Standard Specification for Nickel-Molybdenum Alloy Plate, Sheet, and Strip

This standard is issued under the fixed designation B333; 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.

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

1. Scope

1.1 This specification covers plate, sheet, and strip of nickel-molybdenum alloys (UNS N10001, N10665, N10675, N10629, and N10624)* 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 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:

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, and Scleroscope Hardness

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 cold-rolled plate, n—material ⅛ to ⅜ in. (4.76 to 9.52 mm), inclusive, in thickness.

3.1.2 hot-rolled plate, n—material ⅛ in. (4.76 mm) and over in thickness.

3.1.3 plate, n—material under ⅛ in. (4.76 mm) in thickness.

3.1.4 sheet and strip, n—material under ⅛ in. (4.76 mm) in thickness.

4. General Requirements

4.1 Material furnished under 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; how the plate is to be cut (Specification B906, Table A2.3),

5.1.4 Certification—State if certification or a report of test results is required (Specification B906, Section 21),

5.1.5 Purchase Inspection—State which tests or inspections are to be witnessed (Specification B906, Section 18), and

5.1.6 Samples for Product (Check) Analysis—State whether samples should be furnished (Specification B906, Section 7.2.2).

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* 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.


● New designation established in accordance with ASTM E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).

* For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-335 in Section II of that Code.

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.
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:

<table>
<thead>
<tr>
<th>Element</th>
<th>Alloy N10001</th>
<th>Alloy N10665</th>
<th>Alloy N10675</th>
<th>Alloy N10629</th>
<th>Alloy N10624</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel, remainder</td>
<td>65.0 min</td>
<td>65.0 min</td>
<td>remainder</td>
<td>Bal</td>
<td></td>
</tr>
<tr>
<td>Molybdenum</td>
<td>26.0–30.0</td>
<td>26.0–30.0</td>
<td>27.0–32.0</td>
<td>26.0–30.0</td>
<td>21.0–25.0</td>
</tr>
<tr>
<td>Iron, max</td>
<td>4.0–6.0</td>
<td>2.0 max</td>
<td>1.0–3.0</td>
<td>1.0–6.0</td>
<td>5.0–8.0</td>
</tr>
<tr>
<td>Chromium, max</td>
<td>1.0–3.0</td>
<td>1.0–3.0</td>
<td>0.5–1.5</td>
<td>6.0–10.0</td>
<td></td>
</tr>
<tr>
<td>Carbon, max</td>
<td>0.05</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Silicon, max</td>
<td>1.0</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Cobalt, max</td>
<td>2.5</td>
<td>1.00</td>
<td>3.0</td>
<td>2.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Manganese, max</td>
<td>1.0</td>
<td>1.0</td>
<td>3.0</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Phosphorus, max</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.04</td>
<td>0.025</td>
</tr>
<tr>
<td>Sulfur, max</td>
<td>0.03</td>
<td>0.03</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Vanadium, max</td>
<td>0.2–0.4</td>
<td>...</td>
<td>0.20 max</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Nickel plus</td>
<td>...</td>
<td>...</td>
<td>94.0–98.0</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>...</td>
<td>...</td>
<td>0.50 max</td>
<td>0.1–0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Aluminum, max</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>0.20</td>
<td>...</td>
</tr>
<tr>
<td>Columbium, max</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>0.20</td>
<td>...</td>
</tr>
<tr>
<td>Copper, max</td>
<td>...</td>
<td>...</td>
<td>0.20</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Tantalum, max</td>
<td>...</td>
<td>...</td>
<td>0.20</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Titanium, max</td>
<td>...</td>
<td>...</td>
<td>0.20</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Tungsten, max</td>
<td>...</td>
<td>...</td>
<td>3.0</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Zirconium, max</td>
<td>...</td>
<td>...</td>
<td>0.10</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Magnesium, max</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

* See Specification B906.

8.2 Thickness:

8.2.1 Sheet and Strip—The thickness shall be measured with the micrometer spindle 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 Length:

8.3.1 Sheet and Strip—Sheet and strip may be ordered to cut lengths, in which case a variation of 1⁄8 in. (3.175 mm) over the specified length shall be permitted, with a 0 minus tolerance.

8.4 Straightness:

8.4.1 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.

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

8.5 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° + 0.15 degrees (1⁄16 in. in 24 in. or 2.6 mm/m).

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

8.7 Edges:

8.7.1 Plates shall have sheared, abrasive cut, or plasma-torch-cut edges as specified.

8.7.2 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 plate; sheet; strip; UNS N10001; UNS N10629; UNS N10665; UNS N10675; UNS N10624
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.

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