



# Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Seamless Pipe and Tube<sup>1</sup>

This standard is issued under the fixed designation B690; 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 iron-nickel-chromium-molybdenum alloys (UNS N08366 and UNS N08367)\* cold-finished annealed or hot-finished annealed seamless pipe and tube intended for use in special corrosive service and for heat-resisting applications.

1.2 Pipe and tube shall be supplied in the solution heat treated and descaled condition. When bright annealing is used, descaling is not necessary.

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 safety hazards caveat pertains only to the test method portion, Section 12, 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 Material Safety Data Sheet (MSDS) 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*:<sup>2</sup>

[A450/A450M Specification for General Requirements for Carbon and Low Alloy Steel Tubes](#)

[B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys](#)

<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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\* New designation established in accordance with ASTM E527 and SAE S1086, Practice for Numbering Metals and Alloys (UNS).

<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.

[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](#)

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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

3.1.2 *pipe, n*—seamless tube conforming to the particular dimensions commercially known as standard pipe ([Appendix X1](#)).

3.1.3 *tube, n*—hollow product of round or any other cross section having a continuous periphery.

## 4. Ordering Information

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

4.1.1 Quantity (feet, metres, or number of lengths),

4.1.2 Form (seamless tube or pipe),

4.1.3 Name of material or UNS number,

4.1.4 Finish,

4.1.5 Dimensions:

4.1.5.1 *Tube*—Outside diameter, minimum wall thickness,

4.1.5.2 *Pipe*—Standard pipe size and schedule ([Appendix X1](#)),

4.1.5.3 *Length*—Specified or random,

4.1.6 Certification, if required (Section 15),

4.1.7 Purchaser's inspection, if required, (Section 13),

4.1.8 ASTM designation and year of issue, and

4.1.9 Samples for product analysis, if required.

## 5. Chemical Composition

5.1 The material shall conform to the composition limits specified in [Table 1](#).

5.2 If a product (check) analysis is made by the purchaser, the material shall conform to the permissible variations for product (check) analysis in Specification [B880](#).



TABLE 1 Chemical Requirements

Element	Composition Limits, %	
	N08366	N08367
Carbon	0.035 max	0.030 max
Manganese	2.00 max	2.00 max
Silicon	1.00 max	1.00 max
Phosphorus	0.040 max	0.040 max
Sulfur	0.030 max	0.030 max
Chromium	20.00 to 22.00	20.00 to 22.00
Nickel	23.50 to 25.50	23.50 to 25.50
Molybdenum	6.00 to 7.00	6.00 to 7.00
Nitrogen	...	0.18 to 0.25
Iron <sup>A</sup>	remainder	remainder
Copper		0.75 max

<sup>A</sup> Iron shall be determined arithmetically by difference.

TABLE 2 Mechanical Properties of Pipe and Tube

	Cold-Worked Annealed N08366	Hot-Worked Annealed N08366	Cold-Worked or Hot- Worked Annealed N08367	
			$\leq 3/16$	$> 3/16$
Tensile strength, min, ksi (MPa)	75 (517)	75 (517)	$\leq 3/16$	$> 3/16$
Yield strength, 0.2 % offset, min, ksi (MPa)	30 (206)	30 (206)	100 (670) 45 (310)	95 (655) 45 (310)
Elongation in 2 in. or 50 mm, or 4D, min, %	30	30	30	30

TABLE 3 Permissible Variations in Outside Diameter<sup>A</sup> Tube

Outside Diameter, in. (mm)	Permissible Variations, in. (mm)	
	Plus	Minus
Hot-Finished Seamless Tubes		
4 (101.6) and under	1/64 (0.4)	1/32 (0.8)
Over 4 (101.6) to 7 1/2 (190.5) incl	1/64 (0.4)	3/64 (1.2)
Over 7 1/2 (190.5) to 9 (228.6) incl	1/64 (0.4)	1/16 (1.6)
Cold-Finished Seamless Tubes		
Under 2 1/2 (63.5)	0.010 (0.25)	0.010 (0.25)
2 1/2 (63.5) to 3 (76.2), excl	0.012 (0.30)	0.012 (0.30)
3 (76.2) to 4 (101.6), incl	0.015 (0.38)	0.015 (0.38)
Over 4 (101.6) to 7 1/2 (190.5), incl	0.015 (0.38)	0.025 (0.64)
Over 7 1/2 (190.5) to 9 (228.6), incl	0.015 (0.38)	0.045 (1.14)

<sup>A</sup> These permissible variations include out-of-roundness. These permissible variations in outside diameter apply to hot-finished seamless, and cold-drawn seamless tubes before other fabricating operations such as upsetting, swaging, expanding, bending, or polishing.

## 6. Mechanical and Other Properties

6.1 The material shall conform to the mechanical property requirements specified in Table 2.

### 6.2 Hydrostatic Test:

6.2.1 Each pipe or tube with an outside diameter 1/8 in. (3.2 mm) and larger, or tubes with a wall thickness of 0.015 in. (0.38 mm) and over, shall be tested by the manufacturer to an internal hydrostatic pressure of 1000 psi (68.9 kPa) provided that the fiber stress calculated in accordance with the following equation does not exceed the allowable fiber stress,  $S$ , indicated below:

$$S = (PD/2t) \quad (1)$$

TABLE 4 Permissible Variations in Outside Diameter, Pipe

Nominal Pipe Size in. (mm)	Permissible Variations in Outside Diameter			
	Plus		Minus	
	in.	mm	in.	mm
1/8 (3.2) to 1 1/2 (38.1) incl	1/64	0.4	1/32	0.8
Over 1 1/2 (38.1) to 4 (101.6) incl	1/32	0.8	1/32	0.8
Over 4 (101.6) to 8 (203.2) incl	1/16	1.6	1/32	0.8
Over 8 (203.2) to 18 (457.2) incl	3/32	2.4	1/32	0.8
Over 18 (457.2) to 26 (660.4) incl	1/8	3.2	1/32	0.8
Over 26 (660.4) to 34 (863.6) incl	5/32	4.0	1/32	0.8
Over 34 (863.6) to 48 (1219.2) incl	3/16	4.8	1/32	0.8

where:

$S$  = allowable fiber stress for material in cold-drawn condition, ( $1/4 \times$  UTS.) 16 700 psi (1150 kPa),

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

$D$  = outside diameter of the tube or pipe, in. (or mm), and

$t$  = minimum wall thickness, in. (or mm), equal to the specified wall thickness minus the permissible “minus” wall tolerance, Table 3, or the specified minimum wall thickness.

6.2.2 Any pipe or tube showing leaks during hydrostatic test shall be rejected.

6.2.3 When so agreed upon between the purchaser and manufacturer at the time of the purchase order, pipe or tube may be treated to 1 1/2 times the allowable fiber stress of  $S$  in 6.2.1.

6.2.4 When specified by the purchaser, a nondestructive electric test in accordance with Specification A450/A450M may be used in place of or in addition to, the hydrostatic test.

## 7. Dimensions and Permissible Variations

### 7.1 Outside Diameter and Wall Thickness:

7.1.1 The permissible variations in the outside diameter and wall thickness of pipe and tube shall not exceed those specified in Table 3, Table 4, and Table 5.

7.1.2 Permissible variations given in Table 3, Table 4, and Table 5 are applicable only to two dimensions.

7.2 Length—When pipe or tube is ordered cut-to-length, the permissible variations in length shall be those specified in Table 6 for tubes; the permissible variation in length for pipe shall be plus 1/4 in. (6.4 mm), minus 0 in.

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

## 8. Workmanship, Finish, and Appearance

8.1 The material shall be uniform in quality and condition, smooth, commercially straight or flat, and free of injurious imperfections.

## 9. Sampling

### 9.1 Lot Definition:

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

**TABLE 5 Permissible Variations in Wall Thickness<sup>A</sup>—Tube**

Outside Diameter, in. (mm)	Wall Thickness, %							
	0.095 (2.7) in. (mm) and Under		Over 0.095 (2.7) to 0.150 (3.8) in. (mm), incl		Over 0.150 (3.8) to 0.180 (4.6) in. (mm), incl		Over 0.180 (4.6) in. (mm)	
	Plus	Minus	Plus	Minus	Plus	Minus	Plus	Minus
Seamless, Hot-Finished Tubes								
4 (101.6) and under	40	0	35	0	33	0	28	0
Over 4 (101.6)	...	...	35	0	33	0	28	0
Seamless, Cold-Finished Tubes								
				Plus	Minus			
1½ (38.1) and under				20	0			
Over 1½ (38.1)				22	0			

<sup>A</sup> These permissible variations in wall thickness apply only to tubes, except internal-upset tubes, as rolled or drawn, and before swaging, expanding, bending, polishing, or other fabricating operations.

**TABLE 6 Permissible Variations in Length<sup>A</sup>—Tube**

Method of Manufacture	Outside Diameter, in. (mm)	Cut Length, in. (mm)	
		Plus	Minus
Seamless, hot-finished	all sizes	¾ (4.8)	0
Seamless, cold-finished	under 2 (50.8)	½ (3.2)	0
	2 (50.8) and over	¾ (4.8)	0

<sup>A</sup> These permissible variations in length apply to tubes before bending. They apply to cut lengths up to and including 24 ft (7.3 m). For lengths over 24 ft (7.3 m) an additional over-tolerance of ½ in. (3.2 mm) for each 10 ft (3.0 m) or fraction thereof shall be permissible up to a maximum of ½ in. (12.7 mm).

9.1.2 Lots for mechanical testing and check analysis shall consist of the material from one heat, in the same condition (temper), and of the same specified size (excepting length) and cross section.

### 9.2 Test Material Selection:

#### 9.2.1 Sampling for Chemical Analysis:

9.2.1.1 An analysis of each lot shall be made by the manufacturer from a representative sample obtained during the pouring of the heat or subsequent processing.

9.2.1.2 If samples for product (check) analysis are specified, a representative sample shall be taken from each lot (see 9.1.2) of finished material.

9.2.2 Sampling for Mechanical Testing—Samples of the material to provide test specimens for mechanical testing shall be taken from such locations in each lot (see 9.1.2) as to be representative of that lot.

## 10. Number of Tests and Retests

10.1 Chemical Analysis—One test per lot.

10.2 Mechanical Tests—Tension tests—One test per lot.

10.3 Nondestructive Test—Each piece in each lot (9.1.2).

10.4 Retests—If the specimen used in the mechanical test of any lot fails to meet the specified requirements, an additional specimen shall be taken from a different sample piece and tested. The results of this test specimen shall meet the specified requirements.

## 11. Specimen Preparation

11.1 Tension test specimens shall be taken from the material after final heat treatment and tested in the direction of fabrication.

11.2 Whenever possible, all pipe and tube shall be tested in full tubular size. When testing in full tubular size is not

possible, longitudinal strip specimens, or largest possible round specimen prepared in accordance with Test Methods E8, shall be used.

## 12. Test Methods

12.1 Determine the chemical composition and mechanical properties of the material, as enumerated in this specification, in the case of disagreement, in accordance with the following ASTM methods:

12.1.1 Chemical Analysis—Test Methods E1473.

12.2 Tension Test—Test Methods E8.

12.3 Determination of Significant Places—For purposes of determining compliance with the specified limits for the requirements of the properties listed in the following table, round an observed or a calculated value as indicated, in accordance with the rounding methods of Practice E29.

Requirement	Rounded Unit for Observed or Calculated Value
Chemical composition	nearest unit in the last righthand place of figures of the specified limit
Tensile strength	nearest 1000 psi (7 MPa)
Yield strength	
Elongation	nearest 1 %

## 13. Inspection

13.1 Inspection of the material shall be made as agreed upon between the manufacturer and the purchaser as part of the purchase contract.

## 14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or 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.

## 15. Certification

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

## 16. Product Marking

16.1 *Material*—The name or brand of the manufacturer, the trade name of the material or UNS number, the letters ASTM, the specification number, heat number, and nominal size shall be legibly stenciled on each piece ½ in. (12.7 mm) and over in outside diameter, provided the length is not under 3 ft (914 mm). The material marking shall be any method which will not result in harmful contamination.

16.1.1 For material less than ½ in. (12.7 mm) in outside diameter and material under 3 ft (914 mm) in length, the information specified in 16.1 shall be either stenciled or marked on a tag securely attached to the bundle or box in which the tube is shipped.

16.2 *Packaging*—Each bundle or shipping container shall be marked with the name or brand of the manufacturer, the trade name of the material or UNS number, the letters ASTM, the specification number, heat number, condition (temper), and nominal size; gross, tare, and net weight; consignor and consignee address; contract or order number; or such other information as may be defined in the contract or order.

## 17. Keywords

17.1 seamless pipe; seamless tube; UNS N08367

## APPENDIX

### (Nonmandatory Information)

### X1. SCHEDULES OF COLD-FINISHED SEAMLESS PIPE

X1.1 The schedules of cold-finished, seamless UNS N08366 pipe as given in Table X1.1 are regularly available. Other schedules may be furnished, and the manufacturer should be consulted. Table X1.1 is published for information only.

**TABLE X1.1 Pipe Schedules<sup>A</sup>**

Nominal Pipe Size	Outside Diameter	Nominal Wall Thickness			
		Schedule No. 5	Schedule No. 10	Schedule No. 40	Schedule No. 80
Inches					
¼	0.540	...	0.065	0.088	...
⅜	0.675	...	0.065	0.091	0.126
½	0.840	0.065	0.083	0.109	0.147
⅝	1.050	0.065	0.083	0.113	0.154
1	1.315	0.065	0.109	0.133	0.179
1¼	1.660	0.065	0.109	0.140	0.191
1½	1.900	0.065	0.109	0.145	0.200
2	2.375	0.065	0.109	0.154	0.218
1½	2.875	0.083	0.120	0.203	0.276
3	3.500	0.083	0.120	0.216	0.300
3½	4.000	0.083	0.120	0.226	0.318
4	4.500	0.083	0.120	0.237	0.337
5	5.563	...	...	0.258	...
6	6.625	...	...	0.280	...
Millimetres					
6.4	13.72	...	1.65	2.24	...
9.5	17.14	...	1.65	2.31	3.20
12.7	21.34	1.65	2.11	2.77	3.73
19.1	26.67	1.65	2.11	2.87	3.91
25.4	33.40	1.65	2.77	3.38	4.55
31.8	42.16	1.65	2.77	3.56	4.85
38.1	48.26	1.65	2.77	3.68	5.08
50.8	60.32	1.65	2.77	3.91	5.54
63.5	73.02	2.11	3.05	5.16	7.04
76.2	88.90	2.11	3.05	5.49	7.62
88.9	101.60	2.11	3.05	5.74	8.08
101.6	114.30	2.11	3.05	6.02	8.56
127.0	141.30	...	...	6.55	...
152.4	168.28	...	...	7.11	...

<sup>A</sup> The pipe schedules shown above conform with standards adopted by the American National Standards Institute.

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