



Designation: **B637—18 B637 – 23**

# Standard Specification for Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High Temperature Service<sup>1</sup>

This standard is issued under the fixed designation B637; 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 hot- and cold-worked precipitation-hardenable nickel alloy rod, bar, forgings, and forging stock for moderate or high temperature service ([Table 1](#)).

1.2 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.

1.3 *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 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.*

1.4 *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>3</sup>

[B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys](#)

[B899 Terminology Relating to Non-ferrous Metals and Alloys](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

[E139 Test Methods for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials](#)

[E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness](#)

[E1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys](#)

## 3. Terminology

### 3.1 Definitions:

<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.

Current edition approved Nov. 1, 2018Dec. 1, 2023. Published December 2018December 2023. Originally approved in 1970. Last previous edition addition approved in 20162018 as B637B637 – 18, –16. DOI: 10.1520/B0637-18,10.1520/B0637-23.

<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-637 in Section II of that Code.

<sup>3</sup> 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.

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

TABLE 1 Chemical Requirements<sup>A</sup>

Element	Composition Limits, %							
	UNS N07022	UNS N07208	UNS N07252 (Formerly Grade 689)	UNS N07001 (Formerly Grade 685)	UNS N07500 (Formerly Grade 684)	UNS N07740	UNS N07750 (Formerly Grade 688)	UNS N07718 (Formerly Grade 718)
Carbon	0.010 max	0.04-0.08	0.10-0.20	0.03-0.10	0.15 max	0.005-0.08	0.08 max	0.08 max
Carbon	0.010	0.04-0.08	0.10-0.20	0.03-0.10	0.15	0.005-0.08	0.08	0.08
Manganese	0.5 max	0.3 max	0.50 max	1.00 max	0.75 max	1.00 max	1.00 max	0.35 max
Manganese	0.5	0.3	0.50	1.00	0.75	1.00	1.00	0.35
Silicon	0.08 max	0.15 max	0.50 max	0.75 max	0.75 max	1.00 max	0.50 max	0.35 max
Silicon	0.08	0.15	0.50	0.75	0.75	1.00	0.50	0.35
Phosphorus	0.025 max	0.015 max	0.015 max	0.030 max	0.015 max	0.030 max	...	0.015 max
Phosphorus	0.025	0.015	0.015	0.030	0.015	0.030	...	0.015
Sulfur	0.015 max	0.015 max	0.015 max	0.030 max	0.015 max	0.030 max	0.01 max	0.015 max
Sulfur	0.015	0.015	0.015	0.030	0.015	0.030	0.01	0.015
Chromium	20.0-21.4	18.5-20.5	18.00-20.00	18.00-21.00	15.00-20.00	23.50-25.50	14.00-17.00	17.0-21.0
Cobalt	1.0 max	9.0-11.0	9.00-11.00	12.00-15.00	13.00-20.00	15.00-22.00	1.00 max <sup>A</sup>	1.0 max <sup>A</sup>
Cobalt	1.0	9.0-11.0	9.00-11.00	12.00-15.00	13.00-20.00	15.00-22.00	1.00 <sup>B</sup>	1.0 <sup>B</sup>
Molybdenum	15.5-17.4	8.0-9.0	9.00-10.50	3.50-5.00	3.00-5.00	2.00 max	...	2.80-3.30
Molybdenum	15.5-17.4	8.0-9.0	9.00-10.50	3.50-5.00	3.00-5.00	2.00	...	2.80-3.30
Columbium	...	...	...	...	...	...	0.70-1.20	4.75-5.50
(Nb) + tantalum	...	...	...	...	...	...	0.70-1.20	4.75-5.50
Niobium <sup>D</sup> + Tantalum	...	...	...	...	...	...	0.70-1.20	4.75-5.50
Titanium	...	1.90-2.30	2.25-2.75	2.75-3.25	2.50-3.25	0.50-2.50	2.25-2.75	0.65-1.15
Aluminum	0.5 max	1.38-1.65	0.75-1.25	1.20-1.60	2.50-3.25	0.20-2.00	0.40-1.00	0.20-0.80
Aluminum	0.5	1.38-1.65	0.75-1.25	1.20-1.60	2.50-3.25	0.20-2.00	0.40-1.00	0.20-0.80
Zirconium	...	0.020 max	...	0.02-0.12	...	...	...	...
Zirconium	...	0.020	...	0.02-0.12	...	...	...	...
Boron	0.006 max	0.003-0.010	0.003-0.01	0.003-0.01	0.003-0.01	0.0008-0.006	...	0.006 max
Boron	0.006	0.003-0.010	0.003-0.01	0.003-0.01	0.003-0.01	0.0008-0.006	...	0.006
Iron	1.8 max	1.5 max	5.00 max	2.00 max	4.00 max	3.00 max	5.00-9.00	remainder <sup>B</sup>
Iron	1.8	1.5	5.00	2.00	4.00	3.00	5.00-9.00	rem <sup>B</sup>
Copper	0.5 max	0.1 max	...	0.50 max	0.15 max	0.50 max	0.50 max	0.30 max
Copper	0.5	0.1	...	0.50	0.15	0.50	0.50	0.30
Nickel	remainder <sup>B</sup>	remainder <sup>B</sup>	remainder <sup>B</sup>	remainder <sup>B</sup>	remainder <sup>B</sup>	remainder <sup>B</sup>	70.00 min	50.0-55.0
Nickel	rem <sup>B</sup>	rem <sup>B</sup>	rem <sup>C</sup>	rem <sup>B</sup>	rem <sup>B</sup>	rem <sup>B</sup>	70.00 min	50.0-55.0
Tantalum	0.2 max	0.1 max	...	...	...	...	...	...
Tantalum	0.2	0.1 max	...	...	...	...	...	...
Columbium	...	0.2 max	...	...	...	0.50-2.50	...	...
(Niobium)	...	0.2	...	...	...	0.50-2.50	...	...
Columbium (Niobium)	...	0.2	...	...	...	0.50-2.50	...	...
Tungsten	0.8 max	0.5 max	...	...	...	...	...	...
Tungsten	0.8	0.5	...	...	...	...	...	...
UNS N07080 (Formerly Grade 80A)	UNS N07080	UNS N07752	UNS N09925	UNS N07725				
UNS N07080	UNS N07080	UNS N07752	UNS N09925	UNS N07725				
Carbon	0.10 max	0.020-0.060	0.03 max	0.03 max				
Carbon	0.10	0.020-0.060	0.03	0.03				
Manganese	1.00 max	1.00 max	1.0 max	0.35 max				
Manganese	1.00	1.00	1.0	0.35				
Silicon	1.00 max	0.50 max	0.5 max	0.20 max				
Silicon	1.00	0.50	0.5	0.20				
Phosphorus	...	0.008 max	0.03 max	0.015 max				
Phosphorus	...	0.008	0.03	0.015				
Sulfur	0.015 max	0.003 max	0.03 max	0.010 max				
Sulfur	0.015	0.003	0.03	0.010				
Chromium	18.00-21.00	14.50-17.00	19.5-22.5	19.00-22.50				
Cobalt	...	0.050 max	...	...				
Cobalt	...	0.050	...	...				
Molybdenum	...	...	2.5-3.5	7.00-9.50				
Columbium	...	0.70-1.20	0.5 max (Nb only)	2.75-4.00				
(Nb) + tantalum	...	0.70-1.20	0.5 (Nb only)	2.75-4.00				
Niobium <sup>D</sup> (Nb) + Tantalum	...	0.70-1.20	0.5 (Nb only)	2.75-4.00				
Titanium	1.80-2.70	2.25-2.75	1.9-2.40	1.00-1.70				
Aluminum	0.50-1.80	0.40-1.00	0.1-0.5	0.35 max				
Aluminum	0.50-1.80	0.40-1.00	0.1-0.5	0.35				
Boron	...	0.007 max	...	...				
Boron	...	0.007	...	...				
Iron	3.00 max	5.00-9.00	22.0 min	remainder <sup>B</sup>				
Iron	3.00	5.00-9.00	22.0 min	rem <sup>C</sup>				