~~Designation:B690–96~~ Designation: B 690 – 02 (Reapproved 2007)

Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Seamless Pipe and Tube[1]

This standard is issued under the fixed designation B 690; 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 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 the standard. The values given in parentheses are for information only.

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 establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*~~ 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:* [2]

A 450/A 450M Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes

B 880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys

E 8 Test Methods for Tension Testing of Metallic Materials

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

~~E38Methods for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys~~

~~E354Test Methods for Chemical Analysis of High Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys~~ 1473 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.

~~[1] This specification is under the jurisdiction of ASTM Committee B-2 on Nonferrous Metals Alloys and is the direct responsibility of Subcommittee B02.07 on Refined Nickel and Cobalt, and Alloys Containing Nickel or Cobalt or Both as Principal Constituents.~~

~~Current edition approved May 10, 1996. Published June 1996. Originally published as B690–81. Last previous edition B690–93.~~

[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.

Current edition approved Nov. 1, 2007. Published November 2007. Originally approved in 1981. Last previous edition approved in 2002 as B 690 – 02.

* New designation established in accordance with ASTM E 527 and SAE S1086, Practice for Numbering Metals and Alloys (UNS).

[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* ~~, Vol 01.01.~~volume information, refer to the standard's Document Summary page on the ASTM website.

4. ~~Ordering Information~~

~~4.1Orders for material under this specification shall include the following information, as required:~~ 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 ~~Table 1~~Specification B 880.

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 ⅛ 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 1 Chemical Requirements

Element	Composition Limits, %~~Product (Check) Analysis Variations, under min or over max, of the Specified Limit of Element, %~~	
	N08366	N08367
~~Carbon~~	~~0.035 max~~	~~0.030 max0.005~~
Carbon	0.035 max	0.030 max
~~Manganese~~	~~2.00 max~~	~~2.00 max0.04~~
Manganese	2.00 max	2.00 max
~~Silicon~~	~~1.00 max~~	~~1.00 max0.05~~
Silicon	1.00 max	1.00 max
~~Phosphorus~~	~~0.040 max~~	~~0.040 max0.005~~
Phosphorus	0.040 max	0.040 max
~~Sulfur~~	~~0.030 max~~	~~0.030 max0.005~~
Sulfur	0.030 max	0.030 max
~~Chromium~~	~~20.00 to 22.00~~	~~20.00 to 22.000.25~~
Chromium	20.00 to 22.00	20.00 to 22.00
~~Nickel~~	~~23.50 to 25.50~~	~~23.50 to 25.500.20~~
Nickel	23.50 to 25.50	23.50 to 25.50
~~Molybdenum~~	~~6.00 to 7.00~~	~~6.00 to 7.000.15~~
Molybdenum	6.00 to 7.00	6.00 to 7.00
~~Nitrogen~~	~~...~~	~~0.18 to 0.250.01~~
Nitrogen	...	0.18 to 0.25
Iron[A]	remainder	remainder
~~Copper~~		~~0.75 max0.04~~
Copper		0.75 max

[A] 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	
~~Tensile strength, min, ksi (MPa)~~	~~75 (517)~~	~~75 (517)~~	~~≤ 3/16~~	~~> 3/16~~
Tensile strength, min, ksi (MPa)	75 (517)	75 (517)	≤ 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 4*D*, min,%	30	30	30	30

where:

S = allowable fiber stress for material in cold-drawn condition, (¼ × 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 1½ 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 A 450/A 450M/~~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 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*:

TABLE 3 Permissible Variations in Outside Diameter[A] 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 7½ (190.5) incl	1/64 (0.4)	3/64 (1.2)
Over 7½ (190.5) to 9 (228.6) incl	1/64 (0.4)	1/16 (1.6)
Cold-Finished Seamless Tubes		
Under 2½ (63.5)	0.010 (0.25)	0.010 (0.25)
2½ (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 7½ (190.5), incl	0.015 (0.38)	0.025 (0.64)
Over 7½ (190.5) to 9 (228.6), incl	0.015 (0.38)	0.045 (1.14)

[A] 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.