Designation: B546 – 19

Standard Specification for Electric Fusion-Welded Ni-Cr-Co-Mo Alloy, Ni-Fe-Cr-Si Alloy, Ni-Cr-Fe-Al Alloy, Ni-Cr-Fe Alloy, and Ni-Cr-Fe-Si Alloy Pipe[1]

This standard is issued under the fixed designation B546; 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 electric fusion-welded nickel-chromium-cobalt-molybdenum alloy UNS N06617, nickel-iron-chromium-silicon alloys UNS N08330 and UNS N08332, Ni-Cr-Fe-Al Alloy (UNS N06603), Ni-Cr-Fe Alloy UNS N06025, and Ni-Cr-Fe-Si Alloy UNS N06045 pipe intended for heat resisting applications and general corrosive service.

1.2 This specification covers pipe in sizes 3 in. (76.2 mm) nominal diameter and larger and possessing a minimum wall thickness of 0.083 in. (2.11 mm).

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 Material Safety Data Sheet (MSDS) 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:*[2]

B168 Specification for Nickel-Chromium-Aluminum Alloys (UNS N06699), Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, N06045, and N06696), Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617), Nickel-Iron-Chromium-Tungsten Alloy (UNS N06674), and

B536 Specification for Nickel-Iron-Chromium-Silicon Alloys Plate, Sheet, and Strip

B775 Specification for General Requirements for Nickel and Nickel Alloy Welded Pipe

B899 Terminology Relating to Non-ferrous Metals and Alloys

E10 Test Method for Brinell Hardness 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

2.2 *ASME Standards:*[3]

Boiler and Pressure Vessel Code, Section VIII Paragraph UW-51

Boiler and Pressure Vessel Code, Section IX

3. Terminology

3.1 *Definitions*—Definitions for terms defined in Terminology B899 shall apply unless otherwise defined by the requirements of this document.

4. General Requirement

4.1 Material furnished in accordance with this specification shall conform to the applicable requirements of the current edition of Specification B775 unless otherwise provided herein.

5. Classification

5.1 Two classes of pipe are covered as follows:

[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 Nov. 1, 2019. Published December 2019. Originally approved in 1971. Last previous edition approved in 2014 as B546 – 04 (2014). DOI: 10.1520/B0546-19.

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

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

5.1.1 *Class 1*—All welded joints to be 100 % inspected by radiography.

5.1.2 *Class 2*—No radiographic examination is required.

6. Ordering Information

6.1 It is the responsibility of the purchaser to specify all requirements that are necessary for the safe and satisfactory performance of material ordered under this specification. Examples of such requirements include, but are not limited to, the following:

6.1.1 Alloy (Table 1),

6.1.2 ASTM designation and year of issue,

6.1.3 Class (see 5.1),

6.1.4 Dimensions (standard pipe size and schedule),

6.1.5 Length (specific or random),

6.1.6 Quantity (feet or number of pieces),

6.1.7 Whether type of filler metal and deposited composition is required (see 8.3),

6.1.8 *Samples for Product (Check) Analysis*—State whether samples for product (check) analysis should be furnished, and

6.1.9 *Purchaser Inspection*—If purchaser wishes to witness tests or inspection of material at place of manufacture, the purchase order must so state indicating which tests or inspections are to be witnessed.

7. Materials and Manufacture

7.1 *Materials*—The UNS N08330 and UNS N08332 alloy plate material shall conform to the requirements of Specification B536. The UNS N06617, UNS N06603, UNS N06025, and UNS N06045 alloy plate material shall conform to the requirements of Specification B168.

7.2 *Welding:*

7.2.1 The joints shall be double-welded, full-penetration welds made by qualified operators in accordance with procedures in the ASME Boiler and Pressure Vessel Code, Section IX.

7.2.2 The weld shall be made either manually or automatically by an electric process involving the deposition of filler metal.

7.2.3 The joint shall be reinforced at the center of the weld on each side of the formed plate by a weld bead at least 1/16 in. (1.6 mm) but not more than 1/8 in. (3.2 mm). This reinforcement (weld bead) may be removed at the manufacturer's option or by agreement between the manufacturer and the purchaser. The contour of the reinforcement (weld bead) shall be smooth, with no valley or groove along the edge or in the center of the weld, and the deposited metal shall be fused smoothly and uniformly into the formed-plate surface. The finish of the welded joint shall be reasonably smooth and free of irregularities, grooves, or depressions.

7.2.4 Weld defects shall be repaired by removal to sound metal and rewelding. Subsequent heat treatment and inspection shall be as required on the original welds.

7.3 *Heat Treatment*—All pipe shall be furnished in the annealed condition.

7.4 *Surface Finish*—The pipe shall be free from scale. When bright annealing is used, descaling is not necessary.

8. Chemical Composition

8.1 The material shall conform to the composition limits specified in Table 1. One test is required for each lot as defined in Specification B775.

8.2 If a product analysis is performed, it shall meet the chemistry limits prescribed in Table 1, subject to the analysis tolerances specified in Table 1 of Specification B775.

8.3 The chromium and nickel content of the deposited weld metal shall conform to the minimum chromium and nickel contents required for the base metal. Note that the composition of the deposited weld metal may not be the same as the base metal. The user should establish suitability for his particular application. When specified in the purchase order (see 6.1.7),

TABLE 1 Chemical Requirements

Element	Composition Limits, %					
	N08330	N08332	N06603	N06617	N06025	N06045
Carbon	0.08 max	0.05–0.10	0.20–0.40	0.05–0.15	0.15–0.25	0.05–0.12
Manganese	2.00 max	2.00 max	0.15 max	1.0 max	0.15 max	1.0 max
Phosphorus	0.03 max	0.03 max	0.20 max	...	0.02 max	0.02 max
Sulfur	0.03 max	0.03 max	0.10 max	0.015 max	0.010 max	0.010 max
Silicon	0.75–1.50	0.75–1.50	0.50 max	1.0 max	0.5 max	2.5–3.0
Chromium	17.0–20.0	17.0–20.0	0.24–0.26	20.0–24.0	24.0–26.0	26.0–29.0
Nickel	34.0–37.0	34.0–37.0	Bal	remainder	Bal	45.0 min
Copper	1.00 max	1.00 max	0.50 max	0.5 max	0.1 max	0.3 max
Lead	0.005 max	0.005 max	...	...	...	...
Tin	0.025 max	0.025 max	...	...	...	...
Iron	remainder[A]	remainder	8.0–11.0	3.0 max	8.0–11.0	21.0–25.0
Aluminum	...	...	2.4–3.0	0.8–1.5	1.8–2.4	...
Cobalt	...	...	...	10.0–15.0	...	...
Molybdenum	...	...	...	8.0–10.0	...	...
Zirconium	...	...	0.01–0.10	...	0.01–0.10	...
Yttrium	...	...	0.01–0.15	...	0.05–0.12	...
Cerium	...	...	...	...	...	0.3–0.09
Titanium	...	...	0.010–0.025	...	...	...

[A] Element shall be determined arithmetically by difference.