

SOFT ALLOY TUBE & PIPE



EXTRUDED SEAMLESS ALUMINUM TUBE CAPABILITIES

STANDARD ALLOYS & TEMPERS			
1100	3003	6061	6063
O	O	O	O
	H112	T4, T4511	T4
		T6, T6511	T5
			T6
STANDARD ALLOYS & SPECIFICATIONS			
1100	3003	6061	6063
ASTM B241	ASTM B241	ASTM B241	ASTM B241
ASTM B221	ASTM B221	ASTM B221	ASTM B221
		AMS 4150	
		ASME SB241	
		MIL-P-25995	
		AMS-QQ-A-200/8	
Notes			
Press minimums vary from 500 – 3,000 lbs. Call for availability.			

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EXTRUDED SEAMLESS ALUMINUM TUBE CAPABILITIES

DIMENSIONAL RANGES - ALLOYS 1100, 3003																	
Wall Thickness (in.)	Outside Diameter (in.)																
	<1.000	1.000	1.250	1.500	1.750	2.000	2.250	2.500	2.750	3.000	3.250	3.500	3.750	4.000	4.250	4.500	4.750
0.000-0.049																	
0.050-0.065																	
0.066-0.074																	
0.075-0.084																	
0.085-0.100																	
0.101-0.124																	
0.125-0.149																	
0.150-0.174																	
0.175-0.199																	
0.200-0.224																	
0.225-0.249																	
0.250-0.274																	
0.275-0.299																	
0.300-0.324																	
0.325-0.349																	
0.350-0.374																	
0.375-0.399																	
0.400-0.449																	
0.450-0.499																	
0.500-0.549																	
0.550-0.599																	
0.600-0.649																	
0.650-0.699																	
0.700-0.749																	
0.750-0.799																	
0.800-0.849																	
0.850-0.899																	
0.900-0.949																	
0.950-1.000																	
>1.000											STI	STI	STI	STI	STI	STI	STI

This area identifies available Extruded Seamless Aluminum Tube dimensional ranges.

■ = Capable STI = Subject to inquiry

SOFT ALLOY TUBE & PIPE



EXTRUDED SEAMLESS ALUMINUM TUBE CAPABILITIES

DIMENSIONAL RANGES - ALLOYS 1100, 3003																	
Wall Thickness (in.)	Outside Diameter (in.)																
	5.000	5.250	5.500	5.750	6.000	6.250	6.500	6.750	7.000	7.250	7.500	7.750	8.000	8.250	8.500	8.625	>8.625
0.000-0.049																	
0.050-0.065																	
0.066-0.074																	
0.075-0.084																	
0.085-0.100	■																
0.101-0.124	■	■	■	■	■												
0.125-0.149	■	■	■	■	■	■	■	■	■	■	■	■					
0.150-0.174	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.175-0.199	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.200-0.224	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.225-0.249	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.250-0.274	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.275-0.299	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.300-0.324	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.325-0.349	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.350-0.374	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.375-0.399	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.400-0.449	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.450-0.499	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.500-0.549	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.550-0.599	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.600-0.649	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.650-0.699	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.700-0.749	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.750-0.799	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.800-0.849	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.850-0.899	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.900-0.949	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.950-1.000	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
>1.000		STI	STI	STI	STI	STI	STI										

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EXTRUDED SEAMLESS ALUMINUM TUBE CAPABILITIES

DIMENSIONAL RANGES - ALLOY 6061																	
Wall Thickness (in.)	Outside Diameter (in.)																
	<1.000	1.000	1.250	1.500	1.750	2.000	2.250	2.500	2.750	3.000	3.250	3.500	3.750	4.000	4.250	4.500	4.750
0.000-0.049																	
0.050-0.065																	
0.066-0.074																	
0.075-0.084																	
0.085-0.100																	
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0.375-0.399																	
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0.650-0.699																	
0.700-0.749																	
0.750-0.799																	
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0.850-0.899																	
0.900-0.949																	
0.950-1.000																	
>1.000												STI	STI	STI	STI	STI	STI

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EXTRUDED SEAMLESS ALUMINUM TUBE CAPABILITIES

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Wall Thickness (in.)	Outside Diameter (in.)																
	5.000	5.250	5.500	5.750	6.000	6.250	6.500	6.750	7.000	7.250	7.500	7.750	8.000	8.250	8.500	8.625	>8.625
0.000-0.049																	
0.050-0.065																	
0.066-0.074																	
0.075-0.084																	
0.085-0.100																	
0.101-0.124	■	■															
0.125-0.149	■	■	■	■	■	■	■					■	■	■	■	■	
0.150-0.174	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.175-0.199	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.200-0.224	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.225-0.249	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.250-0.274	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.275-0.299	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.300-0.324	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.325-0.349	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.350-0.374	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.375-0.399	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.400-0.449	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.450-0.499	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.500-0.549	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.550-0.599	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.600-0.649	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.650-0.699	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.700-0.749	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.750-0.799	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.800-0.849	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.850-0.899	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.900-0.949	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
0.950-1.000	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
>1.000			STI	STI	STI	STI	STI	STI									

This area identifies available Extruded Seamless Aluminum Tube dimensional ranges.

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EXTRUDED SEAMLESS ALUMINUM TUBE CAPABILITIES

DIMENSIONAL RANGES - ALLOY 6063																	
Wall Thickness (in.)	Outside Diameter (in.)																
	<1.000	1.000	1.250	1.500	1.750	2.000	2.250	2.500	2.750	3.000	3.250	3.500	3.750	4.000	4.250	4.500	4.750
0.000-0.049																	
0.050-0.065																	
0.066-0.074																	
0.075-0.084																	
0.085-0.100																	
0.101-0.124																	
0.125-0.149																	
0.150-0.174																	
0.175-0.199																	
0.200-0.224																	
0.225-0.249																	
0.250-0.274																	
0.275-0.299																	
0.300-0.324																	
0.325-0.349																	
0.350-0.374																	
0.375-0.399																	
0.400-0.449																	
0.450-0.499																	
0.500-0.549																	
0.550-0.599																	
0.600-0.649																	
0.650-0.699																	
0.700-0.749																	
0.750-0.799																	
0.800-0.849																	
0.850-0.899																	
0.900-0.949																	
0.950-1.000																	
>1.000												STI	STI	STI	STI	STI	STI

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EXTRUDED SEAMLESS ALUMINUM TUBE CAPABILITIES

DIMENSIONAL RANGES - ALLOY 6063																	
Wall Thickness (in.)	Outside Diameter (in.)																
	5.000	5.250	5.500	5.750	6.000	6.250	6.500	6.750	7.000	7.250	7.500	7.750	8.000	8.250	8.500	8.625	>8.625
0.000-0.049																	
0.050-0.065																	
0.066-0.074									STI	STI	STI	STI	STI				
0.075-0.084									STI	STI	STI	STI	STI				
0.085-0.100									STI	STI	STI	STI	STI	STI	STI	STI	
0.101-0.124																	
0.125-0.149																	
0.150-0.174																	
0.175-0.199																	
0.200-0.224																	
0.225-0.249																	
0.250-0.274																	
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0.375-0.399																	
0.400-0.449																	
0.450-0.499																	
0.500-0.549																	
0.550-0.599																	
0.600-0.649																	
0.650-0.699																	
0.700-0.749																	
0.750-0.799																	
0.800-0.849																	
0.850-0.899																	
0.900-0.949																	
0.950-1.000																	
>1.000		STI	STI	STI	STI	STI	STI										

This area identifies available Extruded Seamless Aluminum Tube dimensional ranges.

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TUBE & PIPE ALLOY 1100

ALLOY DESCRIPTION¹

The purest of the aluminum alloys. This alloy is typically used in applications requiring maximum ductility and relatively low strength. Good corrosion resistance, workability and weldability.

¹ Alloy subject to cast lot quantity restriction

TYPICAL MECHANICAL PROPERTIES

Temper	Tensile (.0625" Dia. Specimen)					Hardness	Shear		Fatigue		Modulus	
	Ultimate		Yield		Elongation/4D		Ultimate Shearing Strength		Endurance Limit - R.R. Moore Type		Modulus of Elasticity	
	KSI	MPa	KSI	MPa		%		KSI	MPa	KSI	MPa	KSI x 10 ³	Gpa
0	13	90	5	35	35	23	9	60	5	35	10.0	69
H14	18	125	17	115	9	32	11	75	7	50	10.0	69
H18	24	165	22	150	5	44	13	90	9	60	10.0	69

COMPARATIVE CHARACTERISTICS

Temper	Corrosion Resistance		Cold Workability ³	Machinability ³	Anodize Response ³	Brazeability ⁴	Weldability ⁴		
	General ¹	Stress ²					Gas	Arc	Spot
O	A	A	A	E	A	A	A	A	B
H14	A	A	A	D	A	A	A	A	A
H18	A	A	C	D	A	A	A	A	A

- Ratings A through E are relative ratings in decreasing order of merit, based on exposures to sodium chloride solution by intermittent spraying or immersion. Alloys with A and B ratings can be used in industrial and seacoast atmospheres without protection. Alloys with C, D and E ratings generally should be protected at least on faying surfaces.
- Stress-corrosion cracking ratings are based on service experience and on laboratory tests of specimens exposed to the 3.5% sodium chloride alternate immersion test.
 A= No known instance of failure in service or in laboratory tests.
 B= No known instance of failure in service; limited failures in laboratory tests of short transverse specimens.
 C= Service failures with sustained tension stress acting in short transverse direction relative to grain structure; limited failures in laboratory tests of long transverse specimens.
 D= Limited service failures with sustained longitudinal or long transverse areas.
- Ratings A through D for Workability (cold), A through E for Machinability and A through C for Anodize Response, are relative ratings in decreasing order of merit.
- Ratings A through D for Weldability and Brazeability are relative ratings defined as follows:
 A= Generally weldable by all commercial procedures and methods.
 B= Weldable with special techniques or for specific applications that justify preliminary trials or testing to develop welding procedure and weld performance.
 C= Limited weldability because of crack sensitivity or loss in resistance to corrosion and mechanical properties.
 D= No commonly used welding methods have been developed.

APPLICABLE SPECIFICATIONS

Cold Drawn	Extruded
ASTM B210	ASTM B221
AMS 4062	ASTM B241
AMS-T-700/1	

CHEMICAL COMPOSITION LIMITS

										Others	
Weight %	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Each	Total
Minimum			0.05								
Maximum	0.95 Si + Fe		0.20	0.05				0.10		0.05	0.15

TYPICAL PHYSICAL PROPERTIES

Characteristic			English	Metric
Nominal Density (68 °F / 20 °C)			0.099 lbs./in. ³	2.71 g/cm ³
Melting Range			1190 °F - 1215 °F	640 °C - 655 °C
Coefficient of Thermal Expansion	Linear		13.1 micro in./in. - °F	23.6 micro m/m - °K
	68 °F - 212 °F 20 °C - 100 °C			
Thermal Conductivity (68 °F / 20 °C)	O		1540 BTU/ft. - hr. - °F	222 W/m - °K
	H18		1510 BTU/ft. - hr. - °F	218 W/m - °K
Electrical Conductivity (68 °F / 20 °C)	Equal Volume	O Temper	59% IACS	34 MS/m
		H18	57% IACS	33 MS/m
	Equal Weight	O Temper	194% IACS	113 MS/m
		H18	187% IACS	108 MS/m

TUBE & PIPE ALLOY 3003

ALLOY DESCRIPTION¹

One of the non-heat treatable manganese alloys. Typically used for condensers and heat exchangers in chemical equipment and pressure vessels. Good corrosion resistance, workability and weldability.

¹ Alloy subject to cast lot quantity restriction

TYPICAL MECHANICAL PROPERTIES

Temper	Tensile (.0625" Dia. Specimen)					Hardness Brinell 500kg 10 mm	Shear		Fatigue		Modulus	
	Ultimate		Yield		Elongation/4D %		Ultimate Shearing Strength		Endurance Limit - R.R. Moore Type		Modulus of Elasticity	
	KSI	MPa	KSI	MPa			KSI	MPa	KSI	MPa	KSI x 10 ³	Gpa
0	16	110	6	40	30	28	11	75	7	50	10.0	69
H14	22	152	21	145	16	40	14	96	9	62	10.0	69

COMPARATIVE CHARACTERISTICS

Temper	Corrosion Resistance		Cold Workability ³	Machinability ³	Anodize Response ³	Brazeability ⁴	Weldability ⁴		
	General ¹	Stress ²					Gas	Arc	Spot
O	A	A	A	E	A	A	A	A	B
H14	A	A	A	D	A	A	A	A	A

- Ratings A through E are relative ratings in decreasing order of merit, based on exposures to sodium chloride solution by intermittent spraying or immersion. Alloys with A and B ratings can be used in industrial and seacoast atmospheres without protection. Alloys with C, D and E ratings generally should be protected at least on faying surfaces.
- Stress-corrosion cracking ratings are based on service experience and on laboratory tests of specimens exposed to the 3.5% sodium chloride alternate immersion test.
 A= No known instance of failure in service or in laboratory tests.
 B= No known instance of failure in service; limited failures in laboratory tests of short transverse specimens.
 C= Service failures with sustained tension stress acting in short transverse direction relative to grain structure; limited failures in laboratory tests of long transverse specimens.
 D= Limited service failures with sustained longitudinal or long transverse areas.
- Ratings A through D for Workability (cold), A through E for Machinability and A through C for Anodize Response, are relative ratings in decreasing order of merit.
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 A= Generally weldable by all commercial procedures and methods.
 B= Weldable with special techniques or for specific applications that justify preliminary trials or testing to develop welding procedure and weld performance.
 C= Limited weldability because of crack sensitivity or loss in resistance to corrosion and mechanical properties.
 D= No commonly used welding methods have been developed.

TUBE & PIPE ALLOY 3003



APPLICABLE SPECIFICATIONS

Cold Drawn	Extruded
ASTM B210 ASTM 234	ASTM B221
AMS 4067/AMS 4065	ASTM B241
AMS-T-700/2	

CHEMICAL COMPOSITION LIMITS

										Others	
Weight %	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Each	Total
Minimum			0.05	1.0							
Maximum	0.60	0.70	0.20	1.5				0.10		0.05	0.15

TYPICAL PHYSICAL PROPERTIES

Characteristic			English	Metric
Nominal Density (68 °F / 20 °C)			0.099 lbs./in. ³	2.73 g/cm ³
Melting Range			1190 °F - 1210 °F	640 °C - 655 °C
Coefficient of Thermal Expansion	Linear 68 °F - 212 °F 20 °C - 100 °C		12.9 micro in./in. - °F	23.2 micro m/m - °K
Thermal Conductivity (68 °F / 20 °C)	O Temper		1340 BTU/ft. - hr. - °F	193 W/m - °K
Electrical Conductivity (68 °F / 20 °C)	Equal Volume	O Temper	50% IACS	29 MS/m
	Equal Weight	O Temper	163% IACS	92 MS/m

TUBE & PIPE ALLOY 6061

ALLOY DESCRIPTION

A good all purpose alloy for applications requiring good corrosion resistance, medium strength, and good machining characteristics. Appearance after anodizing is excellent.

TYPICAL MECHANICAL PROPERTIES

Temper	Tensile (.0625" Dia. Specimen)					Hardness	Shear		Fatigue*1		Modulus*2	
	Ultimate		Yield		Elongation/4D		Ultimate Shearing Strength		Endurance Limit - R.R. Moore Type		Modulus of Elasticity	
	KSI	MPa	KSI	MPa		%		KSI	MPa	KSI	MPa	KSI x 10 ³	Gpa
0	18	124	8	55	25	30	12	83	9	62	10.0	68.3
T4	35	241	21	145	22	65	24	165	14	97	10.0	68.3
T6	45	310	40	276	12	95	30	207	14	97	10.0	68.3

*1 - 5 x 10E8 cycles of reversed stress, *2 – Average Tension and Compression

COMPARATIVE CHARACTERISTICS

Temper	Corrosion Resistance		Cold Workability ³	Machinability ³	Anodize Response ³	Brazeability ⁴	Weldability ⁴		
	General ¹	Stress ²					Gas	Arc	Spot
0	B	A	A	D	A	A	A	A	B
T4	B	B	B	C	A	A	A	A	A
T6	B	A	C	C	A	A	A	A	A

- Ratings A through E are relative ratings in decreasing order of merit, based on exposures to sodium chloride solution by intermittent spraying or immersion. Alloys with A and B ratings can be used in industrial and seacoast atmospheres without protection. Alloys with C, D and E ratings generally should be protected at least on faying surfaces.
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 C= Limited weldability because of crack sensitivity or loss in resistance to corrosion and mechanical properties.
 D= No commonly used welding methods have been developed.

APPLICABLE SPECIFICATIONS

Cold Drawn	Extruded
ASTM B210, B234, B241, B483	ASTM B221
ASME SB210	ASTM B241
AMS 4079, 4080, 4081, 4082, 4083	ASME SB241
AMS-T-700/6, AMS-T-7081	AMS-QQ-A-200/8
MIL-P-25995	

CHEMICAL COMPOSITION LIMITS

Weight %	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Others	
									Each	Total
Minimum	0.40		0.15		0.80	0.04				
Maximum	0.80	0.70	0.40	0.15	1.20	0.35	0.25	0.15	0.05	0.15

TYPICAL PHYSICAL PROPERTIES

Characteristic			English	Metric
Nominal Density (68 °F / 20 °C)			0.098 lbs./in. ³	2.70 g/cm ³
Melting Range			1080 °F - 1206 °F	582 °C - 652 °C
Specific Heat (212 °F / 100 °C)			0.214 BTU/lb. - °F	0.896 J/kg - °K
Coefficient of Thermal Expansion	Linear 68 °F - 212 °F 20 °C - 100 °C		13.1 micro in./in. - °F	23.6 micro m/m - °K
Thermal Conductivity (68 °F / 20 °C)	O Temper		1250 BTU/ft. - hr. - °F	180 W/m - °K
	T4		1070 BTU/ft. - hr. - °F	154 155 W/m - °K
	T6		1160 BTU/ft. - hr. - °F	167 W/m - °K
Electrical Conductivity (68 °F / 20 °C)	Equal Volume	O Temper	47% IACS	27 MS/m
		T4	40% IACS	23 MS/m
		T6	43% IACS	25 MS/m
	Equal Weight	O Temper	155% IACS	90 MS/m
		T4	132% IACS	77 MS/m
		T6	142% IACS	82 MS/m

TUBE & PIPE ALLOY 6063

ALLOY DESCRIPTION

Magnesium/Silicon alloy. One of the most popular of the Heat Treatable alloy group. Excellent corrosion resistance and weldability. Finer grain structure than 6061 lends itself to more aesthetically pleasing anodize results. Target applications include air cylinder tubing, electrical bus conductor and architectural applications.

TYPICAL MECHANICAL PROPERTIES

Temper	Tensile (.0625" Dia. Specimen)					Hardness Brinell 500kg 10 mm	Shear		Fatigue		Modulus	
	Ultimate		Yield		Elongation/4D %		Ultimate Shearing Strength	Endurance Limit - R.R. Moore Type	Modulus of Elasticity			
	KSI	MPa	KSI	MPa		KSI			MPa	KSI x 10 ³	Gpa	
O	13	90	7	50		25	10	70	8	55	10.0	69
T1	22	150	13	90	20	42	14	95	9	60	10.0	69
T4	25	170	13	90	22						10.0	69
T5	27	185	21	145	12	60	17	115	10	70	10.0	69
T52												
T6	35	240	31	215	12	73	22	150	10	70	10.0	69
T832	42	290	39	270	12	95	27	185			10.0	69

COMPARATIVE CHARACTERISTICS

Temper	Corrosion Resistance		Cold Workability ³	Machinability ³	Anodize Response ³	Brazeability ⁴	Weldability ⁴		
	General ¹	Stress ²					Gas	Arc	Spot
T1	A	A	B	D	A	A	A	A	A
T4	A	A	B	D	A	A	A	A	A
T6	A	A	C	C	A	A	A	A	A

- Ratings A through E are relative ratings in decreasing order of merit, based on exposures to sodium chloride solution by intermittent spraying or immersion. Alloys with A and B ratings can be used in industrial and seacoast atmospheres without protection. Alloys with C, D and E ratings generally should be protected at least on faying surfaces.
- Stress-corrosion cracking ratings are based on service experience and on laboratory tests of specimens exposed to the 3.5% sodium chloride alternate immersion test.
 A= No known instance of failure in service or in laboratory tests.
 B= No known instance of failure in service; limited failures in laboratory tests of short transverse specimens.
 C= Service failures with sustained tension stress acting in short transverse direction relative to grain structure; limited failures in laboratory tests of long transverse specimens.
 D= Limited service failures with sustained longitudinal or long transverse areas.
- Ratings A through D for Workability (cold), A through E for Machinability and A through C for Anodize Response, are relative ratings in decreasing order of merit.
- Ratings A through D for Weldability and Brazeability are relative ratings defined as follows:
 A= Generally weldable by all commercial procedures and methods.
 B= Weldable with special techniques or for specific applications that justify preliminary trials or testing to develop welding procedure and weld performance.
 C= Limited weldability because of crack sensitivity or loss in resistance to corrosion and mechanical properties.
 D= No commonly used welding methods have been developed.

APPLICABLE SPECIFICATIONS

Cold Drawn	Extruded
ASTM B210	ASTM B221
ASTM B483	ASTM B241
	ASTM B345
	ASTM B429

CHEMICAL COMPOSITION LIMITS

									Others	
Weight %	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Each	Total
Minimum	.020				0.45					
Maximum	0.60	0.35	0.10	0.10	0.90	0.10	0.10	0.10	0.05	0.15

TYPICAL PHYSICAL PROPERTIES

Characteristic			English	Metric
Nominal Density (68 °F / 20 °C)			0.097 lbs./in. ³	2.70 g/cm ³
Melting Range			1140 °F - 1210 °F	615 °C - 655 °C
Coefficient of Thermal Expansion	Linear 68 °F - 212 °F 20 °C - 100 °C		13.0 micro in./in. - °F	23.4 micro m/m - °K
Thermal Conductivity (68 °F / 20 °C)	O		1510 BTU/ft. - hr. - °F	218 W/m - °K
	T1		1340 BTU/ft. - hr. - °F	193 W/m - °K
	T6		1390 BTU/ft. - hr. - °F	201 W/m - °K
Electrical Conductivity (68 °F / 20 °C)	Equal Volume	O Temper	58% IACS	34 MS/m
		T1	50% IACS	29 MS/m
		T5	55% IACS	32 MS/m
		T6	53% IACS	31 MS/m
	Equal Weight	O Temper	191% IACS	111 MS/m
		T1	165% IACS	96 MS/m
		T5	181% IACS	105 MS/m
		T6	175% IACS	102 MS/m

SOFT ALLOY EXTRUDED TUBE & PIPE DEPOT



EFFECTIVE 1-09 (2)										
Alloy	Temper	Shape	A Dim	B Dim	T Dim	Wall	Length	Stock # East of Rockies	Stock # West of Rockies	Bundle Weight (lbs.)
6063	T52	Extruded Square Tube (1)	1.000	1.000		0.125	21'1"	050		537
6063	T52	Extruded Square Tube (1)	1.500	1.500		0.125	21'1"	053		507
6063	T52	Extruded Square Tube (1)	2.000	2.000		0.125	21'1"	055		691
6063	T52	Extruded Rectangular Tube (1)	1.000	2.000		0.125	21'1"	058		507
6063	T52	Extruded Rectangular Tube (1)	2.000	3.000		0.125	21'1"	065		700
6061	T6	Extruded Structural Pipe (1)	1" NPS 40				20'	286		500
6061	T6	Extruded Structural Pipe	1.25" NPS 40				20'	288	288	503
6061	T6	Extruded Structural Pipe	1.5" NPS 40				20'	289	289	507
6061	T6	Extruded Structural Pipe (1)	2" NPS 40				20'	290		506

Notes

(1) Available East of Rockies ONLY.

(2) Orders received by the cut-off time shown below will ship the following day provided available stock exists and we have a regularly scheduled truck.

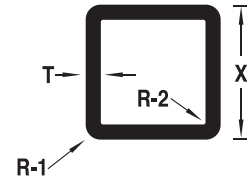
Stocking Depot - Noon Eastern / Los Angeles (local) - 1:00 PM Pacific / Los Angeles (Outside LA area) - 11:30 AM Pacific

All items are subject to a maximum withdrawal of 4M# per week per "Ship To" location.

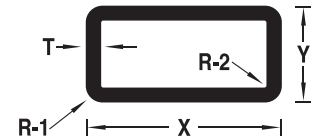
Kaiser Aluminum produces many standard shapes not shown in this depot list.
Please contact your Kaiser sales office for more information.

SELECTED STANDARD TUBE DIE AVAILABILITIES / EXTRUSIONS

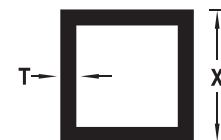
STRUCTURAL SQUARE TUBE WITH ROUNDED CORNERS						
X	T	R-1	R-2	Estimated Weight Per Foot Pounds	Circle Size	Notes
Inches	Inches	Inches	Inches			
1.000	.065	.156	.091	.275	1-2	
1.000	.067	.156	.156	.283	1-2	
1.000	.085	.250	.165	.337	1-2	
1.000	.125	.125	.125	.526	1-2	
1.000	.125	.250	.125	.476	1-2	
1.250	.094	.180	.100	.498	1-2	
1.500	.062	.062	.010	.424	1-2	
2.000	.125	.125	.015	1.109	2-3	
2.000	.125	.250	.125	1.076	2-3	
2.000	.188	.281	.281	1.636	2-3	
3.000	.188	.188	.015	2.502	4-5	
3.000	.250	.250	.062	3.240	4-5	
3.500	.375	.750	.375	5.190	4-5	
4.000	.125	.188	.063	2.293	5-6	
4.000	.175	.375	.375	3.214	5-6	
4.000	.250	.500	.250	4.221	5-6	
5.000	.125	.062	.062	2.867	7-8	(1)
5.000	.250	.500	.250	5.397	6-7	



STRUCTURAL RECTANGULAR TUBE WITH ROUNDED CORNERS							
X	Y	T	R-1	R-2	Estimated Weight Per Foot Pounds	Circle Size	Notes
Inches	Inches	Inches	Inches	Inches			
4.000	2.000	.188	.188	.094	2.511	4-5	
4.000	2.500	.125	.062	.062	1.874	4-5	
4.000	3.000	.188	.188	.015	2.989	5-6	



STRUCTURAL SQUARE TUBE				
X	T	Estimated Weight Per Foot Pounds	Circle Size	Notes
Inches	Inches			
.750	.062	.208	1-2	(1)
.750	.125	.374	1-2	
1.000	.062	.280	1-2	(1)
1.000	.125	.524	1-2	
1.250	.125	.676	1-2	(1)
1.500	.062	.428	2-3	
1.500	.187	1.179	1-2	
1.500	.125	.826	2-3	
1.750	.125	.975	2-3	(1)
2.000	.125	1.126	2-3	
2.000	.187	1.631	2-3	
2.000	.250	2.100	2-3	



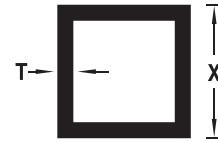
Notes

(1) Available in 6063 alloy only.

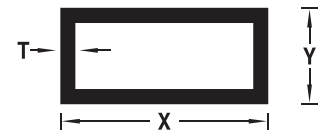
Hollow structural sections manufactured with porthole or bridge-type dies may not be suitable for applications involving internal pressure. Applications requiring internal pressure subject to special inquiry.

SELECTED STANDARD TUBE DIE AVAILABILITIES / EXTRUSIONS

STRUCTURAL SQUARE TUBE				
X	T	Estimated Weight Per Foot Pounds	Circle Size	Notes
Inches	Inches			
2.500	.125	1.426	3-4	
2.500	.188	2.087	3-4	
2.500	.250	2.700	3-4	
3.000	.125	1.726	4-5	
3.000	.188	2.531	4-5	
3.000	.219	2.923	4-5	
3.000	.250	3.300	4-5	
3.500	.125	2.025	4-5	(1)
4.000	.125	2.326	5-6	(1)
4.000	.250	4.500	5-6	
4.000	.313	5.539	5-6	



STRUCTURAL RECTANGULAR TUBE					
X	Y	T	Estimated Weight Per Foot Pounds	Circle Size	Notes
Inches	Inches	Inches			
1.000	.500	.125	.374	1-2	
1.500	.750	.125	.600	1-2	
1.500	1.000	.125	.674	1-2	
1.750	2.000	.125	1.050	2-3	
2.000	1.000	.125	.826	2-3	
2.000	1.500	.125	.976	2-3	
2.250	1.750	.125	1.126	2-3	
2.500	1.250	.125	1.050	2-3	
2.500	2.000	.250	2.400	3-4	
3.000	1.000	.125	1.126	3-4	
3.000	1.500	.125	1.274	3-4	
3.000	1.500	.188	1.861	3-4	
3.000	1.750	.125	1.350	3-4	
3.000	2.000	.125	1.426	3-4	
3.000	2.000	.250	2.700	3-4	
3.500	1.750	.125	1.500	3-4	
4.000	1.750	.094	1.255	4-5	(1)
4.000	1.750	.125	1.650	4-5	
4.000	2.000	.125	1.726	4-5	(1)
4.000	3.000	.125	2.026	4-5	(1)
4.000	3.000	.188	2.989	4-5	
4.500	1.750	.125	1.800	4-5	(1)
5.000	1.750	.125	1.950	5-6	
5.000	1.750	.188	2.876	5-6	
5.000	2.000	.125	2.026	5-6	
5.000	3.000	.125	2.326	5-6	(1)
6.000	2.000	.125	2.326	6-7	(1)
6.000	2.000	.250	4.410	6-7	
6.000	4.000	.250	5.700	7-8	



Notes

(1) Available in 6063 alloy only.

Hollow structural sections manufactured with porthole or bridge-type dies may not be suitable for applications involving internal pressure. Applications requiring internal pressure subject to special inquiry.

SELECTED STANDARD PIPE DIE AVAILABILITIES / EXTRUSIONS



SCHEDULE PIPE								
Nominal Dimensions (in.)			Estimated Weight Per Foot Pounds	USAS Pipe Sizes Schedule Pipe		Available As Seamless	Available As Structural	Notes
X O.D.	Y I.D.	T Wall		Size (in.)	Schedule Number			
.675	.493	.080	.179	.375	40		x	
.840	.622	.109	.294	.500	40		x	
1.050	.824	.113	.391	.750	40	x	x	
1.050	.742	.154	.510	.750	80	x	x	
1.315	1.097	.109	.486	1.000	10	x		
1.315	1.049	.133	.581	1.000	40	x	x	
1.315	.957	.179	.751	1.000	80	x	x	
1.315	.615	.250	.984	1.000	160	x		
1.660	1.530	.065	.383	1.250	5	x		(1)
1.660	1.442	.109	.625	1.250	10	x	x	
1.660	1.380	.140	.786	1.250	40	x	x	
1.660	1.278	.191	1.037	1.250	80	x	x	
1.660	1.160	.250	1.302	1.250	160	x		
1.900	1.770	.065	.441	1.500	5	x		(1)
1.900	1.682	.109	.721	1.500	10	x		
1.900	1.610	.145	.940	1.500	40	x	x	
1.900	1.500	.200	1.256	1.500	80	x	x	
1.900	1.338	.281	1.681	1.500	160	x		
2.375	2.245	.065	.555	2.000	5	x	x	(1)
2.375	2.157	.109	.913	2.000	10	x	x	
2.375	2.067	.154	1.264	2.000	40	x	x	
2.375	1.939	.218	1.737	2.000	80	x	x	
2.375	1.687	.344	2.581	2.000	160	x		
2.875	2.709	.083	.856	2.500	5	x		
2.875	2.635	.120	1.221	2.500	10	x	x	
2.875	2.469	.203	2.004	2.500	40	x	x	
2.875	2.323	.276	2.650	2.500	80	x	x	
2.875	2.125	.375	3.464	2.500	160	x		
3.500	3.334	.083	1.048	3.000	5	x		
3.500	3.260	.120	1.498	3.000	10	x	x	(1)
3.500	3.068	.216	2.621	3.000	40	x	x	
3.500	2.900	.300	3.547	3.000	80	x	x	
3.500	2.624	.438	4.955	3.000	160	x		

Notes

(1) Available in 6063 alloy only.

Hollow structural sections manufactured with porthole or bridge-type dies may not be suitable for applications involving internal pressure. Applications requiring internal pressure subject to special inquiry.

SELECTED STANDARD PIPE DIE AVAILABILITIES / EXTRUSIONS



SCHEDULE PIPE								
Nominal Dimensions (in.)			Estimated Weight Per Foot Pounds	USAS Pipe Sizes Schedule Pipe		Available As Seamless	Available As Structural	Notes
X O.D.	Y I.D.	T Wall		Size (in.)	Schedule Number			
4.000	3.834	.083	1.201	3.500	5	x		
4.000	3.760	.120	1.720	3.500	10	x	x	(1)
4.000	3.548	.226	3.151	3.500	40	x	x	
4.000	3.364	.318	4.326	3.500	80	x	x	
4.500	4.334	.083	1.354	4.000	5	x	x	(1)
4.500	4.260	.120	1.942	4.000	10	x	x	(1)
4.500	4.026	.237	3.733	4.000	40	x	x	
4.500	3.825	.337	5.183	4.000	80	x	x	
4.500	3.624	.438	6.573	4.000	120	x		
4.500	3.438	.531	7.786	4.000	160	x		
5.563	5.345	.109	2.196	5.000	5	x		(1)
5.563	5.295	.134	2.688	5.000	10	x		
5.563	5.047	.258	5.057	5.000	40	x	x	
5.563	4.813	.375	7.188	5.000	80	x	x	
5.563	4.563	.500	9.353	5.000	120	x		
6.625	6.407	.109	2.624	6.000	5	x		(1)
6.625	6.357	.134	3.213	6.000	10	x		
6.625	6.065	.280	6.564	6.000	40	x	x	
6.625	5.761	.432	9.884	6.000	80	x	x	(2)
6.625	5.501	.562	12.589	6.000	120	x		
6.625	5.187	.719	15.668	6.000	160	x		(2)
8.625	8.329	.148	4.635	8.000	10	x		(1)
8.625	8.125	.250	7.735	8.000	20	x		(2)
8.625	7.981	.322	9.878	8.000	40	x	x	(2)
8.625	7.813	.406	12.328	8.000	60	x		(2)
8.625	7.625	.500	15.009	8.000	80	x		(2)

Notes

(1) Available in 6063 alloy only.

(2) Length restrictions apply – Subject to inquiry.

Hollow structural sections manufactured with porthole or bridge-type dies may not be suitable for applications involving internal pressure. Applications requiring internal pressure subject to special inquiry.

AIR BREATHER SEAMLESS ROUND TUBE



AIR BREATHER QUALITY TUBE

Air Breather Seamless Round Tube is an extruded seamless thin wall tube (wall thickness from .050" to .124") that is suitable for anodizing and is relatively free of dents, die lines and other types of surface imperfections. This higher quality tube is commonly used for truck breather tubes, pneumatic tubes and swimming pool cover rolls.

SURFACE FINISH

Produced to 1/2 standard tolerance per Table 12.13 on page KA-TPS-AA4-1.09. Minor scuffs are allowed, scratches are not. Surface is suitable for anodizing.

DENTS

Dents are less frequent and are held to approximately **1/2 standard tolerance** per **Table 12.14 on page KA-TPS-AA4-1.09**. No more than three isolated dents in a 6-foot section. **For this reason it is recommended that orders be entered at the "end use" length and not standard 20-foot lengths.**

Note: O- temper is not covered by Table 12.14. Tolerances for O- temper shall be agreed upon at the time of inquiry/purchase.

To figure dent tolerances using Table 12.14:

- 1. Divide wall thickness by O.D. x 100 which equals the factor percentage**
- 2. Factor percentage x Table 12.2 column three "Other Alloys" (page KA-TPS-AA1-1.09)**
- 3. Divide by two to determine 1/2 standard dent tolerance**

Example: Using a 3.000" O.D. x .065" wall

- .065 wall divided by 3.000 O.D. x 100 = 2.166%
- Table 12.14 states for 2% to 2.5% exclusive - use 2.5 times tolerance
- 2.5 times tolerance shown in Table 12.2 column 3, sub-column "other alloys" is .030", or 2.5 x .030 = .075
- .075 divided by 2 = .0375 rounded to .038" for 1/2 standard dent tolerance

AIR BREATHER SEAMLESS ROUND TUBE



DENTS

The more common sizes are listed below showing the maximum dent depth.

O.D. (in.)	Wall (in.)	I.D. (in.)	Wt./Ft. (lbs.)	Max. Dent Depth (in.)
2.500	0.078	2.344	0.6908	0.015
3.000	0.065	2.870	0.6976	0.038
3.500	0.065	3.370	0.8165	0.045
3.500	0.078	3.344	0.9761	0.038
4.000	0.062	3.876	0.8929	0.075
4.000	0.072	3.856	1.0342	0.075
5.000	0.062	4.876	1.1196	0.100
5.000	0.078	4.844	1.4039	0.075
5.500	0.072	5.356	1.4292	0.100
6.000	0.072	5.856	1.5608	0.150
6.000	0.078	5.844	1.6892	0.150
7.000	0.078	6.844	1.9744	0.150
7.000	0.094	6.812	2.3739	0.150
8.000	0.072	7.856	2.0874	0.200
8.000	0.078	7.844	2.2597	0.200
8.000	0.083	7.834	2.4030	0.200

OVALITY

For walls less than 2.5% of the O.D., the ovality tolerances are **TWO TIMES** the tolerance shown on Table 12.2, column 3 “Other Alloys” (page KA-TPS-AA1-1.09).

For walls greater than 2.5% of the O.D., the ovality tolerances are as published in Table 12.2, column 3 “Other Alloys”.

Note: O- temper is not covered by Table 12.2 if wall thickness is less than 2.5% of outside diameter. The wall thickness of most Air Breather Seamless Tube is less than 2.5% of outside diameter. Tolerances for these sizes in O- temper shall be agreed upon at the time of inquiry/purchase.

AIR BREATHER SEAMLESS ROUND TUBE



PACK

Standard pack is 300# and over AngleBoard Crate with paper interleave. Customers may request other packing and this would be subject to inquiry.

Based on standard AngleBoard crate pack and 20 foot lengths, one truck can be loaded with **8 crates**. Listed below are pieces per crate and pieces per truckload by Outside Diameter of the tube.

Outside Diameter	Pieces Per Crate	Pieces Per Truckload
3.000	175	1400
3.500	132	1056
4.000	95	760
4.500	77	616
5.000	60	480
5.500	48	384
6.000	42	336
7.000	30	240

Maximum cut-to-length for vertical cell pack is 36". Box size is 40" x 40".

In most cases the \$30.00/box minimum charge will apply since 300# minimum weight may not be achievable.

LENGTHS

Because of dent tolerances, the preferred length would be the customer's end use length.

All information contained herein or related hereto is intended only for evaluation by technically skilled persons, with any use thereof to be at their independent discretion and risk. Such information is believed to be reliable, but Kaiser Aluminum shall have no responsibility or liability for results obtained or damages resulting from such use. Kaiser Aluminum grants no license under, and shall have no responsibility or liability for infringement of, any patent or other proprietary right. Sales of Kaiser Aluminum's products shall be independent and subject exclusively to warranties set forth in Kaiser Aluminum's order acknowledgment. The foregoing may be waived or modified only in writing by Kaiser Aluminum.

SOFT ALLOY EXTRUSIONS



PRODUCT ADDERS

ALLOY & TEMPER ADDERS			
Alloy / Temper	Adder / Deductor	Alloy / Temper	Adder / Deductor
6061 T6, T6511 (fine grain)	+.05 / lb. to 6061 base price	6101 all tempers**	+.10 / lb. to 6061 base price
6061, 6063 F	-.01 / lb. from alloy base price	6005 all tempers**	Use 6061 base price
1100 F**	+.25 / lb. to 6061 base price	6105 all tempers**	+.05 / lb. to 6061 base price
3003 H112**	+.35 / lb. to 6061 base price	7005 all tempers**	+.25 / lb. to 6061 base price
1350 H111**	+.25 / lb. to 6063 base price	6082 F, T6	+.05 / lb. to 6061 base price
6070** all tempers	+.10 / lb. to 6061 base price	6061 T6B2, T6B11	+.05 / lb. to 6061 base price
O (annealed) temper			
500 - 1,999 lbs.	+.20 / lb. to alloy base price	5,000 - 9,999 lbs.	+.06 / lb. to alloy base price
2,000 - 4,999 lbs.	+.12 / lb. to alloy base price	10,000 - 30,000 lbs.	+.03 / lb. to alloy base price

*Excludes Drawn Tube / Tempers T61, T63, T64 & T65 are subject to 10,000# age oven minimums / **Select alloys - Subject to inquiry

SPECIFIED LENGTH ADDERS				
Specified Length	lbs. / ft.			
	.125 - .249	.250 - .499	.500 - .999	1.00 & over
3' - 5'	+.055 / lb.	+.040 / lb.	+.035 / lb.	+.030 / lb.
Over 5' - 7'	+.025 / lb.	+.020 / lb.	+.015 / lb.	+.010 / lb.
Over 7' - 40'	BASE	BASE	BASE	BASE
Over 40' - 48'	+.025 / lb.	+.020 / lb.	+.015 / lb.	+.010 / lb.
Over 48'	Subject to inquiry - may require special transportation with additional charge			

PRODUCT ADDERS		
Light Weight Adders	Weight Per Foot	Adder
	.100 to less than .150	+.10 / lb.
	.150 to less than .200	+.07 / lb.
6061 Thin / Wide Bar Adders	.200 to less than .400	+.05 / lb.
	.125" Thickness	Adder
	Widths 5" to not including 6"	+.10 / lb.
	Widths 6" to not including 7"	+.15 / lb.
	Widths 7" and over	+.20 / lb.

STANDARD SHIPPING TOLERANCE	
10,000 lbs. & over	5%
2,000 lbs. - 9,999 lbs.	8%
500 lbs. - 1,999 lbs.	15%
Under 500 lbs.	35%

PACKAGING ADDERS			
Paper or Stretch Wrap Bundle	\$0.05 / lb.	Dustcover	\$0.02 / lb.
Individual Paper Wrap	\$0.10 / lb.	Sling Board	\$0.04 / lb.
Chipboard Strip Layer Separation	\$0.03 / lb.	Skid	\$0.06 / lb.
Fiberboard Overwrap	\$0.03 / lb.	Fiber Box	\$0.06 / lb.
Paper Layer Separation	\$0.04 / lb.	Tri-Wall Box	\$0.09 / lb.
Horizontal & Vertical Separation	\$0.05 / lb.	Angle Board Crate (300 lb. min.)	\$0.11 / lb.
Interleaving	\$0.06 / lb.	Wooden Box (300 lb. min.)	\$0.35 / lb.
Styrofoam Saddle Pack	\$0.07 / lb.	Export Treated Wood	\$0.03 / lb.

OTHER ADDERS			
Actual Chemistry	\$100 / lot	Drop Ship Fee	\$400 / load
Mechanical Testing	\$50 / item	Oiling	\$0.05 / lb.
100% Visual Inspection	\$0.02 / lb.	High Voltage Bus Pipe	\$0.10 / lb. + Freight
Dimensional Checking	\$0.02 / lb.	Roll Contour - 50%	\$0.05 / lb.
Exact Piece Count	\$250 / item	Roll Contour - 100%	\$0.10 / lb.
Warehouse Restocking Fee	\$0.10 / lb. + Freight		

SOFT ALLOY EXTRUSIONS



PRESS MINIMUMS

ROD & BAR PRODUCTS – EXCLUDING MANIFOLD BAR*	
Size Range	Press Minimum
Up to 4.99 lbs. / ft.	1,000 lbs.
5.00 Up to 14.99 lbs. / ft.	1,500 lbs.
15.00 Up to 19.99 lbs. / ft.	2,000 lbs.
20.00 Up to 44.99 lbs. / ft.	3,000 lbs.
45.00 lbs. / ft. & greater	4,000 lbs.
STANDARD STRUCTURALS	
Size Range	Press Minimum
Up to 5.99" Circle Size	1,000 lbs.
6.00" Circle Size to 9.99" Circle Size	2,000 lbs.
10.00" Circle Size & greater	3,000 lbs.
SOLID SHAPES	
Size Range	Press Minimum
Up to 8.00" Circle Size	2,000 lbs.
Over 8.00" Circle Size	3,000 lbs.
SEMI-HOLLOW/HOLLOW SHAPES	
Size Range	Press Minimum
Up to 5.99" Circle Size	2,000 lbs.
6.00" Circle Size & greater	3,000 lbs.
STRUCTURAL TUBE/PIPE	
Size Range	Press Minimum
Up to 3.99" Circle Size	1,000 lbs.
4.00" Circle Size to 5.99" Circle Size	2,000 lbs.
6.00" Circle Size & greater	3,000 lbs.
SEAMLESS TUBE/PIPE	
Size Range	Press Minimum
Small Press (Thru 6.000" O.D. & 4.100 lbs. / ft.)	500 lbs.
Large Press (Over 6.000" O.D. & 4.101 lbs. / ft.)	1,000 lbs.
DRAWN SEAMLESS TUBE	
Size Range	Press Minimum
2.125" thru 6.250" O.D.	2,000 lbs.
*MANIFOLD BAR	
Size Range	Press Minimum
Manifold Bar - up to 44.99 lbs. / ft.	3,000 lbs.
Manifold Bar - 45.00 lbs. / ft. & greater	4,000 lbs.

Notes

The plant reserves the right to request a special press minimum on high difficulty shapes.

The above applies to 6061, 6262 & 6063 only in standard tempers.

TABLE 12.2 Diameter—Round Tube

EXCEPT FOR T3510, T4510, T6510, T73510, T76510 AND T8510 TEMPERS ⑦

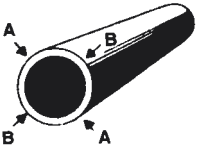
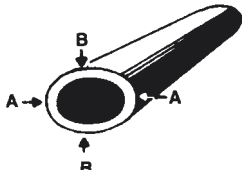
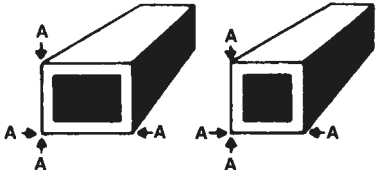
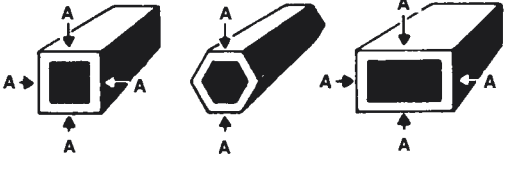
SPECIFIED DIAMETER ① in.	TOLERANCE ②—in. plus and minus			
	ALLOWABLE DEVIATION OF MEAN DIAMETER ③ FROM SPECIFIED DIAMETER (Size)		ALLOWABLE DEVIATION OF DIAMETER AT ANY POINT FROM SPECIFIED DIAMETER ④	
	 Difference between ½ (AA+BB) and specified diameter		 Difference between AA or BB and specified diameter	
Col. 1	Col. 2		Col. 3	
	5xxx ≥4.0 nominal Mg ⑩	Other Alloys	5xxx ≥4.0 nominal Mg ⑩	Other Alloys
0.500–0.999	.015	.010	.030	.020
1.000–1.999	.018	.012	.038	.025
2.000–3.999	.023	.015	.045	.030
4.000–5.999	.038	.025	.075	.050
6.000–7.999	.053	.035	.113	.075
8.000–9.999	.068	.045	.150	.100
10.000–11.999	.083	.055	.188	.125
12.000–13.999	.098	.065	.225	.150
14.000–15.999	.113	.075	.263	.175
16.000–17.999	.128	.085	.300	.200
18.000–19.999	.143	.095	.338	.225
20.000–21.999	.158	.105	.375	.250
22.000–23.999	.173	.115	.413	.275

TABLE 12.3 Width and Depth—Square, Rectangular, Hexagonal and Octagonal Tube

EXCEPT FOR T3510, T4510, T6510, T73510, T76510 AND T8510 TEMPERS ⑦

SPECIFIED WIDTH OR DEPTH in.	TOLERANCE ②—in. plus and minus				
	ALLOWABLE DEVIATION OF WIDTH OR DEPTH AT CORNERS FROM SPECIFIED WIDTH OR DEPTH		ALLOWABLE DEVIATION OF WIDTH OR DEPTH NOT AT CORNERS FROM SPECIFIED WIDTH OR DEPTH ④		
	 Difference between AA and specified width or depth		 Difference between AA and specified width, depth, or distance across flats		
Col. 1	Col. 2		Col. 3		Col. 4
	5xxx ≥4.0 nominal Mg ⑩	Other Alloys	5xxx ≥4.0 nominal Mg ⑩	Other Alloys	All Alloys
0.500–0.749	.018	.012	.030	.020	The tolerance for the width is the value in the previous column for a dimension equal to the depth, and conversely, but in no case is the tolerance less than at the corners. Example: The width tolerance of a 1 × 3 inch alloy 6061 rectangular tube is ±0.025 inch and the depth tolerance ±0.035 inch.
0.750–0.999	.021	.014	.030	.020	
1.000–1.999	.027	.018	.038	.025	
2.000–3.999	.038	.025	.053	.035	
4.000–4.999	.053	.035	.068	.045	
5.000–5.999	.068	.045	.083	.055	
6.000–6.999	.083	.055	.098	.065	
7.000–7.999	.098	.065	.108	.075	
8.000–8.999	.113	.075	.123	.085	
9.000–9.999	.128	.085	.143	.095	
10.000–10.999	.143	.095	.158	.105	
11.000–12.999	.158	.105	.173	.115	

For all numbered footnotes, see page KA-TPS-AA4-1.09

TABLE 12.4 Wall Thickness—Round Extruded Tube


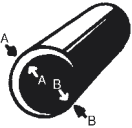
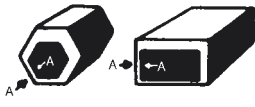
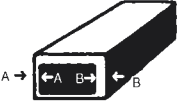
SPECIFIED WALL THICKNESS ⑥ in.	TOLERANCE ① ②—in. plus and minus								ALLOWABLE DEVIATION OF WALL THICKNESS AT ANY POINT FROM MEAN WALL THICKNESS ⑤ (Eccentricity)  Difference between AA and mean wall thickness
	ALLOWABLE DEVIATION OF MEAN WALL THICKNESS ⑤ FROM SPECIFIED WALL THICKNESS  Difference between ½ (AA + BB) and specified wall thickness								
	OUTSIDE DIAMETER—IN.								
	Under 1.250		1.250–2.999		3.000–4.999		5.000 and over		
Col. 1	Col. 2		Col. 3		Col. 4		Col. 5		Col. 6
	5xxx ≥4.0 nominal Mg ⑯	Other Alloys	5xxx ≥4.0 nominal Mg ⑯	Other Alloys	5xxx ≥4.0 nominal Mg ⑯	Other Alloys	5xxx ≥4.0 nominal Mg ⑯	Other Alloys	
Under 0.047	.009	.006	Plus and minus 10% of mean wall thickness
0.047–0.061	.011	.007	.012	.008	.012	.008	.015	.010	
0.062–0.077	.012	.008	.012	.008	.014	.009	.018	.012	
0.078–0.124	.014	.009	.014	.009	.015	.010	.023	.015	
0.125–0.249	.014	.009	.014	.009	.020	.013	.030	.020	
0.250–0.374	.017	.011	.017	.011	.024	.016	.038	.025	
0.375–0.499023	.015	.032	.021	.053	.035	max ±0.060 min ±0.010
0.500–0.749	..	..	.030	.020	.042	.028	.068	.045
0.750–0.999	..	..	..	..	.053	.035	.083	.055
1.000–1.499	..	..	..	..	.068	.045	.098	.065
1.500–2.000	..	..	..	..	..	..	.113	.075
2.001–2.499128	.085	±0.120
2.500–2.999	..	..	..	..	..	..	.143	.095
3.000–3.499	..	..	..	..	..	..	.158	.105
3.500–4.000	..	..	..	..	..	..	.173	.115

TABLE 12.5 Wall Thickness—Other-Than-Round Extruded Tube

SPECIFIED WALL THICKNESS ⑥ in.	TOLERANCE ① ②—in. plus and minus						ALLOWABLE DEVIATION OF WALL THICKNESS AT ANY POINT FROM MEAN WALL THICKNESS ⑤ (Eccentricity)  Difference between AA and mean wall thickness	
	ALLOWABLE DEVIATION OF MEAN WALL THICKNESS ⑤ FROM SPECIFIED WALL THICKNESS  Difference between ½ (AA + BB) and specified wall thickness							
	CIRCUMSCRIBING CIRCLE DIAMETER ⑩—in.							
	Under 5.000		5.000 and over		Under 5.000			5.000 and over
Col. 1	Col. 2		Col. 3		Col. 4		Col. 5	
	5xxx ≥4.0 nominal Mg ⑯	Other Alloys	5xxx ≥4.0 nominal Mg ⑯	Other Alloys	All Alloys	All Alloys	All Alloys	All Alloys
Under 0.047	.008	.005	.012	.008	.005	.005	Plus and minus 10% of mean wall thickness	
0.047–0.061	.009	.006	.014	.009	.007	.007		
0.062–0.124	.011	.007	.015	.010	.010	.010		
0.125–0.249	.012	.008	.023	.015	.015	.015		
0.250–0.374	.017	.011	.030	.020	.025	.025		
0.375–0.499	.021	.014	.045	.030	.030	.030		max ±0.060 min ±0.010
0.500–0.749	.038	.025	.060	.040	.040	.040		
0.750–0.999	.053	.035	.075	.050	.050	.050		
1.000–1.499	.068	.045	.090	.060	.060	.060		
1.500–2.000	..	..	.105	.070	..	..

For all numbered footnotes, see page KA-TPS-AA4-1.09

TABLE 12.6 Length—Extruded Tube

SPECIFIED OUTSIDE DIAMETER OR WIDTH in.	TOLERANCE—in. plus excepted as noted							
	ALLOWABLE DEVIATION FROM SPECIFIED LENGTH							
	STRAIGHT				COILED			
	SPECIFIED LENGTH—ft.							
	Up thru 12	Over 12 thru 30	Over 30 thru 50	Over 50	Up thru 100	Over 100 thru 250	Over 250 thru 500	Over 500
0.500–1.249	1/8	1/4	3/8	1	+5%, -0%	±10%	±15%	±20%
1.250–2.999	1/8	1/4	3/8	1	..	..	..	..
3.000–7.999	3/16	5/16	7/16	1	..	..	..	..
8.000 and over	1/4	3/8	1/2	1	..	..	..	..

TABLE 12.7 Twist ⑩—Other-than-Round Extruded Tube

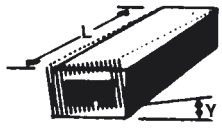
TEMPER	SPECIFIED WIDTH in.	SPECIFIED THICKNESS in.	TOLERANCE ⑨—Degrees	
			ALLOWABLE DEVIATION FROM STRAIGHT	
			IN TOTAL LENGTH OR IN ANY SEGMENT OF ONE FT. OR MORE OF TOTAL LENGTH	MAXIMUM FOR TOTAL LENGTH
All except O, TX510, TX511 ⑧	0.500 thru 1.499	All	 <p>Y (max.) in degrees</p>	
	1.500–2.999	All		
	3.000 and over	All		
O, TX510 ⑧	0.500 and over	0.095 and over	⑦	⑦
TX511 ⑧	0.500–1.499	0.095 and over	1 × Measured length, ft. 1/2 × Measured length, ft. 1/4 × Measured length, ft.	7 5 3
	1.500–2.999	0.095 and over		
	3.000 and over	0.095 and over		

TABLE 12.8 Straightness—Extruded Tube in Straight Lengths

TEMPER	SPECIFIED WIDTH in.	TOLERANCE ⑨ ⑫—in.
		ALLOWABLE DEVIATION (D) FROM STRAIGHT
		IN TOTAL LENGTH OR IN ANY SEGMENT OF ONE FT. OR MORE OF TOTAL LENGTH
All except O, TX510 ⑧	0.500–5.999	.010 × Measured length, ft.
	6.000 and over	.020 × Measured length, ft.
O, TX510 ⑧	0.500 and over	⑦

TABLE 12.9 Flatness (Flat Surfaces)—Extruded Tube

EXCEPT FOR O, T3510, T4510, T6510, T73510, T76510 AND T8510 TEMPER ⑦

MINIMUM THICKNESS OF METAL FORMING THE SURFACE in.	TOLERANCE—in.	
	Maximum Allowable Deviation Y	
	WIDTHS UP THRU 1 IN. OR ANY 1 IN. INCREMENT OF WIDER SURFACES	WIDTHS OVER 1 IN. THRU 5.999 IN.
Up thru 0.187 0.188 and over	0.006 0.004	0.006 × W (inches) 0.004 × W (inches)

For all numbered footnotes, see page KA-TPS-AA4-1.09

**TABLE 12.10 Squareness of Cut Ends—
Extruded Tube**

Allowable deviation from square: 1 degree.
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TABLE 12.11 Corner and Fillet Radii—Extruded Tube

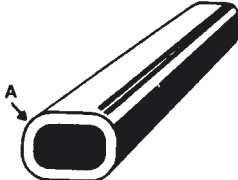
SPECIFIED RADIUS [®] in.	TOLERANCE—in.
	ALLOWABLE DEVIATION FROM SPECIFIED RADIUS
	
Sharp corners 0.016–0.187 0.188 and over	+ $\frac{1}{64}$ $\pm\frac{1}{64}$ $\pm 10\%$

TABLE 12.12 Angularity—Extruded Tube

Allowable deviation from square: ± 2 degrees.

Footnotes for Tables 12.2 through 12.14

- ① When outside diameter, inside diameter, and wall thickness (or their equivalent dimensions in other than round tube) are all specified, standard tolerances are applicable to any two of these dimensions, but not to all three. When both outside and inside diameters or inside diameter and wall thickness are specified, the tolerance applicable to the specified or calculated O.D. dimension shall also apply to the I.D. dimension.
- ② When a dimension tolerance is specified other than as an equal bilateral tolerance, the value of the standard tolerance is that which applied to the mean of the maximum and minimum dimensions permissible under the tolerance for the dimension under consideration.
- ③ Mean diameter is the average of two diameter measurements taken at right angles to each other at any point along the length.
- ④ Not applicable in the annealed (O) temper of if wall thickness is less than 2½ percent of outside diameter of a circle having a circumference equal to the perimeter of the tube.
- ⑤ The mean wall thickness of round tube is the average of two measurements taken opposite each other. The mean wall thickness of other-than-round tube is the average of two measurements taken opposite each other at approximate center line of tube and perpendicular to the longitudinal axis of the cross section.
- ⑥ When dimensions specified are outside and inside, rather than wall thickness itself, allowable deviation at any point (eccentricity) applies to mean wall thickness.
- ⑦ Tolerances for O, T3510, T4510, T6510, T73510, T76510 and T8510 tempers shall be as agreed upon between purchaser and vendor at the time the contract or order is entered.
- ⑧ TX510 and TX511 are general designations for the following stress-relieved tempers: T3510, T4510, T6510, T8510, T73510, T76510; and T3511, T4511, T6511, T8511, T73511, T76511, respectively.
- ⑨ When weight of piece on flat surface minimizes deviation.
- ⑩ The circumscribing circle diameter is the diameter of the smallest circle that will completely enclose the cross section of the extruded product.
- ⑪ Twist is normally measured by placing the extruded tube on a flat surface

**TABLE 12.13 Surface Roughness [®] ^⑭ ^⑰—
Extruded Tube**

Specified Outside Diameter in.	Specified Wall Thickness in.	Allowable Depth of Conditions [®] in., max.
Up thru 12.750	Up thru 0.063	0.0025
	0.064–0.125	0.003
	0.126–0.188	0.0035
	0.189–0.250	0.004
	0.251–0.500	0.005
12.751–15.000	0.501 and over	0.008
	Up thru 0.500	0.010
15.001–20.000	0.501 and over	0.012
	Up thru 0.500	0.015
20.001 and over	0.501 and over	0.015
	Up thru 0.500	0.020

TABLE 12.14 Dents [®]—Extruded Tube

Depth of dents shall not exceed twice the tolerances specified in Table 12.2 for diameter at any point from specified diameter, except for tube having a wall thickness less than 2.5 percent of the outside diameter, in which case the following multipliers apply:

- 2% to 2½% exclusive—2.5 × tolerance (max.)
- 1½% to 2% exclusive—3.0 × tolerance (max.)
- 1% to 1½% exclusive—4.0 × tolerance (max.)

and at any point along its length measuring the maximum distance between the bottom surface of the extruded tube and the flat surface. From this measurement, the actual deviation from straightness of the extruded tube at that point is subtracted. The remainder is the twist. To convert the standard twist tolerance (degrees) to an equivalent linear value, the sine of the standard tolerance is multiplied by the width of the surface of the section that is on the flat surface. The following values are used to convert angular tolerances to linear deviation:

Tolerance, degrees	Maximum allowable linear deviation inch per inch of width
¼	0.004
½	0.009
1	0.017
1½	0.026
3	0.052
5	0.087
7	0.122
9	0.156
15	0.259
21	0.358

- ⑫ Tolerances not applicable to TX510, or TX511 temper tube having a wall thickness less than 0.095 in.
- ⑬ Conditions include die lines, mandrel lines and handling marks.
- ⑭ For tube over 12.750 in. O.D. the 2000 and 7000 series alloys and 5000 series alloys with nominal magnesium content of 3 percent or more are excluded.
- ⑮ Not applicable to O temper tube.
- ⑯ Tolerances apply to 5xxx alloys with $\geq 4.0\%$ Mg.
- ⑰ Not applicable to 2219 alloy tube. Most tubes in 2219 alloy will have die lines about twice the depth shown in the table; however, for each tube size the supplier should be contacted for the roughness value to apply.
- ⑱ If unspecified, the radius shall be ½ in. maximum including tolerances.

TABLE 12.55 Diameters, Wall Thicknesses, Weights—Pipe

NOMINAL PIPE SIZE ^① IN.	SCHEDULE NUMBER	OUTSIDE DIAMETER in.			INSIDE DIAMETER in.	WALL THICKNESS in.			WEIGHT PER FOOT lb.	
		Nom. ^①	Min ^{② ④}	Max. ^{② ④}	Nom.	Nom. ^①	Min ^②	Max. ^②	Nom. ^③	Max. ^{② ③}
1/8	40	0.405	0.374	0.420	0.269	0.068	0.060	..	0.085	0.091
	80	0.405	0.374	0.420	0.215	0.095	0.083	..	0.109	0.118
1/4	40	0.540	0.509	0.555	0.364	0.088	0.077	..	0.147	0.159
	80	0.540	0.509	0.555	0.302	0.119	0.104	..	0.185	0.200
3/8	40	0.675	0.644	0.690	0.493	0.091	0.080	..	0.196	0.212
	80	0.675	0.644	0.690	0.423	0.126	0.110	..	0.256	0.276
1/2	5	0.840	0.809	0.855	0.710	0.065	0.053	0.077	0.186	..
	10	0.840	0.809	0.855	0.674	0.083	0.071	0.095	0.232	..
	40	0.840	0.809	0.855	0.622	0.109	0.095	..	0.294	0.318
	80	0.840	0.809	0.855	0.546	0.147	0.129	..	0.376	0.406
3/4	160	0.840	0.809	0.855	0.464	0.188	0.164	..	0.453	0.489
	5	1.050	1.019	1.065	0.920	0.065	0.053	0.077	0.237	..
	10	1.050	1.019	1.065	0.884	0.083	0.071	0.095	0.297	..
	40	1.050	1.019	1.065	0.824	0.113	0.099	..	0.391	0.422
1	80	1.050	1.019	1.065	0.742	0.154	0.135	..	0.510	0.551
	160	1.050	1.019	1.065	0.612	0.219	0.192	..	0.672	0.726
	5	1.315	1.284	1.330	1.185	0.065	0.053	0.077	0.300	..
	10	1.315	1.284	1.330	1.097	0.109	0.095	0.123	0.486	..
1 1/4	40	1.315	1.284	1.330	1.049	0.133	0.116	..	0.581	0.627
	80	1.315	1.284	1.330	0.957	0.179	0.157	..	0.751	0.811
	160	1.315	1.284	1.330	0.815	0.250	0.219	..	0.984	1.062
	5	1.660	1.629	1.675	1.530	0.065	0.053	0.077	0.383	..
1 1/2	10	1.660	1.629	1.675	1.442	0.109	0.095	0.123	0.625	..
	40	1.660	1.629	1.675	1.380	0.140	0.122	..	0.786	0.849
	80	1.660	1.629	1.675	1.278	0.191	0.167	..	1.037	1.120
	160	1.660	1.629	1.675	1.160	0.250	0.219	..	1.302	1.407
1 3/4	5	1.900	1.869	1.915	1.770	0.065	0.053	0.077	0.441	..
	10	1.900	1.869	1.915	1.682	0.109	0.095	0.123	0.721	..
	40	1.900	1.869	1.915	1.610	0.145	0.127	..	0.940	1.015
	80	1.900	1.869	1.915	1.500	0.200	0.175	..	1.256	1.357
2	160	1.900	1.869	1.915	1.338	0.281	0.246	..	1.681	1.815
	5	2.375	2.344	2.406	2.245	0.065	0.053	0.077	0.555	..
	10	2.375	2.344	2.406	2.157	0.109	0.095	0.123	0.913	..
	40	2.375	2.351	2.399	2.067	0.154	0.135	..	1.264	1.365
2 1/2	80	2.375	2.351	2.399	1.939	0.218	0.191	..	1.737	1.876
	160	2.375	2.351	2.399	1.687	0.344	0.301	..	2.581	2.788
	5	2.875	2.844	2.906	2.709	0.083	0.071	0.095	0.856	..
	10	2.875	2.844	2.906	2.635	0.120	0.105	0.135	1.221	..
3	40	2.875	2.846	2.904	2.469	0.203	0.178	..	2.004	2.164
	80	2.875	2.846	2.904	2.323	0.276	0.242	..	2.650	2.862
	160	2.875	2.846	2.904	2.125	0.375	0.328	..	3.464	3.741
	5	3.500	3.469	3.531	3.334	0.083	0.071	0.095	1.048	..
3 1/2	10	3.500	3.469	3.531	3.260	0.120	0.105	0.135	1.498	..
	40	3.500	3.465	3.535	3.068	0.216	0.189	..	2.621	2.830
	80	3.500	3.465	3.535	2.900	0.300	0.262	..	3.547	3.830
	160	3.500	3.465	3.535	2.624	0.438	0.383	..	4.955	5.351
4	5	4.000	3.969	4.031	3.834	0.083	0.071	0.095	1.201	..
	10	4.000	3.969	4.031	3.760	0.120	0.105	0.135	1.720	..
	40	4.000	3.960	4.040	3.548	0.226	0.198	..	3.151	3.403
	80	4.000	3.960	4.040	3.364	0.318	0.278	..	4.326	4.672

For all numbered footnotes, see page KA-TPS-AA6-1.09

TABLE 12.55 Diameters, Wall Thicknesses, Weights—Pipe (concluded)

NOMINAL PIPE SIZE ^① IN.	SCHEDULE NUMBER	OUTSIDE DIAMETER in.			INSIDE DIAMETER in.	WALL THICKNESS in.			WEIGHT PER FOOT lb.		
		Nom. ^①	Min ^{② ④}	Max. ^{② ④}	Nom.	Nom. ^①	Min ^②	Max. ^②	Nom. ^③	Max. ^{② ③}	
4	5	4.500	4.469	4.531	4.334	0.083	0.071	0.095	1.354	..	
	10	4.500	4.469	4.531	4.260	0.120	0.105	0.135	1.942	..	
	40	4.500	4.455	4.545	4.026	0.237	0.207	..	3.733	4.031	
	80	4.500	4.455	4.545	3.826	0.337	0.295	..	5.183	5.598	
	120	4.500	4.455	4.545	3.624	0.438	0.383	..	6.573	7.099	
	160	4.500	4.455	4.545	3.438	0.531	0.465	..	7.786	8.409	
5	5	5.563	5.532	5.625	5.345	0.109	0.095	0.123	2.196	..	
	10	5.563	5.532	5.625	5.295	0.134	0.117	0.151	2.688	..	
	40	5.563	5.507	5.619	5.047	0.258	0.226	..	5.057	5.461	
	80	5.563	5.507	5.619	4.813	0.375	0.328	..	7.188	7.763	
	120	5.563	5.507	5.619	4.563	0.500	0.438	..	9.353	10.10	
	160	5.563	5.507	5.619	4.313	0.625	0.547	..	11.40	12.31	
6	5	6.625	6.594	6.687	6.407	0.109	0.095	0.123	2.624	..	
	10	6.625	6.594	6.687	6.357	0.134	0.117	0.151	3.213	..	
	40	6.625	6.559	6.691	6.065	0.280	0.245	..	6.564	7.089	
	80	6.625	6.559	6.691	5.761	0.432	0.378	..	9.884	10.67	
	120	6.625	6.559	6.691	5.501	0.562	0.492	..	12.59	13.60	
	160	6.625	6.559	6.691	5.187	0.719	0.629	..	15.69	16.94	
8	5	8.625	8.594	8.718	8.407	0.109	0.095	0.123	3.429	..	
	10	8.625	8.594	8.718	8.329	0.148	0.130	0.166	4.635	..	
	20	8.625	8.539	8.711	8.125	0.250	0.219	..	7.735	8.354	
	30	8.625	8.539	8.711	8.071	0.277	0.242	..	8.543	9.227	
	40	8.625	8.539	8.711	7.981	0.322	0.282	..	9.878	10.67	
	60	8.625	8.539	8.711	7.813	0.406	0.355	..	12.33	13.31	
	80	8.625	8.539	8.711	7.625	0.500	0.438	..	15.01	16.21	
	100	8.625	8.539	8.711	7.437	0.594	0.520	..	17.62	19.03	
	120	8.625	8.539	8.711	7.187	0.719	0.629	..	21.00	22.68	
	140	8.625	8.539	8.711	7.001	0.812	0.710	..	23.44	25.31	
	160	8.625	8.539	8.711	6.813	0.906	0.793	..	25.84	27.90	
	10	5	10.750	10.719	10.843	10.482	0.134	0.117	0.151	5.256	..
		10	10.750	10.719	10.843	10.420	0.165	0.144	0.186	6.453	..
		20	10.750	10.642	10.858	10.250	0.250	0.219	..	9.698	10.47
30		10.750	10.642	10.858	10.136	0.307	0.269	..	11.84	12.79	
40		10.750	10.642	10.858	10.020	0.365	0.319	..	14.00	15.12	
60		10.750	10.642	10.858	9.750	0.500	0.438	..	18.93	20.45	
80		10.750	10.642	10.858	9.562	0.594	0.520	..	22.29	24.07	
100		10.750	10.642	10.858	9.312	0.719	0.629	..	26.65	28.78	
12	5	12.750	12.719	12.843	12.438	0.156	0.136	0.176	7.258	..	
	10	12.750	12.719	12.843	12.390	0.180	0.158	0.202	8.359	..	
	20	12.750	12.622	12.878	12.250	0.250	0.219	..	11.55	12.47	
	30	12.750	12.622	12.878	12.090	0.330	0.289	..	15.14	16.35	
	40	12.750	12.622	12.878	11.938	0.406	0.355	..	18.52	20.00	
	60	12.750	12.622	12.878	11.626	0.562	0.492	..	25.31	27.33	
	80	12.750	12.622	12.878	11.374	0.688	0.602	..	30.66	33.11	

Footnotes for Table 12.55

- ① In accordance with ANSI/ASME Standards B36.10M and B36.19M
- ② Based on standard tolerances for outside diameter, wall thickness and weight shown earlier in this section.

- ③ Based on nominal dimensions, plain ends, and a density of 0.098 lb per cu in., the density of 6061 alloy. For alloy 6063 multiply by 0.99 and for alloy 3003 multiply by 1.011.
- ④ For schedules 5 and 10 these values apply to mean outside diameters.