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Standard Specification for Pressure Consolidated Powder ~~Metallurgy Iron-Nickel-Chromium-Molybdenum (UNS N08367), Nickel-Chromium-Molybdenum-Columbium (Nb) (UNS N06625), Nickel-Chromium-Iron Alloys (UNS N06600 and N06690), and Nickel-Chromium-Iron-Columbium-Molybdenum (UNS N07718)~~ Nickel Alloy Pipe Flanges, Fittings, Valves, and Parts[1]

This standard is issued under the fixed designation B834; 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 pressure consolidated powder metallurgy ~~iron-nickel-chromium-molybdenum (UNS N08367) and nickel-chromium-molybdenumcolumbium (Nb) (UNS N06625), nickel-chromium-iron alloys (UNS N06600 and N06690), and nickel-chromium-iron-columbium (Nb)-molybdenum (UNS N07718)~~ nickel alloy pipe flanges, fittings, valves, and parts intended for general corrosion or heat-resisting service.

1.1.1 UNS N06625 products are furnished in two grades of different heat-treated conditions:

1.1.1.1 Grade 1 (annealed)—Material is normally employed in service temperatures up to ~~1100°F (593°C).~~1100 °F (593 °C).

1.1.1.2 Grade 2 (solution annealed)—Material is normally employed in service temperatures above ~~1100°F (593°C)~~1100 °F (593 °C) when resistance to creep and rupture is required.

1.2 UNS N08367 products are furnished in the solution annealed condition.

1.3 UNS N06600 products are furnished in the annealed condition.

1.4 UNS N06690 products are furnished in the annealed condition.

1.5 UNS N07718 products are furnished in the solution annealed + precipitation hardened condition.

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

1.7 The following safety hazards caveat pertains only to test methods portions, Sections 7.3 and 13, of this specification: *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 to determine the applicability of regulatory limitations prior to use.*

1.8 *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:*[2]

B899 Terminology Relating to Non-ferrous Metals and Alloys
E3 Guide for Preparation of Metallographic Specimens
E8/E8M Test Methods for Tension Testing of Metallic Materials
E29 ~~Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications~~
E1473 Test Methods for Chemical Analysis of Nickel, Cobalt and High-Temperature Alloys
G28 Test Methods for Detecting Susceptibility to Intergranular Corrosion in Wrought, Nickel-Rich, Chromium-Bearing Alloys
G48 Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution

2.2 *Manufacturer's Standardization Society of the Valve and Fittings Industry Standard:*[3]

SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions

2.3 *ASME/ANSI Standard:*[4]

ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings
ASME Boiler and Pressure Vessel Code
Section I
Section III
Section IV
Section VIII
Section XII
ASME B31.1 Power Piping
ASME B31.3 Process Piping

3. Terminology

~~3.1 *Definitions of Terms Specific to This Standard:*~~

~~3.1.1 *can, n*—the container used to encapsulate the powder during the pressure consolidation process; it is removed from the final part.~~

~~3.1.2 *compact, n*—the consolidated powder from one can; it may be used to make one or more parts.~~

~~3.1.3 *fill pin, n*—the part of the compact in the spout used to fill the can; it is not usually integral to the part produced.~~

~~3.1.4 *part, n*—a single item coming from a compact, either prior to or after machining.~~

~~3.1.5 *powder blend, n*—a homogeneous mixture of powder from one or more heats; it is limited to the amount that can be mixed in the same blender at one time.~~

~~3.1.6 *rough part, n*—the part prior to final machining.~~

3.1 *Definitions of Terms:*

[2] 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.

[3] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

3.1.1 The terms and definitions of Terminology B899 apply.

4. Ordering Information

4.1 Orders for material under this specification should include the following information:

4.1.1 Quantity (weight or number of pieces),

4.1.2 Name of material or UNS number,

4.1.3 ~~Condition~~Grade (UNS ~~N06625),~~N06625)—See 1.1.1, 5.2.1, and Table 3,

4.1.3.1 If neither grade of UNS N06625 is specified, Grade 1 (annealed) will be supplied.

4.1.4 ASTM designation and year of issue,

4.1.5 Inspection (14.1),

4.1.6 Whether rough part or finish machined (7.2.2),

4.1.7 Certification—State if certification is required (16.1),

4.1.8 Supplementary requirements, when applicable, and

4.1.9 If possible, the intended end use.

5. Materials and Manufacture

5.1 *Manufacturing Practice:*

5.1.1 Compacts shall be manufactured by placing a single powder blend into a can, evacuating the can, and sealing it. The can material shall be selected to ensure that it has no deleterious effect on the final product. The entire assembly shall be heated and placed under sufficient pressure for a sufficient period of time to ensure that the final consolidated part is fully dense. The compact may represent one part or a number of parts may be machined from it.

5.1.2 The powder shall be produced by vacuum melting followed by gas atomization.

5.1.3 When powder from more than one heat is used to make a blend, the heats shall be thoroughly mixed to ensure homogeneity.

5.1.4 Powder shall be protected during storage to prevent the detrimental pick-up of oxygen and other contaminants.

5.2 *Heat Treatment:*

5.2.1 Alloy N06625 shall be supplied in either:

5.2.1.1 *Grade ~~1.~~ 1*—The annealed condition. At the option of the producer, the anneal may be a separate operation following consolidation or may be part of the consolidation process. In either case, the temperature shall be ~~1600°F (871°C)~~1600 °F (871 °C) minimum, or

5.2.1.2 *Grade ~~2.~~ 2*—The solution annealed condition. At the option of the producer, the anneal may be a separate operation following consolidation or may be part of the consolidation process. In either case, the temperature shall be ~~2000°F (1093°C)~~2000 °F (1093 °C) minimum.

5.2.2 Alloy N08367 shall be supplied in the solution annealed condition.

5.2.2.1 The heat treatment shall consist of heating to a minimum temperature of ~~2025°F~~2025 °F and quenching in water or rapidly cooling by other means.

5.2.3 Alloy N06600 shall be supplied in the annealed condition. The temperature shall be ~~1750°F (954°C)~~1750 °F (954 °C) minimum, A.C. or faster.

5.2.4 Alloy N06690 shall be supplied in the annealed condition. The temperature shall be ~~1950°F (1066°C)~~1950 °F (1066 °C) minimum, with a minimum holding time of 30 min. The material shall be water quenched.

5.2.5 Alloy N07718 shall be supplied in the solution + precipitation hardened condition. The recommended solution temperature is 1700 to ~~1850°F~~1850 °F (924 to ~~1010°C)~~1010 °C) hold ½ h minimum, cool at rate equivalent to air cool or faster. The precipitation hardening treatment is 1325 ± ~~25°F~~25 °F (718 ± ~~14°C).~~14 °C). Hold at temperature for 8 h, furnace cool to 1150 ± ~~25°F~~25 °F (621 ± ~~14°C),~~14 °C), hold until total precipitation heat treatment time has reached 18 h, and air cool.

6. Chemical Composition

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

6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations prescribed in Table 2.

7. Mechanical and Other Requirements

7.1 *Mechanical Properties*—The material shall conform to the requirements for mechanical properties prescribed in Table 3 at room temperature.

7.2 *Hydrostatic Tests*—After machining, valve bodies, fittings, and other pressure-containing parts shall be tested to the hydrostatic shell-test pressures prescribed in ASME/ANSI B16.5 for the applicable steel rating for which the compact is designed, and shall show no leaks. Parts ordered under these specifications for working pressures other than those listed in the American National Standard ratings shall be tested to such pressures as may be agreed upon between the manufacturer and purchaser.

7.2.1 No hydrostatic test is required for welding neck or other flanges.

7.2.2 The compact manufacturer is not required to perform pressure tests on rough parts that are to be finish machined by others. The fabricator of the finished part is not required to pressure test parts that are designed to be pressure containing only after assembly by welding into a larger structure. However, the manufacturer of such parts is responsible as required in 15.1 for the satisfactory performance of the parts under the final test required in 7.2.

TABLE 1 Chemical Requirements

Element	Composition,%				
	UNS N06625	UNS N08367	UNS N06600	UNS N06690	UNS N07718
Carbon, max	0.10	0.030	0.15	0.05	0.08
Manganese, max	0.50	2.00	1.0	0.5	0.35
Silicon, max	0.50	1.00	0.5	0.5	0.35
Phosphorus, max	0.015	0.040	...	...	0.015
Sulfur, max	0.015	0.030	0.015	0.015	0.015
Chromium	20.00 to 23.00	20.00 to 22.00	14.0 to 17.0	27.0 to 31.0	17.0 to 21.0
Molybdenum	8.00 to 10.00	6.00 to 7.00	...	...	2.80 to 3.30
Nickel	58.0 min[A]	23.50 to 25.50	72.0 min	58.0 min	50.0 to 55.0
Iron	5.00 max	remainder[A]	6.0 to 10.0	7.0 to 11.0	remainder[A]
~~Cobalt (when specified)~~	~~1.00 max~~	~~...~~	~~...~~	~~...~~	~~1.0 max~~
Cobalt	1.00 max	...	...	...	1.0 max
~~Columbium (Nb)~~	~~3.15 to 4.15~~	~~...~~	~~...~~	~~...~~	~~4.75 to 5.50[B]~~
Niobium[C]	3.15 to 4.15	...	...	...	4.75 to 5.50[B]
Aluminum	0.50 max	...	...	...	0.20 to 0.80
Titanium	0.40 max	...	...	...	0.65 to 1.15
Nitrogen	...	0.18 to 0.25	...	...	...
Copper	...	0.75 max	0.5 max	0.5 max	0.30 max

[A] Element shall be determined arithmetically by difference.
[B] ~~Columbium (Nb)~~ Niobium + tantalum.
[C] The terms niobium (Nb) and columbium (Cb) are alternate names for the same element.

TABLE 2 Product Analysis Tolerance

Element	Tolerance, Over the Maximum Limit or Under the Minimum Limit, %				
	UNS N06625	UNS N08367	UNS N06600	UNS N06690	UNS N07718
Carbon, max	0.01	0.005	0.01	0.01	0.01
Manganese, max	0.03	0.04	0.03	0.03	0.03
Silicon, max	0.03	0.05	0.03	0.03	0.03
Phosphorus, max	0.005	0.005	...	...	0.005
Sulfur, max	0.003	0.005	0.003	0.003	0.003
Chromium	0.25	0.25	0.25	0.30	0.25
Molybdenum	0.15	0.15	...	...	0.10
Nickel	0.35	0.25	0.45	0.35	0.35
Iron	0.07	...	0.10	0.15	...
~~Cobalt (when specified)~~	~~0.03~~	~~...~~	~~...~~	~~...~~	~~...~~
Cobalt	0.03	...	...	...	0.03
~~Columbium (Nb)~~	~~0.15~~	~~...~~	~~...~~	~~...~~	~~0.20~~
Niobium[A]	0.15	...	...	...	0.20
Aluminum	0.05	...	...	...	0.10
Titanium	0.03	...	...	...	0.05
Nitrogen	...	0.01	...	...	...
Copper	...	0.04	0.03	0.03	0.03

[A] The terms niobium (Nb) and columbium (Cb) are alternate names for the same element.

TABLE 3 Mechanical Property Requirements

Alloy	Condition	Tensile Strength		Yield Strength		Elongation, min%
		ksi	MPa	ksi	MPA	
N06600	Annealed	85	585	35	240	30
N06625	Grade 1 (annealed)	120	827	60	414	30
N06625	Grade 2 (solution annealed)	110	758	50	345	30
N06690	Annealed	85	585	35	240	30
N07718	Solution annealed + precipitation hardened	185	1275	150	1034	12
N08367	Solution annealed	95	655	45	310	30

7.3 *Density*—The density shall be determined for one sample from each production lot. The sample shall be suspended from a scale and weighed in air and water using Archimede's principle. The equipment used shall have accuracy sufficient for the test. The measured value shall not be less than 0.3047 lb/in.^{3} (8.452 gm/cm^3) for UNS N06625, ~~0.2904~~ 0.2904 lb ~~lb/in.~~/in.^{3} ~~(8.055~~ (8.055 gm ~~gm/cm~~/cm^3) for UNS N08367, ~~0.3029~~ 0.3029 lb ~~lb/in.~~/in.^{3} ~~(8.385~~ (8.385 gm ~~gm/cm~~/cm^3) for UNS N06600, ~~0.2930~~ 0.2930 lb ~~lb/in.~~/in.^{3}) (8.111 gm/cm^3) for UNS N06690, and 0.2940 lb/in.^{3} (8.139 gm/cm^3) for UNS N07718. (See Note 1.)

NOTE 1—The density is a function of alloy variations. Because of this, density differences may be the result of either alloy content or differences in micro-porosity.

8. Dimensions and Permissible Variations

8.1 The parts shall conform to the sizes and shapes specified by the purchaser.

9. Workmanship, Finish, and Appearance

9.1 The parts shall be uniform in quality and condition, and shall be free from injurious imperfections.

10. Sampling

10.1 *Lot*—A lot is defined as follows:

10.1.1 A lot for chemical analysis shall consist of one powder blend.

10.1.2 A lot for mechanical properties shall consist of finished parts with the same dimensions made from the same powder blend consolidated in the same hot isostatic press using the same pressure, temperature, and time parameters and heat-treated in the same final heat-treatment charge.