Designation: ~~B775 – 13~~ B775 – 15

Standard Specification for General Requirements for Nickel and Nickel Alloy Welded Pipe[1]

This standard is issued under the fixed designation B775; 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 contains various requirements that, with the exception of Section 5 and Section 10, are mandatory requirements to the following ASTM nickel and nickel alloy, longitudinally welded piping specifications:[2]

Title of Specification	ASTM Designation[2]
~~Welded UNS N08020, N08024, and N08026 Alloy Pipe~~	~~B464~~
Welded UNS N08020, N08024, and N08026 Alloy Pipe	B464/B464M
Welded Nickel-Iron-Chromium Alloy Pipe	B514
Welded Nickel-Chromium-Iron-Alloy (UNS N06600, UNS N06603, UNS N06025 and UNS N06045) Pipe	B517
~~Welded Nickel and Nickel-Cobalt Alloy Pipe~~	~~B619~~
Welded Nickel and Nickel-Cobalt Alloy Pipe	B619/B619M
UNS N08904, UNS N08925, and UNS N08926 Welded Pipe	B673
UNS N08367 Welded Pipe	B675
Nickel-Alloy (UNS N06625, N06219, and N08825) Welded Pipe	B705
Ni-Cr-Mo-Co-W-Fe-Si Alloy (UNS N06333) Welded Pipe	B723
Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Pipe	B725

1.2 One or more of the test requirements of Section 5 apply only if specifically stated in the product specification or in the purchase order.

1.3 In case of conflict between a requirement of the product specification and a requirement of this general specification, only the requirement of the product specification needs to be satisfied.

1.4 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.

1.5 *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)~~(SDS) 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:*[2]

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

~~B464~~B464/B464M Specification for Welded UNS N08020 Alloy Pipe

B514 Specification for Welded Nickel-Iron-Chromium Alloy Pipe

B517 Specification for Welded Nickel-Chromium-Iron-Alloy (UNS N06600, UNS N06603, UNS N06025, and UNS N06045) Pipe

[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~~standard's Document Summary page on the ASTM website.

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

B619B619/B619M Specification for Welded Nickel and Nickel-Cobalt Alloy Pipe
B673 Specification for UNS N08925, UNS N08354, and UNS N08926 Welded Pipe
B675 Specification for UNS N08367 Welded Pipe
B705 Specification for Nickel-Alloy (UNS N06625, N06219 and N08825) Welded Pipe
B723 Specification for Nickel-Chromium-Molybdenum-Cobalt-Tungsten-Iron-Silicon Alloy (UNS N06333) Welded Pipe
B725 Specification for Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Pipe
B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys
E8 Test Methods for Tension Testing of Metallic Materials
E18 Test Methods for Rockwell Hardness of Metallic Materials
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E39 Methods for Chemical Analysis of Nickel (Withdrawn 1995)[3]
E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)[3]
E112 Test Methods for Determining Average Grain Size
E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing
E426 Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Titanium, Austenitic Stainless Steel and Similar Alloys
E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)
E571 Practice for Electromagnetic (Eddy-Current) Examination of Nickel and Nickel Alloy Tubular Products
E1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys

2.2 *ANSI Standards:*[4]
B1.20.1 Pipe Threads
B36.10 Welded and Seamless Wrought Steel Pipe
B36.19 Stainless Steel Pipe

2.3 *Other Documents:*[5]
ASME Boiler and Pressure Vessel Code Section IX – Welding and Brazing Qualifications

2.4 *SAE:*[6]
SAE J 1086 Practice for Numbering Metals and Alloys (UNS)

3. Terminology

3.1 *Definitions:*

3.1.1 *average diameter, n*—the average of the maximum and minimum outside diameters, as determined at any one cross section of the pipe.

3.1.2 *nominal wall, n*—a specified wall thickness with a plus or minus tolerance from the specified thickness.

3.1.3 *welded pipe, n*—a round hollow produced by forming flat stock and joining the single longitudinal seam by welding, and produced to the particular dimensions commercially known as pipe sizes (NPS).

4. Chemical Composition

4.1 In case of disagreement, the chemical composition shall be determined in accordance with the following methods:

UNS No. Prefixes	ASTM Method
N02	E39
N04	E76
N06, N08	E1473

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N02	E39
N04	E76
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4.2 The ladle analysis of the material shall conform to the chemical requirements prescribed by the individual product specification.

4.3 The product (check) analysis of the material shall meet the requirements for the ladle analysis within the tolerance limits prescribed in Specification B880.

5. Test Requirements

5.1 *Flattening Test:*

[3] The last approved version of this historical standard is referenced on www.astm.org.
[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.
[6] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, http://www.sae.org.

5.1.1 A length of pipe not less than 4 in. (102 mm), shall be flattened under a load applied gradually at room temperature until the distance between the platens is five times the wall thickness. The weld shall be positioned 90° from the direction of the applied flattening force.

5.1.2 The flattened specimen shall not exhibit cracks.

5.1.3 Superficial ruptures resulting from surface imperfections shall not be a cause for rejection.

5.2 *Transverse Guided-Bend Weld Test:*

5.2.1 For welded pipe made either with or without the addition of filler and at the option of the manufacturer, the transverse guided bend weld test may be substituted in lieu of the flattening test. Two bend test specimens shall be taken transversely from pipe or the test specimens may be taken from a test plate of the same material and heat as the pipe, which is attached to the end of the cylinder and welded as a prolongation of the pipe longitudinal seam. Except as provided in 5.2.2, one shall be subject to a face guided bend test and a second to a root guided bend test. One specimen shall be bent with the inside surface of the pipe against the plunger and the other with the outside surface of the pipe against the plunger. Guided bend test specimens shall be prepared and tested in accordance with Section IX, Part QW, Paragraph QW 160 of the ASME Boiler and Pressure Vessel Code and shall be one of the types shown in QW 463.1 of that code.

5.2.2 For wall thicknesses over ⅜ in. (9.5 mm) but less than ¾ in. (19 mm) side bend tests may be made instead of the face and root bend tests. For specified wall thicknesses ¾ in. and over, both specimens shall be subjected to the side bend tests. Side bend specimens shall be bent so that one of the side surfaces becomes the convex surface of the bend specimen.

5.2.3 The bend test shall be acceptable if no cracks or other defects exceeding ⅛ in. (3 mm) in any direction be present in the weld metal or between the weld and the pipe or plate metal after bending. Cracks which originate along the edges of the specimen during testing, and that are less than ¼ in. (6.5 mm) measured in any direction shall not be considered.

5.3 *Pressure (Leak Test):*

5.3.1 *Hydrostatic*—Each pipe shall be tested by the manufacturer to a minimum internal hydrostatic pressure of 1000 psi (6.9 MPa) provided that the fiber stress, calculated from the following equation, does not exceed the allowable fiber stress for the material:

$$P = 2St/D \quad (1)$$

where:

P = hydrostatic test pressure, psi (MPa),
S = allowable fiber stress, for material in the condition (temper) furnished as specified in the product specification (S is calculated as the lower of ⅔ of the specified minimum 0.2 % offset yield strength or ¼ of the specified minimum ultimate strength for the material),
t = minimum wall thickness permitted, in. (mm), including minus tolerance, if any, and
D = nominal outside diameter of the pipe, in. (mm).

5.3.1.1 The test pressure shall be held for a sufficient time to permit the entire length of the welded seam to be inspected.

5.3.2 *Pneumatic (Air Underwater Test)*—Each pipe shall be tested at a pressure of 150 psi (1.05 MPa). The test pressure shall be held for a minimum of 5 s. Visual examination is to be made when the material is submerged and under pressure. The full length of pipe must be examined for leaks.

5.3.3 If any pipe shows leaks during hydrostatic or pneumatic testing, it shall be rejected.

5.4 *Nondestructive Electric Test:*

5.4.1 *Eddy Current Testing*—Testing shall be conducted in accordance with Practices E426 or E571. The eddy current examination reference in this specification has the capability of detecting significant discontinuities, especially of the short, abrupt type.

5.4.1.1 Unless otherwise specified by the purchaser, the calibration standard shall contain, at the option of the manufacturer, any one of the following discontinuities to establish a minimum sensitivity level for rejection. The discontinuity shall be placed in the weld if visible.

5.4.1.2 *Drill Hole*—A hole not larger than 0.031 in. (0.79 mm) diameter shall be drilled radially and completely through the wall, care being taken to avoid distortion of the material while drilling.

5.4.1.3 *Transverse Tangential Notch*—Using a round file or tool with a ¼ in. (6 mm) diameter, a notch shall be filed or milled on the pipe outside diameter tangential to the surface and transverse to the longitudinal axis of the material. Said notch shall have a depth not exceeding 12.5 % of the specified wall thickness of the material, or 0.004 in. (0.10 mm), whichever is greater.

5.4.2 *Ultrasonic Testing*—Testing shall be conducted in accordance with Practice E213. The ultrasonic examination referred to in this specification is intended to detect longitudinal discontinuities having a reflective area similar to or larger than the calibration reference notches specified in 5.4.2.1. The examination may not detect circumferentially oriented imperfections or short, deep defects.

5.4.2.1 For ultrasonic testing, longitudinal calibration notches shall be machined on the outside and inside diameter surfaces. The depth of the notches shall not exceed 12.5 % of the specified wall thickness or 0.004 in. (0.10 mm), whichever is greater. The notch shall be placed in the weld, if visible.

5.4.3 *Calibration Frequency*—The frequency of calibration checks shall be as follows:
5.4.3.1 At the beginning of each production run.
5.4.3.2 At least every four hours during testing.
5.4.3.3 At the end of each production run.
5.4.3.4 After any suspected equipment malfunction or work stoppage.
5.4.3.5 If, during any check, the equipment fails to detect the calibration defects, the instrument must be recalibrated and all material tested since the last satisfactory check shall be retested.
5.4.4 *Acceptance and Rejection*—Material producing a signal equal to or greater than the calibration defect shall be subject to rejection.
5.4.4.1 Test signals that are produced by imperfections that cannot be identified or that are produced by cracks or crack-like imperfections shall result in rejection of the pipe, subject to rework and retest.
5.4.4.2 If the imperfection is judged as not fit for use, the tube shall be rejected, but may be reconditioned and retested providing the wall thickness requirements are met. To be accepted, retested material shall meet the original electric test requirements.
5.4.4.3 If the imperfection is explored to the extent that it can be identified, and the pipe is determined to be fit for use, the material may be accepted without further testing providing the imperfection does not encroach on minimum wall thickness requirements.

5.5 *Tension Test*—Tension testing shall be conducted in accordance with Test Methods E8.
5.5.1 The material shall conform to the tensile properties prescribed in the individual product specification.

5.6 *Hardness Test*—Hardness testing shall be conducted in accordance with Test Methods E18.

5.7 *Grain Size*—The measurement of average grain size may be carried out by the planimetric method, the comparison method, or the intercept method described in Test Methods E112. In case of dispute, the "referee" method for determining average grain size shall be the intercept method.

5.8 For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed value or a calculated value shall be rounded in accordance with the rounding method of Practice E29:

~~Requirements~~ Requirements	~~Rounded Unit for Observed or Calculated Value~~ Rounded Unit for Observed or Calculated Value
Chemical composition and tolerances	nearest unit in the last right-hand place of figures of the specified limit
Tensile strength and yield strength	nearest 1000 psi (7 MPa)
Elongation	nearest 1 %

6. Dimensions and Permissible Variations

6.1 Dimensions of pipe are shown in Table 1.
6.1.1 Permissible variations in outside diameter and wall thickness are shown in Table 2.

6.2 *Length*—When material is ordered as cut-to-length, the length shall conform to the permissible variations prescribed in Table 3. When material is ordered to random lengths, the lengths and variations shall be agreed upon between the manufacturer and purchaser.

6.3 *Straightness*—Material shall be reasonably straight and free of bends and kinks.

6.4 *Ends*—Ends shall be reasonably square and free from burrs.

7. Workmanship, Finish, and Appearance

7.1 The material shall be uniform in quality and temper, smooth, and free from imperfections that would render it unfit for use.

8. Sampling

8.1 *Lot Definition:*
8.1.1 A lot for chemical analysis shall consist of one heat.
8.1.2 A lot for all other testing shall consist of all material from the same heat, nominal size (excepting length), and condition (temper). When final heat treatment is in a batch-type furnace, a lot shall include only those pipes of the same size and the same heat that are heat-treated in the same furnace charge. When heat treatment is in a continuous furnace, a lot shall include all pipe of the same size and heat, heat-treated in the same furnace at the same temperature, time at temperature, and furnace speed during one production run. At no time shall a lot consist of more than 20 000 lb (9070 kg).
8.1.2.1 Where material cannot be identified by heat, a lot shall consist of not more than 500 lb (227 kg) of material of the same alloy in the same condition (temper) and nominal size (excepting length).

NOTE 1—For tension, hardness and flattening test requirements, the term lot applies to all lengths prior to cutting.