Designation: B 472 – 03

Standard Specification for Nickel Alloy Billets and Bars for Reforging[1]

This standard is issued under the fixed designation B 472; 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 UNS N06002, UNS N06030, UNS N06022, UNS N06200, UNS N06230, UNS N06600, UNS N06617, UNS N06625, UNS N08020, UNS N08026, UNS N08024, UNS N08120, UNS N08926, UNS N08367, UNS N10242, UNS N10276, UNS N10665, UNS N10675, UNS N12160, UNS R20033, and UNS R30556* billets and bars for reforging.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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:*

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels[2]

B 880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys[3]

E 1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *billets and bars,, n*—terms billets and bars as used in this specification shall be understood as billets and bars for reforging.

4. Ordering Information

4.1 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:

4.1.1 Quantity (weight or number of pieces),

4.1.2 Name of material or UNS number,

4.1.3 Form (bar or billet),

4.1.4 Dimensions,

4.1.5 ASTM designation and year of issue,

4.1.6 Inspection (12.1),

4.1.7 Certification—State if certification or a report of test results is required (Section 14),

4.1.8 Supplementary requirements, if any, and

4.1.9 If possible, the intended end use.

NOTE 1—A typical ordering description is as follows: 10 000 lb (4536 kg), UNS N08020, forging bar, 4¼ in. (107.95 mm) round, Specification B 472.

5. Materials and Manufacture

5.1 The products shall be hot worked from ingots by rolling, forging, extruding, hammering, or pressing.

5.2 The products may be conditioned by chipping, grinding, or machining to remove injurious surface defects provided the depth of conditioning does not exceed that which will affect the surface condition or dimensions of the article to be forged from the bar or billet.

6. Chemical Composition

6.1 The material shall conform to the requirements as to chemical composition prescribed in Table 1.

6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the requirements specified in Table 1 subject to the permissible tolerances in B 880.

7. Dimensions and Permissible Variations

7.1 Billets shall conform to the shapes and dimensions specified by the purchaser within a permissible variation of ±5 %.

7.2 Bars shall conform to the shape and dimensions specified by the purchaser within the permissible variations prescribed in Table 2.

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[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.

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* New designation established in accordance with ASTM E 527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

[2] *Annual Book of ASTM Standards*, Vol 01.03.

[3] *Annual Book of ASTM Standards*, Vol 02.04.

[4] *Annual Book of ASTM Standards*, Vol 03.06.

TABLE 1 Chemical Requirements

Element	Composition, %					
	UNS N08026	UNS N08020	UNS N08024	UNS N08367	UNS N08926	UNS R20033
Carbon, max	0.03	0.07	0.03	0.030	0.020	0.015
Manganese, max	1.00	2.00	1.00	2.00	2.00	2.0
Phosphorus, max	0.03	0.045	0.035	0.040	0.03	0.02
Sulfur, max	0.03	0.035	0.035	0.030	0.01	0.01
Silicon, max	0.50	1.00	0.50	1.00	0.50	0.50
Nickel	33.00–37.20	32.00–38.00	35.00–40.00	23.50–25.50	24.00–26.00	30.0–33.0
Chromium	22.00–26.00	19.00–21.00	22.50–25.00	20.00–22.00	19.00–21.00	31.0–35.0
Molybdenum	5.00–6.70	2.00–3.00	3.50–5.00	6.00–7.00	6.0–7.0	0.50–2.0
Copper	2.00–4.00	3.00–4.00	0.50–1.50	0.75 max	0.5–1.5	0.30–1.20
Columbium (Nb) + tantalum	...	8 × carbon–1.00	0.15–0.35	...	...	...
Nitrogen	0.10–0.16	...	...	0.18–0.25	0.15–0.25	0.35–0.60
Iron[A]	remainder	remainder	remainder	remainder	balance	balance

Element	Composition, %							
	UNS N06030	UNS N06022	UNS N06200	UNS N10276	UNS N10665	UNS N10675	UNS N06002	UNS N06230
Carbon, max	0.03	0.015	0.010	0.010	0.02	0.01	0.05-0.15	0.05-0.15
Manganese, max	1.5	0.50	0.50	1.0	1.0	3.0	1.00	0.30-1.00
Phosphorous, max	0.04	0.02	0.025	0.04	0.04	0.030	0.04	0.030
Sulfur, max	0.02	0.02	0.010	0.03	0.03	0.010	0.03	0.015
Silicon, max	0.8	0.08	0.08	0.08	0.10	0.10	1.00	0.25-0.75
Nickel	remainder	remainder	remainder	remainder	remainder	65.0 min	remainder[A]	remainder[A]
Chromium	28.0-31.5	20.0-22.5	22.0-24.0	14.5-16.5	1.0 max	1.0-3.0	20.5-23.0	20.0-24.0
Molybdenum	4.0-6.0	12.5-14.5	15.0-17.0	15.0-17.0	26.0-30.0	27.0-32.0	8.0-10.0	1.0-3.00
Copper	1.0-2.4	...	1.3-1.9	...	...	0.20	...	...
Columbium (Nb) + tantalum	0.30-1.50	...	...	...	...	...	...	...
Iron	13.0-17.0	2.0-6.0	3.0 max	4.0-7.0	2.0 max	1.0-3.0	17.0-20.0	3.0 max
Cobalt, max	5.0	2.5	2.0	2.5	1.0	3.0	0.5-2.5	5.0
Tungsten	1.5-4.0	2.5-3.5	...	3.0-4.5	...	3.0 max	0.2-1.0	13.0-15.0
Vanadium, max	...	0.35	...	0.35	...	0.20	...	...
Titanium, max	...	...	...	...	...	0.2	...	...
Zirconium, max	...	...	...	...	...	0.10	...	...
Columbium (Nb)	...	...	...	...	...	0.20 max	...	...
Tantalum	...	...	...	...	...	0.20 max		
Nickel + Molybdenum	...	...	...	...	...	94.0-98.0	...	...
Aluminum, max	...	...	0.50	...	...	0.50	...	0.20-0.50
Lanthanum	...	...	...	...	...	...	...	0.005-0.050
Boron	...	...	...	...	...	...	...	0.015 max

Element	Composition, %						
	UNS N12160	UNS R30556	UNS N06625	UNS N06600	UNS N10242	UNS N08120	UNS N06617
Carbon	0.15 max	0.05-0.15	0.10 max	0.15 max	0.03	0.02-0.10	0.05-0.15
Manganese	1.5 max	0.50-2.00	0.50 max	1.0 max	0.80 max	1.5 max	1.0 max
Phosphorous	0.030 max	0.04 max	0.015 max	...	0.030 max	0.040 max	...
Sulfur	0.015 max	0.015 max	0.015 max	0.015 max	0.015 max	0.03 max	0.015 max
Silicon	2.4-3.0	0.20-0.80	0.50 max	0.50 max	0.80 max	1.0 max	1.0 max
Nickel	remainder[A]	19.0-22.5	58.0 min[A]	72.0 min[A]	remainder[A]	35.0-39.0	44.5 min[A]
Chromium	26.0-30.0	21.0-23.0	20.0-23.0	14.0-17.0	7.0-9.0	23.0-27.0	20.0-24.0
Molybdenum	1.0 max	2.5-4.0	8.0-10.0	...	24.0-26.0	2.50 max	8.0-10.0
Copper	...	...	...	0.5 max	...	0.50 max	0.5 max
Columbium (Nb) + tantalum	...	...	3.15-4.15	...	...	0.4-0.9	...
Nitrogen	...	0.10-0.30	...	...	...	0.15-0.30	...
Iron	3.5 max	remainder[A]	5.0 max	6.0-10.0	2.0 max	remainder[A]	3.0 max
Cobalt, max	27.0-33.0	16.0-21.0	...	...	1.00 max	3.0	10.0 min-15.0 max
Tungsten	1.0 max	2.0-3.5	...	...	...	2.50 max	...
Titanium	0.20-0.80	...	0.4 max	...	...	0.20 max	0.6 max
Zirconium	...	0.001-0.10	...	...	...	...	...
Columbium	1.0 max	0.30 max	...	...	...	...	...
Tantalum	...	0.30-1.25	...	...	...	...	...
Aluminum,max	...	0.10-0.50	0.4	...	0.50	0.40	0.8-1.5
Lanthanum	...	0.005-0.10	...	...	...	...	...
Boron	...	0.02 max	...	...	0.006 max	0.010 max	0.006 max

[A] See 11.1.