



Designation: B690 – 22

# Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloy 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope\*

1.1 This specification covers iron-nickel-chromium-molybdenum alloy (UNS N08367)<sup>2</sup> 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 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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<sup>2</sup> Designation established in accordance with ASTM E527 and SAE S1086, Practice for Numbering Metals and Alloys (UNS).

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>3</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

E8/E8M 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.

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, meters, 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,

<sup>3</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.

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

- 4.1.5 *Dimensions:*
  - 4.1.5.1 *Tube*—Outside diameter, minimum wall thickness,
  - 4.1.5.2 *Pipe*—Standard pipe size and schedule,
  - 4.1.5.3 *Length*—Specified or random,
- 4.1.6 Purchaser’s inspection, if required (Section 13),
- 4.1.7 ASTM designation and year of issue, and
- 4.1.8 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.

**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:

$$S = (PD/2t) \tag{1}$$

where:

- S* = allowable fiber stress for material in cold-drawn condition, (1/4 × 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 1/2 times the allowable fiber stress of *S* in 6.2.1.

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

	Cold-Worked or Hot-Worked Annealed	
	N08367	
Thickness	≤ 3/16 in. (5 mm)	> 3/16 in. (5 mm)
Tensile strength, min, ksi (MPa)	100 (690)	95 (655)
Yield strength, 0.2 % offset, min, ksi (MPa)	45 (310)	45 (310)
Elongation in 2 in. or 50 mm, or 4D, min,%	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.

**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

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.

**TABLE 1 Chemical Requirements**

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

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

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.

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 ¼ 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.

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/E8M, 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/E8M.

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.

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	3/16 (4.8)	0
Seamless, cold-finished	under 2 (50.8)	1/8 (3.2)	0
	2 (50.8) and over	3/16 (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 1/8 in. (3.2 mm) for each 10 ft (3.0 m) or fraction thereof shall be permissible up to a maximum of 1/2 in. (12.7 mm).