

1. Scope*

1.1 This specification covers nominal-wall-thickness welded tubes and heavily cold worked welded tubes made from the austenitic steels listed in Table 1, with various grades intended for such use as boiler, superheater, heat exchanger, or condenser tubes.

1.2 Grades TP304H, TP309H, TP309HCb, TP310H, TP310HCb, TP316H, TP321H, TP347H, and TP348H are modifications of Grades TP304, TP309S, TP309Cb, TP310S, TP310Cb, TP316, TP321, TP347, and TP348, and are intended for high-temperature service such as for superheaters and reheaters.

1.3 The tubing sizes and thicknesses usually furnished to this specification are 1/8 in. [3.2 mm] in inside diameter to 12 in. [304.8 mm] in outside diameter and 0.015 to 0.320 in. [0.4 to 8.1 mm], inclusive, in wall thickness. Tubing having other dimensions may be furnished, provided such tubes comply with all other requirements of this specification.

1.4 Mechanical property requirements do not apply to tubing smaller than 1/8 in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

1.5 Optional supplementary requirements are provided and, when one or more of these are desired, each shall be so stated in the order.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

The inch-pound units shall apply unless the "M" designation of this specification is specified in the order.

1.7 The following safety hazards caveat pertains only to the test method described in the Supplementary Requirements 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.* A specific warning statement is given in Supplementary Requirement S7, Note S7.1.

2. Referenced Documents

2.1 *ASTM Standards:* 3

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A 1016/A 1016M Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

E 112 Test Methods for Determining Average Grain Size

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing

E 273 Practice for Ultrasonic Examination of the Weld Zone of Welded Pipe and Tubing

E 527 Practice for Numbering Metals and Alloys (UNS)

2.2 *ASME Boiler and Pressure Vessel Code*. Section VIII 4

3. Ordering Information

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

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

3.1.2 Name of material welded tubes (WLD) or heavily cold worked tubes (HCW),

3.1.3 Grade (Table 1),

3.1.4 Size (outside diameter and nominal wall thickness),

3.1.5 Length (specific or random),

3.1.6 Optional requirements (13.6),

3.1.7 Test report required (see Certification Section of Specification A 1016/A 1016M),

3.1.8 Specification designation, and

3.1.9 Special requirements and any supplementary requirements selected.

Heat Treatment Requirements

Grade	UNS Number	Solutioning Temperature, min or range	Quenching Method
All grades not individually below listed below			
		1900°F [1040°C]	A
...	S30815	1920°F [1050°C]	B
TP309HCb	S30941	1900°F [1040°C]C	B
TP310H	S31009	1900°F [1040°C]	B
TP310HCb	S31041	1900°F [1040°C]C	B
...	S31254	2100°F [1150°C]	B
TP316H	S31609	1900°F [1040°C]	B
TP321	S32100	1900°F [1040°C]C	B
TP321H	S32109	2000°F [1100°C]C	B
...	S32654	2100°F [1150°C]	B
...	S33228	2050°F [1120°C]	B
...	S34565	2050°F [1120°C]–	B
		2140°F [1170°C]	B
TP347	S34700	1900°F [1040°C]C	B
TP347H	S34709	2000°F [1100°C]C	B
TP348	S34800	1900°F [1040°C]C	B
TP348H	S34809	2000°F [1100°C]C	B
...	S35045	2000°F [1100°C]	D
...	S38815	1950°F [1065°C]	B
...	N08367	2025°F [1110°C]	B
...	N08904	2000°F [1100°C]	B
...	N08926	2010°F [1105°C]	B

A Quenched in water or rapidly cooled by other methods, at a rate sufficient to prevent reprecipitation of carbides, as demonstrated by the capability of passing Practices A 262, Practice E. The manufacturer is not required to run the test unless it is specified on the purchase order (See Supplementary Requirement S6). Note that Practices A 262 requires the test to be performed on sensitized specimens in the low carbon and stabilized types and on specimens representative of the as-shipped condition of the other types. In the case of low-carbon types containing 3 % or more molybdenum, the applicability of the sensitizing treatment prior to testing shall be a matter for negotiation between the seller and purchaser.

B Quenched in water or rapidly cooled by other methods.

C A solution treating temperature above 1950°F [1065°C] may impair resistance to intergranular corrosion after subsequent exposure to sensitizing conditions in the indicated grades. When specified by the purchaser, a lower temperature stabilization or re-solution anneal shall be used subsequent to the higher-temperature solution anneal prescribed in this table (See Supplementary Requirement S4).

DCooled in still air, or faster.

Tensile and Hardness Requirements

Grade	UNS Designation	Tensile Strength, min, ksi [MPa]	Yield Strength, min, ksi [MPa]	Elongation in 2 in. or 50 mm, min, %	Rockwell Hardness Number, max
TP201	S20100	95 [655]	38 [260]	35	B95
TP202	S20200	90 [620]	38 [260]	35	B95
TP304	S30400	75 [515]	30(205)	35	B90
TP304L	S30403	70 [485]	30(205)	35	B90
TP304H	S30409	75 [515]	25(170)	35	B90
TP304N	S30451	80 [550]	35 [240]	35	B90
TP309S	S30908	75 [515]	30 [205]	35	B90
TP309H	S30909	75 [515]	30 [205]	35	B90
TP309Cb	S30940	75 [515]	30 [205]	35	B90
TP310S	S31008	75 [515]	30 [205]	35	B90
TP310H	S31009	75 [515]	30 [205]	35	B90
TP310Cb	S31040	75 [515]	30 [205]		B90
TP316	S31600	75 [515]	30 [205]	35	B90
TP316L	S31603	70 [485]	25 [170]	35	B90

TP316H	S31609	75 [515]	30 [205]	35	B90
TP316N	S31651	80 [550]	35 [240]	35	B90
TP317	S31700	75 [515]	30 [205]	35	B90
TP317L	S31703	75 [515]	30 [205]	35	B90
TP321	S32100	75 [515]	30 [205]	35	B90
TP321H	S32109	75 [515]	30 [205]	35	B90
TP347	S34700	75 [515]	30 [205]	35	B90
TP347H	S34709	75 [515]	30 [205]	35	B90
			30 [205]	35	B90

A Not applicable to tubes less than 1/8 in. [3.2 mm] in outside diameter or having wall thickness below 0.015 in. [0.4 mm], or both. The tensile properties of such small diameter or thin wall tubes shall be a matter of agreement between the manufacturer and the purchaser.

Standard/Item	Outside Diameter					Thickness	Length
		O.D. <	25mm	+0.10mm	, - 0.11mm		
ASTM A249	25mm ≤	O.D. ≤	40mm	± 0.15mm		±10%	O.D. < 50.8mm +3.0mm
	40mm <	O.D. <	50mm	±0.20mm			-0mm
	50mm ≤	O.D. <	65mm	±0.25mm			O.D. ≥ 50.8mm +5.0mm
	65mm ≤	O.D. <	75mm	±0.30mm			-0mm
	75mm ≤	O.D. ≤	100mm	±0.38mm			
	100mm <	O.D. ≤	200mm	+0.38mm	, - 0.64mm		
	200mm <	O.D. ≤	225mm	+0.38mm	, - 1.14mm		