

**Not For Production Use (For Reference Only)**

**ASTM A213-04b and UI Chart**

Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, Heat Exchanger Tubes

**ASTM Chemical Requirements**

Elements	304	304L	309S	316	316L	321
	S30400	S30403	S30908	S31600	S31603	S33200
(C) Carbon, max	0.080	0.035	0.08	0.080	0.035	0.080
(Mn) Manganese, max	2.000	2.000	2.000	2.000	2.000	2.000
(P) Phosphorus, max	0.040	0.040	0.045	0.040	0.040	0.045
(S) Sulfur, max	0.030	0.030	0.030	0.030	0.030	0.030
(Si) Silicon	0.750	0.750	0.750	0.750	0.750	0.750
(Ni) Nickel	8.0-11.0	8.0-13.0	12.0-15.0	11.0-14.0	10.0-15.0	9.0-12.0
(Cr) Chromium	18.0-20.0	18.0-20.0	22.0-24.0	16.0-18.0	16.0-18.0	17.0-20.0
(Mo) Molybdenum	N/A	N/A	0.75 max	2.0-3.0	2.0-3.0	N/A
(Ti) Titanium	N/A	N/A	N/A	N/A	N/A	5xC-0.70

**Heat Treatment**

-The material will be heat treated to a minimum of 1900 degrees F and quenched.

**Surface Condition**

-The tubes, after heat treatment, shall be chemically descaled or pickled free of scale. Pickling or chemical descaling is not needed if bright annealing is used.

**Product Marking**

-Man. Name or brand, spec. number, and grade on tube. For tubes less than 1 1/4" in diameter or under 3' in length, a tag may be secured to the box or bundle.

**Mechanical Testing Test**

Test	ASTM	United
Flare	Required	Required
Flatten	Required	Required
Flange	Not Required	Not Required
Reverse Bend	Not Required	Not Required
Tension Test	Required	Required
Eddy Current	Required*	Required
Hydrostatic Pressure	Required*	Not Required
	Not Required	Not Required

**Mechanical Properties**

Type	Tensile	Yield	Elong. At 2"	Hardness
	min, ksi (Mpa)	min, ksi (Mpa)	min, %	Rockwell B, max.
304	75 (515)	30 (205)	35	90
304L	70 (484)	25 (170)	35	90
309S	75 (515)	30 (205)	35	90
316	75 (515)	30 (205)	35	90
316L	70 (485)	25 (170)	35	90
321	75 (515)	30 (205)	35	90

\* ASTM required either an Eddy Current or a Hydrostatic test be performed.

**Dimensional Requirements**

Size	Outside Diameter		Squareness		Length**		Straightness		Weld Height		Wall***	
	ASTM	United	ASTM	United	ASTM	United	ASTM	United	ASTM	United	ASTM	United
1/2"	+/- .004	+/- .004	N/A	.015	-0 +1/8	-0 +1/8	.030/36"	.030/36"	.006	+0.004	+/- 10%	+/- 10%
3/4"	+/- .004	+/- .004	N/A	.015	-0 +1/8	-0 +1/8	.030/36"	.030/36"	.006	+0.004	+/- 10%	+/- 10%
1"	+/- .006	-.006/+0.002	N/A	.015	-0 +1/8	-0 +1/8	.030/36"	.030/36"	.006	+0.004	+/- 10%	+/- 10%

\*\* These tolerances apply to 24 ft. lengths or less. For lengths over 24 ft. add a tolerance of 1/8 in. for each 10 ft., or fraction thereof, up to a max of 1/2 in.

\*\*\* Applicable only when nominal wall is specified. When minimum wall is specified, the tolerance is -0 +18%.