








# Appendix A

## Abbreviations and Symbols

Across Flats . . . . .	ACR FLT	Kilogram . . . . .	.kg
American National Standards Institute . . . . .	ANSI	Kilometer . . . . .	km
Approximate . . . . .	APPROX	Left Hand . . . . .	LH
Assembly . . . . .	ASSY	Liter . . . . .	L
Bill of Materials . . . . .	B/M	Material . . . . .	MATL
Bolt Circle . . . . .	BC	Maximum . . . . .	MAX
Carbon Steel . . . . .	CS	Maximum Material Condition . . . . .	Ⓜ or MMC
Casting . . . . .	CSTG	Meter . . . . .	m
Cast Iron . . . . .	CI	Metric Thread . . . . .	M
Center Line . . . . .	Ⓢ or CL	Micrometer . . . . .	μm
Center to Center . . . . .	C to C	Millimeter . . . . .	mm
Centimeter . . . . .	cm	Minimum . . . . .	MIN
Chamfer . . . . .	CHAM	Nominal . . . . .	NOM
Cold-Rolled Steel . . . . .	CRS	Number . . . . .	NO.
Concentric . . . . .	CONC	Outside Diameter . . . . .	OD
Counterbore . . . . .	 or CBORE	Radius . . . . .	R
Counterdrill . . . . .	CDRILL	Reference or Reference Dimension . . ( ) or REF	
Countersink . . . . .	 or CSK	Right Hand . . . . .	RH
Depth . . . . .	DP or Ⓡ	Slotted . . . . .	SLOT
Diameter . . . . .	∅ or DIA	Spherical . . . . .	SPHER
Drawing . . . . .	DWG	Spotface . . . . .	 or SFACE
Equally Spaced . . . . .	EQL SP	Square . . . . .	□ or SQ
Finish All Over . . . . .	FAO	Steel . . . . .	STL
Gage . . . . .	GA	Symmetrical . . . . .	⊕---⊕ or SYM
Heat Treat . . . . .	HT TR	Taper—Flat . . . . .	
Hexagon . . . . .	HEX	Taper—Round . . . . .	
Inside Diameter . . . . .	ID	Through . . . . .	THRU
International Standards Organization . . . . .	ISO	Tolerance . . . . .	TOL
		U.S. Gage . . . . .	USG



# Appendix B

## Pipe Symbols

Table B. Pipe Symbols					
	Flanged	Screwed	Bell & Spigot	Welded	Soldered
Motor-Operated					
Globe Valve					
Motor-Operated Globe					
Hose Valve—Angle					
Hose Valve—Gate					
Hose Valve—Globe					
Lockshield Valve					
Quick-Opening Valve					
Safety Valve					
Governor-Operated					
Reducing					
Check Valve (Straight Way)					
Cock					
Diaphragm Valve					
Float Valve					
Gate Valve					

Table B. Pipe Symbols (continued)					
	Flanged	Screwed	Bell & Spigot	Welded	Soldered
Bull Plug					
Pipe Plug					
Concentric Reducer					
Eccentric Reducer					
Sleeve					
Tee (Straight Size)					
Tee (Outlet Up)					
Tee (Outlet Down)					
Tee (Double Sweep)					
Reducing Tee					
Tee (Single Sweep)					
Side Outlet (Outlet Down)					
Side Outlet (Outlet Up)					
Union					
Angle Valve—Check					
Angle Valve—Gate (Elevation)					
Angle Valve—Gate (Plan)					
Angle Valve—Globe (Elevation)					
Angle Valve—Globe (Plan)					
Automatic Valve—By-Pass					

# Appendix B

Table B. Pipe Symbols (continued)					
	Flanged	Screwed	Bell & Spigot	Welded	Soldered
Long Radius					
Reducing					
Side Outlet (Outlet Down)					
Side Outlet (Outlet Up)					
Street					
Connecting Pipe Joint					
Expansion Joint					
Lateral					
Orifice Flange					
Reducing Flange					
Bushing					
Cap					
Reducing Cross					
Straight Size Cross					
Crossover					
45° Elbow					
90° Elbow					
Elbow (Turned Down)					
Elbow (Turned Up)					
Base					
Double Branch					

**Table B. Pipe Symbols (continued)**

Air Conditioning	
Brine Return	— — — — BR — — — —
Brine Supply	———— B —————
Circulating Chilled or Hot-Water Flow	———— CH —————
Circulating Chilled or Hot-Water Return	— — — — CHR — — — —
Condenser Water Flow	———— C —————
Condenser Water Return	— — — — CR — — — —
Drain	———— D —————
Humidification Line	— — — — H — — — —
Make-Up Water	— — — — — — — — — —
Refrigerant Discharge	———— RD —————
Refrigerant Liquid	———— RL —————
Refrigerant Suction	— — — — RS — — — —
Heating	
Air-Relief Line	— — — — — — — — — —
Boiler Blow-Off	———— —————
Compressed Air	———— A —————
Condensate or Vacuum Pump Discharge	—O— —O— —O—
Feedwater Pump Discharge	—OO— —OO— —OO—
Fuel-Oil Flow	— — — FOF — — — —
Fuel-Oil Return	— — — FOR — — — —
Fuel-Oil Tank Vent	— — — FOV — — — —
High-Pressure Return	— # — # — # —
High-Pressure Steam	— # — # — # —
Hot-Water Heating Return	— — — — — — — — — —
Hot-Water Heating Supply	———— —————

# Appendix C

## Reference Tables

In the United States, the governing body responsible for the standards established for technical and engineering drawing is the **American National Standards Institute (ANSI)**. However, ANSI has enlisted the help of the **American Society of Mechanical Engineers (ASME)** to assist in the revision, maintenance, and marketing of these standards. A catalog of their drafting standards and other ASME publications is available by writing to ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900. Standards established for other technical fields, also controlled by ANSI, are maintained by their respective professional organizations.

International drafting standards are controlled by the **International Standards Organization (ISO)**. However, since the United States holds a leadership role in ISO, the international standards continue to move toward those established and maintained by ASME. The differences become less noticeable with each revision.

Selected standards useful to the drafter are listed below. Since all standards are constantly under revision, it is important to consult the most current ASME catalog for the latest editions.

### ANSI/ASME Standards

#### Standards for Drawings

Abbreviations for Use on Drawings and Text . . . . .	Y1.1
Decimal Inch Drawing Sheet Size and Format . . . . .	Y14.1
Metric Drawing Sheet Size and Format . . . . .	Y14.1M
Line Conventions and Lettering . . . . .	Y14.2M
Multi- and Sectional-View Drawings . . . . .	Y14.3M
Pictorial Drawing . . . . .	Y14.4M
Dimensioning and Tolerancing . . . . .	Y14.5M
Preferred Limits and Fits for Cylindrical Parts . . . . .	B4.1
Preferred Metric Limits and Fits . . . . .	B4.2
General Tolerances for Metric Dimensioned Products . . . . .	B4.3
Screw Thread Representation . . . . .	Y14.6
Screw Thread Representation (Metric Supplement) . . . . .	Y14.6M
Gear Drawing Standards—Part 1: For Spur, Helical, Double Helical, and Rack . . . . .	Y14.7.1
Gear Drawing Standards—Part 2: Bevel and Hypoid Gears . . . . .	Y14.7.2
Castings and Forgings . . . . .	Y14.8M
Mechanical Spring Representation . . . . .	Y14.13
Types and Applications of Engineering Drawings . . . . .	Y14.24
Surface Texture Symbols . . . . .	Y14.36M
Surface Texture (Surface Roughness, Waviness, and Lay . . . . .	B46.1
Engineering Drawing Practices . . . . .	Y14.100M
Graphic Symbols for Pipe Fittings, Valves, and Piping . . . . .	Y32.2.3
Graphic Symbols for Heating, Ventilating, and Air Conditioning . . . . .	Y32.2.4
Graphic Symbols for Plumbing Fixtures for Diagrams Used in Architecture and Building Construction . . . . .	Y32.4



Preferred Metric Sizes for Fluid Power Diagrams . . . . .	Y32.10
Preferred Metric Sizes for Round, Square, Rectangular, and Hexagon Metal Products . . . . .	B32.4M
Preferred Metric Sizes for Tubular Metal Products Other Than Pipe . . . . .	B32.5
Preferred Metric Equivalents of Inch Sizes for Tubular Metal Products Other Than Pipe . . . . .	B32.6M
Welded and Seamless Wrought Steel Pipe . . . . .	B36.10M

## Fasteners in Metric Units

Metric Small Solid Rivets . . . . .	B18.1.3M
Metric Hex Cap Screws . . . . .	B18.2.3.1M
Metric Formed Hex Screws . . . . .	B18.2.3.3M
Metric Heavy Hex Screws . . . . .	B18.2.3.4M
Metric Hex Bolts . . . . .	B18.2.3.5M
Metric Heavy Hex Bolts . . . . .	B18.2.3.6M
Square Head Bolts (Metric Series) . . . . .	B18.2.3.10M
Metric Hex Nuts, Style 1 . . . . .	B18.2.4.1M
Metric Hex Nuts, Style 2 . . . . .	B18.2.4.2M
Metric Slotted Hex Nuts . . . . .	B18.2.4.6M
Metric Heavy Hex Nuts . . . . .	B18.2.4.6M
Socket Head Cap Screws . . . . .	B18.3.1M
Hexagon Socket Flat Countersunk Head Cap Screws . . . . .	B18.3.5M
Metric Series Socket Set Screws . . . . .	B18.3.6M
Cotter Pins (Metric Series) . . . . .	B18.8.6M
Square and Rectangular Keys and Keyways . . . . .	B18.25.1M
Woodruff Keys and Keyways . . . . .	B18.25.2M

## Fasteners in Customary Units

Small Solid Rivets . . . . .	B18.1.1
Large Rivets . . . . .	B18.1.2
Square and Hex Bolts and Screws (Inch Series) . . . . .	B18.2.1
Square and Hex Nuts (Inch Series) . . . . .	B18.2.2
Clearance Holes for Bolts, Screws, and Studs . . . . .	B18.2.8
Socket Cap, Shoulder, and Set Screws, Hex and Spline Keys (Inch Series) . . . . .	B18.3
Round Head Bolts (Inch Series) . . . . .	B18.5
Wood Screws (Inch Series) . . . . .	B18.6.1
Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws . . . . .	B18.6.2
Machine Screws and Machine Screw Nuts . . . . .	B18.6.3
Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series) . . . . .	B18.8.2
Lock Washers (Inch Series) . . . . .	B18.8.2
Plain Washers . . . . .	B18.2.2.1
Keys and Keyseats . . . . .	B17.1
Woodruff Keys and Keyseats . . . . .	B17.2

## ANSI/AWS Standard

Symbols for Welding and Nondestructive Testing . . . . .	AWS A2.4
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# The Reference Tables

The tables that follow are needed to work some of the problems in this edition of *Mechanical Drawing: Board and CAD Techniques*. These tables have been adapted from the ANSI/ASME standards for use in this book. Although most of the tables are self-explanatory, the following sections provide additional information about some of them.

## American National Standard Limits and Fits

Tables C-9 through C-16 are designed for use with the basic hole system of limits and fits described in Chapter 7, “Dimensioning.” Information from these tables is adapted from ASME B4.1, “Preferred Limits and Fits for Cylindrical Parts.” For larger sizes and additional information, refer to the standard.

There are five distinct classes of fits:

- RC** Running or sliding clearance fits
- LC** Locational clearance fits
- LT** Transition clearance or interference fits
- LN** Locational interference fits
- FN** Force or shrink fits

These five classes of fits are placed in three general categories, as follows.

### Running and Sliding Fits (Table C-9)

These fits provide a similar running performance, with suitable lubrication allowance, throughout the range of sizes. The clearances for the first two classes, used chiefly as sliding fits, increase more slowly than for the other classes, so that accurate location is maintained even at the expense of free relative motion.

**RC 1:** *Close sliding fits* accurately locate parts that must assemble without perceptible play.

**RC 2:** *Sliding fits* are for accurate location, but with greater maximum clearance than RC 1. Parts move and turn easily but do not run freely, and in the larger sizes may seize with small temperature changes.

**RC 3:** *Precision running fits* are the closest fits expected to run freely. They are for precision work at slow speeds and light journal pressures. They are not suitable under appreciable temperature differences.

**RC 4:** *Close running fits* are chiefly for running fits on accurate machinery with moderate surface speeds and journal pressures, where accurate location and minimum play are desired.

**RC 5 and RC 6:** *Medium running fits* are for higher running speeds, heavy journal pressures, or both.



**RC 7:** *Free running fits* are for use where accuracy is not essential, where large temperature variations are likely, or under both of these conditions.

**RC 8 and RC 9:** *Loose running fits* are for materials such as cold-rolled shafting and tubing, made to commercial tolerances.

### Locational Fits (Tables C-10 Through C-12)

These fits determine only the location of mating parts. They may provide rigid or accurate location, as in interference fits, or some freedom of location, as in clearance fits. They fall into the following three groups:

**LC:** *Locational clearance fits* are for normally stationary parts that can be freely assembled or disassembled. They run from snug fits for parts requiring accuracy of location, through the medium clearance fits for parts such as spigots, to the looser fastener fits where freedom of assembly is of prime importance.

**LT:** *Transitional locational fits* fall between clearance and interference fits. They are for application where accuracy of location is important, but a small amount of clearance or interference is permissible.

**LN:** *Locational interference fits* are used where accuracy of location is of prime importance, and for parts needing rigidity and alignment with no special requirements for bore pressure. Such fits are not for parts that transmit frictional loads from one part to another by virtue of the tightness of fit; those conditions are met by force fits.

### Force Fits (Table C-13)

A force fit is a special type of interference fit, normally characterized by maintenance of constant bore pressures throughout the range of sizes. Thus the interference varies almost directly with diameter. To maintain the resulting pressures within reasonable limits, the difference between its minimum and maximum value is small.

**FN 1:** *Light drive fits* require light assembly pressures and produce more or less permanent assemblies. These are suitable for thin sections, long fits, or cast-iron external members.

**FN 2:** *Medium drive fits* are for ordinary steel parts or for shrink fits on light sections. They are about the tightest fits that can be used with high-grade cast-iron external members.

**FN 3:** *Heavy drive fits* are suitable for heavier steel parts or for shrink fits in medium sections.

**FN 4 and FN 5:** *Force fits* are for parts that can be highly stressed, or for shrink fits where heavy pressing forces are impractical.

# Appendix C

**Table C-1. Fractional-Inch, Decimal-Inch, and Millimeter Equivalent Chart**

Fractions					Decimal Inches			Millimeters		
4ths	8ths	16ths	32nds	64ths	To 2 Places	To 3 Places	To 4 Places	To 1 Place	To 2 Places	To 3 Places
				1/64	.02	.016	.0156	0.4	.40	.397
			1/32	...	.03	.031	.0312	0.8	.80	.794
				3/64	.05	.047	.0469	1.2	1.20	1.191
		1/16	...	...	.06	.062	.0625	1.6	1.59	1.588
				5/64	.08	.078	.0781	2.0	1.98	1.984
			3/32	...	.09	.094	.0938	2.4	2.38	2.381
				7/64	.11	.109	.1094	2.8	2.78	2.778
	1/8	...	...	...	.12	.125	.1250	3.2	3.18	3.175
				9/64	.14	.141	.1406	3.6	3.57	3.572
			5/32	...	.16	.156	.1562	4.0	3.97	3.969
				11/64	.17	.172	.1719	4.4	4.37	4.366
		3/16	...	...	.19	.188	.1875	4.8	4.76	4.762
				13/64	.20	.203	.2031	5.2	5.16	5.159
			7/32	...	.22	.219	.2188	5.6	5.56	5.556
				15/64	.23	.234	.2344	6.0	5.95	5.953
1/4	...	...	...	...	.25	.250	.2500	6.4	6.35	6.350
				17/64	.27	.266	.2656	6.8	6.75	6.747
			9/32	...	.28	.281	.2812	7.1	7.14	7.144
				19/64	.30	.297	.2969	7.5	7.54	7.541
		5/16	...	...	.31	.312	.3125	7.9	7.94	7.938
				21/64	.33	.328	.3281	8.3	8.33	8.334
			11/32	...	.34	.344	.3438	8.7	8.73	8.731
				23/64	.36	.359	.3594	9.1	9.13	9.128
	3/8	...	...	...	.38	.375	.3750	9.5	9.52	9.525
				25/64	.39	.391	.3906	9.9	9.92	9.922
			13/32	...	.41	.406	.4062	10.3	10.32	10.319
				27/64	.42	.422	.4219	10.7	10.72	10.716
		7/16	...	...	.44	.438	.4375	11.1	11.11	11.112
				29/64	.45	.453	.4531	11.5	11.51	11.509
			15/32	...	.47	.469	.4688	11.9	11.91	11.906
				31/64	.48	.484	.4844	12.3	12.30	12.303
				...	.50	.500	.5000	12.7	12.70	12.700
				33/64	.52	.516	.5156	13.1	13.10	13.097
			17/32	...	.53	.531	.5312	13.5	13.49	13.494
				35/64	.55	.547	.5469	13.9	13.89	13.891
		9/16	...	...	.56	.562	.5625	14.3	14.29	14.288
				37/64	.58	.578	.5781	14.7	14.68	14.684
			19/32	...	.59	.594	.5938	15.1	15.08	15.081
				39/64	.61	.609	.6094	15.5	15.48	15.478
	5/8	...	...	...	.62	.625	.6250	15.9	15.88	15.875

(continued on next page)

**Table C-1. Fractional-Inch, Decimal-Inch, and Millimeter Equivalent Chart (continued)**

Fractions					Decimal Inches			Millimeters		
4ths	8ths	16ths	32nds	64ths	To 2 Places	To 3 Places	To 4 Places	To 1 Place	To 2 Places	To 3 Places
				$\frac{41}{64}$	.64	.641	.6406	16.3	16.27	16.272
			$\frac{21}{32}$	...	.66	.656	.6562	16.7	16.67	16.669
				$\frac{43}{64}$	.67	.672	.6719	17.1	17.07	17.066
		$\frac{11}{16}$	...	...	.69	.688	.6875	17.5	17.46	17.462
				$\frac{45}{64}$	.70	.703	.7031	17.9	17.86	17.859
			$\frac{23}{32}$	...	.72	.719	.7188	18.3	18.26	18.256
				$\frac{47}{64}$	.73	.734	.7344	18.6	18.65	18.653
$\frac{3}{4}$	...	...	...	...	.75	.750	.7500	19.1	19.05	19.050
				$\frac{49}{64}$	.77	.766	.7656	19.4	19.45	19.447
			$\frac{25}{32}$	...	.78	.781	.7812	19.8	19.84	19.844
				$\frac{51}{64}$	.80	.797	.7969	20.2	20.24	20.241
		$\frac{13}{16}$	...	...	.81	.812	.8125	20.6	20.64	20.638
				$\frac{53}{64}$	.83	.828	.8281	21.0	21.03	21.034
			$\frac{27}{32}$	...	.84	.844	.8438	21.4	21.43	21.431
				$\frac{55}{64}$	.86	.859	.8594	21.8	21.83	21.828
	$\frac{7}{8}$	...	...	...	.88	.875	.8750	22.2	22.22	22.225
				$\frac{57}{64}$	.89	.891	.8906	22.6	22.62	22.622
			$\frac{29}{32}$	...	.91	.906	.9062	23.0	23.02	23.019
				$\frac{59}{64}$	.92	.922	.9219	23.4	23.42	23.416
		$\frac{15}{16}$	...	...	.94	.938	.9375	23.8	23.81	23.812
				$\frac{61}{64}$	.95	.953	.9531	24.2	24.21	24.209
			$\frac{31}{32}$	...	.97	.969	.9688	24.6	24.61	24.606
				$\frac{63}{64}$	.98	.984	.9844	25.0	25.00	25.003
					1.00	1.000	1.0000	25.4	25.40	25.400

# Appendix C

**Table C-2. Threads per Inch and Tap Drill Sizes**

Size (Inches)		Graded Pitch Series						Constant Pitch Series					
Number or Fraction	Decimal	Coarse UNC		Fine UNF		Extra Fine UNF		8 UN		12 UN		16 UN	
		Threads per Inch	Tap Drill Dia.	Threads per Inch	Tap Drill Dia.	Threads per Inch	Tap Drill Dia.	Threads per Inch	Tap Drill Dia.	Threads per Inch	Tap Drill Dia.	Threads per Inch	Tap Drill Dia.
0	.060	—	—	80	<sup>3</sup> / <sub>64</sub>	—	—	—	—	—	—	—	—
2	.086	56	No. 50	64	No. 49	—	—	—	—	—	—	—	—
4	.112	40	No. 43	48	No. 42	—	—	—	—	—	—	—	—
5	.125	40	No. 38	44	No. 37	—	—	—	—	—	—	—	—
6	.138	32	No. 36	40	No. 33	—	—	—	—	—	—	—	—
8	.164	32	No. 29	36	No. 29	—	—	—	—	—	—	—	—
10	.190	24	No. 25	32	No. 21	—	—	—	—	—	—	—	—
<sup>1</sup> / <sub>4</sub>	.250	20	7	28	3	32	.219	—	—	—	—	—	—
<sup>5</sup> / <sub>16</sub>	.312	18	F	24	1	32	.281	—	—	—	—	—	—
<sup>3</sup> / <sub>8</sub>	.375	16	.312	24	Q	32	.344	—	—	—	—	UNC	—
<sup>7</sup> / <sub>16</sub>	.438	14	U	20	.391	28	Y	—	—	—	—	16	V
<sup>1</sup> / <sub>2</sub>	.500	13	.422	20	.453	28	.469	—	—	—	—	16	.438
<sup>9</sup> / <sub>16</sub>	.562	12	.484	18	.516	24	.516	—	—	UNC	—	16	.500
<sup>5</sup> / <sub>8</sub>	.625	11	.531	18	.578	24	.578	—	—	12	.547	16	.562
<sup>3</sup> / <sub>4</sub>	.750	10	.656	16	.688	20	.703	—	—	12	.672	UNF	—
<sup>7</sup> / <sub>8</sub>	.875	9	.766	14	.812	20	.828	—	—	12	.797	16	.812
1	1.000	8	.875	12	.922	20	.953	UNC	—	UNF	—	16	.938
<sup>1</sup> / <sub>8</sub>	1.125	7	.984	12	1.047	18	1.078	8	1.000	UNF	—	16	1.062
<sup>1</sup> / <sub>4</sub>	1.250	7	1.109	12	1.172	18	1.188	8	1.125	UNF	—	16	1.188
<sup>3</sup> / <sub>8</sub>	1.375	6	1.219	12	1.297	18	1.312	8	1.250	UNF	—	16	1.312
<sup>1</sup> / <sub>2</sub>	1.500	6	1.344	12	1.422	18	1.438	8	1.375	UNF	—	16	1.438
<sup>5</sup> / <sub>8</sub>	1.625	—	—	—	—	18	—	8	1.500	12	1.547	16	1.562
<sup>3</sup> / <sub>4</sub>	1.750	5	1.562	—	—	—	—	8	1.625	12	1.672	16	1.688
<sup>7</sup> / <sub>8</sub>	1.875	—	—	—	—	—	—	8	1.750	12	1.797	16	1.812
2	2.000	4.5	1.781	—	—	—	—	8	1.875	12	1.922	16	1.938
<sup>2</sup> / <sub>4</sub>	2.250	4.5	2.031	—	—	—	—	8	2.125	12	2.172	16	2.188
<sup>2</sup> / <sub>2</sub>	2.500	4	2.250	—	—	—	—	8	2.375	12	2.422	16	2.438
<sup>2</sup> / <sub>4</sub>	2.750	4	2.500	—	—	—	—	8	2.625	12	2.672	16	2.688
3	3.000	4	2.750	—	—	—	—	8	2.875	12	2.922	16	2.938
<sup>3</sup> / <sub>4</sub>	3.250	4	3.000	—	—	—	—	8	3.125	12	3.172	16	3.188
<sup>3</sup> / <sub>2</sub>	3.500	4	3.250	—	—	—	—	8	3.375	12	3.422	16	3.438
<sup>3</sup> / <sub>4</sub>	3.750	4	3.500	—	—	—	—	8	3.625	12	3.668	16	3.688
4	4.000	4	3.750	—	—	—	—	8	3.875	12	3.922	16	3.938

**Notes:** The tap diameter sizes shown are nominal. The class and length of thread will govern the limits on the tapped hole size.

Table C-3. ISO Metric Screw Threads																				
Size	Graded Pitch Series				Constant Pitch Series															
Dia. (mm)	Coarse		Fine		4		3		2		1.5		1.25		1		0.75		0.5	
	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size	Thread Pitch	Tap Drill Size
*1.6	0.35	1.25																		
1.8	0.35	1.45																		
*2	0.4	1.6																		
2.2	0.45	1.75																		
*2.5	0.45	2.05																		
*3	0.5	2.5																		
3.5	0.6	2.9																		
*4	0.7	3.3																	0.5	3.5
4.5	0.75	3.7																	0.5	4.0
*5	0.8	4.2																	0.5	4.5
*6	1	5.0															0.75	5.2		
*8	1.25	6.7	1	7.0										1	7.0	0.75	7.2			
*10	1.5	8.5	1.25	8.7								1.25	8.7	1	9.0	0.75	9.2			
*12	1.75	10.2	1.25	10.8						1.5	10.5	1.25	10.7	1	11					
14	2	12	1.5	12.5						1.5	12.5	1.25	12.7	1	13					
*16	2	14	1.5	14.5						1.5	14.5			1	15					
18	2.5	15.5	1.5	16.5					2	16	1.5	16.5			1	17				
*20	2.5	17.5	1.5	18.5					2	18	1.5	18.5			1	19				
22	2.5	19.5	1.5	20.5					2	20	1.5	20.5			1	21				
*24	3	21	2	22					2	22	1.5	22.5			1	23				
27	3	24	2	25					2	25	1.5	25.5			1	26				
*30	3.5	26.5	2	28					2	28	1.5	28.5			1	29				
33	3.5	29.5	2	31					2	31	1.5	31.5								
*36	4	32	3	33					2	34	1.5	34.5								
39	4	35	3	36					2	37	1.5	37.5								
*42	4.5	37.5	3	39	4	38	3	39	2	40	1.5	40.5								
45	4.5	39	3	42	4	41	3	42	2	43	1.5	43.5								
*46	5	43	3	45	4	44	3	45	2	46	1.5	46.5								

**Notes:** The diameter sizes are nominal. Sizes preceded by an asterisk (\*) are preferred.

# Appendix C

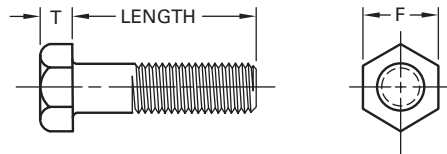
**Table C-4. Acme and Stub Acme Threads**

ANSI Preferred Diameter-Pitch Combinations							
Nominal (Major) Diameter	Threads per Inch	Nominal (Major) Diameter	Threads per Inch	Nominal (Major) Diameter	Threads per Inch	Nominal (Major) Diameter	Threads per Inch
1/4 (.250)	16	3/4 (.750)	6	1 1/2 (1.500)	4	3 (3.000)	2
5/16 (.312)	14	7/8 (.875)	6	1 3/4 (1.750)	4	3 1/2 (3.500)	2
3/8 (.375)	12	1 (1.000)	5	2 (2.000)	4	4 (4.000)	2
7/16 (.438)	12	1 1/8 (1.125)	5	2 1/4 (2.250)	3	4 1/2 (4.500)	2
1/2 (.500)	10	1 1/4 (1.250)	5	2 1/2 (2.500)	3	5 (5.000)	2
5/8 (.625)	8	1 3/8 (1.375)	4	2 3/4 (2.750)	3		

**Note:** Diameters in inches.

**Table C-5. Hexagon-Head Bolts and Cap Screws**

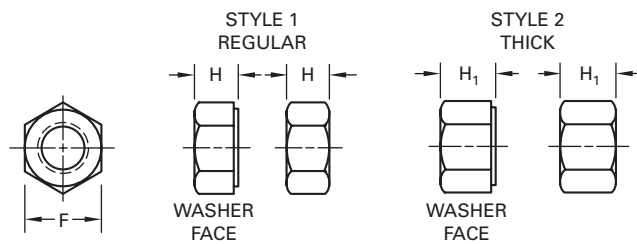
U.S. Customary (Inches)			Metric (Millimeters)		
Nominal Bolt Size	Width Across Flats F	Thickness T	Nominal Bolt Size and Thread Pitch	Width Across Flats F	Thickness T
.250	.438	.172	M5 X 0.8	8	3.9
.312	.500	.219	M6 X 1	10	4.7
.375	.562	.250	M8 X 1.25	13	5.7
.438	.625	.297			
.500	.750	.344	M10 X 1.5	15	6.8
.625	.938	.422	M12 X 1.75	18	8
.750	1.125	.500	M14 X 2	21	9.3
.875	1.312	.578	M16 X 2	24	10.5
1.000	1.500	.672	M20 X 2.5	30	13.1
1.125	1.688	.750	M24 X 3	36	15.6
1.250	1.875	.844	M30 X 3.5	46	19.5
1.375	2.062	.906	M36 X 4	55	23.4
1.500	2.250	1.000			





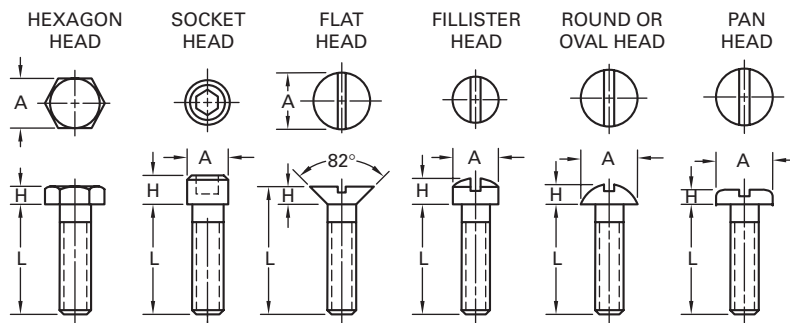
**Table C-6. Hexagon-Head Nuts**

U.S. Customary (Inches)				Metric (Millimeters)			
Nominal Nut Size	Distance Across Flats F	Thickness Max.		Nominal Nut Size and Thread Pitch	Distance Across Flats F	Thickness Max.	
		Style 1 (Regular)-H	Style 2 (Thick)-H <sub>1</sub>			Style 1 (Regular)-H	Style 2 (Thick)-H <sub>1</sub>
.250	.438	.218	.281	M4 X 0.7	7	—	3.2
.312	.500	.266	.328	M5 X 0.8	8	4.5	5.3
.375	.596	.328	.406	M6 X 1	10	5.6	6.5
.438	.625	.375	.453	M8 X 1.25	13	6.6	7.8
.500	.750	.438	.562	M10 X 1.5	15	9	10.7
.562	.875	.484	.609	M12 X 1.75	18	10.7	12.8
.625	.938	.547	.719	M14 X 2	21	12.5	14.9
.750	1.125	.641	.812	M16 X 2	24	14.5	17.4
.875	1.312	.750	.906	M20 X 2.5	30	18.4	21.2
1.000	1.500	.859	1.000	M24 X 3	36	22	25.4
1.125	1.688	.969	1.156	M30 X 3.5	46	26.7	31
1.250	1.875	1.062	1.250	M36 X 4	55	32	37.6
1.375	2.062	1.172	1.375				
1.500	2.250	1.281	1.500				



**Table C-7. Common Machine and Cap Screws**

U.S. Customary (Inches)						Metric (Millimeters)															
Nominal Size	Hexagon Head		Socket Head		Flat Head		Fillister Head		Round or Oval Head		Nominal Size	Hexagon Head		Socket Head		Flat Head		Fillister Head		Round or Oval Head	
	A	H	A	H	A	H	A	H	A	H		A	H	A	H	A	H	A	H	A	H
.250	.44	.17	.38	.25	.50	.14	.38	.17	.44	.19	M3	5.5	2	5.5	3	5.6	1.6	6	2.4	5.6	1.9
.312	.50	.22	.47	.31	.62	.18	.44	.20	.56	.25	4	7	2.8	7	4	7.5	2.2	8	3.1	7.5	2.5
.375	.56	.25	.56	.38	.75	.21	.56	.25	.62	.27	5	8.5	3.5	9	5	9.2	2.5	10	3.8	9.2	3.1
.438	.62	.30	.66	.44	.81	.21	.62	.30	.75	.33	6	10	4	10	6	11	3	12	4.6	11	3.8
.500	.75	.34	.75	.50	.88	.21	.75	.33	.81	.35	8	13	5.5	13	8	14.5	4	16	6	14.5	5
.625	.94	.42	.94	.62	1.12	.28	.88	.42	1.00	.44	10	17	7	16	10	18	5	20	7.5	18	6.2
.750	1.12	.50	1.12	.75	1.38	.35	1.00	.50	1.25	.55	12	19	8	18	12						
											14	22	9	22	14						
											16	24	10	24	16						

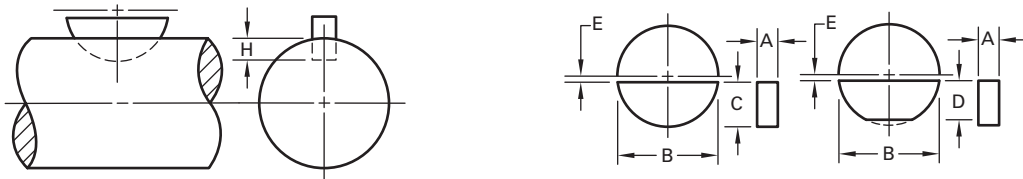


# Appendix C

**Table C-8. Woodruff Keys**

U.S. Customary (Inches)					Metric (Millimeters)					
Nominal Size A X B	Key			Keyseat	Key No.	Nominal Size A X B	Key			Keyseat
	E	C	D	H			E	C	D	H
.062 X .500	.047	.203	.194	.172	204	1.6 X 12.7	1.5	5.1	4.8	4.2
.094 X .500	.047	.203	.194	.156	304	2.4 X 12.7	1.3	5.1	4.8	3.8
.094 X .625	.062	.250	.240	.203	305	2.4 X 15.9	1.5	6.4	6.1	5.1
.125 X .500	.049	.203	.194	.141	404	3.2 X 12.7	1.3	5.1	4.8	3.6
.125 X .625	.062	.250	.240	.188	405	3.2 X 15.9	1.5	6.4	6.1	4.6
.125 X .750	.062	.313	.303	.251	406	3.2 X 19.1	1.5	7.9	7.6	6.4
.156 X .625	.062	.250	.240	.172	505	4.0 X 15.9	1.5	6.4	6.1	4.3
.156 X .750	.062	.313	.303	.235	506	4.0 X 19.1	1.5	7.9	7.6	5.8
.156 X .875	.062	.375	.365	.297	507	4.0 X 22.2	1.5	9.7	9.1	7.4
.188 X .750	.062	.313	.303	.219	606	4.8 X 19.1	1.5	7.9	7.6	5.3
.188 X .875	.062	.375	.365	.281	607	4.8 X 22.2	1.5	9.7	9.1	7.1
.188 X 1.000	.062	.438	.428	.344	608	4.8 X 25.4	1.5	11.2	10.9	8.6
.188 X 1.125	.078	.484	.475	.390	609	4.8 X 28.6	2.0	12.2	11.9	9.9
.250 X .875	.062	.375	.365	.250	807	6.4 X 22.2	1.5	9.7	9.1	6.4
.250 X 1.000	.062	.438	.428	.313	808	6.4 X 25.4	1.5	11.2	10.9	7.9

**Note:** Metric key sizes were not available at the time of publication. Sizes shown are inch-designed key sizes soft-converted to millimeters. Conversion was necessary to allow the student to compare keys with slot sizes given in millimeters.



<b>Table C-9. Running and Sliding Fits</b>																
Basic hole system. Limits are in thousandths of an inch.																
Nominal Size Range (Inches)		Class RC 1 Close Sliding Fit			Class RC 2 Sliding Fit			Class RC 3 Precision Running Fit			Class RC 4 Close Running Fit					
		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits				
			Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft			
Over	To															
0-0.12		0.1	+0.2	-0.1	0.1	0.25	+0.1	-0.3	+0.4	-0.3	0.3	+0.6	-0.3			
		0.45	-0	-0.25	0.55	-0	-0.3	0.95	-0	-0.55	1.3	-0	-0.7			
0.12-0.24		0.15	+0.2	-0.15	0.15	+0.3	-0.15	0.4	+0.5	-0.4	0.4	+0.7	-0.4			
		0.5	-0	-0.3	0.65	-0	-0.35	1.12	-0	-0.7	1.6	-0	-0.9			
0.24-0.40		0.2	+0.25	-0.2	0.2	+0.4	-0.2	0.5	+0.6	-0.5	0.5	+0.9	-0.5			
		0.6	-0	-0.35	0.85	-0	-0.45	1.5	-0	-0.9	2.0	-0	-1.1			
0.40-0.71		0.25	+0.3	-0.25	0.25	+0.4	-0.25	0.6	+0.7	-0.6	0.6	+1.0	-0.6			
		0.75	-0	-0.45	0.95	-0	-0.55	1.7	-0	-1.3	2.8	-0	-1.3			
0.71-1.19		0.3	+0.4	-0.3	0.3	+0.5	-0.3	0.8	+0.8	-0.8	0.8	+1.2	-0.8			
		0.95	-0	-0.55	1.2	-0	-0.7	2.1	-0	-1.3	2.8	-0	-1.6			
1.19-1.97		0.4	+0.4	-0.4	0.4	+0.6	-0.4	1.0	+1.0	-1.0	1.0	+1.6	-1.0			
		1.1	-0	-0.7	1.4	-0	-0.8	2.6	-0	-1.6	3.6	-0	-2.0			
1.97-3.15		0.4	+0.5	-0.4	0.4	+0.7	-0.4	1.2	+1.2	-1.2	1.2	+1.8	-1.2			
		1.2	-0	-0.7	1.6	-0	-0.9	3.1	-0	-1.9	4.2	-0	-2.4			
Nominal Size Range (Inches)		Medium Running Fits									Loose Running Fits					
		Class RC 5			Class RC 6			Class RC 7			Class RC 8			Class RC 9		
		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits	
Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft
Over	To															
0-0.12		0.6	+0.6	-0.6	0.6	+1.0	-0.6	1.0	+1.0	-1.0	2.5	+1.6	-2.5	4.0	+2.5	-4.0
		1.6	-0	-1.0	2.2	-0	-1.2	2.6	-0	+1.6	5.1	-0	-3.5	8.1	-0	-5.6
0.12-0.24		0.8	+0.7	-0.8	0.8	+1.2	-0.8	1.2	+1.2	-1.2	2.8	+1.8	-2.8	4.5	+3.0	-4.5
		2.0	-0	-1.3	2.7	-0	-1.5	3.1	-0	-1.9	5.8	-0	-4.0	9.0	-0	-6.0
0.24-0.40		1.0	+0.9	-1.0	1.0	+1.4	-1.0	1.6	+1.4	-1.6	3.0	+2.2	-3.0	5.0	+3.5	-5.0
		2.5	-0	-1.6	3.3	-0	-1.9	3.9	-0	-2.5	6.6	-0	-4.4	10.7	-0	-7.2
0.40-0.71		1.2	+1.0	-1.2	1.2	+1.6	-1.2	2.0	+1.6	-2.0	3.5	+2.8	-3.5	6.0	+4.0	-6.0
		2.9	-0	-1.9	3.8	-0	-2.2	4.6	-0	-3.0	7.9	-0	-5.1	12.8	-0	-8.8
0.71-1.19		1.6	+1.2	-1.6	1.6	+2.0	-1.6	2.5	+2.0	-2.5	4.5	+3.5	-4.5	7.0	+5.0	-7.0
		3.6	-0	-2.4	4.8	-0	-2.8	5.7	-0	-3.7	10.0	-0	-6.5	15.5	-0	-10.5
1.19-1.97		2.0	+1.6	-2.0	2.0	+2.5	-2.0	3.0	+2.5	-3.0	5.0	+4.0	-5.0	8.0	+6.0	-8.0
		4.6	-0	-3.0	6.1	-0	-3.6	7.1	-0	-4.6	11.5	-0	-7.5	18.0	-0	-12.0
1.97-3.15		2.5	+1.8	-2.5	2.5	+3.0	-2.5	4.0	+3.0	-4.0	6.0	+4.5	-6.0	9.0	+7.0	-9.0
		5.5	-0	-3.7	7.3	-0	-4.3	8.8	-0	-5.8	13.5	-0	-9.0	20.5	-0	-13.5

# Appendix C

**Table C-10. Clearance Locational Fits**

Basic hole system. Limits are in thousandths of an inch.

Nominal Size Range (Inches)		Class LC 1			Class LC 2			Class LC 3			Class LC 4			Class LC 5					
		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits				
			Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft	Hole	Shaft	
Over	To																		
0-0.12	0	+0.25	+0	0	+0.4	+0	0	+0.6	+0	0	+1.6	+0	0.1	+0.4	-0.1				
	0.45	-0	-0.2	0.65	-0	-0.25	1	-0	-0.4	2.6	-0	-1.0	0.75	-0	-0.35				
0.12-0.24	0	+0.3	+0	0	+0.5	+0	0	+0.7	+0	0	+1.8	+0	0.15	+0.5	-0.15				
	0.5	-0	-0.2	0.8	-0	-0.3	1.2	-0	-0.5	3.0	-0	-1.2	0.95	-0	-0.45				
0.24-0.40	0	+0.4	+0	0	+0.6	+0	0	+0.9	+0	0	+2.2	+0	0.2	+0.6	-0.2				
	0.65	-0	-0.25	1.0	-0	-0.4	1.5	-0	-0.6	3.6	-0	-1.4	1.2	-0	-0.6				
0.40-0.71	0	+0.4	+0	0	+0.7	+0	0	+1.0	+0	0	+2.8	+0	0.25	+0.7	-0.25				
	0.7	-0	-0.3	1.1	-0	-0.4	1.7	-0	-0.7	4.4	-0	-1.6	1.35	-0	-0.65				
0.71-1.19	0	+0.5	+0	0	+0.8	+0	0	+1.2	+0	0	+3.5	+0	0.3	+0.8	-0.3				
	0.9	-0	-0.4	1.3	-0	-0.5	2	-0	-0.8	5.5	-0	-2.0	1.6	-0	-0.8				
1.19-1.97	0	+0.6	+0	0	+1.0	+0	0	+1.6	+0	0	+4.0	+0	0.4	+1.0	-0.4				
	1.0	-0	-0.4	1.6	-0	-0.6	2.6	-0	-1	6.5	-0	-2.5	2.0	-0	-1.0				
1.97-3.15	0	+0.7	+0	0	+1.2	+0	0	+1.8	+0	0	+4.5	+0	0.4	+1.2	-0.4				
	1.2	-0	-0.5	1.9	-0	-0.7	3	-0	-1.2	7.5	-0	-3	2.3	-0	-1.1				
Nominal Size Range (Inches)		Class LC 6			Class LC 7			Class LC 8			Class LC 9			Class LC 10			Class LC 11		
		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits		Limits of Clearance	Standard Limits	
			Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft
Over	To																		
0-0.12	0.3	+1.0	-0.3	0.6	+1.6	-0.6	1.0	+1.6	1.0	2.5	+2.5	-2.5	4	+4	-4	5	+6	-5	
	1.9	-0	-0.9	3.2	-0	-1.6	3.6	-0	-2.0	6.6	-0	-4.1	12	-0	-8	17	-0	-11	
0.12-0.24	0.4	+1.2	-0.4	0.8	+1.8	-0.8	1.2	+1.8	-1.2	2.8	+3.0	-2.8	4.5	+5	-4.5	6	+7	-6	
	2.3	-0	-1.1	3.8	-0	-2.0	4.2	-0	-2.4	7.6	-0	-4.6	14.5	-0	-9.5	20	-0	-13	
0.24-0.40	0.5	+1.5	-0.5	1.0	+2.2	-1.0	1.6	+2.2	-1.6	3.0	+3.5	-3.0	5	+6	-5	7	+9	-7	
	2.8	-0	-1.4	4.6	-0	-2.4	5.2	-0	-3.0	8.7	-0	-5.2	17	-0	-11	25	-0	-16	
0.40-0.71	0.6	+1.6	-0.6	1.2	+2.8	-1.2	2.0	+2.8	-2.0	3.5	+4.0	-3.5	6	+7	-6	8	+10	-8	
	3.2	-0	-1.6	5.6	-0	-2.8	6.4	-0	-3.6	10.3	-0	-6.3	20	-0	-13	28	-0	-18	
0.71-1.19	0.8	+2.0	-0.8	1.6	+3.5	-1.6	2.5	+3.5	-2.5	4.5	+5.0	-4.5	7	+8	-7	10	+12	-10	
	4.0	-0	-2.0	7.1	-0	-3.6	8.0	-0	-4.5	13.0	-0	-8.0	23	-0	-15	34	-0	-22	
1.19-1.97	1.0	+2.5	-1.0	2.0	+4.0	-2.0	3.0	+4.0	-3.0	5	+6	-5	8	+10	-8	12	+16	-12	
	5.1	-0	-2.6	8.5	-0	-4.5	9.5	-0	-5.5	15	-0	-9	28	-0	-18	44	-0	-28	
1.97-3.15	1.2	+3.0	-1.2	2.5	+4.5	-2.5	4.0	+4.5	-4.0	6	+7	-6	10	+12	-10	14	+18	-14	
	6.0	-0	-3.0	10.0	-0	-5.5	11.5	-0	-7.0	17.5	-0	-10.5	34	-0	-22	50	-0	-32	

<b>Table C-11. Transition Locational Fits</b>																		
Basic hole system. Limits are in thousandths of an inch.																		
Nominal Size Range (Inches)	Class LT 1			Class LT 2			Class LT 3			Class LT 4			Class LT 5			Class LT 6		
	Over	To	Standard Limits			Standard Limits			Standard Limits			Standard Limits			Standard Limits			
			Fit	Hole	Shaft	Fit	Hole	Shaft	Fit	Hole	Shaft	Fit	Hole	Shaft	Fit	Hole	Shaft	
0-0.12	-0.10	+0.4	+0.10	-0.2	+0.6	+0.2	...	...	...	...	...	...	-0.5	+0.4	+0.5	-0.65	+0.4	+0.65
	+0.50	-0	-0.10	+0.8	-0	-0.2	...	...	...	...	...	...	+0.15	-0	+0.25	+0.15	-0	+0.25
0.12-0.24	-0.15	+0.5	+0.15	-0.25	+0.7	+0.25	...	...	...	...	...	...	-0.6	+0.5	+0.6	-0.8	+0.5	+0.8
	+0.65	-0	-0.15	+0.95	-0	-0.25	...	...	...	...	...	...	+0.2	-0	+0.3	+0.2	-0	+0.3
0.24-0.40	-0.2	+0.6	+0.2	-0.3	+0.9	+0.3	-0.5	+0.6	+0.5	-0.7	+0.9	+0.7	-0.8	+0.6	+0.8	-1.0	+0.6	+1.0
	+0.8	-0	-0.2	+1.2	-0	-0.3	+0.5	-0	+0.1	+0.8	-0	+0.1	+0.2	-0	+0.4	+0.2	-0	+0.4
0.40-0.71	-0.2	+0.7	+0.2	-0.35	+1.0	+0.35	-0.5	+0.7	+0.5	-0.8	+1.0	+0.8	-0.9	+0.7	+0.9	-1.2	+0.7	+1.2
	+0.9	-0	-0.2	+1.35	-0	-0.35	+0.6	-0	+0.1	+0.9	-0	+0.1	+0.2	-0	+0.5	+0.2	-0	+0.5
0.71-1.19	-0.25	+0.8	+0.25	-0.4	+1.2	+0.4	-0.6	+0.8	+0.6	-0.9	+1.2	+0.9	-1.1	+0.8	+1.1	-1.4	+0.8	+1.4
	+1.05	-0	-0.25	+1.6	-0	-0.4	+0.7	-0	+0.1	+1.1	-0	+0.1	+0.2	-0	+0.6	+0.2	-0	+0.6
1.19-1.97	-0.3	+1.0	+0.3	-0.5	+1.6	+0.5	-0.7	+1.0	+0.7	-1.1	+1.6	+1.1	-1.3	+1.0	+1.3	-1.7	+1.0	+1.7
	+1.3	-0	-0.3	+2.1	-0	-0.5	+0.9	-0	+0.1	+1.5	-0	+0.1	+0.3	-0	+0.7	+0.3	-0	+0.7
1.97-3.15	-0.3	+1.2	+0.3	-0.6	+1.8	+0.6	-0.8	+1.2	+0.8	-1.3	+1.8	+1.3	-1.5	+1.2	+1.5	-2.0	+1.2	+2.0
	+1.5	-0	-0.3	+2.4	-0	-0.6	+1.1	-0	+0.1	+1.7	-0	+0.1	+0.4	-0	+0.8	+0.4	-0	+0.8

<b>Table C-12. Interference Locational Fits</b>										
Basic hole system. Limits are in thousandths of an inch.										
Nominal Size Range (Inches)	Class LN 1			Class LN 2			Class LN 3			
	Over	To	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits	
			Hole	Shaft		Hole	Shaft		Hole	Shaft
0-0.12	0	+0.25	+0.45	0	+0.4	+0.65	0.1	+0.4	+0.75	
	0.45	-0	+0.25	0.65	-0	+0.4	0.75	-0	+0.5	
0.12-0.24	0	+0.3	+0.5	0	+0.5	+0.8	0.1	+0.5	+0.9	
	0.5	-0	+0.3	0.8	-0	+0.5	0.9	0	+0.6	
0.24-0.40	0	+0.4	+0.65	0	+0.6	+1.0	0.2	+0.6	+1.2	
	0.65	-0	+0.4	1.0	-0	+0.6	1.2	-0	+0.8	
0.40-0.71	0	+0.4	+0.8	0	+0.7	+1.1	0.3	+0.7	+1.4	
	0.8	-0	+0.4	1.1	-0	+0.7	1.4	-0	+1.0	
0.71-1.19	0	+0.5	+1.0	0	+0.8	+1.3	0.4	+0.8	+1.7	
	1.0	-0	+0.5	1.3	-0	+0.8	1.7	-0	+1.2	
1.19-1.97	0	+0.6	+1.1	0	+1.0	+1.6	0.4	+1.0	+2.0	
	1.1	-0	+0.6	1.6	-0	+1.0	2.0	-0	+1.4	
1.97-3.15	0.1	+0.7	+1.3	0.2	+1.2	+2.1	0.4	+1.2	+2.3	
	1.3	-0	+0.7	2.1	-0	+1.4	2.3	-0	+1.6	

# Appendix C

**Table C-13. Force and Shrink Fits**

Basic hole system. Limits are in thousandths of an inch.

Nominal Size Range (Inches)		Class FN 1 Light Drive Fit			Class FN 2 Medium Drive Fit			Class FN 3 Heavy Drive Fit			Class FN 4 Force Fit			Class FN 5 Force Fit		
		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits		Limits of Interference	Standard Limits	
			Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft		Hole	Shaft
Over	To															
0-0.12	0.05	+0.25	+0.5	0.2	+0.4	+0.85	...	...	...	0.3	+0.4	+0.95	0.3	+0.6	+1.3	
	0.5	-0	+0.3	0.85	-0	+0.6	...	...	...	0.95	-0	+0.7	1.3	-0	+0.9	
0.12-0.24	0.1	+0.3	+0.6	0.2	+0.5	+1.0	...	...	...	0.4	+0.5	+1.2	0.5	+0.7	+1.7	
	0.6	-0	+0.4	1.0	-0	+0.7	...	...	...	1.2	-0	+0.9	1.7	-0	+1.2	
0.24-0.40	0.1	+0.4	+0.75	0.4	+0.6	+1.4	...	...	...	0.6	+0.6	+1.6	0.5	+0.9	+2.0	
	0.75	-0	+0.5	1.4	-0	+1.0	...	...	...	1.6	-0	+1.2	2.0	-0	+1.4	
0.40-0.56	0.1	+0.4	+0.8	0.5	+0.7	+1.6	...	...	...	0.7	+0.7	+1.8	0.6	+1.0	+2.3	
	0.8	-0	+0.5	1.6	-0	+1.2	...	...	...	1.8	-0	+1.4	2.3	-0	+1.6	
0.56-0.71	0.2	+0.4	+0.9	0.5	+0.7	+1.6	...	...	...	0.7	+0.7	+1.8	0.8	+1.0	+2.5	
	0.9	-0	+0.6	1.6	-0	+1.2	...	...	...	1.8	-0	+1.4	2.5	-0	+1.8	
0.71-0.95	0.2	+0.5	+1.1	0.6	+0.8	+1.9	...	...	...	0.8	+0.8	+2.1	1.0	+1.2	+3.0	
	1.1	-0	+0.7	1.9	-0	+1.4	...	...	...	2.1	-0	+1.6	3.0	-0	+2.2	
0.95-1.19	0.3	+0.5	+1.2	0.6	+0.8	+1.9	0.8	+0.8	+2.1	1.0	+0.8	+2.3	1.3	+1.2	+3.3	
	1.2	-0	+0.8	1.9	-0	+1.4	2.1	-0	+1.6	2.3	-0	+1.8	3.3	-0	+2.5	
1.19-1.58	0.3	+0.6	+1.3	0.8	+1.0	+2.4	1.0	+1.0	+2.6	1.5	+1.0	+3.1	1.4	+1.6	+4.0	
	1.3	-0	+0.9	2.4	-0	+1.8	2.6	-0	+2.0	3.1	-0	+2.5	4.0	-0	+3.0	
1.58-1.97	0.4	+0.6	+1.4	0.8	+1.0	+2.4	1.2	+1.0	+2.8	1.8	+1.0	+3.4	2.4	+1.6	+5.0	
	1.4	-0	+1.0	2.4	-0	+1.8	2.8	-0	+2.2	3.4	-0	+2.8	5.0	-0	+4.0	
1.97-2.56	0.6	+0.7	+1.8	0.8	+1.2	+2.7	1.3	+1.2	+3.2	2.3	+1.2	+4.2	3.2	+1.8	+6.2	
	1.8	-0	+1.3	2.7	-0	+2.0	3.2	-0	+2.5	4.2	-0	+3.5	6.2	-0	+5.0	



**Table C-14. Description of Preferred Metric Fits**

ISO Symbol		Description
Hole Basis	Shaft Basis	
H11/c11	C11/h11	<b>Loose running fit</b> for wide commercial tolerances or allowances on external members.
H9/d9	D9/h9	<b>Free running fit</b> not for use where accuracy is essential, but good for large temperature variations, high running speeds, or heavy journal pressures.
H8/f7	F8/h7	<b>Close running fit</b> for running on accurate machines and for accurate location at moderate speeds and journal pressures.
H7/g6	G7/h6	<b>Sliding fit</b> not intended to run freely, but to move and turn freely and locate accurately.
H7/h6	H7/h6	<b>Locational clearance fit</b> provides snug fit for locating stationary parts; but can be freely assembled and disassembled.
H7/k6	K7/h6	<b>Locational transition fit</b> for accurate location, a compromise between clearance and interference.
H7/n6	N7/h6	<b>Locational transition fit</b> for more accurate location where greater interference is permissible.
H7/p6 <sup>1</sup>	P7/h6	<b>Locational interference fit</b> for parts requiring rigidity and alignment with prime accuracy of location but without special bore pressure requirements.
H7/s6	S7/h6	<b>Medium drive fit</b> for ordinary steel parts or shrink fits on light sections, the tightest fit usable with cast iron.
H7/u6	U7/h6	<b>Force fit</b> suitable for parts which can be highly stressed or for shrink fits where the heavy pressing forces required are impractical.

Clearance Fits  
 Transition Fits  
 Interference Fits

More Clearance  
 More Interference

<sup>1</sup>Transition fit for basic sizes in range from 0 through 3 mm.

# Appendix C

**Table C-15A. Preferred Hole Basis Clearance Fits**

Basic hole system. Dimensions are in millimeters.

Basic Size	Loose Running			Free Running			Close Running			Sliding			Locational Clearance			
	Hole H11	Shaft c11	Fit	Hole H9	Shaft d9	Fit	Hole H8	Shaft f7	Fit	Hole H7	Shaft g6	Fit	Hole H7	Shaft h6	Fit	
1	MAX	1.060	0.940	.180	1.025	0.980	.070	1.014	0.994	.030	1.010	0.998	.018	1.010	1.000	.016
	MIN	1.000	0.880	.060	1.000	0.955	.020	1.000	0.984	.006	1.000	0.992	.002	1.000	0.994	.000
1.2	MAX	1.260	1.140	.180	1.225	1.180	.070	1.214	1.194	.030	1.210	1.198	.018	1.210	1.200	.016
	MIN	1.200	1.080	.060	1.200	1.155	.020	1.200	1.184	.006	1.200	1.192	.002	1.200	1.194	.000
1.6	MAX	1.660	1.540	.180	1.625	1.580	.070	1.614	1.594	.030	1.610	1.598	.018	1.610	1.600	.016
	MIN	1.600	1.480	.060	1.600	1.555	.020	1.600	1.584	.006	1.600	1.592	.002	1.600	1.594	.000
2	MAX	2.060	1.940	.180	2.025	1.980	.070	2.014	1.994	.030	2.010	1.998	.018	2.010	2.000	.016
	MIN	2.000	1.880	.060	2.000	1.955	.020	2.000	1.984	.006	2.000	1.992	.002	2.000	1.994	.000
2.5	MAX	2.560	2.440	.180	2.525	2.480	.070	2.514	2.494	.030	2.510	2.498	.018	2.510	2.500	.016
	MIN	2.500	2.380	.060	2.500	2.455	.020	2.500	2.484	.006	2.500	2.492	.002	2.500	2.494	.000
3	MAX	3.060	2.940	.180	3.025	2.980	.070	3.014	2.994	.030	3.010	2.998	.018	3.010	3.000	.016
	MIN	3.000	2.880	.060	3.000	2.955	.020	3.000	2.984	.006	3.000	2.992	.002	3.000	2.994	.000
4	MAX	4.075	3.930	.220	4.030	3.970	.090	4.108	3.990	.040	4.012	3.996	.024	4.012	4.000	.020
	MIN	4.000	3.855	.070	4.000	3.940	.030	4.000	3.978	.010	4.000	3.988	.004	4.000	3.992	.000
5	MAX	5.075	4.930	.220	5.030	4.970	.090	5.018	4.990	.040	5.012	4.996	.024	5.012	5.000	.020
	MIN	5.000	4.855	.070	5.000	4.940	.030	5.000	4.978	.010	5.000	4.988	.004	5.000	4.992	.000
6	MAX	6.075	5.930	.220	6.030	5.970	.090	6.018	5.990	.040	6.012	5.996	.024	6.012	6.000	.020
	MIN	6.000	5.855	.070	6.000	5.940	.030	6.000	5.978	.010	6.000	5.988	.004	6.000	5.992	.000
8	MAX	8.090	7.920	.260	8.036	7.960	.112	8.022	7.987	.050	8.015	7.995	.029	8.015	8.000	.024
	MIN	8.000	7.830	.080	8.000	7.924	.040	8.000	7.972	.013	8.000	7.986	.006	8.000	7.991	.000
10	MAX	10.090	9.920	.260	10.036	9.960	.112	10.022	9.987	.050	10.015	9.995	.029	10.015	10.000	.024
	MIN	10.000	9.830	.080	10.000	9.924	.040	10.000	9.972	.013	10.000	9.986	.005	10.000	9.991	.000
12	MAX	12.110	11.905	.315	12.043	11.950	.136	12.027	11.984	.061	12.018	11.994	.035	12.018	12.000	.029
	MIN	12.000	11.795	.095	12.000	11.907	.050	12.000	11.966	.016	12.000	11.983	.006	12.000	11.989	.000
16	MAX	16.110	15.905	.315	16.043	15.950	.136	16.027	15.984	.061	16.018	15.994	.035	16.018	16.000	.029
	MIN	16.000	15.795	.095	16.000	15.907	.050	16.000	15.966	.016	16.000	15.983	.006	16.000	15.989	.000
20	MAX	20.130	19.890	.370	20.052	19.935	.169	20.033	19.980	.074	20.021	19.993	.041	20.021	20.000	.034
	MIN	20.000	19.760	.110	20.000	19.883	.065	20.000	19.959	.020	20.000	19.980	.007	20.000	19.987	.000
25	MAX	25.130	24.890	.370	25.052	24.935	.169	25.033	24.980	.074	25.021	24.993	.042	25.021	25.000	.034
	MIN	25.000	24.760	.110	25.000	24.883	.065	25.000	24.959	.020	25.000	24.980	.007	25.000	24.987	.000
30	MAX	30.130	29.890	.370	30.052	29.935	.169	30.033	29.980	.074	30.021	29.993	.041	30.021	30.000	.034
	MIN	30.000	29.760	.110	30.000	29.883	.065	30.000	29.959	.020	30.000	29.980	.007	30.000	29.987	.000
40	MAX	40.160	39.880	.440	40.062	39.920	.204	40.039	39.975	.089	40.025	39.991	.050	40.025	40.000	.041
	MIN	40.000	39.720	.120	40.000	39.858	.080	40.000	39.950	.025	40.000	39.975	.009	40.000	39.984	.000
50	MAX	50.160	49.870	.450	50.062	49.920	.204	50.039	49.975	.089	50.025	49.991	.050	50.025	50.000	.041
	MIN	50.000	49.710	.130	50.000	49.858	.080	50.000	49.950	.025	50.000	49.975	.009	50.000	49.984	.000
60	MAX	60.190	59.860	.520	60.074	59.900	.248	60.046	59.970	.106	60.030	59.990	.059	60.030	60.000	.049
	MIN	60.000	59.670	.140	60.000	59.826	.100	60.000	59.940	.030	60.000	59.971	.010	60.000	59.981	.000
80	MAX	80.190	79.850	.530	80.074	79.900	.248	80.046	79.970	.106	80.030	79.990	.059	80.030	80.000	.049
	MIN	80.000	79.660	.150	80.000	79.826	.100	80.000	79.940	.030	80.000	79.971	.010	80.000	79.981	.000
100	MAX	100.220	99.830	.610	100.087	99.880	.294	100.054	99.964	.125	100.035	99.988	.069	100.035	100.000	.057
	MIN	100.000	99.610	.170	100.000	99.793	.120	100.000	99.929	.036	100.000	99.966	.012	100.000	99.978	.000
120	MAX	120.220	119.820	.620	120.087	119.880	.294	120.054	119.964	.125	120.035	119.988	.069	120.035	120.000	.057
	MIN	120.000	119.600	.180	120.000	119.793	.120	120.000	119.929	.036	120.000	119.966	.012	120.000	119.978	.000
160	MAX	160.250	159.790	.710	160.100	159.855	.345	160.063	159.957	.146	160.040	159.986	.079	160.040	160.000	.065
	MIN	160.000	159.540	.210	160.000	159.755	.145	160.000	159.917	.043	160.000	159.961	.014	160.000	159.975	.000

**Table C-15B. Preferred Hole Basis Transition and Interference Fits**

Basic hole system. Dimensions are in millimeters.

Basic Size	Locational Transition			Locational Transition			Locational Interference			Medium Drive			Force			
	Hole H7	Shaft k6	Fit	Hole H7	Shaft n6	Fit	Hole H7	Shaft p6	Fit	Hole H7	Shaft s6	Fit	Hole H7	Shaft u6	Fit	
1	MAX	1.010	1.006	-.010	1.010	1.010	.006	1.010	1.012	.004	1.010	1.020	-.004	1.010	1.024	-.008
	MIN	1.000	1.000	-.006	1.000	1.004	-.010	1.000	1.006	-.012	1.000	1.014	-.020	1.000	1.018	-.024
1.2	MAX	1.210	1.206	-.010	1.210	1.210	.006	1.210	1.212	.004	1.210	1.220	-.004	1.210	1.224	-.008
	MIN	1.200	1.200	-.006	1.200	1.204	-.010	1.200	1.206	-.012	1.200	1.214	-.020	1.200	1.218	-.024
1.6	MAX	1.610	1.606	-.010	1.610	1.610	.006	1.610	1.612	.004	1.610	1.620	-.004	1.610	1.624	-.008
	MIN	1.600	1.600	-.006	1.600	1.604	-.010	1.600	1.606	-.012	1.600	1.614	-.020	1.600	1.618	-.024
2	MAX	2.010	2.006	-.010	2.010	2.010	.006	2.010	2.012	.004	2.010	2.020	-.004	2.010	2.024	-.008
	MIN	2.000	2.000	-.006	2.000	2.004	-.010	2.000	2.006	-.012	2.000	2.014	-.020	2.000	2.018	-.024
2.5	MAX	2.510	2.506	-.010	2.510	2.510	.006	2.510	2.512	.004	2.510	2.520	-.004	2.510	2.524	-.008
	MIN	2.500	2.500	-.006	2.500	2.504	-.010	2.500	2.506	-.012	2.500	2.514	-.020	2.500	2.518	-.024
3	MAX	3.010	3.006	-.010	3.010	3.010	.006	3.010	3.012	.004	3.010	3.020	-.004	3.010	3.024	-.008
	MIN	3.000	3.000	-.006	3.000	3.004	-.010	3.000	3.006	-.012	3.000	3.014	-.020	3.000	3.018	-.024
4	MAX	4.012	4.009	-.011	4.012	4.016	.004	4.012	4.020	.000	4.012	4.027	-.007	4.012	4.031	-.011
	MIN	4.000	4.001	-.009	4.000	4.008	-.016	4.000	4.012	-.020	4.000	4.019	-.027	4.000	4.023	-.031
5	MAX	5.012	5.009	-.011	5.012	5.016	.004	5.012	5.020	.000	5.012	5.027	-.007	5.012	5.031	-.011
	MIN	5.000	5.001	-.009	5.000	5.008	-.016	5.000	5.012	-.020	5.000	5.019	-.027	5.000	5.023	-.031
6	MAX	6.012	6.009	-.011	6.012	6.016	.004	6.012	6.020	.000	6.012	6.027	-.007	6.012	6.031	-.011
	MIN	6.000	6.001	-.009	6.000	6.008	-.016	6.000	6.012	-.020	6.000	6.019	-.027	6.000	6.023	-.031
8	MAX	8.015	8.010	-.014	8.015	8.019	.005	8.015	8.024	.000	8.015	8.032	-.008	8.015	8.037	-.013
	MIN	8.000	8.001	-.010	8.000	8.010	-.019	8.000	8.015	-.024	8.000	8.023	-.032	8.000	8.028	-.037
10	MAX	10.015	10.010	-.014	10.015	10.019	.005	10.015	10.024	.000	10.015	10.032	-.008	10.015	10.037	-.013
	MIN	10.000	10.001	-.010	10.000	10.010	-.019	10.000	10.015	-.024	10.000	10.023	-.032	10.000	10.028	-.037
12	MAX	12.018	12.012	-.017	12.018	12.023	.006	12.018	12.029	.000	12.018	12.039	-.010	12.018	12.044	-.015
	MIN	12.000	12.001	-.012	12.000	12.012	-.023	12.000	12.018	-.029	12.000	12.028	-.039	12.000	12.033	-.044
16	MAX	16.018	16.012	-.017	16.018	16.023	.006	16.018	16.029	.000	16.018	16.039	-.010	16.018	16.044	-.015
	MIN	16.000	16.001	-.012	16.000	16.012	-.023	16.000	16.018	-.029	16.000	16.028	-.039	16.000	16.033	-.044
20	MAX	20.021	20.015	-.019	20.021	20.028	.006	20.021	20.035	-.001	20.021	20.048	-.014	20.021	20.054	-.020
	MIN	20.000	20.002	-.015	20.000	20.015	-.028	20.000	20.022	-.035	20.000	20.035	-.048	20.000	20.041	-.054
25	MAX	25.021	25.015	-.019	25.021	25.028	.006	25.021	25.035	-.001	25.021	25.048	-.014	25.021	25.061	-.027
	MIN	25.000	25.002	-.015	25.000	25.015	-.028	25.000	25.022	-.035	25.000	25.035	-.048	25.000	25.048	-.061
30	MAX	30.021	30.015	-.019	30.021	30.028	.006	30.021	30.035	-.001	30.021	30.048	-.014	30.021	30.061	-.027
	MIN	30.000	30.002	-.015	30.000	30.015	-.028	30.000	30.022	-.035	30.000	30.035	-.048	30.000	30.048	-.061
40	MAX	40.025	40.018	-.023	40.025	40.033	.008	40.025	40.042	-.001	40.025	40.059	-.018	40.025	40.076	-.035
	MIN	40.000	40.002	-.018	40.000	40.017	-.033	40.000	40.026	-.042	40.000	40.043	-.059	40.000	40.060	-.076
50	MAX	50.025	50.018	-.023	50.025	50.033	.008	50.025	50.042	-.001	50.025	50.059	-.018	50.025	50.086	-.045
	MIN	50.002	50.000	-.018	50.000	50.017	-.033	50.000	50.026	-.042	50.000	50.043	-.059	50.000	50.070	-.086
60	MAX	60.030	60.021	-.028	60.030	60.039	.010	60.030	60.051	-.002	60.030	60.072	-.023	60.030	60.106	-.057
	MIN	60.000	60.002	-.021	60.000	60.020	-.039	60.000	60.032	-.051	60.000	60.053	-.072	60.000	60.087	-.106
80	MAX	80.030	80.021	-.028	80.030	80.039	.010	80.030	80.051	-.002	80.030	80.078	-.029	80.030	80.121	-.072
	MIN	80.000	80.002	-.021	80.000	80.020	-.039	80.000	80.032	-.051	80.000	80.059	-.078	80.000	80.102	-.121
100	MAX	100.035	100.025	-.032	100.035	100.045	.012	100.035	100.059	-.002	100.035	100.093	-.036	100.035	100.146	-.089
	MIN	100.000	100.003	-.025	100.000	100.023	-.045	100.000	100.037	-.059	100.000	100.071	-.093	100.000	100.124	-.146
120	MAX	120.035	120.025	-.032	120.035	120.045	.012	120.035	120.059	-.002	120.035	120.101	-.044	120.035	120.166	-.109
	MIN	120.000	120.003	-.025	120.000	120.023	-.045	120.000	120.037	-.059	120.000	120.079	-.101	120.000	120.144	-.166
160	MAX	160.040	160.028	-.037	160.045	160.052	.013	160.040	160.068	-.003	160.040	160.125	-.060	160.040	160.215	-.150
	MIN	160.000	160.003	-.028	160.000	160.027	-.052	160.000	160.043	-.068	160.000	160.000	-.125	160.000	160.190	-.215

# Appendix C

**Table C-16A. Preferred Shaft Basis Clearance Fits**

Basic shaft system. Dimensions are in millimeters.

Basic Size	Loose Running			Free Running			Close Running			Sliding			Locational Clearance			
	Hole C11	Shaft h11	Fit	Hole D9	Shaft h9	Fit	Hole F8	Shaft h7	Fit	Hole G7	Shaft h6	Fit	Hole H7	Shaft h6	Fit	
1	MAX	1.120	1.000	.180	1.045	1.000	.070	1.020	1.000	.030	1.012	1.000	.018	1.010	1.000	.016
	MIN	1.060	0.940	.060	1.020	0.975	.020	1.006	0.990	.006	1.002	0.994	.002	1.000	0.994	.000
1.2	MAX	1.320	1.200	.180	1.245	1.200	.070	1.220	1.200	.030	1.212	1.200	.018	1.210	1.200	.016
	MIN	1.260	1.140	.060	1.220	1.175	.020	1.206	1.190	.006	1.202	1.194	.002	1.200	1.194	.000
1.6	MAX	1.720	1.600	.180	1.645	1.600	.070	1.620	1.600	.030	1.612	1.600	.018	1.610	1.600	.016
	MIN	1.660	1.540	.060	1.620	1.575	.020	1.606	1.590	.006	1.602	1.594	.002	1.600	1.594	.000
2	MAX	2.120	2.000	.180	2.045	2.000	.070	2.020	2.000	.030	2.012	2.000	.018	2.010	2.000	.016
	MIN	2.060	1.940	.060	2.020	1.975	.020	2.006	1.990	.006	2.002	1.994	.002	2.000	1.994	.000
2.5	MAX	2.620	2.500	.180	2.545	2.500	.070	2.520	2.500	.030	2.512	2.500	.018	2.510	2.500	.016
	MIN	2.560	2.440	.060	2.520	2.475	.020	2.506	2.490	.006	2.502	2.494	.002	2.500	2.494	.000
3	MAX	3.120	3.000	.180	3.045	3.000	.070	3.020	3.000	.030	3.012	3.000	.018	3.010	3.000	.016
	MIN	3.060	2.940	.060	3.020	2.975	.020	3.006	2.990	.006	3.002	2.994	.002	3.000	2.994	.000
4	MAX	4.145	4.000	.220	4.060	4.000	.090	4.028	4.000	.040	4.016	4.000	.024	4.012	4.000	.020
	MIN	4.070	3.925	.070	4.030	3.970	.030	4.010	3.988	.010	4.004	3.992	.004	4.000	3.992	.000
5	MAX	5.145	5.000	.220	5.060	5.000	.090	5.028	5.000	.040	5.016	5.000	.024	5.012	5.000	.020
	MIN	5.070	4.925	.070	5.030	4.970	.030	5.010	4.988	.010	5.004	4.992	.004	5.000	4.992	.000
6	MAX	6.145	6.000	.220	6.060	6.000	.090	6.028	6.000	.040	6.016	6.000	.024	6.012	6.000	.020
	MIN	6.070	5.925	.070	6.030	5.970	.030	6.010	5.988	.010	6.004	5.992	.004	6.000	5.992	.000
8	MAX	8.170	8.000	.260	8.076	8.000	.112	8.035	8.000	.050	8.020	8.000	.029	8.015	8.000	.024
	MIN	8.080	7.910	.080	8.040	7.964	.040	8.013	7.985	.013	8.005	7.991	.005	8.000	7.991	.000
10	MAX	10.170	10.000	.260	10.076	10.000	.112	10.035	10.000	.050	10.020	10.000	.029	10.015	10.000	.024
	MIN	10.080	9.910	.080	10.040	9.964	.040	10.013	9.985	.013	10.005	9.991	.005	10.000	9.991	.000
12	MAX	12.205	12.000	.315	12.093	12.000	.136	12.043	12.000	.061	12.024	12.000	.035	12.018	12.000	.029
	MIN	12.095	11.890	.095	12.050	11.957	.050	12.016	11.982	.016	12.006	11.989	.006	12.000	11.989	.000
16	MAX	16.205	16.000	.315	16.093	16.000	.136	16.043	16.000	.061	16.024	16.000	.035	16.018	16.000	.029
	MIN	16.095	15.890	.095	16.050	15.957	.050	16.016	15.982	.016	16.006	15.989	.006	16.000	15.989	.000
20	MAX	20.240	20.000	.370	20.117	20.000	.169	20.053	20.000	.074	20.028	20.000	.041	20.021	20.000	.034
	MIN	20.110	19.870	.110	20.065	19.948	.065	20.020	19.979	.020	20.007	19.987	.007	20.000	19.987	.000
25	MAX	25.240	25.000	.370	25.117	25.000	.169	25.053	25.000	.074	25.028	25.000	.041	25.021	25.000	.034
	MIN	25.110	24.870	.110	25.065	24.948	.065	25.020	24.979	.020	25.007	24.987	.007	25.000	24.987	.000
30	MAX	30.240	30.000	.370	30.117	30.000	.169	30.053	30.000	.074	30.028	30.000	.041	30.021	30.000	.034
	MIN	30.110	29.870	.110	30.065	29.948	.065	30.020	29.979	.020	30.007	29.987	.007	30.000	29.987	.000
40	MAX	40.280	40.000	.440	40.142	40.000	.204	40.064	40.000	.089	40.034	40.000	.050	40.025	40.000	.041
	MIN	40.120	39.840	.120	40.080	39.938	.080	40.025	39.975	.025	40.009	39.984	.009	40.000	39.984	.000
50	MAX	50.290	50.000	.450	50.142	50.000	.204	50.064	50.000	.089	50.034	50.000	.050	50.025	50.000	.041
	MIN	50.130	49.840	.130	50.080	49.938	.080	50.025	49.975	.025	50.009	49.984	.009	50.000	49.984	.000
60	MAX	60.330	60.000	.520	60.174	60.000	.248	60.076	60.000	.106	60.040	60.000	.059	60.030	60.000	.049
	MIN	60.140	59.810	.140	60.100	59.926	.100	60.030	59.970	.030	60.010	59.981	.010	60.000	59.981	.000
80	MAX	80.340	80.000	.530	80.174	80.000	.248	80.076	80.000	.106	80.040	80.000	.059	80.030	80.000	.049
	MIN	80.150	79.810	.150	80.100	79.926	.100	80.030	79.970	.030	80.010	79.981	.010	80.000	79.981	.000
100	MAX	100.390	100.000	.610	100.207	100.000	.294	100.090	100.000	.125	100.047	100.000	.069	100.035	100.000	.057
	MIN	100.170	99.780	.170	100.120	99.913	.120	100.036	99.965	.036	100.012	99.978	.012	100.000	99.978	.000
120	MAX	120.400	120.000	.620	120.207	120.000	.294	120.090	120.000	.125	120.047	120.000	.069	120.035	120.000	.057
	MIN	120.180	119.780	.180	120.120	119.913	.120	120.036	119.965	.036	120.012	119.978	.012	120.000	119.978	.000
160	MAX	160.460	160.000	.710	160.245	160.000	.345	160.106	160.000	.146	160.054	160.000	.079	160.040	160.000	.065
	MIN	160.210	159.750	.210	160.145	159.900	.145	160.043	159.960	.043	160.014	159.975	.014	160.000	159.975	.000

**Table C-16B. Preferred Shaft Basis Transition and Interference Fits**

Basic shaft system. Dimensions are in millimeters.

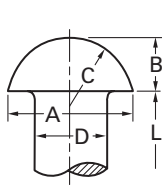
Basic Size	Locational Transition			Locational Transition			Locational Interference			Medium Drive			Force			
	Hole K7	Shaft h6	Fit	Hole N7	Shaft h6	Fit	Hole P7	Shaft h6	Fit	Hole S7	Shaft h6	Fit	Hole U7	Shaft h6	Fit	
1	MAX	1.000	1.000	.006	0.996	1.000	.002	0.994	1.000	.000	0.986	1.000	-.008	0.982	1.000	-.012
	MIN	0.990	0.994	-.010	0.986	0.994	-.014	0.984	0.994	-.016	0.976	0.994	-.024	0.972	0.994	-.028
1.2	MAX	1.200	1.200	.006	1.196	1.200	.002	1.194	1.200	.000	1.186	1.200	-.008	1.182	1.200	-.012
	MIN	1.190	1.194	-.010	1.186	1.194	-.014	1.184	1.194	-.016	1.176	1.194	-.024	1.172	1.194	-.028
1.6	MAX	1.600	1.600	.006	1.596	1.600	.002	1.594	1.600	.000	1.586	1.600	-.008	1.582	1.600	-.012
	MIN	1.590	1.594	-.010	1.586	1.594	-.014	1.584	1.594	-.016	1.576	1.594	-.024	1.572	1.594	-.028
2	MAX	2.000	2.000	.006	1.996	2.000	.002	1.994	2.000	.000	1.986	2.000	-.008	1.982	2.000	-.012
	MIN	1.990	1.994	-.010	1.986	1.994	-.014	1.984	1.994	-.016	1.976	1.994	-.024	1.972	1.994	-.028
2.5	MAX	2.500	2.500	.006	2.496	2.500	.002	2.494	2.500	.000	2.486	2.500	-.008	2.482	2.500	-.012
	MIN	2.490	2.494	-.010	2.486	2.494	-.014	2.484	2.494	-.016	2.476	2.494	-.024	2.472	2.494	-.028
3	MAX	3.000	3.000	.006	2.996	3.000	.002	2.994	3.000	.000	2.986	3.000	-.008	2.982	3.000	-.012
	MIN	2.990	2.994	-.010	2.986	2.994	-.014	2.984	2.994	-.016	2.976	2.994	-.024	2.972	2.994	-.028
4	MAX	4.003	4.000	.011	3.996	4.000	.004	3.992	4.000	.000	3.985	4.000	-.007	3.981	4.000	-.011
	MIN	3.991	3.992	-.009	3.984	3.992	-.016	3.980	3.992	-.020	3.973	3.992	-.027	3.969	3.992	-.031
5	MAX	5.003	5.000	.011	4.996	5.000	.004	4.992	5.000	.000	4.985	5.000	-.007	4.981	5.000	-.011
	MIN	4.991	4.992	-.009	4.984	4.992	-.016	4.980	4.992	-.020	4.973	4.992	-.027	4.969	4.992	-.031
6	MAX	6.003	6.000	.011	5.996	6.000	.004	5.992	6.000	.000	5.985	6.000	-.007	5.981	6.000	-.011
	MIN	5.991	5.992	-.009	5.984	5.992	-.016	5.980	5.992	-.020	5.973	5.992	-.027	5.969	5.992	-.031
8	MAX	8.005	8.000	.014	7.996	8.000	.005	7.991	8.000	.000	7.983	8.000	-.008	7.978	8.000	-.013
	MIN	7.990	7.991	-.010	7.981	7.991	-.019	7.976	7.991	-.024	7.968	7.991	-.032	7.963	7.991	-.037
10	MAX	10.005	10.000	.014	9.996	10.000	.005	9.991	10.000	.000	9.983	10.000	-.008	9.978	10.000	-.013
	MIN	9.990	9.991	-.010	9.981	9.991	-.019	9.976	9.991	-.024	9.968	9.991	-.032	9.963	9.991	-.037
12	MAX	12.006	12.000	.017	11.995	12.000	.006	11.989	12.000	.000	11.979	12.000	-.010	11.974	12.000	-.015
	MIN	11.988	11.989	-.012	11.977	11.989	-.023	11.971	11.989	-.029	11.961	11.989	-.039	11.956	11.989	-.044
16	MAX	16.006	16.000	.017	15.995	16.000	.006	15.989	16.000	.000	15.979	16.000	-.010	15.974	16.000	-.015
	MIN	15.988	15.989	-.012	15.977	15.989	-.023	15.971	15.989	-.029	15.961	15.989	-.039	15.956	15.989	-.044
20	MAX	20.006	20.000	.019	19.993	20.000	.006	19.986	20.000	-.001	19.973	20.000	-.014	19.967	20.000	-.020
	MIN	19.985	19.987	-.015	19.972	19.987	-.028	19.965	19.987	-.035	19.952	19.987	-.048	19.946	19.987	-.054
25	MAX	25.006	25.000	.019	24.993	25.000	.006	24.986	25.000	-.001	24.973	25.000	-.014	24.960	25.000	-.027
	MIN	24.985	24.987	-.015	24.972	24.987	-.028	24.965	24.987	-.035	24.952	24.987	-.048	24.939	24.987	-.061
30	MAX	30.006	30.000	.019	29.993	30.000	.006	29.986	30.000	-.001	29.973	30.000	-.014	29.960	30.000	-.027
	MIN	29.985	29.987	-.015	29.972	29.987	-.028	29.965	29.987	-.035	29.952	29.987	-.048	29.939	29.987	-.061
40	MAX	40.007	40.000	.023	39.992	40.000	.008	39.983	40.000	-.001	39.966	40.000	-.018	39.949	40.000	-.035
	MIN	39.982	39.984	-.018	39.967	39.984	-.033	39.958	39.984	-.042	39.941	39.984	-.059	39.924	39.984	-.076
50	MAX	50.007	50.000	.023	49.992	50.000	.008	49.983	50.000	-.001	49.966	50.000	-.018	49.939	50.000	-.045
	MIN	49.982	49.984	-.018	49.967	49.984	-.033	49.958	49.984	-.042	49.941	49.984	-.059	49.914	49.984	-.086
60	MAX	60.009	60.000	.028	59.991	60.000	.010	59.979	60.000	-.002	59.958	60.000	-.023	59.924	60.000	-.057
	MIN	59.979	59.981	-.021	59.961	59.981	-.039	59.949	59.981	-.051	59.928	59.981	-.072	59.894	59.981	-.106
80	MAX	80.009	80.000	.028	79.991	80.000	.010	79.979	80.000	-.002	79.952	80.000	-.029	79.909	80.000	-.072
	MIN	79.979	79.981	-.021	79.961	79.981	-.039	79.949	79.981	-.051	79.922	79.981	-.078	79.879	79.981	-.121
100	MAX	100.010	100.000	.032	99.990	100.000	.012	99.976	100.000	-.002	99.942	100.000	-.036	99.889	100.000	-.089
	MIN	99.975	99.978	-.025	99.955	99.978	-.045	99.941	99.978	-.059	99.907	99.978	-.093	99.854	99.978	-.146
120	MAX	120.010	120.000	.032	119.990	120.000	.012	119.976	120.000	-.002	119.934	120.000	-.044	119.869	120.000	-.109
	MIN	119.975	119.978	-.025	119.955	119.978	-.045	119.941	119.978	-.059	119.899	119.978	-.101	119.834	119.978	-.166
160	MAX	160.012	160.000	.037	159.988	160.000	.013	159.972	160.000	-.003	159.915	160.000	-.060	159.825	160.000	-.150
	MIN	159.972	159.975	-.028	159.948	159.975	-.052	159.932	159.975	-.068	159.875	159.975	-.125	159.785	159.975	-.215



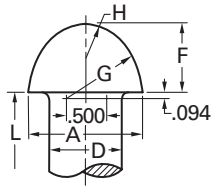
# Appendix C

**Table C-17. Large Rivets**

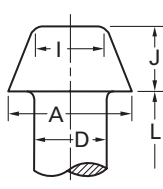
Manufactured Shapes																
D Nominal	A Basic	B Basic (Min.)	C	E Basic	F Basic	G	H	I Basic	J Basic (Min.)	K Basic	M Basic (Min.)	N	O	P Basic	Q Basic (Min.)	S Basic
.50	0.875	0.375	0.443	0.781	0.500	0.656	0.094	0.469	0.438	0.905	0.250	0.095	1.125	0.800	0.381	0.500
.62	1.094	0.469	0.553	0.969	0.594	0.750	0.188	0.586	0.547	1.131	0.312	0.119	1.406	1.000	0.469	0.625
.75	1.312	0.562	0.664	1.156	0.688	0.844	0.282	0.703	0.656	1.358	0.375	0.142	1.688	1.200	0.556	0.750
.88	1.531	0.656	0.775	1.344	0.781	0.937	0.375	0.820	0.766	1.584	0.438	0.166	1.969	1.400	0.643	0.875
1.00	1.750	0.750	0.885	1.531	0.875	1.031	0.469	0.938	0.875	1.810	0.500	0.190	2.250	1.600	0.731	1.000
1.12	1.969	0.844	0.996	1.719	0.969	1.125	0.563	1.055	0.984	2.036	0.562	0.214	2.531	1.800	0.835	1.125
1.25	2.188	0.938	1.107	1.906	1.062	1.218	0.656	1.172	1.094	2.262	0.625	0.238	2.812	2.000	0.922	1.250
1.38	2.406	1.031	1.217	2.094	1.156	1.312	0.750	1.290	1.203	2.489	0.688	0.261	3.094	2.200	1.009	1.375
1.50	2.625	1.125	1.328	2.281	1.250	1.406	0.844	1.406	1.312	2.715	0.750	0.285	3.375	2.400	1.113	1.500
1.62	2.844	1.219	1.439	2.469	1.344	1.500	0.938	1.524	1.422	2.941	0.812	0.309	3.656	2.600	1.201	1.625
1.75	3.062	1.312	1.549	2.656	1.438	1.594	1.032	1.641	1.531	3.168	0.875	0.332	3.938	2.800	1.288	1.750



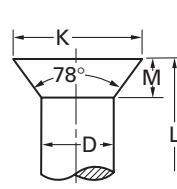
BUTTON HEAD



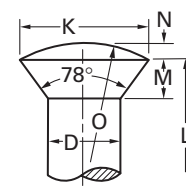
HIGH  
BUTTON HEAD



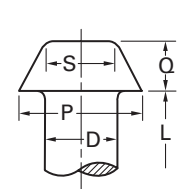
CONE HEAD



FLAT-TOP  
COUNTERSUNK  
HEAD



ROUND-TOP  
COUNTERSUNK  
HEAD



PAN HEAD



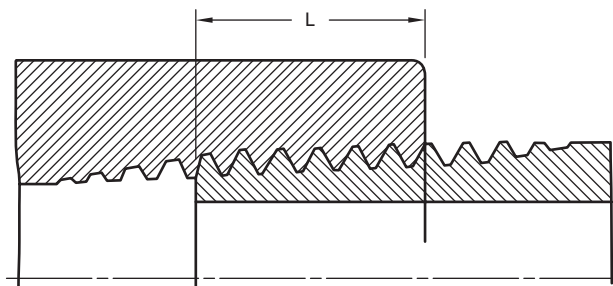
Table C-18. Geometric Dimensioning Symbol Sizes	
<p>STRAIGHTNESS</p>	<p>TOTAL RUNOUT</p>
<p>FLATNESS</p>	<p>CIRCULAR RUNOUT</p>
<p>CIRCULARITY</p>	<p>CONCENTRICITY</p>
<p>CYLINDRICITY</p>	<p>POSITION</p>
<p>PROFILE OF A LINE</p>	<p>SYMMETRY</p>
<p>PROFILE OF A SURFACE</p>	<p>MMC, LMC PROJ TOL ZONE TANGENT PLANE FREE STATE</p>
<p>PARALLELISM</p>	<p>STATISTICAL TOLERANCE</p>
<p>ANGULARITY</p>	<p>BETWEEN</p>
<p>PERPENDICULARITY</p>	

# Appendix C

**Table C-19. American Standard Wrought Steel Pipe**

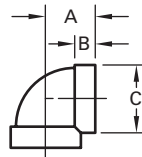
	Nominal Pipe Size Inches	Outside Diameter	Threads Per Inch	Wall Thickness			Approx. Distance Pipe Enters Fitting L	Weight (lbs/ft)		
				Sched. 40 (Standard)	Sched. 80 (Extra Strong)	Sched. 160		Sched. 40 (Standard)	Sched. 80 (Extra Strong)	Sched. 160
U.S. Customary (Inches)	1/8 (.125)	.405	27	.068	.095	—	.188	.24	.31	—
	1/4 (.250)	.540	18	.088	.119	—	.281	.42	.54	—
	3/8 (.375)	.675	18	.091	.126	—	.297	.57	.74	—
	1/2 (.500)	.840	14	.109	.147	.188	.375	.85	1.09	1.31
	3/4 (.750)	1.050	14	.113	.154	.219	.406	1.13	1.47	1.94
	1.00	1.315	11.50	.133	.179	.250	.500	1.68	2.17	2.84
	1.25	1.660	11.50	.140	.191	.250	.549	2.27	3.00	3.76
	1.50	1.900	11.50	.145	.200	.281	.562	2.72	3.63	4.86
	2	2.375	11.50	.154	.218	.344	.578	3.65	5.02	7.46
	2.5	2.875	8	.203	.276	.375	.875	5.79	7.66	10.01
	3	3.500	8	.216	.300	.438	.938	7.58	10.25	14.31
	3.5	4.000	8	.226	.318	—	1.000	9.11	12.51	—
	4	4.500	8	.237	.337	.531	1.062	10.79	14.98	22.52
5	5.563	8	.258	.375	.625	1.156	14.62	20.78	32.96	
6	6.625	8	.280	.432	.719	1.250	18.97	28.57	45.34	
8	8.625	8	.322	.500	.906	1.469	28.55	43.39	74.71	

	Nominal Pipe Size Inches	Outside Diameter mm	Threads Per Inch	Wall Thickness			Approx. Distance Pipe Enters Fitting L	Weight (lbs/ft)		
				Sched. 40 (Standard)	Sched. 80 (Extra Strong)	Sched. 160		Sched. 40 (Standard)	Sched. 80 (Extra Strong)	Sched. 160
Metric (Millimeters)	1/8 (.125)	10.3	27	1.7	2.4	—	5	0.36	0.46	—
	1/4 (.250)	13.7	18	2.2	3.0	—	7	0.63	0.80	—
	3/8 (.375)	17.1	18	2.3	3.2	—	8	0.85	1.10	—
	1/2 (.500)	21.3	14	2.8	3.7	4.8	10	1.26	1.62	1.95
	3/4 (.750)	26.7	14	2.9	3.9	5.6	11	1.68	2.19	2.89
	1.00	33.4	11.50	3.4	4.6	6.4	13	2.50	3.23	4.23
	1.25	42.1	11.50	3.6	4.9	6.4	14	3.38	4.46	5.60
	1.50	48.3	11.50	3.7	5.1	7.1	14	4.05	5.40	7.23
	2.00	60.3	11.50	3.9	5.5	8.7	15	5.43	7.47	11.10
	2.50	73	8	5.2	7.0	9.5	22	8.62	11.40	14.90
	3.00	88.9	8	5.5	7.6	11.1	24	11.28	15.25	21.30
	3.50	101.6	8	5.7	8.1	—	25	13.56	18.62	—
	4.00	114.3	8	6.0	8.6	13.5	27	16.06	22.30	33.51
5.00	141.3	8	6.6	9.5	15.9	29	21.76	30.92	49.05	
6.00	168.3	8	7.1	11.0	18.3	32	28.23	42.52	67.47	
8.00	219	8	8.2	12.7	23.0	38	42.49	64.57	111.18	

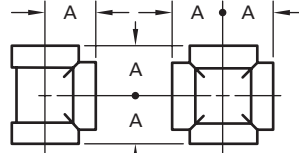


**Table C-20. American Standard (125 lb) Cast-Iron Screwed-Pipe Fittings**

Nominal Pipe Size in Inches	U.S. Customary (Inches)						Metric (Millimeters)					
	A	Min. B	Min. C	D	E	F	A	Min. B	Min. C	D	E	F
.25	.81	.38	.93	—	—	.73	21	10	24	—	—	19
.375	.95	.44	1.12	—	—	.80	24	11	28	—	—	20
.50	1.12	.50	1.34	2.50	1.87	.88	28	13	34	64	47	22
.75	1.31	.56	1.63	3.00	2.25	.98	33	14	41	76	57	25
1.00	1.50	.62	1.95	3.50	2.75	1.12	38	16	50	89	70	28
1.25	1.75	.69	2.39	4.25	3.25	1.29	44	18	61	108	83	33
1.50	1.94	.75	2.68	4.87	3.81	1.43	49	19	68	124	97	36
2.00	2.25	.84	3.28	5.75	4.25	1.68	57	21	83	146	108	43
2.50	2.70	.94	3.86	6.75	5.18	1.95	69	24	98	171	132	50
3.00	3.08	1.00	4.62	7.87	6.12	2.17	78	25	117	200	155	55
3.50	3.42	1.06	5.20	8.87	6.87	2.39	87	27	132	225	174	61
4.00	3.79	1.12	5.79	9.75	7.62	2.61	96	28	147	248	194	66
5.00	4.50	1.18	7.05	11.62	9.25	3.05	114	30	179	295	235	77
6.00	5.13	1.28	8.28	13.43	10.75	3.46	130	33	210	341	273	88
8.00	6.56	1.47	10.63	16.94	13.63	4.28	167	37	270	430	346	109
10.00	8.08	1.68	13.12	20.69	16.75	5.16	205	43	333	613	425	131

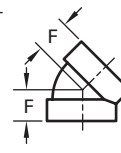


90° ELBOW

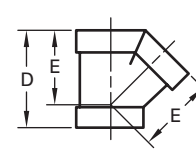


TEE

CROSS



45° ELBOW

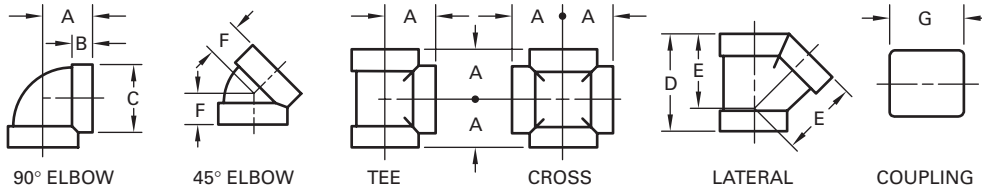


LATERAL

# Appendix C

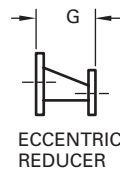
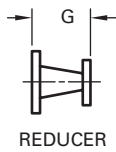
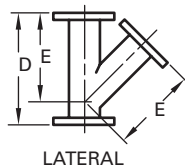
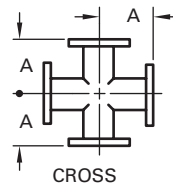
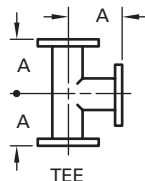
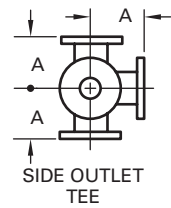
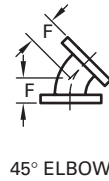
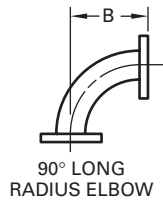
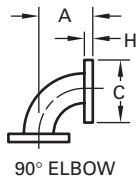
**Table C-21. American Standard (150 lb) Malleable-Iron Screwed-Pipe Fittings**

Nominal Pipe Size in Inches	U.S. Customary (Inches)							Metric (Millimeters)						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
.125	.69	.20	.69	—	—	—	.96	18	5.0	18	—	—	—	24
.250	.81	.22	.84	—	—	.73	1.06	21	5	21	—	—	19	27
.375	.95	.23	1.02	1.93	1.43	.80	1.16	24	6	26	49	36	20	29
.500	1.12	.25	1.20	2.32	1.71	.88	1.34	28	6	30	59	43	22	34
.750	1.31	.27	1.46	2.77	2.05	.98	1.52	33	7	37	70	52	25	39
1.00	1.50	.30	1.77	3.28	2.43	1.12	1.67	38	8	45	83	62	28	42
1.25	1.75	.34	2.15	3.94	2.92	1.29	1.93	44	9	55	100	74	33	49
1.50	1.94	.37	2.43	4.38	3.28	1.43	2.15	49	9	62	111	83	36	55
2.00	2.25	.42	2.96	5.17	3.93	1.68	2.53	57	11	75	131	100	43	64
2.50	2.70	.48	3.59	6.25	4.73	1.95	2.88	69	12	91	159	120	50	73
3.00	3.08	.55	4.29	7.26	5.55	2.17	3.18	78	14	109	184	141	55	81
3.50	3.42	.60	4.84	—	—	2.39	3.43	87	15	123	—	—	61	87
4.00	3.79	.66	5.40	8.98	—	2.61	3.69	96	17	137	228	177	66	94
5.00	4.50	.78	6.58	—	6.97	3.05	—	114	20	167	—	—	77	—
6.00	5.13	.90	7.77	—	—	3.46	—	130	23	197	—	—	88	—

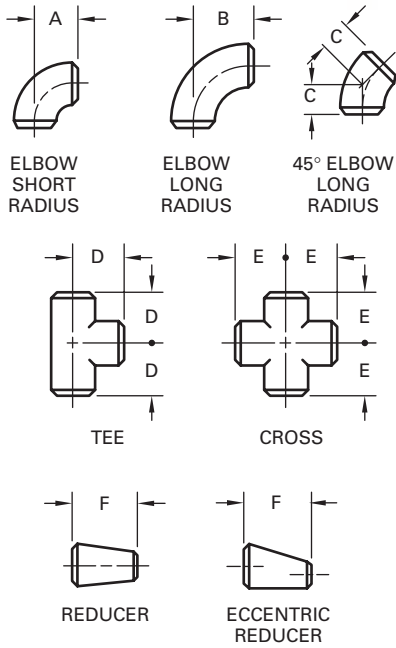


**Table C-22. American Standard Flanged Fittings**

	Nominal Pipe Size in Inches	A	B	C	D	E	F	G	H
U.S. Customary (Inches)	1.50	4.00	6.00	5.00	9.00	7.00	2.25	—	.56
	2.00	4.50	6.50	6.00	10.50	8.00	2.50	5.00	.62
	2.50	5.00	7.00	7.00	12.00	9.50	3.00	5.50	.69
	3.00	5.50	7.75	7.50	13.00	10.00	3.00	6.00	.75
	3.50	6.00	8.50	8.50	14.50	11.50	3.50	6.50	.81
	4.00	6.50	9.00	9.00	15.00	12.00	4.00	7.00	.94
	5.00	7.50	10.25	10.00	17.00	13.50	4.50	8.00	.94
	6.00	8.00	11.50	11.00	18.00	14.50	5.00	9.00	1.00
	8.00	9.00	14.00	13.50	22.00	17.50	5.50	11.00	1.12
10.00	11.00	16.50	16.00	25.50	20.50	6.50	12.00	1.19	
Metric (Millimeters)	1.50	102	152	127	229	178	57	—	14
	2.00	114	165	152	267	203	64	127	16
	2.50	127	178	178	305	241	76	140	18
	3.00	140	197	190	330	254	76	152	19
	3.50	153	216	216	368	292	89	165	21
	4.00	165	229	229	381	305	102	178	24
	5.00	190	260	254	432	343	114	203	24
	6.00	203	292	280	457	368	127	229	25
	8.00	229	356	343	559	445	140	279	28
10.00	279	419	406	648	521	165	305	30	



# Appendix C



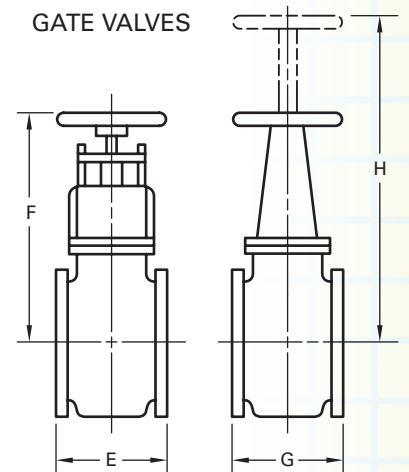
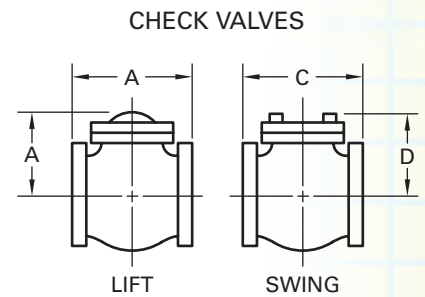
**Table C-23. American Standard Steel Butt-Welding Fittings**

	Nominal Pipe Size in Inches	A	B	C	D	E	F
U.S. Customary (Inches)	1.50	1.50	2.25	1.12	2.25	2.25	2.50
	2.00	2.00	3.00	1.38	2.50	2.50	3.00
	2.50	2.50	3.75	1.75	3.00	3.00	3.50
	3.00	3.00	4.50	2.00	3.38	3.38	3.50
	3.50	3.50	5.25	2.25	3.75	3.75	4.00
	4.00	4.00	6.00	2.50	4.12	4.12	4.00
	5.00	5.00	7.50	3.12	4.89	4.89	5.00
	6.00	6.00	9.00	3.75	5.62	5.62	5.50
	8.00	8.00	12.00	5.00	7.00	7.00	6.00
	10.00	10.00	15.00	6.25	8.50	8.50	7.00
Metric (Millimeters)	1.50	38	57	28	57	57	64
	2.00	51	76	35	64	64	76
	2.50	64	95	44	76	76	89
	3.00	76	114	51	86	86	89
	3.50	89	133	57	95	95	102
	4.00	102	152	64	105	105	102
	5.00	127	190	79	124	124	127
	6.00	152	229	95	143	143	140
	8.00	203	305	127	178	178	152
	10.00	254	381	159	216	216	178



**Table C-24. Common Valves**

	Nominal Pipe Size in Inches	Check Valves					
		Lift Check			Swing Check		
		A		B	C		D
		Screwed	Flanged		Screwed	Flanged	
U.S. Customary (Inches)	2.00	6.50	—	3.50	6.50	8.00	4.25
	2.50	7.00	—	4.25	7.00	8.50	4.81
	3.00	8.00	9.50	5.00	8.00	9.50	5.06
	3.50	—	—	—	9.00	10.50	5.81
	4.00	10.00	11.50	6.25	10.00	11.50	6.19
	5.00	—	13.00	7.00	11.25	13.00	7.19
	6.00	—	14.00	8.25	12.50	14.00	7.50
	8.00	—	—	—	—	19.50	10.19
	10.00	—	—	—	—	24.50	12.12
Metric (Millimeters)	2.00	165	—	89	165	203	108
	2.50	178	—	108	178	216	122
	3.00	203	241	127	203	241	129
	3.50	—	—	—	229	267	148
	4.00	254	292	159	254	292	157
	5.00	—	330	178	286	330	183
	6.00	—	356	210	318	356	190
	8.00	—	—	—	—	495	259
	10.00	—	—	—	—	622	308
	Nominal Pipe Size in Inches	Gate Valves					
		Nonrising Spindle			Rising Spindle		
		E		F	G		H
		Screwed	Flanged		Screwed	Flanged	
U.S. Customary (Inches)	2.00	4.75	7.00	10.50	4.75	7.00	13.12
	2.50	5.50	7.50	11.19	5.50	7.50	14.50
	3.00	6.00	8.00	12.62	6.00	8.00	16.62
	3.50	6.62	8.50	13.31	6.62	8.50	18.44
	4.00	7.12	9.00	15.25	7.12	9.00	21.06
	5.00	8.12	10.00	17.88	8.12	10.00	25
	6.00	9.00	10.50	20.19	9.00	10.50	29.25
	8.00	10.00	11.50	24.00	10.00	11.50	37.25
	10.00	—	13.00	28.19	—	13.00	44.12
Metric (Millimeters)	2.00	121	178	267	121	178	333
	2.50	140	190	284	140	190	368
	3.00	152	203	321	152	203	422
	3.50	168	216	338	168	216	468
	4.00	181	229	387	181	229	535
	5.00	206	254	454	206	254	635
	6.00	229	267	513	229	267	743
	8.00	254	292	610	254	292	946
	10.00	—	330	716	—	330	1121



Dimensions taken from manufacturer's catalogs for drawing purposes.

(continued on next page)

**Table C-24. Common Valves (continued)**

	Nominal Pipe Size in Inches	Globe and Angle Valves					
		Globe			Angle		
		J		K	L		M
		Screwed	Flanged		Screwed	Flanged	
U.S. Customary (Inches)	2.00	4.75	7.00	9.44	3.50	3.88	10.38
	2.50	5.50	7.50	11.06	3.88	4.50	12.06
	3.00	6.00	8.00	12.38	4.69	4.62	12.69
	3.50	6.62	8.50	13.19	5.00	5.38	13.62
	4.00	7.12	9.00	15.25	6.00	5.88	14.88
	5.00	8.12	10.00	17.25	6.31	6.50	17.69
	6.00	9.00	10.50	18.81	8.00	8.00	19.06
	8.00	10.00	11.50	22.12	—	9.25	22.75
	10.00	—	13.00	24.75	—	10.62	24.94
Metric (Millimeters)	2.00	121	178	240	89	98	264
	2.50	140	190	281	98	114	281
	3.00	152	203	314	119	118	346
	3.50	168	216	335	127	136	348
	4.00	181	229	387	152	149	378
	5.00	206	254	438	160	165	449
	6.00	229	267	478	203	203	484
	8.00	254	292	562	—	235	578
	10.00	—	330	629	—	270	633

Dimensions taken from manufacturer's catalogs for drawing purposes.

