



Designation: **B690—18** **B690 – 22**

## Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloy (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 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 of 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:<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:

<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.

Current edition approved Nov. 1, 2018. Oct. 1, 2022. Published January 2019. November 2022. Originally approved in 1981. Last previous edition approved in 2013 as B690-02 (2013); B690-18. DOI: 10.1520/B0690-18.10.1520/B0690-22.

<sup>2</sup> Designation established in accordance with ASTM E527 and SAE S1086, Practice for Numbering Metals and Alloys (UNS).

<sup>3</sup> 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.

\*A Summary of Changes section appears at the end of 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,

4.1.5 ~~Dimensions:~~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,~~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**.

**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 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. 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)~~ 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:

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

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  $1\frac{1}{2}$  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.

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.

**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								
1½ (38.1) and under					Minus			
Over 1½ (38.1)					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.