



**EARLE M. JORGENSEN
COMPANY**

REFERENCE BOOK

**ALLOY • ALUMINUM • BRASS • BRONZE
CARBON • CAST IRON • CHROME • NICKEL
STAINLESS • SUPER ALLOY • TITANIUM
BAR • PIPE • PLATE • SHEET • TUBE**

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SECTION O

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AND
MACHINING ALLOWANCES**

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TOLERANCES

HOT ROLLED CARBON AND ALLOY BARS

SIZE TOLERANCES — ROUNDS AND SQUARES

Specified Size Inches	Size Tolerance, Inches		Out-of-Round or Square, In.
	Over	Under	
To 5/16 incl.	0.005	0.005	0.008
Over 5/16 to 7/16 incl.	0.006	0.006	0.009
Over 7/16 to 5/8 incl.	0.007	0.007	0.010
Over 5/8 to 7/8 incl.	0.008	0.008	0.012
Over 7/8 to 1 incl.	0.009	0.009	0.013
Over 1 to 1 1/8 incl.	0.010	0.010	0.015
Over 1 1/8 to 1 1/4 incl.	0.011	0.011	0.016
Over 1 1/4 to 1 3/8 incl.	0.012	0.012	0.018
Over 1 3/8 to 1 1/2 incl.	0.014	0.014	0.021
Over 1 1/2 to 2 incl.	1/64	1/64	0.023
Over 2 to 2 1/2 incl.	1/32	0	0.023
Over 2 1/2 to 3 1/2 incl.	3/64	0	0.035
Over 3 1/2 to 4 1/2 incl.	1/16	0	0.046
Over 4 1/2 to 5 1/2 incl.	5/64	0	0.058
Over 5 1/2 to 6 1/2 incl.	1/8	0	0.070
Over 6 1/2 to 8 1/4 incl.	5/32	0	0.085
Over 8 1/4 to 9 1/2 incl.	3/16	0	0.100
Over 9 1/2 to 10 incl.	1/4	0	0.120

Out-of-round is the difference between the maximum and minimum diameters of the bar, measured at the same cross-section. Out-of-square is the difference in the two dimensions at the same cross-section of a square bar, each dimension being the distance between opposite sides.

SIZE TOLERANCES — HEXAGONS

Specified Size Between Opposite Sides, Inches	Size Tolerance, Inches		Out-of-Round or Square, In.
	Over	Under	
To 1/2 incl.	0.007	0.007	0.011
Over 1/2 to 1 incl.	0.010	0.010	0.015
Over 1 to 1 1/2 incl.	0.021	0.013	0.025
Over 1 1/2 to 2 incl.	1/32	1/64	1/32
Over 2 to 2 1/2 incl.	3/64	1/64	3/64
Over 2 1/2 to 3 1/2 incl.	1/16	1/64	1/16

Out-of-hexagon section is the greatest difference between any two dimensions at the same cross-section between opposite faces.

SIZE TOLERANCES — FLATS

Specified Width Inches	Thickness Tolerance, for Thickness Given, Over and Under, Inches							Width Tolerance Inches	
	.203 to .230, excl.	.230 to 1/4, excl.	1/4 to 1/2, incl.	Over 1/2 to 1, incl.	Over 1 to 2, incl.	Over 2 to 3, incl.	Over 3	Over	Under
To 1 incl.	0.007	0.007	0.008	0.010	—	—	—	1/64	1/64
Over 1 to 2 incl.	0.007	0.007	0.012	0.015	1/32	—	—	1/32	1/32
Over 2 to 4 incl.	0.008	0.008	0.015	0.020	1/32	3/64	3/64	1/16	1/32
Over 4 to 6 incl.	0.009	0.009	0.015	0.020	1/32	3/64	3/64	3/32	1/16
Over 6 to 8 incl.	*	0.015	0.016	0.025	1/32	3/64	1/16	1/8	3/32

*Flats over 6" to 8", incl. in width are not available as hot rolled carbon steel bars in thickness over 0.230.

STRAIGHTNESS TOLERANCES

ROUNDS, SQUARES, HEXAGONS, OCTAGONS, FLATS, SPRING FLATS

Standard

1/4 inch in any 5 feet, or 1/4 x $\frac{\text{number of feet of length}}{5}$ inches

Special

1/8 inch in any 5 feet, or 1/8 x $\frac{\text{number of feet of length}}{5}$ inches

Because of warpage, straightness tolerances do not apply to bars if any subsequent heating operation has been performed after straightening.

TOLERANCES

COLD FINISHED CARBON BARS

Minus Tolerances in Inches
(No Plus Tolerances Apply)

Specified Size Inches	Maximum of Carbon Range 0.28% or less	Maximum of Carbon Range Over 0.28% to 0.55% incl.	Stress or Strain Relieved After Cold Finishing (Max. of Carbon Range to .55% incl.)	Maximum of Carbon Range Over .55% or Quenched and Tempered Before Cold Finishing
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ROUNDS — COLD DRAWN OR TURNED AND POLISHED¹

Up to 1½ Incl.	0.002	0.003	0.004	0.005
Over 1½ to 2½ incl.	0.003	0.004	0.005	0.006
Over 2½ to 4 incl.	0.004	0.005	0.006	0.007
Over 4 to 6 incl.	0.005	0.006	0.007	0.008
Over 6 to 8 incl.	0.006	0.007	0.008	0.009
Over 8 to 9 incl.	0.007	0.008	0.009	0.010
Over 9	0.008	0.009	0.010	0.011

ROUNDS — TURNED, GROUND AND POLISHED AND COLD DRAWN, GROUND AND POLISHED

Up to 1½ Incl.	0.001	0.001	0.001	0.001
Over 1½ to 2½ incl.	0.0015	0.0015	0.0015	0.0015
2½ to 3 incl.	0.002	0.002	0.002	0.002
Over 3 to 4 incl.	0.003	0.003	0.003	0.003

HEXAGONS — COLD DRAWN¹

Up to ¾ incl.	0.002	0.003	0.004	0.006
Over ¾ to 1½ incl.	0.003	0.004	0.005	0.007
Over 1½ to 2½ incl.	0.004	0.005	0.006	0.008
Over 2½ to 3½ incl.	0.005	0.006	0.007	0.009

SQUARES — COLD DRAWN¹

Up to ¾ incl.	0.002	0.004	0.005	0.007
Over ¾ to 1½ incl.	0.003	0.005	0.006	0.008
Over 1½ to 2½ incl.	0.004	0.006	0.007	0.009
Over 2½ to 4 incl.	0.005	0.008	0.009	0.011
Over 2½ to 3½ incl.	0.010	—	—	—

FLATS — COLD DRAWN OR COLD ROLLED¹

Tolerances apply to thickness as well as width²

Width in Inches				
Up to ¾ Incl.	0.003	0.004	0.006	0.008
Over ¾ to 1½ incl.	0.004	0.005	0.008	0.010
Over 1½ to 3 incl.	0.005	0.006	0.010	0.012
Over 3 to 4 incl.	0.006	0.008	0.011	0.016
Over 4 to 6 incl.	0.008	0.010	0.012	0.020
Over 6	0.013	0.015	—	—

¹Tolerances apply to bars that have been annealed, spheroidize annealed, normalized, normalized and tempered, or quenched and tempered before cold finishing. Tolerances shown do not apply to bars that are annealed, spheroidize annealed, normalized, normalized and tempered, or quenched and tempered after cold finishing.

²Width governs the tolerances for both width and thickness of flats. For example, when the maximum of carbon range is 0.28% or less, for a flat 2" wide and 1" thick, the width tolerance is 0.005" and the thickness tolerance is the same.

TOLERANCES

COLD FINISHED ALLOY BARS

Minus Tolerances in Inches
(No Plus Tolerances Apply)

Specified Size Inches	Maximum of Carbon Range .028% or less As Cold Finished and without any Thermal Treatment	Maximum of Carbon Range Over 0.28% to 0.55% incl. As Cold Finished and without any Thermal Treatment	Maximum of Carbon Range up to 0.55% incl. Annealed or Stress Relieved after Cold Finishing	Maximum of Carbon Range over 0.55%, or all Carbons Quenched and Tempered or Normalized and Tempered before Cold Finishing, or all Carbons Stress Relieved after Cold Finishing
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ROUNDS — COLD DRAWN OR TURNED AND POLISHED

Up to 1½ incl.	0.003	0.004	0.005	0.006
Over 1½ to 2½ incl.	0.004	0.005	0.006	0.007
Over 2½ to 4 incl.	0.005	0.006	0.007	0.008
Over 4 to 6 incl.	0.006	0.007	0.008	0.008
Over 6 to 8 incl.	0.007	0.008	0.009	0.010
Over 8 to 9 incl.	0.008	0.009	0.010	0.011
Over 9	0.009	0.010	0.011	0.012

**ROUNDS — TURNED, GROUND AND POLISHED AND
COLD DRAWN, GROUND AND POLISHED**

Up to 1½ incl.	0.001	0.001	0.001	0.001
Over 1½ to 2½ incl.	0.0015	0.0015	0.0015	0.0015
2½ to 3 incl.	0.002	0.002	0.002	0.002
Over 3 to 4 incl.	0.003	0.003	0.003	0.003

HEXAGONS

Up to ¾ incl.	0.003	0.004	0.005	0.007
Over ¾ to 1½ incl.	0.004	0.005	0.006	0.008
Over 1½ to 2½ incl.	0.005	0.006	0.007	0.009
Over 2½ to 3½ incl.	0.006	0.007	0.008	0.010
Over 3½ to 4 incl.	0.006	—	—	—

SQUARES

Up to ¾ incl.	0.003	0.005	0.006	0.008
Over ¾ to 1½ incl.	0.004	0.006	0.007	0.009
Over 1½ to 2½ incl.	0.005	0.007	0.008	0.010
Over 2½ to 4 incl.	0.007	0.009	0.010	0.012

FLATS

Tolerances apply to thickness as well as width¹

Up to ¾ incl.	0.004	0.005	0.007	0.009
Over ¾ to 1½ incl.	0.005	0.006	0.009	0.011
Over 1½ to 3 incl.	0.006	0.007	0.011	0.013
Over 3 to 4 incl.	0.007	0.009	0.012	0.017
Over 4 to 6 incl.	0.009	0.011	0.013	0.021
Over 6	0.014	—	—	—

¹Width governs the tolerances for both width and thickness of flats. For example, when the maximum of carbon range is 0.28% or less, for a flat 2" wide and 1" thick, the width tolerance is 0.006" and the thickness tolerance is the same, namely 0.006".

TOLERANCES

STAINLESS BARS

SIZE TOLERANCES — HOT ROLLED ROUNDS AND SQUARES

Specified Size Inches	Size Tolerance, Inches		Out-of-Round Out-of-Square Section, Inches ¹
	Over	Under	
Over 5/16 to 7/16 incl. ²	0.006	0.006	0.009
Over 7/16 to 5/8 incl. ²	0.007	0.007	0.010
Over 5/8 to 7/8 incl.	0.008	0.008	0.012
Over 7/8 to 1 incl.	0.009	0.009	0.013
Over 1 to 1 1/8 incl.	0.010	0.010	0.015
Over 1 1/8 to 1 1/4 incl.	0.011	0.011	0.016
Over 1 1/4 to 1 3/8 incl.	0.012	0.012	0.018
Over 1 3/8 to 1 1/2 incl.	0.014	0.014	0.021
Over 1 1/2 to 2 incl.	1/64	1/64	0.023
Over 2 to 2 1/2 incl.	1/32	0	0.023
Over 2 1/2 to 3 1/2 incl.	3/64	0	0.035
Over 3 1/2 to 4 1/2 incl.	1/16	0	0.046
Over 4 1/2 to 5 1/2 incl.	5/64	0	0.058
Over 5 1/2 to 6 1/2 incl.	1/8	0	0.070
Over 6 1/2 to 8 incl.	5/32	0	0.085

¹Out-of-round is the difference between the maximum and minimum diameters of the bar, measured at the same cross-section. Out-of-square is the difference in the two dimensions at the same cross-section of a square bar, each dimension being the distance between opposite faces.

²Round sections in the size range of 1/4" to approximately 5/8" diameter are commonly produced on rod mills in coils. Tolerances on the product made this way have not been established.

**SIZE TOLERANCES — COLD FINISHED ROUNDS
(Drawn, Smooth Turned, Ground, or Ground and Polished)**

Specified Size Inches	Over	Under
.044 to 5/16 excl.	0.001	0.001
5/16 to 1/2 excl.	0.0015	0.0015
1/2 to 1 excl.	0.002	0.002
1 to 1 1/2 excl.	0.0025	0.0025
1 1/2 to 4 incl.	0.003	0.003
4 1/8 to 4 1/2 incl.	0.005	0.005
4 9/16 to 6 incl.	0.008	0.008

SIZE TOLERANCES — COLD FINISHED HEXAGONS, SQUARES

Specified Size Inches	Hexagons		Squares	
	Over	Under	Over	Under
1/8 to 5/16 excl.	0	0.002	0	0.002
5/16 to 1/2 excl.	0	0.003	0	0.003
1/2 to 1 incl.	0	0.004	0	0.004
Over 1 to 2 incl.	0	0.006	0	0.006
Over 2 to 3 incl.	0	0.008	0	0.008
Over 3 to 4 incl.	0	0.010	0	0.010

When it is necessary to heat treat or heat treat and pickle after cold finishing, because of special hardness or mechanical property requirements, tolerances are commonly double those shown above.

STRAIGHTNESS TOLERANCES

ROUNDS, SQUARES, HEXAGONS, OCTAGONS, FLATS, SPRING FLATS

Measurement is taken on the concave side of the bar with a straight edge.

Hot Finished

1/8 inch in any 5 feet, but may not exceed 1/8 x $\frac{\text{no. of feet of length}}{5}$ inches

Cold Finished

1/16 inch in any 5 feet, but may not exceed 1/16 x $\frac{\text{no. of feet of length}}{5}$ inches

TOLERANCES

**ALUMINUM TOLERANCES
ROD, BAR, AND WIRE**

ROUNDS		HEXAGONS	
Diameter in Inches	Tolerance in Inches	Diameter In Inches	Tolerance In Inches
Standard Screw Machine Stock		Standard Screw Machine Stock	
0.125 - 0.500	±0.0015	0.125 - 0.500	±0.0020
0.501 - 1.000	±0.0020	0.501 - 1.000	±0.0025
1.001 - 1.500	±0.0025	1.001 - 1.500	±0.0030
1.501 - 2.000	±0.0040	1.501 - 2.000	±0.0050
2.001 - 3.000	±0.0060	2.001 - 3.000	±0.0080
3.001 - 3.375	±0.0080		
Drawn Round Wire		Drawn Hexagonal Wire	
0.0126 - 0.0201	±0.0005	0.0202 - 0.0359	±0.0010
0.0202 - 0.0359	±0.0005		±0.0015
0.036 - 0.064	±0.0010	0.036 - 0.064	±0.0020
0.065 - 0.374	±0.0015	0.065 - 0.374	
Cold Finished Rod		Cold Finished Hexagonal Bar	
0.375 - 0.500	±0.0015	0.375 - 0.500	±0.0020
0.501 - 1.000	±0.0020	0.501 - 1.000	±0.0025
1.001 - 1.500	±0.0025	1.001 - 1.500	±0.0030
1.501 - 2.000	±0.0040	1.501 - 2.000	±0.0050
2.001 - 3.000	±0.0060	2.001 - 3.000	±0.0080
Rolled Rod		Rolled Hexagon Bar	
1.501 - 2.000	±0.006	1.501 - 2.000	±0.016
2.001 - 3.000	±0.008	2.001 - 3.000	±0.020
3.001 - 3.499	±0.012		
3.500 - 5.000	+0.031, -0.016		
5.001 - 8.000	+0.062, -0.031		

EXTRUDED ROUNDS, SQUARES, AND RECTANGLES

Cross-Sectional Dimensions Inches	Tolerance in Inches	Cross-Sectional Dimensions Inches	Tolerance in Inches
Under 0.125	±0.006	1.0 to under1.5	±0.012
0.125 to under 0.250	±0.007	1.5 to under2.0	±0.014
0.250 to under 0.500	±0.008	2.0 to under4.0	±0.024
0.500 to under 0.750	±0.009	4.0 to under6.0	±0.034
0.750 to under 1.0	±0.010	6.0 to under8.0	±0.044
		8.0 to under10.0	±0.054

TOLERANCES

ALUMINUM THICKNESS TOLERANCES FLAT SHEET — COILED SHEET — PLATE

Inches — Plus or Minus

2036 3004 5052	5083 5086 5154	5252 5254 5454	5456 5652 6061	Brazing Sheet 11,12,23,24 Also Alclad Alloys					
'Specified Thickness In Inches	Specified Widths in Inches								
	39.37 and Under	Over 39.37- 59.06	Over 59.06- 78.74	Over 78.74- 98.43	Over 98.43- 118.11	Over 118.11- 137.80	Over 137.80- 157.48	Over 157.48- 177.17	
0.006-0.010	.0010	.0020	—	—	—	—	—	—	
0.011-0.016	.0015	.0025	—	—	—	—	—	—	
0.017-0.025	.0020	.0030	—	—	—	—	—	—	
0.026-0.032	.0020	.0035	.0045	—	—	—	—	—	
0.033-0.039	.0025	.0035	.0055	.007	—	—	—	—	
0.040-0.047	.0030	.0040	.006	.008	.010	.011	—	—	
0.048-0.063	.0030	.0045	.007	.009	.011	.013	—	—	
0.064-0.079	.0035	.0055	.007	.010	.013	.015	—	—	
0.080-0.098	.0035	.006	.008	.011	.015	.018	—	—	
0.099-0.126	.0045	.007	.010	.013	.016	.020	—	—	
0.127-0.158	.0055	.008	.012	.015	.018	.022	—	—	
0.159-0.197	.007	.010	.015	.018	.022	.026	—	—	
0.198-0.248	.009	.012	.017	.021	.025	.029	—	—	
0.249-0.315	.012	.015	.019	.024	.029	.033	.041	.051	
0.316-0.394	.017	.018	.022	.028	.033	.039	.047	.059	
0.395-0.630	.023	.023	.028	.033	.039	.047	.059	.070	
0.631-0.984	.031	.031	.037	.043	.051	.060	.070	.085	
0.985-1.575	.039	.039	.047	.055	.065	.075	.090	.105	
1.576-2.362	.055	.055	.060	.070	.090	.100	.115	—	
2.363-3.150	.075	.075	.085	.100	.110	.125	—	—	
3.160-3.937	.100	.100	.115	.130	.150	.160	—	—	
3.938-6.299	.130	.130	.145	.165	—	—	—	—	
1060	3003	5005	5657						
1100	3005	5050	1100 Reflector Sheet						
1350	3105	5457	Also Alclad Alloys						
0.006-0.010	.0010	.0015	—	—	—	—	—	—	
0.011-0.016	.0010	.0020	—	—	—	—	—	—	
0.017-0.025	.0015	.0020	.0030	.0035	—	—	—	—	
0.026-0.032	.0020	.0025	.0035	.0040	—	—	—	—	
0.033-0.039	.0020	.0030	.0035	.0045	.006	—	—	—	
0.040-0.047	.0025	.0035	.0045	.0055	.007	—	—	—	
0.048-0.063	.0030	.0035	.0055	.006	.007	.009	—	—	
0.064-0.079	.0035	.0040	.006	.007	.008	.010	—	—	
0.080-0.098	.0035	.0045	.007	.008	.010	.011	—	—	
0.099-0.126	.0045	.0055	.007	.010	.011	.013	—	—	
0.127-0.158	.0055	.007	.009	.011	.013	.015	—	—	
0.159-0.197	.007	.009	.011	.013	.015	.018	—	—	
0.198-0.248	.009	.011	.013	.015	.018	.022	.027	—	
0.249-0.315	.012	.014	.015	.018	.022	.027	.036	.047	
0.316-0.394	.017	.017	.020	.023	.027	.033	.041	.051	
0.395-0.630	.023	.023	.027	.032	.037	.043	.053	.065	
0.631-0.984	.031	.031	.037	.043	.051	.060	.070	.085	
0.985-1.575	.039	.039	.047	.055	.065	.075	.090	.105	
1.576-2.362	.055	.055	.060	.070	.090	.100	.115	—	
2.363-3.150	.075	.075	.085	.100	.110	.125	—	—	
3.160-3.937	.100	.100	.115	.130	.150	.160	—	—	
3.938-6.299	.130	.130	.145	.165	—	—	—	—	

When a dimension tolerance is specified other than as an equal bilateral tolerance, the value of the standard tolerance is that which applies to the mean of the maximum and minimum dimensions permissible under the tolerance for the dimension.

TOLERANCES

ALUMINUM THICKNESS TOLERANCES FLAT SHEET — COILED SHEET — PLATE

Inches — Plus or Minus

	2014	2219	7050	7178		
	2024	2324	7075	7475		
	2124	2419	7150	Also Alclad Alloys		
Thickness In Inches	Specified Widths through 78.74 Inches					
	39.37 and Under	Over 39.37- 47.24	Over 47.24- 55.12	Over 55.12- 59.06	Over 59.06- 70.87	Over 70.87- 78.74
0.006-0.010	.0010	.0020	.0020	.0020	—	—
0.011-0.016	.0015	.0025	.0025	.0025	—	—
0.017-0.025	.0015	.0025	.0025	.0025	—	—
0.026-0.032	.0015	.0015	.0020	.0030	.0030	—
0.033-0.039	.0015	.0015	.0020	.0030	.0030	.0035
0.040-0.047	.0020	.0020	.0020	.0030	.0030	.0035
0.048-0.063	.0020	.0020	.0030	.0030	.0030	.0035
0.064-0.079	.0020	.0020	.0030	.0035	.0035	.0035
0.080-0.098	.0020	.0020	.0035	.0040	.0040	.0045
0.099-0.126	.0035	.0035	.0035	.0045	.0045	.0045
0.127-0.158	.0040	.0040	.0045	.007	.007	.009
0.159-0.197	.0055	.007	.007	.009	.009	.011
0.198-0.248	.009	.012	.012	.012	.017	.017
0.249-0.315	.012	.015	.015	.015	.019	.019
0.316-0.394	.017	.018	.018	.018	.022	.022
0.395-0.630	.023	.023	.023	.023	.028	.028
0.631-0.984	.031	.031	.031	.031	.037	.037
0.985-1.575	.039	.039	.039	.039	.047	.047
1.576-2.362	.055	.055	.055	.055	.060	.060
2.363-3.150	.075	.075	.075	.075	.085	.085
3.160-3.937	.100	.100	.100	.100	.115	.115
3.938-6.299	.130	.130	.130	.130	.145	.145
	Specified Widths through 78.75 Inches					
	Over 78.74- 86.61	Over 86.61- 98.43	Over 98.43- 118.11	Over 118.11- 137.80	Over 137.80- 157.48	Over 157.48- 177.17
0.033-0.039	.0035	.007	—	—	—	—
0.040-0.047	.0035	.008	.010	.011	—	—
0.048-0.063	.0035	.009	.011	.013	—	—
0.064-0.079	.0035	.010	.013	.015	—	—
0.080-0.098	.0045	.011	.015	.018	—	—
0.099-0.126	.0045	.013	.016	.020	—	—
0.127-0.158	.009	.015	.018	.022	—	—
0.159-0.197	.011	.018	.022	.026	—	—
0.198-0.248	.021	.021	.025	.029	—	—
0.249-0.315	.024	.024	.029	.033	.041	.051
0.316-0.394	.028	.028	.033	.039	.047	.059
0.395-0.630	.033	.033	.039	.047	.059	.070
0.631-0.984	.043	.043	.051	.060	.070	.085
0.985-1.575	.055	.055	.065	.075	.090	.105
1.576-2.362	.070	.070	.090	.100	.115	—
2.363-3.150	.100	.100	.110	.125	—	—
3.160-3.937	.130	.130	.115	.160	—	—
3.938-6.299	.165	.165	—	—	—	—

When a dimension tolerance is specified other than as an equal bilateral tolerance, the value of the standard tolerance is that which applies to the mean of the maximum and minimum dimensions permissible under the tolerance for the dimension.

MACHINING ALLOWANCES

Experience has shown that it is advisable for purchasers of bars and tubing to make adequate allowances to remove surface imperfections and to specify sizes accordingly.

These allowances require consideration of mill manufacturing practices, the type of steel, the size and length of bars, the tolerances for size, out-of-roundness, and straightness, and the practice used to remove surface metal.

In order to minimize or eliminate the incidence of surface defects on finished parts, and in order to minimize thermal cracking from heat treatment, it is advisable that adequate allowance be made to permit stock removal of not less than the amounts show in the following tables. Also, the minimum recommended stock removal should be made before heat treatment to minimize thermal cracking.

REGULAR QUALITY ALLOY STEEL HOT ROLLED BARS and SPECIAL QUALITY CARBON STEEL HOT ROLLED BARS

As recommended by the American Iron and Steel Institute

	Minimum Machining Allowance Per side (Per Cent of Specified Size)			
	Non-Resulphurized		Resulphurized	
	2" and Under	Over 2"	2" and Under	Over 2"
Centerless Turned or Ground	2.6%	1.6%	3.4%	2.4%
Other than Centerless Turned or Ground	1.6%		2.4%	
Sizes under 5/8" Diameter, Hex, Square or Thickness	0.010" Min		0.015" Min	

Turned on Centers: Since this operation is dependent upon length and straightness considerations, each item should be negotiated between consumer and supplier.

TOOL STEEL HOT ROLLED BARS

As recommended by the American Iron and Steel Institute

Nominal Diameter of Bar (inches)	Minimum Machining Allowance Per Side (inches)
Up to 1/2 incl.	.016
Over 1/2 to 1 incl.	.031
Over 1 to 2 incl.	.048
Over 2 to 3 incl.	.063
Over 3 to 4 incl.	.088
Over 4 to 5 incl.	.112
Over 5 to 6 incl.	.150
Over 6 to 8 incl.	.200

COLD FINISHED ALLOY and CARBON BARS

Cold Finished bars are produced to closer size tolerances than hot rolled bars and are subjected to more critical inspection standards. Their surface is generally considered to be free from the major types of defects of hot rolled bars such as slivers, scabs, and pronounced rolling defects.

They are not, however, free from such lesser surface discontinuities as light seams and laps and small pits. Decarburization present in hot rolled bars is also present in cold drawn bars since cold drawing does not remove any surface.

For Cold Drawn Bars, the following allowances are recommended in order to minimize or eliminate surface discontinuities:

	Minimum Recommended Stock Removal from Surface (inches)	
	Up to 5/8" incl.	Over 5/8" for each 1/16" diameter
Grades with Free-Machining Additives	.015	.0015
Grades with no Free-Machining Additives	.010	.001
Leaded Grades	.010	.001

Examples:

1" diameter, 1213, .024" removal from surface (.048" on diameter)

1" diameter, 1018, .016" removal from surface (.032" on diameter)

1" diameter, 86L20, .016" removal from surface (.032" on diameter)

For Cold Drawn, Ground, & Polished Bars, the allowance recommended in order to minimize or eliminate surface discontinuities is 50% of the above.

MACHINING ALLOWANCES (Continued)

STAINLESS BAR

*Minimum Recommended Stock Removal

Cold Drawn;	Rounds - Hexagons - Squares
Up to & Incl. $\frac{5}{16}$ "	.003 per side except 440-C
Over $\frac{5}{16}$ "	1% of Diameter per Side

Centerless Ground:

All Ground **Defect Free** within the Standard Size Tolerances

Example: $1\frac{1}{2}$ " Rd. TOL is $\pm .003$

Material must not have any defect under $-.003$

Rough Turned:

All "R.T." sizes are produced on the plus side.

Material must be defect free on size.

Example: 5" Rd. HR-RT must be defect free at 5"

HP-A&P Flats & Squares and Cold Drawn Flats

*Recommended Machining Allowances

(B) Removal From Thickness	Each Surface Specified Thickness (D)				(Inches)
(A) SPECIFIED	1/8-1/2"	1/2-1"	1-2"	2-3"	(C) REMOVAL FROM WIDTH- EACH SURFACE
Up to 1" Incl.	.008	.010	—	—	.015
Over 1-2" Incl.	.012	.015	.031	—	.031
Over 2-3" Incl.	.015	.020	.031	.047	.047
Over 3-4" Incl.	.015	.020	.031	.047	.062
Over 4-6" Incl.	.015	.020	.031	—	.093

(A) Select the "Width" first and then read across to

(B) Select the reading — this is the stock removal for the thickness per side

(C) Continue across on same line for the readings for width

(D) As measured from the minimum of the tolerance

*THESE RECOMMENDATIONS ARE BASED ON EXPERIENCE AND DO NOT NECESSARILY CONSTITUTE A GUARANTEE OF CLEAN UP.

MACHINING ALLOWANCES (Continued)

AIRCRAFT QUALITY BARS AND MECHANICAL TUBING Subject to Magnetic Particle (Magnaflux) Inspection

Bars and Mechanical Tubing produced to meet Aircraft Quality Standards are usually used for critically stressed applications. Special steelmaking practices and techniques are employed to meet the rigid quality imposed by Aerospace Material Specification AMS 2301 for Alloy, and AMS 2303 for Stainless.

The following tables list the minimum recommended stock removal to minimize or eliminate injurious nonmetallic inclusions in accordance with AMS 2301 or AMS 2303.

BARS

HOT ROLLED SIZE (Inches)	COLD DRAWN SIZE (Inches)	MINIMUM REMOVAL PER SIDE (Inch)
1/4 to 1/2, incl.	1/4 to 7/16, incl.	.030
Over 1/2 to 3/4, incl.	Over 7/16 to 11/16, incl.	.045
Over 3/4 to 1, incl.	Over 11/16 to 15/16, incl.	.060
Over 1 to 1 1/2, incl.	Over 15/16 to 17/16, incl.	.075
Over 1 1/2 to 2, incl.	Over 17/16 to 1 ¹⁵ / ₁₆ , incl.	.090
Over 2 to 2 1/2, incl.	Over 1 ¹⁵ / ₁₆ to 2 ⁷ / ₁₆ , incl.	.125
Over 2 1/2 to 3 1/2, incl.	Over 2 ⁷ / ₁₆ to 3 ³ / ₈ , incl.	.156
Over 3 1/2 to 4 1/2, incl.	Over 3 ³ / ₈ to 4 ³ / ₈ , incl.	.187
Over 4 1/2 to 6, incl.		.250

MECHANICAL TUBING

Tubing with nominal wall thicknesses less than .250" should have 10% of the wall thickness or .015", which ever is less, removed from the OD before heat treatment. Tubing with wall thicknesses .250" and over should be machined to conform to the following minimum stock removal.

Machined Outside Diameter (Inches)	Minimum Stock Removal Per Side
2 1/2 and under	.044
Over 2 1/2 to 3 1/2, incl.	.046
Over 3 1/2 to 4 1/2, incl.	.052
Over 4 1/2 to 5 1/2, incl.	.057
Over 5 1/2 to 6 1/2, incl.	.064
Over 6 1/2 to 8, incl.	.074
Over 8 to 10, incl.	.087

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