

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

TOLERANCES AND MACHINING ALLOWANCES

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HOT ROLLED CARBON AND ALLOY BARS							
SIZE TOLERANCES — ROUNDS AND SQUARES							
Specified Size	Size Tolera	nce, Inches	Out-of-Round				
Inches	Over	Under	or Square, In.				
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 $\frac{5}{8}$ to $\frac{7}{8}$ incl.	0.008	0.008	0.012				
Over $\frac{7}{8}$ 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 $3\frac{1}{2}$ to $4\frac{1}{2}$ incl.	1/16	0	0.046				
Over $4\frac{1}{2}$ to $5\frac{1}{2}$ incl.	5⁄64	0	0.058				
Over $5\frac{1}{2}$ to $6\frac{1}{2}$ 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				

TOLERANCES HOT ROLLED CARBON AND ALLOY BARS

Out-of-round is the difference between the maximum and minimum diameters of the bar, measured at the samecross-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	Size Tolera	nce, Inches	Out-of-Round		
Opposite Sides, Inches	Over	Under	or Square, In.		
To ½ incl.	0.007	0.007	0.011		
Over ½ to 1 incl.	0.010	0.010	0.015		
Over 1 to 1½ incl.	0.021	0.013	0.025		
Over 1½ to 2 incl.	1/ <u>32</u>	1/64	1/ <u>32</u>		
Over 2 to 2½ incl.	3/64	1/64	3/64		
Over 2½ to 3½ 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

	Thickness Tolerance, for Thickness Given, Over and Under, Inches							Width Tolerance Inches	
Specified Width 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. Over 1 to 2 incl. Over 2 to 4 incl.	0.007 0.007 0.008	0.007 0.007 0.008		0.010 0.015 0.020	1/32 1/32	 3/ ₆₄		1 <i> </i> 64 1 <i> </i> 32 1/16	1/64 1/32 1/32
Over 4 to 6 incl. Over 6 to 8 incl.	0.009	0.009 0.015	0.015 0.016		1/32 1/32	³ /64 3/64	³ /64 1/16	³ /32 1/8	¹ /16 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 <u>number of feet of length</u> inches <u>5</u>

¹/₈ inch in any 5 feet, or 1/₈ x <u>number of feet of length</u> inches

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

		RANCES						
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				
ROUNDS — CO	LD DRAWN	OR TURNE	D AND POL	LISHED ¹				
Up to 1 ¹ / ₂ Incl. Over 1 ¹ / ₂ to 2 ¹ / ₂ incl. Over 2 ¹ / ₂ to 4 incl.	0.002 0.003 0.004	0.003 0.004 0.005	0.004 0.005 0.006	0.005 0.006 0.007				
Over 4 to 6 incl. Over 6 to 8 incl. Over 8 to 9 incl. Over 9	0.005 0.006 0.007 0.008	0.006 0.007 0.008 0.009	0.007 0.008 0.009 0.010	0.008 0.009 0.010 0.011				
ROUNDS — T COLD E	URNED, GR DRAWN, GRO	OUND AND) POLISHEI POLISHED	D AND				
Up to 11/2 Incl. Over 11/2 to 21/2 incl.	0.001 0.0015	0.001 0.0015	0.001 0.0015	0.001 0.0015				
$2^{1/2}$ to 3 incl. Over 3 to 4 incl.	0.002 0.003	0.002 0.003	0.002 0.003	0.002 0.003				
H	EXAGONS -	– COLD DR	AWN ¹					
Up to ³ /4 incl. Over ³ /4 to 1 ¹ /2 incl.	0.002 0.003	0.003 0.004	0.004 0.005	0.006 0.007				
Over 11/2 to 21/2 incl. Over 21/2 to 31/8 incl.	0.004 0.005	0.005 0.006	0.006 0.007	0.008 0.009				
S	QUARES —	COLD DRA	WN ¹					
Up to ³ / ₄ incl. Over ³ / ₄ to 1 ¹ / ₂ incl. Over 1 ¹ / ₂ to 2 ¹ / ₂ incl.	0.002 0.003 0.004	0.004 0.005 0.006	0.005 0.006 0.007	0.007 0.008 0.009				
Over 21/2 to 4 incl. Over 21/2 to 31/8 incl.	0.005 0.010	0.008	0.009	0.011				
FLATS — COLD DRAWN OR COLD ROLLED ¹ Tolerances apply to thickness as well as width ²								
Width in Inches Up to 3 /4 Incl. Over 3 /4 to 1 /2 incl. Over 1 /2 to 3 incl.	0.003 0.004 0.005	0.004 0.005 0.006	0.006 0.008 0.010	0.008 0.010 0.012				
Over 3 to 4 incl. Over 4 to 6 incl. Over 6	0.006 0.008 0.013	0.008 0.010 0.015	0.011 0.012 —	0.016 0.020 —				

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.

	TOL	ERANCES					
C	OLD FINISH	IED ALLOY					
	(NO Plus To Maximum of Carbon Range	Dierances Appl Maximum of Carbon Range	y) Maximum of Carbon Range	Maximum of Carbon Range			
Specified Size Inches	.028% or less As Cold Finished and without any Thermal Treatment	Over 0.28% to 0.55% incl. As Cold Finished and without any Thermal Treatment	up to 0.55% incl. Annealed or Stress Relieved after Cold Finishing	over 0.55%, or all Carbons Quenched and Tempered or Normalized and Tempered before Cold Finishing, or all Carbons Stress Relieved after Cold Finishing			
ROUNDS — C	OLD DRAWN	OR TURNI	ED AND PO	LISHED			
Up to $1\frac{1}{2}$ incl. Over $1\frac{1}{2}$ to $2\frac{1}{2}$ incl. Over $2\frac{1}{2}$ to 4 incl.	0.003 0.004 0.005	0.004 0.005 0.006	0.005 0.006 0.007	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 — COLD	TURNED, GI DRAWN, GR			D AND			
Up to 1 ¹ /2 incl.	0.001	0.001	0.001	0.001			
Over $1\frac{1}{2}$ to $2\frac{1}{2}$ incl. $2\frac{1}{2}$ to 3 incl.	0.0015	0.0015 0.002	0.0015 0.002	0.0015 0.002			
Over 3 to 4 incl.	0.002	0.002	0.002	0.002			
	НЕХ	AGONS					
Up to ³ /4 incl.	0.003	0.004	0.005	0.007			
Over $\frac{3}{4}$ to $\frac{1}{2}$ incl. Over $\frac{1}{2}$ to $\frac{2}{2}$ incl.	0.004	0.005	0.006	0.008			
	0.005	0.006	0.007	0.009			
Over $2^{1/2}$ to $3^{1/8}$ incl. Over $3^{1/8}$ to 4 incl.	0.006 0.006	0.007	0.008	0.010			
	SQ	UARES					
Up to 3/4 incl.	0.003	0.005	0.006	0.008			
Over 3/4 to 11/2 incl.	0.004	0.006	0.007	0.009			
Over $1^{1/2}$ to $2^{1/2}$ incl.	0.005	0.007	0.008	0.010			
Over 21/2 to 4 incl.	0.007	0.009	0.010	0.012			
FLATS Tolerances apply to thickness as well as width'							
Up to 3/4 incl.	0.004	0.005	0.007	0.009			
Over 3/4 to 11/2 incl.	0.005	0.006	0.009	0.011			
Over 1 ¹ / ₂ 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							
	Size Tolera	nce, Inches	Out-of-Round				
Specified Size Inches	Over	Under	Out-of Square Section, Inches				
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 $4\frac{1}{2}$ to $5\frac{1}{2}$ incl.	5/64	0	0.058				
Over $5\frac{1}{2}$ to $6\frac{1}{2}$ incl.	1/8	0	0.070				
Over $6\frac{1}{2}$ to 8 incl.	5/32	0	0.085				

'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 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	Hex	agons	Squares		
Inches	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

 $\frac{1}{16}$ inch in any 5 feet, but may not exceed $\frac{1}{8} \times \frac{\text{no. of feet of length}}{5}$ inches Cold Finished

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

TOLERANCES ALUMINUM TOLERANCES ROD, BAR, AND WIRE

RC	DUNDS			HEXAGONS		
Diameter in Inches		Tolerance in Inches	Diameter In Inches	Tolerance In Inches		
Standard Scr	ew Machi	ne 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		
		±0.0060	2.001 - 3.000	±0.0080		
2.001 - 3.000		±0.0080				
3.001 - 3.375						
Drawn	Round W	ire	Drawn Hexa	gonal Wire		
0.0126 - 0	0.0201	±0.0005	0.0202 -	±0.0010		
0.0202 - 0	0.0359	±0.0005	0.0359	±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 F	inished R	od	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		
		±0.0060	2.001 - 3.000	±0.0080		
2.001 - 3.000						
Rol	lled Rod		Rolled Hex	agon Bar		
1.501 - 2.000	±0.00	6	1.501 - 2.000	±0.016		
2.001 - 3.000	±0.00	8	2.001 - 3.000	±0.020		
3.001 - 3.499	±0.01	2				
3.500 - 5.000	+0.03	1, -0.016				
5.001 - 8.000	+0.06	2, -0.031				

EXTRUDED ROUNDS, SQUARES, AND RECTANGLES

Cross-Sectional Dimensions Inches	Tolerance in Inches	Cross-Sectional Dimensions Inches	Tolerance in Inches
Under 0.12	5 ±0.006	1.0 to under1.5	±0.012
0.125 to under 0.250	±0.007	1.5 to under2.0	±0.014
	+0.000	2.0 to under4.0	±0.024
0.250 to under 0.500	±0.009	4.0 to under 6.0	±0.034
0.500 to under 0.750)	6.0 to under 8.0	±0.044
0.750 to under 1.0	±0.010	8.0 to under10.0	±0.054

TOLERANCES ALUMINUM THICKNESS TOLERANCES FLAT SHEET — COILED SHEET — PLATE

		Ir	nches —	Plus or l	Minus			
2036 3004 5052	5086 525			5252 5456 5254 5652 5454 6061			azing Sho 12,23,24 to Alclad	ļ
'Specified			Specifie	d Widths i	n Inches			
Thickness 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 0.011-0.016 0.017-0.025 0.026-0.032 0.033-0.039	.0010 .0015 .0020 .0020 .0025	.0020 .0025 .0030 .0035 .0035	 	 .007				
0.040-0.047 0.048-0.063 0.064-0.079 0.080-0.098 0.099-0.126	.0030 .0030 .0035 .0035 .0045	.0040 .0045 .0055 .006 .007	.006 .007 .007 .008 .010	.008 .009 .010 .011 .013	.010 .011 .013 .015 .016	.011 .013 .015 .018 .020		
$\begin{array}{c} 0.127 \hbox{-} 0.158 \\ 0.159 \hbox{-} 0.197 \\ 0.198 \hbox{-} 0.248 \\ 0.249 \hbox{-} 0.315 \\ 0.316 \hbox{-} 0.394 \end{array}$.0055 .007 .009 .012 .017	.008 .010 .012 .015 .018	.012 .015 .017 .019 .022	.015 .018 .021 .024 .028	.018 .022 .025 .029 .033	.022 .026 .029 .033 .039	 .041 .047	 .051 .059
0.395-0.630 0.631-0.984 0.985-1.575 1.576-2.362 2.363-3.150	.023 .031 .039 .055 .075	.023 .031 .039 .055 .075	.028 .037 .047 .060 .085	.033 .043 .055 .070 .100	.039 .051 .065 .090 .110	.047 .060 .075 .100 .125	.059 .070 .090 .115 —	.070 .085 .105 —
3.160-3.937 3.938-6.299	.100 .130	.100 .130	.115 .145	.130 .165	.150	.160	_	_
1060 1100 1350	3	3003 3005 3105	5()05)50 157			Reflector Iclad All	
0.006-0.010 0.011-0.016 0.017-0.025 0.026-0.032 0.033-0.039	.0010 .0010 .0015 .0020 .0020	.0015 .0020 .0020 .0025 .0030	 .0030 .0035 .0035	 .0035 .0040 .0045	 .006			
0.040-0.047 0.048-0.063 0.064-0.079 0.080-0.098 0.099-0.126	.0025 .0030 .0035 .0035 .0045	.0035 .0035 .0040 .0045 .0055	.0045 .0055 .006 .007 .007	.0055 .006 .007 .008 .010	.007 .007 .008 .010 .011	.009 .010 .011 .013		
0.127-0.158 0.159-0.197 0.198-0.248 0.249-0.315 0.316-0.394	.0055 .007 .009 .012 .017	.007 .009 .011 .014 .017	.009 .011 .013 .015 .020	.011 .013 .015 .018 .023	.013 .015 .018 .022 .027	.015 .018 .022 .027 .033	 .027 .036 .041	 .047 .051
0.395-0.630 0.631-0.984 0.985-1.575 1.576-2.362	.023 .031 .039 .055	.023 .031 .039 .055	.027 .037 .047 .060	.032 .043 .055 .070	.037 .051 .065 .090	.043 .060 .075 .100	.053 .070 .090 .115	.065 .085 .105 —
2.363-3.150 3.160-3.937 3.938-6.299	.075 .100 .130	.075 .100 .130	.085 .115 .145	.100 .130 .165	.110 .150 —	.125 .160 —		

¹When 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

		Inches –	– Plus or M	inus		
2014 2024 2124	2219 2324 2419		7050 7075 7150	74	178 175 Iso Alclad /	Alloys
'Specified	Specified Widths through 78.74 Inches					
Thickness In 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 0.011-0.016 0.017-0.025 0.026-0.032 0.033-0.039	.0010 .0015 .0015 .0015 .0015 .0015	.0020 .0025 .0025 .0015 .0015	.0020 .0025 .0025 .0020 .0020	.0020 .0025 .0025 .0030 .0030	 .0030 .0030	 .0035
0.040-0.047 0.048-0.063 0.064-0.079 0.080-0.098 0.099-0.126	.0020 .0020 .0020 .0020 .0020 .0035	.0020 .0020 .0020 .0020 .0020 .0035	.0020 .0030 .0030 .0035 .0035	.0030 .0030 .0035 .0040 .0045	.0030 .0030 .0035 .0040 .0045	.0035 .0035 .0035 .0045 .0045
0.127-0.158 0.159-0.197 0.198-0.248 0.249-0.315 0.316-0.394	.0040 .0055 .009 .012 .017	.0040 .007 .012 .015 .018	.0045 .007 .012 .015 .018	.007 .009 .012 .015 .018	.007 .009 .017 .019 .022	.009 .011 .017 .019 .022
0.395-0.630 0.631-0.984 0.985-1.575 1.576-2.362	.023 .031 .039 .055	.023 .031 .039 .055	.023 .031 .039 .055	.023 .031 .039 .055	.028 .037 .047 .060	.028 .037 .047 .060
2.363-3.150 3.160-3.937 3.938-6.299	.075 .100 .130	.075 .100 .130	.075 .100 .130	.075 .100 .130	.085 .115 .145	.085 .115 .145
		Specifi	ed Widths th	rough 78.75 II	nches	
	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 0.040-0.047 0.048-0.063 0.064-0.079 0.080-0.098	.0035 .0035 .0035 .0035 .0035 .0045	.007 .008 .009 .010 .011		.011 .013 .015 .018		
0.099-0.126 0.127-0.158 0.159-0.197 0.198-0.248 0.249-0.315	.0045 .009 .011 .021 .024	.013 .015 .018 .021 .024	.016 .018 .022 .025 .029	.020 .022 .026 .029 .033	 .041	 .051
0.316-0.394 0.395-0.630 0.631-0.984 0.985-1.575 1.576-2.362	.028 .033 .043 .055 .070	.028 .033 .043 .055 .070	.033 .039 .051 .065 .090	.039 .047 .060 .075 .100	.047 .059 .070 .090 .115	.059 .070 .085 .105 —
2.363-3.150 3.160-3.937 3.938-6.299	.100 .130 .165	.100 .130 .165	.110 .115 —	.125 .160 —		

¹When 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

	Mi		ing Allowance P nt of Specified S	
	Non-Resulp	ohurized	Resulphurize	
	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	0.01	5" Min
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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	e American Iron and Steel Institute	
Nominal Diameter	Minimum Machining Allowance	
of Bar (inches)	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:

		ecommended Stock om 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:			

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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.

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STAINLESS BAR

*Minimum Recommen	nded Stock Removal
Cold Drawn;	Rounds - Hexagons - Squares
Up to & Incl. ⁵ /16"	.003 per side except 440-C
Over ⁵ /16"	1% of Diameter per Side
Centerless Ground:	
All Ground **Defect Free** within the Star	ndard Size Tolerances
Example: 11/2" Rd. TOL is ±	.003
Material must not have any c	defect under003

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

				,	5
(B) Removal From	Thickness	Each Su	rface Specif	ied 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 form the minimum of the tolerance

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

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.

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 11/2, incl.	Over ¹⁵ /16 to 1 ⁷ /16, incl.	.075
Over 11/2 to 2, incl.	Over 17/16 to 115/16, incl.	.090
Over 2 to 21/2, incl.	Over 1 ¹⁵ /16 to 2 ⁷ /16, incl.	125
Over 21/2 to 31/2, incl.	Over 27/16 to 33/8, incl.	.156
Over 31/2 to 41/2, incl.	Over 3 ³ /8 to 4 ³ /8, incl.	.187
Over 41/2 to 6, incl.		.250

BARS

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 21/2 to 31/2, incl.	.046	
Over 31/2 to 41/2, incl.	.052	
Over 41/2 to 51/2, incl.	.057	
Over 51/2 to 61/2, incl.	.064	
Over 61/2 to 8, incl.	.074	
Over 8 to 10, incl.	.087	

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