



## ASTM A 554 – 94

### Welded Stainless Steel Mechanical Tubing

This specification covers round, square, rectangular and special shaped welded stainless steel tubing for use in mechanical applications where appearance, mechanical properties or corrosion resistance is needed. As-welded and cold reduced tubing is covered.

### Dimensions and Tolerances

- **Dimensions.** Round tubes normally furnished to this specification are in sizes <16 in (406.4 mm) OD and >0.020 in (0.51 mm) wall thickness. Square and rectangular tubing is normally furnished in sizes up to 5 1/2 in across flats.
- **Tolerances.** Refer to page 3-41.
- **Cut Length Tolerances.** See table below.

### Cut Length Tolerances (all tubing)

Length		Outside Diameter OD		Variations in length		
				Over		Under
ft	m	in	mm	in	mm	in or mm
<4	1.2	<2	<50.8	1/16	1.6	0
<4	1.2	>2 to 4	>50.8 to 101.6	3/32	2.4	0
<4	1.2	>4	>101.6	1/8	3.2	0
>4 to 10	>1.2 to 3.0	<2	<50.8	3/32	2.4	0
>4 to 10	>1.2 to 3.0	>2	>50.8	1/8	3.2	0
>10 to 24	>3.0 to 7.3	All	All	3/16	4.8	0

### Manufacture

- **Material.** Refer to chemical composition table.
- **Manufacturing Process.** Tubes are made from flat-rolled stainless steel by automatic welding process without the addition of filler metal.
- **Heat Treatment.** As required to meet specification.
- **Marking.** Each box, bundle or lift (or piece if individually shipped) to be identified with tag or stencil. Manufacturers name or brand, size, purchase order number, specification number and grade to be included. Bar code may be used for supplementary marking.

### Finish and Repair

- **Finish.** Workmanlike finish free of injurious defects and with smooth ends free of burrs. Surface imperfections <10% of nominal wall or <0.002 in (0.05 mm) are acceptable.
- **Repair.** Surface imperfections are only removed if special finish is specified.
- **Surface Finish.** Free of scale. Special finishes may be specified.
- **Coating.** Specified protection coating may be requested.

### Mandatory Testing

- **Heat Analysis.** Each heat of steel or secondary melt to be analysed.
- **Product Analysis.** Alternative to heat analysis. A report may be requested by purchaser.



# NATAL STAINLESS STEEL

## Ordering Information

Item	Notes
Specification number	ASTM A 554-94
Size	<b>Round</b> - Outside diameter and wall thickness. Alternatively for cold reduced tube: outside diameter and inside diameter, or inside diameter and wall thickness. <b>Square and Rectangular</b> - Outside diameter and wall thickness.
Quantity	Random or specified lengths. Total length or number of lengths
Length	Mill lengths, cut lengths or multiple lengths. Cutting allowance should be specified for multiple lengths.
Name of material	Welded stainless steel mechanical tubing
Form	Round, square, rectangular or special
Grade	Selected from chemical composition table
Manufacture	Automatic welding without filler metal
Condition	The following options are available: As welded. Welded and annealed. Cold reduced. Cold reduced and annealed. Inside bead not removed. Inside bead controlled to 0.005 in (0.13 mm) or 15% of the wall thickness whichever is greater. Inside bead removed.
Test report	DIN 50049.3.1.B standard, or DIN 50049.3.1.C optional (3rd party witness test) at extra cost
Options and supplementary requirements	Refer to optional and supplementary requirements S1 to S6

Note  
 - The above table is based on ASTM requirements except with regard to test reports, where standard practice options are added. See also page 10-2 for ISO based ordering and general delivery information.

## Optional and Supplementary Requirements

- **Protective Coating** to be specified as required.
- **Special Surface Finishes** may be specified.
- **Special Packing Requirements** may be specified.
- **Condition.** Options as listed in ordering information.
- **Report** of heat or product analysis may be requested.
- **S1 Hardness Test.** Test performed on a specimen from one tube from each 2500 ft (760 m).
- **S1 Tension Test.** One test shall be performed on a specimen from one tube of each lot of 2500 ft (760 m) or fraction thereof from each heat of steel, prior to cutting to length.
- **S1 Nondestructive Test.** When required, the test to be used and the inspection limits shall be specified in the order.
- **S1 Test Reports.** Mill test reports furnished when specified in the order.
- **S1 Certification for Government Orders.** Not applicable
- **S1 Rejection Provisions for Government Orders.** Not applicable.

## Tensile and Hardness Requirements

Grade	Tensile Strength min		Yield Strength min		Elongation in 2 in (50 mm), min	Brinell Hardness HB	Rockwell Hardness HRB
	ksi	MPa	ksi	MPa	%	max	scale/max
All	75	517	30	207	35	192	B90
MT304L	70	483	25	172	35	192	B90
MT316L	70	483	25	172	35	192	B90
MT429 <sub>1</sub>	60	414	35	241	20	190	B90
MT430 <sub>1</sub>	60	414	35	241	20	190	B90
MT430Ti <sub>1</sub>	60	414	30	207	20	190	B90

Notes  
 - All = All austenitic grades except MT304L and MT316L.  
 1 Ferritic grade



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## Heat Treatment

Heat treatments to meet the specification are not defined in this standard.

## Chemical Composition

Grade	Composition Percentage, max or range								Note
	&DUERn C	0DQJDQHve Mn	3KRVSkrUXs P	6XOSKXr S	6LOLFRn Si	1LFNHI Ni	&KURPLXm Cr	0RO\EGHQXm Mo	
Austenitic Stainless Steels:									
MT301	0.15	2.00	0.040	0.030	1.00	6.0-8.0	16.0-18.0	-	
MT302	0.15	2.00	0.040	0.030	1.00	8.0-10.0	17.0-19.0	-	
MT304	0.08	2.00	0.040	0.030	1.00	8.0-11.0	18.0-20.0	-	
MT304L	0.035	2.00	0.040	0.030	1.00	8.0-13.0	18.0-20.0	-	4
MT305	0.12	2.00	0.040	0.030	1.00	10.0-13.0	17.0-19.0	-	
MT309S	0.08	2.00	0.040	0.030	1.00	12.0-15.0	22.0-24.0	-	
MT309SCb	0.08	2.00	0.040	0.030	1.00	12.0-15.0	22.0-24.0	-	1
MT310S	0.08	2.00	0.040	0.030	1.00	19.0-22.0	24.0-26.0	-	
MT316	0.08	2.00	0.040	0.030	1.00	10.0-14.0	16.0-18.0	2.0-3.0	
MT316L	0.035	2.00	0.040	0.030	1.00	10.0-15.0	16.0-18.0	2.0-3.0	4
MT317	0.08	2.00	0.040	0.030	1.00	11.0-14.0	18.0-20.0	3.0-4.0	
MT321	0.08	2.00	0.040	0.030	1.00	9.0-13.0	17.0-20.0	-	2
MT330	0.15	2.00	0.040	0.030	1.00	33.0-36.0	14.0-16.0	-	
MT347	0.08	2.00	0.040	0.030	1.00	9.0-13.0	17.0-20.0	-	1
Ferritic Stainless Steels:									
MT429	0.12	1.00	0.040	0.030	1.00	0.50 max	14.0- 16.0	-	
MT430	0.12	1.00	0.040	0.030	1.00	0.50 max	16.0- 18.0	-	
MT430Ti	0.10	1.00	0.040	0.030	1.00	0.075	16.0- 19.5	-	3

## Composition Notes

1 Niobium + Tantalum >10 x Carbon and 1.00% max

2 Titanium >5 x Carbon and 0.60% max

3 Titanium >5 x Carbon and 0.75% max

4 Carbon 0.040% max is necessary for tubes where many drawing passes are required, as with outside diameter <0.5 in (12.7 mm) or nominal wall thickness <0.049 in (1.2 mm) (minimum wall thickness <0.044 in (1.12 mm))

### Note

- Niobium is sometimes referred to as Columbium.



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## Round Tube Tolerances

Round tube cross sectional tolerances (all conditions except tubing with bead removed)

Outside Diameter (OD)		Wall Thickness (t)		Variations in OD <sup>1</sup>		Variation in t	Ovality (Thin walled tube) <sup>1,3</sup>	
				±		±		
in	mm	in	mm	in	mm	%	in	mm
<1/2	<12.7	0.020 to 0.049	0.51 to 1.24	0.004	0.10	10	0.004	0.10
1/2 to 1	12.7 to 25.4	0.020 to 0.065	0.51 to 1.65	0.005	0.13	10	0.005	0.13
1/2 to 1	12.7 to 25.4	>0.065 to 0.134	>1.65 to 3.40	0.010	0.25	10	0.010	0.25
>1 to 1 1/2	>25.4 to 38.1	0.025 to 0.065	0.64 to 1.65	0.008	0.20	10	0.008	0.20
>1 to 1 1/2	>25.4 to 38.1	>0.065 to 0.134	>1.65 to 3.40	0.010	0.25	10	0.010	0.25
>1 1/2 to 2	>38.1 to 50.8	0.025 to 0.049	0.64 to 1.24	0.010	0.25	10	0.010	0.25
>1 1/2 to 2	>38.1 to 50.8	>0.049 to 0.083	>1.24 to 2.11	0.011	0.28	10	0.011	0.28
>1 1/2 to 2	>38.1 to 50.8	>0.083 to 0.149	>2.11 to 3.78	0.012	0.30	10	0.012	0.30
>2 to 2 1/2	>50.8 to 63.5	0.032 to 0.065	0.81 to 1.65	0.012	0.30	10	0.012	0.30
>2 to 2 1/2	>50.8 to 63.5	>0.065 to 0.109	>1.65 to 2.77	0.013	0.33	10	0.013	0.33
>2 to 2 1/2	>50.8 to 63.5	>0.109 to 0.165	>2.77 to 4.19	0.014	0.36	10	0.014	0.36
>2 1/2 to 3 1/2	>63.5 to 88.9	0.032 to 0.165	0.81 to 4.19	0.014	0.36	10	0.014	0.36
>2 1/2 to 3 1/2	>63.5 to 88.9	>0.165	>4.19	0.020	0.51	10	0.020	0.51
>3 1/2 to 5	>88.9 to 127.0	0.035 to 0.165	0.89 to 4.19	0.020	0.51	10	0.020	0.51
>3 1/2 to 5	>88.9 to 127.0	>0.165	>4.19	0.025	0.64	10	0.025	0.64
>5 to 16	>127.0 to 406.4	All	All	0.00125 <sup>2</sup>		10	1.5% OD	

### Notes

- 1 OD tolerance includes ovality tolerance except for thin wall tube
- 2 in/in or mm/mm of circumference
- 3 Ovality = Difference between maximum and minimum OD
- Thin wall tube is defined as that with a wall thickness t <3% of OD

## Round tube cross-sectional tolerances (for tubing with bead removed)

Outside Diameter OD		Wall Thickness (t)		Variations in OD <sup>1</sup>		Variation in ID		Variation in t	Ovality (Thin walled tube) <sup>1,3</sup>	
				±		±		±		
in	mm	in	mm	in	mm	in	mm	%	in	mm
<3/32	<2.4	All	All	0.001	0.03	0.001	0.03	10	0.002	0.06
3/32 to <3/16	2.4 to <4.8	All	All	0.0015	0.038	0.0015	0.038	10	0.003	0.076
3/16 to <1/2	4.8 to <12.7	All	All	0.003	0.08	0.005	0.13	10	0.006	0.16
1/2 to <1	12.7 to <25.4	All	All	0.004	0.10	0.006	0.15	10	0.008	0.20
1 to <1 1/2	25.4 to <38.1	All	All	0.005	0.13	0.007	0.18	10	0.010	0.26
1 1/2 to <2	38.1 to <50.8	All	All	0.006	0.15	0.008	0.20	10	0.012	0.30
2 to <2 1/2	50.8 to <63.5	All	All	0.007	0.18	0.010	0.25	10	0.014	0.36
2 1/2 to <3 1/2	63.5 to <88.9	All	All	0.010	0.25	0.014	0.36	10	0.020	0.050
3 1/2 to 5	88.9 to	All	All	0.015	0.38	0.020	0.51	10	0.030	0.76



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	127.0							
>5 to 16	>127.0 to 406.4	All	All	0.00125 <sub>2</sub>	0.0013 <sub>2</sub>	10	0.0025 <sub>2</sub>	

## Notes

1 OD tolerance includes ovality tolerance except for thin wall tube

2 in/in or mm/mm of circumference

3 Ovality = Difference between maximum and minimum OD

Thin wall tube is defined as that with a wall thickness  $t < 3\%$  of OD

## Square and Rectangular Tube Tolerances

### Outside dimension tolerances

Largest Nominal Outside Dimension Across Flats		Wall Thickness, t	Variation across Flats, Convexity or Concavity, $\pm$		Variation in t, $\pm$
in	mm	in/mm	in	mm	%
<1 1/4	<31.8	All	0.015	0.38	10
>1 1/4 to 2 1/2	31.8 to 63.5	All	0.020	0.51	10
>2 1/2 to 5 1/2	63.5 to 139.7	All	0.030	0.76	10

### Maximum radii of corners

Wall Thickness		Radii of Corners, max	
in	mm	in	mm
>0.020 to 0.049	0.51 to 1.24	3/32	2.4
>0.049 to 0.065	1.24 to 1.65	1/8	3.2
>0.065 to 0.083	1.65 to 2.11	9/64	3.6
>0.083 to 0.095	2.11 to 2.42	3/16	4.8
>0.095 to 0.109	2.42 to 2.77	13/64	5.2
>0.109 to 0.134	2.77 to 3.40	7/32	5.6
>0.134 to 0.156	3.40 to 3.96	1/4	6.4

### Twist tolerances

Size		Twist	
in	mm	in/3ft	mm/m
<1/2	12.7	0.050	1.4
>1/2 to 1 1/2	>12.7 to 38.1	0.075	2.1
>1 1/2 to 2 1/2	>38.1 to 63.5	0.095	2.6
>2 1/2	>63.5	0.125	3.5

### Squareness of sides

Sizes and types	Out of Square Tolerances
All	0.006 x length of longest side

### Straightness tolerances

Size	Twist	
	in/3ft	mm/m
All	0.075	2.1