



Designation: B725 – 22

# Standard Specification for Welded Nickel and Nickel Copper Alloy Pipe<sup>1</sup>

This standard is issued under the fixed designation B725; 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.

## 1. Scope\*

1.1 This specification covers nickel (UNS N02200), low carbon nickel (UNS N02201) and nickel copper alloy (UNS N04400) in the form of welded and annealed or welded and stress relieved pipe intended for general corrosive service and for mechanical applications.

1.2 This specification covers outside diameter and nominal wall pipe in Schedules 5S, 10S, and 40S through 30-in. nominal pipe size shown in ANSI B36.19 (see [Table 1](#)) and Specification [B775](#) (see [Table 1](#)). Pipe having other dimensions may be furnished provided such pipe complies with all other requirements of this specification.

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 The following precautionary caveat pertains only to the test methods portion, Section [13](#), of this specification: *This standard does not purport to address all of the safety problems, 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.*

1.5 *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.*

<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.

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## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

[B775 Specification for General Requirements for Nickel and Nickel Alloy Welded Pipe](#)

[E8/E8M Test Methods for Tension Testing 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)<sup>3</sup>

[E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing](#)

[E571 Practice for Electromagnetic \(Eddy-Current\) Examination of Nickel and Nickel Alloy Tubular Products](#)

2.2 *ANSI Standards*:<sup>4</sup>

[B 1.20.1 Pipe Threads](#)

[B 36.10 Welded and Seamless Wrought Steel Pipe](#)

[B 36.19 Stainless Steel Pipe](#)

2.3 *ASME Boiler and Pressure Vessel Code*:<sup>5</sup>  
[Section IX Welding and Brazing Qualifications](#)

## 3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Alloy name or UNS number,

3.1.2 ASTM designation and date of issue,

3.1.3 Condition (temper) ([Table 2](#)),

3.1.4 *Dimensions*:

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>5</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

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

**TABLE 1 Dimensions of Welded Pipe**

NOTE 1—The following table is a partial reprint of Table 1 of ANSI B36.19.

NOTE 2—The decimal thicknesses listed for the respective pipe size represent their nominal wall dimensions.

Nominal Pipe Size, in.	Outside Diameter		Nominal Wall Thickness							
			Schedule 5S <sup>A</sup>		Schedule 10S <sup>A</sup>		Schedule 40S		Schedule 80S	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
1/8	0.405	10.29	...	...	0.049	1.245	0.068	1.727	0.095	2.41
1/4	0.540	13.72	...	...	0.065	1.651	0.088	2.235	0.119	3.02
3/8	0.675	17.15	...	...	0.065	1.651	0.091	2.311	0.126	3.20
1/2	0.840	21.34	0.065	1.651	0.083	2.108	0.109	2.768	0.147	3.73
3/4	1.050	26.67	0.065	1.651	0.083	2.108	0.113	2.870	0.154	3.91
1	1.315	33.40	0.065	1.651	0.109	2.768	0.133	3.378	0.179	4.55
1 1/4	1.660	42.16	0.065	1.651	0.109	2.768	0.140	3.556	0.191	4.85
1 1/2	1.900	48.26	0.065	1.651	0.109	2.768	0.145	3.683	0.200	5.08
2	2.375	60.33	0.065	1.651	0.109	2.768	0.154	3.912	0.218	5.54
2 1/2	2.875	73.03	0.083	2.108	0.120	3.048	0.203	5.156	0.276	7.01
3	3.500	88.90	0.083	2.108	0.120	3.048	0.216	5.486	0.300	7.62
3 1/2	4.000	101.6	0.083	2.108	0.120	3.048	0.226	5.740	0.318	8.08
4	4.500	114.3	0.083	2.108	0.120	3.048	0.237	6.020	0.337	8.56
5	5.563	141.30	0.109	2.77	0.134	3.40	0.258	6.55	0.375	9.52
6	6.625	168.28	0.109	2.77	0.134	3.40	0.280	7.11	0.432	10.97
8	8.625	219.08	0.109	2.77	0.148	3.76	0.322	8.18	0.500	12.70
10	10.750	273.05	0.134	3.40	0.165	4.19	0.365	9.27	0.500 <sup>B</sup>	12.70 <sup>B</sup>
12	12.750	323.85	0.156	3.96	0.180	4.57	0.375 <sup>B</sup>	9.52 <sup>B</sup>	0.500 <sup>B</sup>	12.70 <sup>B</sup>
14	14.000	355.60	0.156	3.96	0.188 <sup>B</sup>	4.78 <sup>B</sup>	...	...	...	...
16	16.000	406.40	0.165	4.19	0.188 <sup>B</sup>	4.78 <sup>B</sup>	...	...	...	...
18	18.000	457.20	0.165	4.19	0.188 <sup>B</sup>	4.78 <sup>B</sup>	...	...	...	...
20	20.000	508.00	0.188	4.78	0.218 <sup>B</sup>	5.54 <sup>B</sup>	...	...	...	...
22	22.000	558.80	0.188	4.78	0.218 <sup>B</sup>	5.54 <sup>B</sup>	...	...	...	...
24	24.000	609.60	0.218	5.54	0.250	6.35	...	...	...	...
30	30.000	762.00	0.250	6.35	0.312	7.92	...	...	...	...

<sup>A</sup> Schedules 5S and 10S wall thicknesses do not permit threading in accordance with ANSI B1.20.1.

<sup>B</sup> These do not conform to ANSI B36.10.

**TABLE 2 Mechanical Properties of Pipe and Tube**

Condition and Size	Tensile Strength, min, psi (MPa)			Yield Strength (0.2 % offset), min, psi (MPa)			Elongation in 2 in. or 50 mm (or 4D), min, %		
	Nickel	Low-Carbon Nickel	UNS N04400	Nickel	Low-Carbon Nickel	UNS N04400	Nickel	Low-Carbon Nickel	UNS N04400
Annealed									
5 in. (127 mm) and under outside diameter	55 000 (380)	50 000 (345)	70 000 (480)	15 000 (105)	12 000 (80)	28 000 (195)	35	35	35
Over 5 in. (127 mm) in outside diameter	55 000 (380)	50 000 (345)	70 000 (480)	12 000 (80)	10 000 (70)	25 000 (170)	40	40	35
Stress-relieved									
All sizes	65 000 (450)	60 000 (415)	85 000 (585)	40 000 (275)	30 000 (205)	55 000 (380)	15	15	15

3.1.4.1 Nominal pipe size or outside diameter and schedule number or nominal wall thickness (**Table 1**),

3.1.4.2 Length (specific or random),

3.1.5 *Quantity*—Feet or metres, or number of pieces,

3.1.6 *Certification*—State if certification is required (**Section 16**),

3.1.7 *Samples for Product (Check) Analysis*—State whether samples for product (check) analysis should be furnished (**10.2**),

3.1.8 *Purchaser Inspection*—If the purchaser wishes to witness tests or inspection of material at the place of manufacture, the purchase order must so state indicating which tests or inspections are to be witnessed (**Section 14**),

3.1.9 *Nondestructive Tests (see 7.4)*—Specify either Test Category 1 or 2. If Test Category 1 is required, specify if either a hydrostatic, eddy-current or ultrasonic test is to apply. If Test Category 2 is required, specify if either an eddy-current or ultrasonic test is to apply. See **Section S1**.

**TABLE 3 Chemical Requirements**

Element	Composition, %			Product (Check) Analysis Variations, under min or over max, of the Specified Limit of Element
	Nickel (UNS N02200)	Low-Carbon Nickel (UNS N02201)	Nickel-Copper (UNS N04400)	
Nickel, min	99.0	99.0	63.0	0.60
Copper, max	0.25	0.25	28.0–34.0	0.03
Iron, max	0.40	0.40	2.5	0.03
Manganese, max	0.35	0.35	2.0	0.03
Carbon, max	0.15	...	0.3	0.01
Carbon, max	...	0.02	...	0.005
Silicon, max	0.35	0.35	0.5	0.03
Sulfur, max	0.01	0.01	0.024	0.003

3.1.10 Supplementary requirements.

#### 4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of Specification **B775** unless otherwise provided herein.

#### 5. Materials and Manufacture

5.1 Pipe shall be made from flat-rolled alloy by an automatic welding process with no addition of filler metal. Subsequent to welding and prior to final heat treatment, the pipe shall be cold worked to assure that optimum corrosion resistance in the weld area and base metal will be developed during heat treatment.

5.2 Pipe shall be furnished with a scale free finish. When bright annealing is used, descaling is not necessary.

#### 6. Chemical Composition

6.1 The material shall conform to the requirements as to chemical composition prescribed in **Table 3**.

6.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations in **Table 3**.

#### 7. Mechanical Properties and Other Requirements

7.1 *Mechanical Properties*—The material shall conform to the requirements for mechanical properties prescribed in **Table 2**.

7.2 *Flattening Test Requirements*—Flattening test specimens made in accordance with **13.3** shall show no cracks or breaks on the inside, outside, or end surfaces.

7.3 *Transverse Guided Bend Test*—See **13.6.3** for acceptance criteria.

##### 7.4 *Nondestructive Tests:*

7.4.1 Pipe shall be subjected to the nondestructive tests outlined in the following test categories.

7.4.1.1 *Category 1*—Hydrostatic, eddy-current, or ultrasonic test at the manufacturer's option unless the purchaser specifies in accordance with **3.1.9**.

7.4.1.2 *Category 2*—Hydrostatic plus eddy-current or ultrasonic test at the manufacturer's option unless the purchaser specifies in accordance with **3.1.9**.

7.4.1.3 The manufacturer shall have the option to use Test Category 1 or 2 if the purchaser does not specify the test category options in accordance with **3.1.9**.

7.4.2 *Hydrostatic Test*—When tested in accordance with the requirements of **13.4**, any pipe that leaks shall be rejected. Any leaking area may be cut out and the pipe retested.

7.4.3 *Acceptance and Rejection*—Pipe producing a signal equal to or greater than the calibration imperfection shall be subject to rejection.

7.4.3.1 Test signals produced by imperfections that cannot be identified or produced by cracks or crack-like imperfections shall result in rejection of the pipe subject to rework and retest. To be accepted, the pipe must pass the same electric test to which it was originally subjected provided that the dimensional requirements are met.

7.4.3.2 If the imperfection is judged as injurious, the pipe shall be rejected but may be reconditioned and retested providing the dimensional requirements are met. To be accepted, retested pipe shall meet the original electric test requirements.

7.4.3.3 If the imperfection is explored to the extent that it can be identified as noninjurious, the pipe may be accepted without further test, providing the imperfection does not encroach on the minimum wall thickness.

#### 8. Dimensions and Permissible Variations

8.1 The outside diameter shall not exceed the permissible variations prescribed in **Table 4**.

8.1.1 Pipe having a specified wall thickness that is 3 % or less of the outside diameter cannot be straightened properly without a certain amount of ovality resulting in the diameter. The limits to this ovality are stated in Footnote B of **Table 4**.

8.2 The wall thickness shall not vary from nominal by more than  $\pm 12\frac{1}{2}$  %.

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

8.4 *Length*—Variations from the specified length shall not exceed the amounts prescribed in **Table 5**.

#### 9. Workmanship, Finish, and Appearance

9.1 The material shall be uniform in quality and temper, smooth, commercially straight, and free of injurious imperfections.

**TABLE 4 Permissible Variations in Outside Diameter<sup>A,B</sup>**

NPS Designator	Permissible Variations in Outside Diameter			
	Over		Under	
	in.	mm	in.	mm
1/8 to 1/2, incl	1/64 (0.015)	0.4	1/32 (0.031)	0.8
Over 1/2 to 4, incl	1/32 (0.031)	0.8	1/32 (0.031)	0.8
Over 4 to 8, incl	1/16 (0.062)	1.6	1/32 (0.031)	0.8
Over 8 to 18, incl	3/32 (0.093)	2.4	1/32 (0.031)	0.8
Over 18 to 26, incl	1/8 (0.125)	3.2	1/32 (0.031)	0.8
Over 26 to 34, incl	5/32 (0.156)	4.0	1/32 (0.031)	0.8
Over 34 to 48, incl	3/16 (0.187)	4.8	1/32 (0.031)	0.8

<sup>A</sup> These permissible variations in outside diameter apply only to material as finished at the mill before subsequent swaging, expanding, bending, polishing, or other fabricating operations.

<sup>B</sup> Ovality is the difference between the maximum and the minimum outside diameter measured at any one cross section. There is no additional tolerance for ovality on material having a nominal wall thickness for more than 3% of the outside diameter. On this material, the average of the maximum and the minimum outside diameter measurements will fall within outside diameter tolerance shown in Table 4. An additional ovality tolerance of twice the outside diameter tolerance spreads shown in Table 4, applied  $\pm 1/2$ , is allowed for material having a nominal wall thickness of 3% or less of the nominal outside diameter.

**TABLE 5 Permissible Variations in Length<sup>A</sup>**

Outside Diameter, in. (mm)	Cut Length, in. (mm)	
	Over	Under
Under 2 (50.8)	1/8 (3.18)	0
2 (50.8) and over	3/16 (4.75)	0

<sup>A</sup> These permissible variations in length apply to pipe before bending. They apply to cut lengths up to and including 24 ft (7.3 m). For lengths over 24 ft, an additional over-tolerance of 1/8 in. (3.18 mm) for each 10 ft (3.0 m) or fraction thereof shall be permissible up to a maximum additional over-tolerance of 1/2 in. (12.7 mm).

## 10. Sampling

### 10.1 Lots of Chemical Analysis and Mechanical Testing.

10.1.1 A lot for chemical analysis shall consist of one heat.

10.1.2 A lot for mechanical properties and flattening or transverse guided bend testing shall consist of all material from the same heat, nominal size (excepting length), and condition (temper).

### 10.2 Test Material Selection.

10.2.1 *Chemical Analysis*—Representative samples shall be taken during pouring or subsequent processing.

10.2.1.1 Product (check) analysis shall be wholly the responsibility of the purchaser.

10.2.2 *Mechanical Properties and Flattening Testing*—Samples of the material to provide test specimens shall be taken from such locations in each lot as to be representative of that lot.

## 11. Number of Tests

11.1 *Chemical Analysis*—One test per lot.

11.2 *Mechanical Properties*—One test per lot.

11.3 *Flattening or Transverse Guided Bend Test*—One test per lot.

11.4 *Nondestructive*—Each piece in each lot.

## 12. Specimen Preparation

12.1 Tension test specimens shall be taken from material in the final condition (temper) and tested in the direction of fabrication.

12.1.1 Whenever possible, all pipe shall be tested in full-tubular size. When testing in full-tubular size is not possible, longitudinal strip specimens shall be used. In the event of disagreement when full-tubular testing is not possible, a longitudinal strip specimen with reduced gauge length in accordance with Test Methods E8/E8M shall be used.

## 13. Test Methods

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

Test	ASTM Designation
Chemical Analysis	E39
Tension	E8/E8M
Rounding procedure	E29

13.2 For purposes of determining compliance with the limits in this specification, an observed value or a calculated value shall be rounded in accordance with the rounding method of Practice E29:

Test	Rounded Unit for Observed or Calculated Value
Chemical composition and tolerances (when expressed in decimals).	nearest unit in the last right-hand place of figures of the specified limit.
Tensile strength and yield strength.	nearest 1000 psi (6.9 MPa)
Elongation	nearest 1%

13.3 *Flattening Test*—Pipe shall be capable of withstanding, without cracking, flattening 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.

13.4 *Hydrostatic Test*—Each pipe shall be tested at a pressure calculated by the following equation:

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

where:

$P$  = hydrostatic test pressure, psi (or MPa),

$t$  = specified wall thickness, in. (or mm),

$D$  = specified outside diameter, in. (or mm), and

$S$  = allowable fiber stress for material in the condition furnished, as follows:

	Nickel	Low Carbon Nickel	Nickel-Copper (Allowable Fiber Stress)
Annealed			
5 in. (127 mm) outside diameter and under	10 000 psi (70 MPa)	8000 psi (55 MPa)	17 500 psi (120 MPa)
Over 5 in. outside diameter	8000 psi (55 MPa)	6700 psi (45 MPa)	16 700 psi (115 MPa)
Stress Relieved:			Nickel-Copper (Allowable Fiber Stress)
All sizes	Nickel 16 200 psi (110 MPa)	Low Carbon Nickel 15 000 psi (105 MPa)	21 200 psi (145 MPa)

13.4.1 The test pressure shall be held for a minimum of 5 s.

13.4.2 Visual examination shall be made when the pipe is under pressure. The full length of the pipe must be examined for leaks. If any pipe shows leaks during the hydrostatic test, it shall be rejected.