



Designation: B435 – 22

Standard Specification for Heat and Corrosion Resistant High Temperature Alloy Plate, Sheet, and Strip¹

This standard is issued under the fixed designation B435; 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 specification² covers alloys in the form of rolled plate, sheet, and strip that are typically used for (though not limited) heat-resisting and general corrosive service.

1.2 Alloys that can currently be certified to this specification are UNS N06002, UNS N06230, UNS N12160, and UNS R30556.

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 by the manufacturer, to establish appropriate safety, health, and environmental 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:*³

B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys

¹ 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.

Current edition approved Oct. 1, 2022. Published November 2022. Originally approved in 1966. Last previous edition approved in 2016 as B435 – 06 (2016). DOI: 10.1520/B0435-22.

² For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-435 in Section II of that Code.

³ 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.

B899 Terminology Relating to Non-ferrous Metals and Alloys

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

B1015 Practice for Form and Style of Standards Relating to Refined Nickel and Cobalt and Their Alloys

3. Terminology

3.1 Common B02.07 terminology is found in Specification **B899**.

3.2 The definitions for plate, sheet, and strip used in Specification **B906** apply to the products of this specification with the following adjustments:

3.2.1 Strip can be either a cold rolled or hot rolled material.

3.2.2 The finishes allowed for products certified to this specification are stipulated in Section 6.

4. General Requirements

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

4.2 Product furnished to this specification shall conform to the requirements of Specification **B906**. Failure to comply with the general requirements of Specification **B906** constitutes nonconformance with this specification. In case of conflict between the requirements and this specification, and the requirements of Specification **B906**, this specification shall prevail.

5. Ordering Information

5.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered to this specification.

5.2 Refer to the ordering information section of Specification **B906** for examples of requirements.

6. Materials and Manufacture

6.1 The products certified to this specification shall have been manufactured in accordance with Specification **B906**.

6.2 The finish of the final products certified to this specification are:

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

6.2.1 *Sheet and Strip*—Hot- or cold-rolled, annealed, and descaled unless annealing is performed in an atmosphere yielding a bright finish.

6.2.2 *Plate*—Hot-rolled, annealed, and descaled.

7. Chemical Composition

7.1 The material shall conform to the chemical requirements prescribed in **Table 1**.

7.2 If a product (check) analysis is made by the purchaser, it shall be done in conformance with Specification **B880**.

8. Mechanical Properties and Other Requirements

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

8.2 *Grain Size for Sheet and Strip*:

8.2.1 Annealed alloys UNS N06002, UNS N06230, and UNS R30556 sheet and strip shall conform to the grain size requirements given in **Table 3**.

8.2.2 Annealed alloy UNS N12160 shall conform to an average grain size of ASTM No. 5 or coarser.

9. Dimensions, Mass, and Permissible Variations

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

Alloy	Density
	lb/in. ³ (g/cm ³)
N06002	0.297 (8.23)
N06230	0.324 (8.97)
R30556	0.297 (8.23)
N12160	0.292 (8.08)

9.2 *Thickness*:

9.2.1 *Plate*—The permissible variations in thickness of plate shall be as prescribed in Table A2.1 in Specification **B906**.

9.2.2 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be as prescribed in Table A2.2 in Specification **B906**.

TABLE 2 Mechanical Property Requirements

UNS	Tensile Strength, min, ksi (MPa)	Yield Strength (0.2 % Offset), min, ksi (MPa)	Elongation in 2 in. (50.8 mm) or 4D, ^A min, %
N06002	95 (655)	35 (240)	35
N06230	110 (760)	45 (310)	40
R30556	100 (690)	45 (310)	40
N12160	90 (620)	35 (240)	40

^A D refers to the diameter of the tension specimen.

TABLE 3 Grain Size for Annealed Sheet

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

9.2.3 Products that are at least 1.00 in. (25.4 mm) in width shall have thickness measured with the micrometer spindle positioned 0.375 in. (9.53 mm) or more from any edge. Products that are less than 1.00 in. (25.4 mm) width may have the thickness measured with the micrometer spindle positioned anywhere.

9.3 *Width*:

9.3.1 *Plate*—The permissible variations in width of rectangular plates shall be as prescribed in Table A2.3 in Specification **B906**.

9.3.2 *Sheet and Strip*—The permissible variations in width for sheet and strip shall be as prescribed in Table A2.4 in Specification **B906**.

9.4 *Length*:

9.4.1 *Plate*—Permissible variations in the length of rectangular plate shall be as prescribed in Table A2.3 in Specification **B906**.

TABLE 1 Chemical Requirements^A

Element	Composition Limits, %			
	UNS N06002	UNS N06230	UNS R30556	UNS N12160
Nickel	remainder	remainder	19.0–22.5	remainder
Iron	17.0–20.0	3.0	remainder	3.5
Chromium	20.5–23.0	20.0–24.0	21.0–23.0	26.0–30.0
Cobalt	0.5–2.5	5.0	16.0–21.0	27.0–33.0
Molybdenum	8.0–10.0	1.0–3.00	2.5–4.0	1.0
Tungsten	0.2–1.0	13.0–15.0	2.0–3.5	1.0
Carbon	0.05–0.15	0.05–0.15	0.05–0.15	0.15
Silicon	1.00	0.25–0.75	0.20–0.80	2.4–3.0
Manganese	1.00	0.30–1.00	0.50–2.00	1.5
Phosphorus	0.04	0.030	0.04	0.030
Sulfur	0.03	0.015	0.015	0.015
Columbium (Nb)	...	...	0.30	1.0
Tantalum	...	...	0.30–1.25	...
Aluminum	...	0.50	0.10–0.50	...
Zirconium	...	...	0.001–0.10	...
Lanthanum	...	0.005–0.050	0.005–0.10	...
Nitrogen	...	...	0.10–0.30	...
Boron	...	0.015	0.02	...
Titanium	...	...	...	0.20–0.80

^A Values in the table are maximums unless a range or minimum is indicated.