Offset), min, psi (MPa)	Elongation in 2 in. (50.8 mm) or 4D <sup>A</sup> min, %	Rockwell Hardness, <sup>B</sup> max
N10276	100 000 (690)	41 000 (283)	40	100 HRB
N06022	100 000 (690)	45 000 (310)	45	100 HRB
N06455	100 000 (690)	40 000 (276)	40	100 HRB
N06035	85 000 (586)	35 000 (241)	30	100 HRB
N06044	100 000 (690)	45 000 (310)	30	100 HRB
N06058	110 000 (760)	52 000 (360)	40	100 HRB
N06059	100 000 (690)	45 000 (310)	45	100 HRB
N06200	100 000 (690)	45 000 (310)	45	100 HRB
N10362	105 000 (725)	45 000 (310)	40	100 HRB
N06686	100 000 (690)	45 000 (310)	45	100 HRB
N06210	100 000 (690)	45 000 (310)	45	100 HRB

<sup>A</sup> D refers to the diameter of the tension specimen.

<sup>B</sup> Hardness values are shown for information purposes only and are not to be used as a basis of acceptance or rejection. For approximate hardness conversions, see Hardness Conversion Tables E140.

#### 4. General Requirements

4.1 Material furnished to this specification shall conform to the applicable requirements of Specification B906 unless otherwise provided herein.

#### 5. Ordering Information

5.1 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 the following:

5.1.1 *Alloy*—Table 1,

5.1.2 *Dimensions*—Thickness (in decimals of an inch), width, and length (inch or fractions of an inch),

5.1.3 *Optional Requirement*—Plate; state how plate is to be cut (Specification B906, table titled Permissible Variations in Width and Length of Sheared, Torch-Cut, or Abrasive-Cut Rectangular Plate),

5.1.4 *Certification*—State if certification or a report of test results is required (Specification B906, section on Material Test Report and Certification),

5.1.5 *Purchase Inspection*—State which tests or inspections are to be witnessed (Specification B906, section on Inspection), and

5.1.6 *Samples for Product (Check) Analysis*—State whether samples should be furnished (Specification B906, section on Sampling).

#### 6. Chemical Composition

6.1 The material shall conform to the composition limits specified in Table 1.

6.2 If a product (check) analysis is made by the purchaser, the material shall conform to the requirements specified in Table 1 and Specification B906.

#### 7. Mechanical Properties and Other Requirements

7.1 *Tensile Properties*—The material shall conform to the room temperature tensile properties prescribed in Table 2.

7.2 *Hardness*—The hardness values given in Table 2 are informative only.

7.3 *Grain Size for Sheet and Strip*—Sheet and strip shall conform to the grain sizes as illustrated in Plate 1 of Test Methods E112. The requirements shall be as indicated in Table 3.

#### 8. Dimensions, Mass, and Permissible Variations

8.1 *Weight*—For calculations of mass or weight, the following densities shall be used:

Alloy	Density	
	lb/in. <sup>3</sup>	g/cm <sup>3</sup>
N10276	0.321	(8.87)
N06022	0.314	(8.69)
N06455	0.312	(8.64)
N06035	0.296	(8.18)
N06044	0.287	(7.97)
N06058	0.318	(8.80)
N06059	0.311	(8.60)
N06200	0.307	(8.50)
N06210	0.316	(8.76)
N10362	0.319	(8.83)
N06686	0.315	(8.73)

8.2 *Thickness:*

8.2.1 *Plate*—The permissible variations in thickness of plate shall be as prescribed in Specification B906, table titled Permissible Variations in Thickness of Plate.

8.2.2 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be as prescribed in Specification B906, table titled Permissible Variations in thickness of Sheet and Strip. The thickness shall be measured with the micrometer spindle  $\frac{3}{8}$  in. (9.525 mm) or more from any edge for material 1 in. (25.4 mm) or over in width and at any place on material under 1 in. (25.4 mm) in width.

8.3 *Width:*

8.3.1 *Plate*—The permissible variations in width of rectangular plates shall be as prescribed in Specification B906, table

**TABLE 3 Grain Size for Annealed Sheet**

Thickness, in. (mm)	ASTM Micrograin Size Number	Average Grain Diameter, mm (in.)
0.125 (3.175) and under	3.0 or finer	0.127 (0.0050)
Over 0.125 (3.175)	1.5 or finer	0.214 (0.0084)

titled Permissible Variations in Width and Length of Sheared, Torch-Cut, or Abrasive-Cut Rectangular Plate.

8.3.2 *Sheet and Strip*—The permissible variations in width for sheet and strip shall be as prescribed in Specification B906, table titled Permissible Variations in width of Sheet and Strip.

#### 8.4 Length:

8.4.1 *Plate*—Permissible variations in the length of rectangular plate shall be as prescribed in Specification B906, table titled Permissible Variations in Width and Length of Sheared, Torch-Cut, or Abrasive-Cut Rectangular Plate.

8.4.2 *Sheet and Strip*—Sheet and strip may be ordered to cut lengths, in which case a variation of  $\frac{1}{8}$  in. (3.175 mm) over the specified length shall be permitted, with a 0 minus tolerance.

#### 8.5 Straightness:

8.5.1 The edgewise curvature (depth of chord) of flat sheet, strip, and plate shall not exceed 0.05 in. (1.27 mm) multiplied by the length in feet or 0.04 mm multiplied by the length in centimetres.

8.5.2 Straightness for coiled strip is subject to agreement between the manufacturer and the purchaser.

8.6 *Squareness* (Sheet)—For sheets of all thicknesses and widths of 6 in. (152.4 mm) or more, the angle between adjacent sides shall be  $90 \pm 0.15^\circ$  ( $\frac{1}{16}$  in. in 24 in. of 2.6 mm/m).

8.7 *Flatness*—Plate, sheet, and strip shall be commercially flat.

#### 8.8 Edges:

8.8.1 Plates shall have sheared or cut (machined, abrasive cut, powder cut, or inert arc cut) edges, as specified.

8.8.2 Sheet and strip shall have sheared or slit edges.

### 9. Product Marking

9.1 Each plate, sheet, or strip shall be marked on one face with the specification number, alloy, heat number, manufacturer's identification, and size. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

9.2 Each bundle or shipping container shall be marked with the name of the material; this specification number; alloy; the size; gross, tare, and net weight; consignor and consignee address; contract or order number; and such other information as may be defined in the contract or order.

### 10. Keywords

10.1 N06022; N06035; N06044; N06058; N06059; N06200; N06210; N10362; N06455; N06686; N10276; plate; sheet; strip

## APPENDIX

### (Nonmandatory Information)

#### X1. HEAT TREATMENT

X1.1 Proper heat treatment during or subsequent to fabrication is necessary for optimum performance, and the manufacturer shall be consulted for details.

## SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B575–15<sup>e1</sup>) that may impact the use of this standard. (Approved June 1, 2017.)

(1) Revised Scope, Table 1, Table 2, paragraph 8.1, and Keywords to add new Ni-Cr-Mo alloy N06044.

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