

**ASTM A-48 - A-691**

**ASTM A-500 Tubing**

**ASTM B-75 - B626**

Only general information is presented here. Please contact ASTM for greater detail.

**ASTM**

**Number                      Explanation**

- A-48**      This specification covers gray iron castings intended for general engineering use where tensile strength is a major consideration.
- A-53**      Covers seamless and welded black and galvanized steel Pipe furnished in the following types and grades:  
Type F - furnace Butt Welded (also known as continuous Weld) 1/8 in. to 4 in. NPS  
Type E - Electric-Resistance Welded, Grades A and B 1/8 in. to 24 in. NPS  
Type S - Seamless, Grades A and B 1/8 in. to 26 in. NPS  
Except for Type F, pipe ordered to this specification is suitable For forming, bending, and flanging. Grade B, the most common, has a minimum yield of 35,000 psi.
- A-72**      Welded wrought iron pipe in Std. XS, and XXS weights suitable for fabrication. More highly resistant to some types of corrosion than carbon steel, astm 72 is suited for protective coating such as galvanizing. Although highly resistant to vibration, wrought iron has a somewhat low tensile strength due to low carbon content.
- A-105**     This specification covers forged carbon steel piping components for ambient and higher temperature service in pressure systems. Included are flanges, fittings, valves and similar parts ordered either to dimensions specified by the purchaser or to dimensional standards such as the ANSI and API specifications referenced in the full ASTM Specification. Forgings made to this specification are limited to a maximum weight of 10000 lb or 4540 kg. Larger forgings may be ordered to Specification A 266. Tubesheets and hollow cylindrical forgings for pressure vessel shells are not included within the scope of this specification. Although this specification covers some piping components machined from rolled bar and seamless tubular products, it does not cover raw material produced in these forms.
- A-106**     Covers seamless only carbon steel pipe for high-temperature service. Furnished in one of three grades, A, B, or C. Suitable for bending, flanging, and similar forming operations.
- A-126**     This specification covers three classes of gray iron for castings intended for use as valve pressure retaining parts, threaded and flanged pipe fittings and flanges.
- A-134**     Covers electric-fusion-(arc)-welded straight seam or spiral Seam plate pipe 16 in. and over in diameter, with wall thicknesses up to 0.75 in. This pipe is intended for conveying liquid, gas or vapor.
- A-135**     Covers two grades of electric-resistance-welded steel pipe A and B) 30 in. diameter and under. Pipe is intended for conveying liquid, gas or vapor; and only grade A is adapted for flanging and bending.
- A-139**     Covers five grades (A and E) of electric-fusion-(arc)-welded, Straight-seam, or spiral-seam steel pipe, 4 in. and over in Diameter with nominal wall thicknesses up to 1.00 in. Has different mechanical properties than standard plate grades. Used for conveying liquid, gas or vapor.

- A-161** Covers seamless, hot finished and cold drawn, low carbon and carbon-molybdenum steel still tubes, for use in carrying fluids at elevated temperatures and pressures in various types of Heaters. This specification includes tubes 2 to 9 in. O.D. Inclusive and over 0.220 in. in minimum wall thickness.
- A-178** Covers electric-resistance-welded tubes made of carbon steel and intended for use as boiler tubes and superheater flues. Includes tubes 1/2 in. to 5 in. O.D. and 0.035 to 0.320 in. in Minimum wall thickness.
- A-179** Covers seamless cold drawn low carbon steel tubes for tubular head transfer apparatus. Includes sizes 1/8 to 3 in. O.D. inclusive.
- A-182** This specification covers forged low alloy and stainless steel piping components for use in pressure systems. Included are flanges, fittings, valves and similar parts to specified dimensions or to dimensional standards such as the ANSI specifications referenced in the full ASTM Specifications.
- A-192** This specification supersedes A-83 and covers seamless carbon steel boiler and superheater tubes for high pressure service. Includes sizes 1/2 to 7 in. O.D. and 0.085 to 1.000 in. minimum wall thickness.
- A-197** This specification covers malleable irons for castings manufactured by the cupola process.
- A-199** Covers several grades of chromium-molybdenum and chromium-molybdenum-silicon seamless cold drawn intermediate alloy steel tubes for head exchangers, condensers, and similar heat transfer apparatus. Includes sizes 1/8 in. to 3 in. inclusive in O.D.
- A-200** Covers same grades as A-199 except use and size range varies. This specification covers sizes 2 to 9 in. in O.D. and wall thickness over 0.220 in.
- A-203** This specification covers nickel-alloy steel plates intended primarily for welded pressure vessels. It covers five grades, A, B, D, E and F.
- A-204** This specification covers molybdenum-alloy steel plates, intended particularly for welded boilers and other pressure vessels covering three grades, A, B and C.
- A-209** Covers three grades of seamless carbon-molybdenum alloy steel Boiler and superheater tubes. Includes sizes 1.2 to 5 in. in O.D. and 0.035 to 0.500 in minimum wall thickness.
- A-210** Covers seamless medium carbon steel boiler tubes and boiler flues including safe ends, arch and stay tubes, and superheater tubes. Includes sizes 1/2 to 5 in. in O.D. and 0.035 to 0.500 in. in minimum wall thickness.
- A-211** Covers spiral welded steel or iron pipe 4 to 48 in. in diameter, and 0.0625 to 0.6875 in. in wall thickness. Intended for conveying liquid, gas, or vapor.
- A-213** This specification covers minimum-wall-thickness, seamless ferritic and austenitic steel, boiler and superheater tubes and austenitic steel heat-exchanger tubes, designated Grades T5, TP304, etc. These steels are referenced in the full ASTM Specification.
- A-216** This specification covers carbon steel castings for valves, flanges, fittings or other pressure-containing parts for high-temperature service

and of quality suitable for assembly with other castings or wrought-steel parts by fusion welding. The three grades included are WCA, WCB and WCC.

- A-217** This specification covers martensitic stainless steel and alloy steel castings for valves, flanges, fittings and other pressure-containing parts intended primarily for high-temperature and corrosive service. The grades included in this specification are WC1, WC4, WC5, WC6, WC9, WC11, C5, C12 AND CA15.
- A-234** This specification covers wrought carbon steel and alloy steel fittings of seamless and welded construction covered by the latest revision of ANSI B 16.9, ANSI B 16.11, ANSI B 16.28, MSS-SP79 and MSS-SP95. These fittings are for use in pressure piping and in pressure vessel fabrication for service at moderate and elevated temperatures. Fittings differing from these ANSI and MSS standards shall be identified with the marking "S9".
- A-240** This specification covers chromium, chromium-nickel and chromium-manganese-nickel stainless and heat-resisting steel plate, sheet and strip for pressure vessels.
- A-249** This specification covers nominal-wall-thickness welded tubes made from the austenitic steels, referenced in the full ASTM Specification, with various grades intended for such use as boiler, superheater, or condenser tubes.
- A-252** Covers welded and seamless steel pipe for piling application or Permanent load carrying member. Available in Grades 1, 2 and 3 to meet physical properties as required.
- A-269** This specification covers grades of nominal-wall-thickness, stainless steel tubing for general corrosion-resisting and low or high-temperature service, as referenced in the full ASTM Specification.
- A-278** This specification covers gray iron for castings suitable for pressure-containing parts for use at temperatures up to 650F.
- A-297** This specification covers iron-chromium and iron-chromium-nickel alloy castings for heat-resistant service.
- A-311** Covers stress-relieved cold-drawn carbon steel bars produced to mechanical property requirements. On class, B, is cold-drawn with higher than normal (heavy) drafts to provide higher strength levels.
- A-312** This specification covers seamless and straight-seam welded austenitic steel pipe intended for high-temperature and general corrosive service.
- A-333** Covers nominal wall seamless and welded carbon and alloy steel pipe intended for low temperature service. (-50 to -320F). Several grades are covered including Grades 1, 3, 4, 6, 7, 8, and 9.
- A-334** Covers six grades of seamless or welded carbon and alloy steel tubes intended for use at low temperatures (-50 to -320F).
- A-335** Covers nominal wall seamless alloy steel pipe intended for high temperature service. Pipe ordered to this specification shall be suitable for bending, flanging, and similar forming operations, and for fusion welding. Selection will depend upon design, service conditions, mechanical properties, and high temperature characteristics. This specification covers twelve grades, most common of which are Grades 1, 5, 7, 9, 11 and 22.
- A-338** This specification covers malleable iron flanges, pipe fittings and valve parts, including parts to be assembled for use in railroad, marine and

other heavy duty service applications where fittings furnished in accordance American National Standard for Malleable Iron Threaded Fittings, Class 150 and 300 (ANSI B16.3) are not considered adequate.

- A-350** This specification covers several grades of carbon and low-alloy steel forged or ring-rolled flanges, forged fittings and valve intended primarily for low-temperature service and requiring notch toughness testing. They are made to specified dimensions, or to dimensional standards, such as the ANSI and API specifications referenced in the full ASTM Specification. Although this specification covers some piping components machined from rolled bar and seamless tubular materials. It does not cover raw material produced in these product forms.
- A-351** This specification covers austenitic and austenitic-ferritic (duplex) steel castings for valves, fittings and other pressure-containing parts. Grades included in this specification are CF3, CF8, CF3M, CF8M, CF3MN and so on.
- A-352** This specification covers steel castings for valves, flanges, fittings and other pressure-containing parts intended primarily for low-temperature service. This specification contains the following grades LCA, LCB, LCC, LC1, LC2, LC2-1, LC3, LC4, LC9 and CA6NM.
- A-358** This specification covers electric-fusion-welded austenitic chromium-nickel alloy steel pipe suitable for corrosive or high-temperature service, or both. (Although no restrictions are placed on the sizes of pipe which may be furnished under this specification, commercial practice is commonly limited to sizes not less than NPS 8).
- A-387** This specification covers chromium-molybdenum alloy steel plates intended primarily for welded boilers and pressure vessels designed for elevated temperature service. It covers the following grades, 2, 5, 9, 11, 12, 21, 21L, 22, 22L and 91.
- A-403** This specification covers two general classes, WP and CR, of wrought austenitic stainless steel fittings of seamless and welded construction covered by the latest revision of ANSI B 16.9, ANSI B 16.11, ANSI B 16.28, MSS-SP79 and MSS-SP95. Fittings differing from these ANSI and MSS standards shall be identified with the marking "S9".
- A-405** Covers on grade (P-24) of seamless ferritic alloy-steel pipe specially heated treated for high temperature service.
- A-420** This specification covers wrought carbon steel and alloy steel fittings of seamless and welded construction covered by the latest revision of ANSI B 16.9, ANSI B 16.11, ANSI B 16.28, MSS-SP79 and MSS-SP95. Fittings differing from these ANSI and MSS standards shall be identified with the marking "S6". These fittings are for use in pressure piping and pressure vessel service at low temperatures.
- A-500** Covers cold formed welded and seamless carbon square, rectangular, or special shape structural tubing for general structural purposes. Covers three grades:  
Grade A - 39,000 psi Min. Yield  
Grade B - 46,000 psi Min. Yield  
Grade C - 50,000 psi Min. Yield
- A-501** Covers hot formed welded and seamless carbon steel, rectangular, square, or special shape tubing for general structural purposes.
- A-512** This specification covers cold-drawn buttweld carbon steel tubes for use as mechanical tubing. It covers round, square, rectangular, and special shapes. Common grades in warehouse stock are 1010, 1015, and 1020.

- A-513** This specification covers electric-resistance welded carbon and alloy steel tubing for use as mechanical tubing. It covers round, square, rectangular, and special shapes made from hot or cold rolled steel. It covers "as welded," "sink drawn," "mandrel drawn," and "special smooth inside diameter."
- A-519** This specification covers a multitude of grades of carbon and alloy steel seamless mechanical tubing. It covers both hot finished and cold drawn tubing up to and including 12-3/4 in. outside diameter with wall thickness as required.
- A-524** Covers seamless carbon steel pipe for process piping applications. Suitable for welding, bending, flanging, and similar forming operations. Two grades are covered: Grade I (0.375 in. wall thickness and under) and Grade II (greater than 0.375 in. wall thickness).
- A-618** Covers three grades of hot-formed welded and seamless high-strength low-alloy square, rectangular, round or special shape tubing for use in bridge or building construction and general structural purposes.
- A-671** Covers electric-fusion-welded steel pipe with filler metal added, fabricated from pressure vessel quality plate of several analyses and strength levels and suitable for service at atmospheric and lower temperatures.
- A-672** Covers electric-fusion-welded steel pipe with filler metal added, fabricated from pressure vessel quality plate of several analyses and strength levels and suitable for high-pressure service at moderate temperatures.
- A-691** Covers electric-fusion-welded carbon and alloy steel pipe with filler metal added, fabricated from pressure vessel quality plate of several analyses and strength levels and suitable for high-pressure service at high temperatures.

**ASTM A-500 SQUARE AND RECTANGULAR STEEL TUBING**

**Mechanical Properties**

	<b>Grade A</b>	<b>Grade B</b>	<b>Grade C</b>
<b>Tensile Strength</b>	45,000 (310)	58,000 (400)	62,000 (427)
min. psi (M Pa)			
<b>Yield Strength</b>	39,000 (269)	46,000 (317)	50,000 (345)
min. psi (M Pa)			
<b>Elongation in 2 in.</b>	25(1)	23(2)	21(3)
(50.8 mm). min. %			

- (1) Applies to specified wall thicknesses 0.120 in. (3.05 mm) and over. For wall thicknesses under 0.120 in., the minimum elongation shall be calculated by the formula: percent elongation in 2 in. = 56t + 17.5.
- (2) Applies to specified wall thicknesses 0.180 in. (4.57 mm) and over. For wall thicknesses under 0.180 in., the minimum elongation shall be calculated by the formula: percent elongation: in 2 in. = 61t + 12.
- (3) Applies to specified wall thicknesses 0.120 in. (3.05 mm) and over. For lighter wall thicknesses, elongation shall be by agreement with the manufacturer.

**Tolerances - Wall Thickness**

The tolerance for wall thickness exclusive of the weld area shall be plus or minus 0 percent of the nominal wall thickness specified. The wall thickness is to be measured at the center of the flat.

### Square of Sides

For square or rectangular structural tubing, adjacent sides may deviate from 90 degrees by a tolerance of plus or minus 2 degrees maximum.

### Straightness

The permissible variation for straightness of square and rectangular structural tubing shall be 1/8 in. times the number of feet of total length divided by 5.

### Corner Radii

For square or rectangular structural tubing, the radius of any outside corner of the section shall not exceed three times the specified wall thickness.

## CSA G40.21-92 HOLLOW STRUCTURAL SECTIONS

### Mechanical Properties Table

Specification	Grade	Minimum Yield Strength		Tensile Strength		Minimum Elongation	
		ksi	Mpa	ksi	Mpa	% in 2 inches (50.8 mm)	
CSA G40.21	44W	44	304	65-90	448-621		23
Class H	50W	50	345	65-95	448-655		22
	55W	55	379	70-95	483-655		21
	50WT	50	345	70-95	483-655		22
	55WT	55	379	70-95	483-655		21
	50A	50	345	70-95	483-655		21
	50AT	50	345	70-95	483-655		21

**G40.21 - Class H:** HSS products conform to CSA G40.21 Class H. Class H HSS is hot formed to final shape or cold formed to final shape and stress relieved. Residual stresses in the Class H product are relatively small and Class H gives superior structural performance.

**G40.21 - Class C:** Class C is equivalent to H except no stress relieving operation is performed.

**G40.21 - Type W:** Type W is suitable for general welded construction where notch toughness at low temperatures is not a design consideration.

**G40.21 - Type WT:** Type WT is suitable for welded construction where notch toughness at low temperatures is a design requirement.

**G40.21 - Type AT:** Type AT is suitable for welded construction where notch toughness at low temperatures is a design requirement and are often used in structures in unpainted conditions.

**G40.21 - Type A:** Type A is suitable for use as weathering steel and has improved low temperature notch toughness. The atmospheric corrosion resistance is 4-6 times that of plain carbon steel.

### Tolerances - Wall Thickness

Wall thickness shall not deviate by more than -5% or +10% from the nominal wall thickness specified, except that the weld seam of welded sections may overrun the maximum thickness tolerance. In the case of rectangular sections, wall thickness shall be measured at the center of the flat.

### Square of Sides

For rectangular sections, corners shall be square (90 degrees) within +/-1 degree for hot-formed sections and +/-2 degrees for cold formed sections. Squareness shall be determined with a protractor or other suitable measuring device. The average slope and the sides shall be the basis for determination.

### **Straightness**

Deviation from straightness shall not exceed 1/8 in. x the number of feet of total length, divided by 5.

### **Corner Radii**

For square or rectangular structural tubing, the radius of any outside corner of the section shall not exceed three times the specified wall thickness.

### **ASTM**

<b>Number</b>	<b>Explanation</b>
B-75	This specification covers seamless copper, round and rectangular, including square tube suitable for general engineering purposes.
B-75	This specification covers Copper UNS No. C12200 seamless copper water tube suitable for general plumbing, and similar applications for the conveyance of fluids, and commonly used with solder, flared, or compression type fittings.
B-127	This specification covers rolled nickel-copper alloy (UNS04400) plate, sheet and strip.
B-160	This specification covers nickel (UNS N02200) and low carbon nickel (UNS N02201) in the form of hot-worked and cold-worked rod and bar.
B-161	This specification covers nickel (UNS N02200) and low-carbon nickel (UNS N02201) in the form of cold-worked seamless pipe and tube.
B-162	This specification covers rolled nickel (UNS N02200) and low-carbon nickel (UNS N02201) plate, sheet and strip.
B-163	This specification covers seamless tubes of nickel and nickel alloys for use in condenser and heat-exchanger service. Please see the appropriate ASTM specification for all the alloys covered by this specification.
B-164	This specification covers nickel-copper alloys (UNS N04400 and N04405), in the form of hot-worked and cold-worked rod and bar and cold-worked wire.
B-165	This specification covers nickel-copper alloy (UNS N04400), in the form of cold-worked seamless pipe and tube.
B-166	This specification covers nickel-chromium-iron alloys (UNS N06600, N06601, N06690, N06025 and N06045) and nickel-chromium-cobalt-molybdenum alloy (UNS N06617) in the form of hot-finished and cold-worked rounds, squares, hexagons, rectangles and cold-worked wire.
B-167	This specification covers nickel-chromium-iron alloys (UNS N06600, N06601, N06690, N06025 and N06045) in cold-worked annealed, hot-worked annealed and hot-finished seamless pipe and tube intent for general corrosion resistant and heat resistant applications.
B-168	This specification covers rolled nickel-chromium-iron alloys (UNS N06600, N06601, N06690, N06025 and N06045) and nickel-chromium-cobalt-molybdenum alloy (UNS N06617) plate, sheet and strip.
B-210	This specification covers aluminum and aluminum-alloy drawn seamless tubes in straight lengths and coils for general purpose and pressure applications in various alloys, tempers and thicknesses. Coiled tubes

are generally available only as round tubes with a wall thickness not exceeding 0.083 in. and only in nonheat-treatable alloys. Please see the appropriate ASTM specification for all the alloys covered by this specification.

- B-221** This specification covers aluminum and aluminum alloy extruded bar, rod, wire, shape and tube in aluminum-alloys. Please see the appropriate ASTM specification for all the alloys covered by this specification.
- B-234** This specification covers aluminum-alloy drawn seamless round tube in straight lengths designated for use in surface condensers, evaporators and heat exchangers. Please see the appropriate ASTM specification for all the alloys covered by this specification.
- B-241** This specification covers aluminum and aluminum-alloy seamless pipe and extruded round seamless tube in various alloys and tempers intended for pressure applications. Please see the appropriate ASTM specification for all the alloys covered by this specification.
- B-247** This specification covers aluminum-alloy die forgings, hand forgings and rolled ring forgings. Please see the appropriate ASTM specification for all the alloys covered by this specification.
- B-361** This specification covers only factory-made wrought aluminum and aluminum-alloy welding fittings in contrast to field-made fittings. Please see the appropriate ASTM specification for all the alloys covered by this specification.
- B-366** This specification covers wrought welding fittings for pressure piping, factory-made from nickel and nickel alloys. The term welding applies to butt-weld or socket-welding parts such as 45 and 90 elbows, 180 bends, caps, tees, reducers, lap-joint stub ends and other types, as covered by ANSI B 16.9, ANSI B 16.11, ANSI B 16.28 and MSS-SP43.
- B-407** This specification covers UNS N08800, N08801, N08810 and N08811 in the form of cold-worked and hot finished annealed seamless pipe and tube. Alloy UNS N08800 is normally employed in service up to and including 1100F. Alloys UNS N08810 and N08811 are normally employed in service temperatures above 1100F where resistance to creep and rupture is required, and they are annealed to develop controlled grain size for optimum properties in the temperature range.
- B-408** This specification covers UNS N08800, N08801, N08810 and N08811 in the form of cold-worked and cold-worked rod and bar. Alloy UNS N08800 is normally employed in service up to and including 1100F. Alloys UNS N08810 and N08811 are normally employed in service temperatures above 1100F where resistance to creep and rupture is required, and they are annealed to develop controlled grain size for optimum properties in the temperature range.
- B-409** This specification covers UNS N08800, UNS N08810 and UNS N08811 in the form of rolled plate, sheet and strip. Alloy UNS N08800 is normally employed in service temperatures up to and including 1100 F or 593 C. Alloys UNS N08810 and UNS N08811 are normally employed in service temperatures above 1100 F or 593 C, where resistance to creep and rupture is required, and they are annealed to develop controlled grain size for optimum properties in this temperature range.
- B-462** This specification covers forged or rolled UNS N08020, UNS N08024, UNS N08026, and UNS N08367 pipe flanges, forged fittings and valves and parts intended for corrosive high-temperature service.



- B-463** This specification covers UNS N08020, UNS N08026 and UNS N08024 alloy plate, sheet and strip.
- B-464** This specification covers welded UNS N08020, UNS N08024 and UNS N08026 alloy pipe for general corrosion-resisting and low or high-temperature service.
- B-468** This specification covers welded UNS N08020, UNS N08024 and UNS N08026 alloy boiler, heat exchanger and condenser tubes for general corrosion-resisting and low or high-temperature service.
- B-474** This specification covers electric fusion welded UNS N08020, UNS N08026 and UNS N08024 alloy pipe suitable for high-temperature or corrosive service. (Although no restrictions are placed on the sizes of pipe that may be furnished under this specification, commercial practice is commonly limited to sizes not less than NPS 8).
- B-483** This specification covers aluminum and aluminum-alloy drawn tubes in straight lengths and coils for general purpose applications in various alloys. Please see the appropriate ASTM specification for all the alloys covered by this specification.
- B-574** This specification covers rod of low-carbon nickel-molybdenum-chromium alloys, (UNS N10276, N06022 and N06455), low-carbon nickel-chromium-molybdenum alloy (UNS N06059), and low-carbon nickel-chromium-molybdenum-tungsten alloy (UNS N06686) for use in general corrosive service.
- B-575** This specification covers plate, sheet and strip of low-carbon nickel-molybdenum-chromium alloys, (UNS N10276, N06022 and N06455), low-carbon nickel-chromium-molybdenum alloy (UNS N06059), and low-carbon nickel-chromium-molybdenum-tungsten alloy (UNS N06686) for use in general corrosive service.
- B-587** This specification covers round, rectangular, and square-welded copper-alloy tube for general engineering purposes.
- B-619** This specification covers welded pipe of nickel and nickel-cobalt alloys (UNS N10001, N10665, N12160, N10629, N10675, N10276, N06455, N06007, N06975, N08320, N06002, N06022, N06059, N06230 and N06686).
- B-622** This specification covers seamless pipe and tube of nickel and nickel-cobalt alloys (UNS N10001, N10665, N12160, N10629, N10675, N10276, N06455, N06007, N06975, N08320, N06002, N06022, N06059, N06230 and N06686).
- B-626** This specification covers welded tube of nickel and nickel-cobalt alloys (UNS N10001, N10665, N12160, N10629, N10675, N10276, N06455, N06007, N06975, N08320, N06002, N06022, N06059, N06230 and N06686).
- B-729** This specification covers UNS N08020, UNS N08026 and UNS N08024 seamless, cold-worked pipe and tube intended for general corrosive service.