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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) 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) 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).

1.1.1.2 Grade 2 (solution annealed)—Material is normally employed in service temperatures above 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.

1.7 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 and health practices, and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E8 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

[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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[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.

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

2.3 *ASME/ANSI Standard:*[4]
ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings

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.

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 (UNS N06625),
4.1.4 Microstructure examination, if required (5.1.4),
4.1.5 ASTM designation and year of issue,
4.1.6 Inspection (14.1),
4.1.7 Whether rough part or finish machined (7.2.2),
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 When specified on the order, a section of the compact may be sectioned and the microstructure examined to show porosity and other internal imperfections. This is usually performed on the fill pin. In such cases, the section location and the question of acceptable and unacceptable microstructure shall be agreed upon by the manufacturer and the purchaser.

5.2 *Heat Treatment:*

5.2.1 Alloy N06625 shall be supplied in either:

5.2.1.1 *Grade 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) minimum.

or

5.2.1.2 *Grade 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 1800°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 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) 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) 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 (924 to 1010°C) hold ½ h minimum, cool at rate equivalent to air cool or faster. The precipitation hardening treatment is 1325 ± 25°F (718 ± 14°C). Hold at temperature for 8 h, furnace cool to 1150 ± 25°F (621 ± 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

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

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	balance[A]	6.0 to 10.0	7.0 to 11.0	remainder[A]
Cobalt (when specified)	1.00 max	...	...	...	1.0 max
Columbium (Nb)	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) + tantalum.

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	...	...	...	...
Columbium (Nb)	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

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	6
N08367	Solution annealed	95	655	45	310	30

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.

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 lb/in.^{3} (8.055 gm/cm^3) for UNS N08367, 0.3029 lb/in.^{3} (8.385 gm/cm^3) for UNS N06600, 0.2930 lb/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.

7.4 *Microstructure Examination*—Examinations shall show sound and reasonably uniform material, free from injurious porosity, voids, laps, cracks, segregations, and similar objectionable defects. The etching can be performed after the

consolidation or final heat treatment. If the sample fails to meet the requirements of this section, all parts from that compact shall be rejected.

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.

10.1.3 A lot for density shall be all parts from the same compact.

10.2 *Test Material Selection:*

10.2.1 *Chemical Analysis*—Representative samples shall be taken after powder blending or during subsequent processing.

10.2.1.1 *Check Analysis* shall be wholly the responsibility of the purchaser.

10.2.2 *Mechanical Properties*—Test specimens shall be taken from compacts in the final heat-treated condition from locations in that lot in order to be representative of that lot.

10.2.3 *Density*—Test specimens shall be taken from the fill pin of each compact after consolidation or after final heat-treatment.

11. Number of Tests

11.1 *Chemical Analysis*—One test per lot.

11.2 *Mechanical Properties*—One test per lot.

11.3 *Density*—One test per lot.

12. Specimen Preparation

12.1 The tension test specimens taken from the compact shall be machined to the form and dimensions of the standard 2-in. (50.8-mm) gage length tension test specimen shown in Fig. 8 of Test Methods E8, except as specified in 12.2.

12.2 In the case of small sections from which a standard test specimen (specified in 12.1) cannot be taken, the tension test specimen shall be as large as feasible and its dimensions shall be proportional to those shown in Fig. 8 of Test Methods E8. The gage length for measuring elongation shall be four times the diameter of the specimen.

12.3 For the purpose of tests, extra compacts or test bars shall be provided as necessary. The test specimen, if cut from a flange, shall be cut tangentially from the flange portion approximately midway between the inner and outer surfaces and approximately midway between the front and back faces. Test bar compacts made separately must be processed in the same manner as the parts.

13. Test Methods

13.1 The chemical composition and mechanical properties of the material as enumerated in this specification shall, in the case of disagreement, be determined in accordance with the following test methods:

Test	ASTM Test Methods
Chemical analysis	E1473
Tension	E8

14. Inspection

14.1 If specified, source inspection of the material by the purchaser at the manufacturer's plant shall be made as agreed upon between the manufacturer and the purchaser as part of the purchase contract.

15. Rejection and Rehearing

15.1 Material tested by the purchaser that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

16. Certification

16.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser stating that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet its requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

17. Product Marking

17.1 Identification marks consisting of the manufacturer's symbol or name, designation of service rating, specification number, grade of material, condition and size shall be stamped legibly on each part in accordance with MSS SP-25, and in such position as not to injure the usefulness of the part.

18. Keywords

18.1 compact; iron-nickel-chromium-molybdenum; nickel-chromium-iron; nickel-chromium-iron-columbium-molybdenum; nickel-chromium-molybdenum-columbium; powder parts; pressure consolidated powder metallurgy; UNS N06600; UNS N06625; UNS N06690; UNS N07718; UNS N08367

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall be applied when specified by the purchaser in the inquiry, contract, or order.

S1. Corrosion Tests

S1.1 UNS N06625 shall be tested in accordance with Test Methods G28 and UNS N08367 in accordance with Test Methods G48. Acceptance criteria shall be a matter of agreement between the manufacturer and purchaser.

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B834–13) that may impact the use of this standard. (Approved October 1, 2015.)

(1) Alloys UNS N06600, UNS N06690, and UNS N07718 were added throughout.