

APPENDIX A

TABLES

TABLE 3-1. Proper wire gages for extension cords.

AMPERAGE RATING ON NAMEPLATE	3.5-5.0	5.1-7.0	7.1-12.0	12.1-16.0	16.1-20.0
EXTENSION CORD LENGTH	WIRE GAGES				
25 ft.	18	18	16	14	12
50 ft.	18	16	14	12	10
75 ft.	16	14	12	10	
100 ft.	14	12	10		
150 ft.	12	12			
200 ft.	12	10			
300 ft.	10				
Sizes smaller than wire gage 10 are not normally available as flexible extension cord.					

TABLE 3-2. Selection of abrasive disks.

OPERATION	ABRASIVE DISK	
	GRAIN NO.	TYPE OF COAT
REMOVING RUST -----	16 to 30	OPEN
REMOVING PAINT -----	16 to 36	OPEN
SANDING METAL (ROUGH CUTS) -----	24 to 36	CLOSED
SANDING METAL (MEDIUM CUTS) -----	36 to 60	CLOSED
SANDING METAL (FINISHING CUTS) -----	36 to 80	CLOSED
SANDING WOOD (ROUGH CUTS) -----	16 to 24	OPEN
SANDING WOOD (MEDIUM CUTS) -----	24 to 50	OPEN
SANDING WOOD (FINISHING CUTS) -----	60 to 120	OPEN

TABLE 3-3. Recommended use of bandsaw blades.

RECOMENDED USE	THICKNESS OF MATERIAL TO BE CUT	TEETH PER INCH	RECOMENDED USE	THICKNESS OF MATERIAL TO BE CUT	TEETH PER INCH
<b>CARBON STEEL</b>			<b>ALLOY STEEL</b>		
High speed cutting of aluminum, brass, copper, soft bronze, magnesium, wood, mild steel and tougher steels at slow speed.	1/2"-3 3/8"	6	High speed cutting of aluminum, brass iron, cast iron, bronze, brass, copper, galvanized pipe, mild steel and tougher steel including chrome and tungsten steels at slower speed.	3/16"-1"	10
High speed cutting of aluminum, brass, copper, magnesium, mild steels and tougher steels at slow speed.	3/8"-1"	8	High speed cutting of aluminum, angle iron, cast iron, bronze, brass, copper, galvanized pipe, mild steel and tougher steels including chrome, tungsten steels and electric cable at slow speed.	5/32"-3/4"	14
High speed cutting of aluminum, angle iron, cast iron, bronze, brass, copper, galvanized pipe, mild steel and tougher steels at slow speed.	3/16"-3/4"	10	High speed cutting of angle iron, bronze, brass, copper, galvanized pipe, thin wall tubing, mild steel and tougher steels including chrome and tungsten steels at slow speed.	1/8"-1/2"	18
High speed cutting of aluminum, angle iron, cast iron, bronze, brass, copper, galvanized pipe, mild steel and tougher steels and electric cable at slow speed.	5/32"-1/2"	14	High speed cutting of angle iron, bronze, brass, copper, galvanized pipe, thin wall tubing, mild steel and tougher steels at slow speed.	3/32"-1/8"	24
High speed cutting of angle iron, bronze, brass, copper, galvanized pipe, thin wall tubing, mild steel and tougher steels at slow speed.	1/8"-1/4" 3/32"-1/8"	18 24	<b>HIGH SPEED STEEL</b>		
			High speed cutting of aluminum, angle iron, bronze, brass, copper, galvanized pipe, mild steel and tougher steels including stainless, chrome, tungsten steels plus other problem material at slow speed.	7/32"-7/8" 3/16"-5/8" 5/32"-3/8"	10 14 18

TABLE 4-1 Common Twist Drill Sizes

Drill Designation	Decimal Equivalent	Drill Designation	Decimal Equivalents	Drill Designation	Decimal Equivalents	Drill Designation	Decimal Equivalents	Drill Designation	Decimal Equivalents
No. 80	.0135	No. 49	.0730	4.10mm	.1614	6.80mm	.2877	27/64	.4219
35mm	.0138	1.90mm	.0748	4.20mm	.1654	6.90mm	.2717	11.00mm	.4331
No. 79	.0145	No. 48	.0760	No. 19	.1660		.2720	7/16	.4375
1/64	.0156	1.95mm	.0768	4.25mm	.1673	7.00mm	.2756	11.50mm	.4528
.40mm	.0158	5/64	.0781	4.30mm	.1693	l	.2770	29/64	.4531
								11.80mm	.4646
No. 78	.0160	No. 47	.0785	No. 18	.1695	7.10mm	.2795	15/32	.4688
.45mm	.0177	2.00mm	.0787	11/64	.1719	K	.2810	12.00mm	.4724
No. 77	.0180	2.05mm	.0807	No. 17	.1730	9/32	.2812	31/64	.4844
.50mm	.0197	No. 46	.0810	4.40mm	.1732	7.20mm	.2835	12.50mm	.4921
No. 76	.0200	No. 45	.0820	No. 16	.1770	7.25mm	.2854	1/2	.5000
								12.80mm	.5039
No. 75	.0210	2.10mm	.0827	4.50mm	.1772	7.30mm	.2874	13.0mm	.5118
.55mm	.0217	2.15mm	.0846	No. 15	.1800	L	.2900	33/64	.5156
No. 74	.0225	No. 44	.0860	4.60mm	.1811	7.40mm	.2913	17/32	.5312
.60mm	.0236	2.20mm	.0866	No. 14	.1820	m	.2950	13.5mm	.5315
.61 mm	.0240	2.25mm	.0886	No. 13	.1850	7.50mm	.2953	35/64	.5469
No. 73	.0240	No. 43	.0890	4.70mm	.1850	19/64	.2969	14.0mm	.5512
No. 72	.0250	2.30mm	.0906	4.75mm	.1870	7.60mm	.2992	9/16	.5625
.65mm	.0256	2.35mm	.0925	3/16	.1875	N	.3020	14.5mm	.5709
No. 71	.0260	No. 42	.0935	4.80mm	.1890	7.70mm	.3031	37/64	.5781
.70mm	.0276	3/32	.0938	No. 12	.1890	7.75mm	.3051	15.0mm	.5906
No. 70	.0280	2.40mm	.0945	No. 11	.1910	7.80mm	.3071	19/32	.5938
No.69	.0292	No. 41	.0960	4.90mm	.1929	7.90mm	.3110	39/64	.6094
.75mm	.0295	2.45mm	.0965	No. 10	.1935	5/18	.3125	15.5mm	.6102
No. 68	.0310	No. 40	.0980	No. 9	.1960	8.00mm	.3150	5/8	.6250
1/32	.0312	2.50mm	.0984	5.00mm	.1968	0	.3160	16.0mm	.6299
								16.25mm	.6388
.80mm	.0315	No. 39	.0995	No. 8	.1990	8.10mm	.3189	41/64	.6406
No. 67	.0320	No. 38	.1015	5.10mm	.2008	8.20mm	.3228	16.5mm	.6496
No. 66	.0330	2.60mm	.1024	No. 7	.2010	p	.3230	21/32	.6562
.85mm	.0335	No. 37	.1040	13/64	.2031	8.25mm	.3248	17.0mm	.6693
No. 65	.0350	2.70mm	.1063	No. 6	.2040	8.30mm	.3268	43/64	.6719
								17.25mm	.6791
.90mm	.0354	No. 36	.1065	5.20mm	.2047	21/64	.3281	11/16	.6875
No. 64	.0360	2.75mm	.1083	No. 5	.2055	8.40mm	.3307	17.5mm	.6890
No. 63	.0370	7/64	.1094	5.25mm	.2067	a	.3320	45/64	.7031
.95mm	.0374	No. 35	.1100	5.30mm	.2087	8.50mm	.3346	15.0mm	.7087
No. 62	.0380	2.80mm	.1102	No. 4	.2090	8.60mm	.3386	23/32	.7188
No. 61	.0390	No. 34	.1110	5.40mm	.2126	R	.3390	18.5mm	.7283
1.00mm	.0394	No. 33	.1130	No. 3	.2130	8.70mm	.3425	47/64	.7344
No. V	.0400	2.90mm	.1142	5.50mm	.2165	11/32	.3437	19.0mm	.7480
No. 59	.0410	No. 32	.1160	7/32	.2187	8.75mm	.3445	3/4	.7500
1.05mm	.0413	3.00mm	.1181	5.60mm	.2205	5.50mm	.3465	49/64	.7656
No. 58	.0420	No. 31	.1200	No. 2	.2210	S	.3480	19.5mm	.7677
No. 57	.0430	3.10mm	.1220	5.70mm	.2244	8.90mm	.3504	25/32	.7812
1.10mm	.0433	1/8	.1250	5.75mm	.2264	9.00mm	.3543	20.0mm	.7874
1.15mm	.0453	3/20mm	.1260	No. 1	.2280	T	.3580	51/64	.7969
No. 56	.0465	3.25mm	.1280	5.80mm	.2283	9.10mm	.3583	20.5mm	.8071
3/64	.0469	No. 30	.1285	5.90mm	.2323	23/64	.3594	13/16	.8125
1.20mm	.0472	3.30mm	.1299	A	.2340	9.20mm	.3622	21.0mm	.8268
1.25mm	.0492	3.40mm	.1339	15/64	.2344	9.25mm	.3642	53/64	.8281
1.30mm	.0512	No. 29	.1360	6.00mm	.2362	9.30mm	.3661	27/32	.8438
No. 55	.0520	3.50mm	.1378	8	.2380	u	.3680	21.5mm	.8465
1.35mm	.0531	No. 28	.1405	6.10mm	.2402	9.40mm	.3701	55/64	.8594
No. 54	.0550	9/64	.1406	c	.2420	9.50mm	.3740	22.0mm	.8861
1.40mm	.0551	3.6mm	.1417	6.20mm	.2421	3/8	.3750	7/8	.8750
1.45mm	.0571	No. 27	.1440	D	.2460	v	.3770	22.5mm	.8858
1.50mm	.0591	3.70mm	.1457	6.25mm	.2461	9.60mm	.3780	57/64	.8906
No. 53	.0595	No. 26	.1470	6.30mm	.2480	9.70mm	.3819	23.0mm	.9055
1.55mm	.0610	3.75mm	.1476	1/4	.2500	9.75mm	.3839	29/32	.9063
1/16	.0625	No. 25	.1495	E	.2500	9.8mm	.3858	59/64	.9219
1.60mm	.0630	3.80mm	.1496	6.40mm	.2520	w	.3860	23.5mm	.9252
No. 52	.0635	No. 24	.1520	6.50mm	.2559	9.90mm	.3898	15/16	.9375
1.65mm	.0650	3.90mm	.1535	F	.2570	25/64	.3906	24.0mm	.9400
1.70mm	.0669	No. 23	.1540	6.60mm	.2598	10.0mm	.3937	61/64	.9531
No. 51	.0670	5/32	.1562	G	.2610	x	.3970	24.5mm	.9646
1.75mm	.0689	No. 22	.1570	6.70mm	.2638	y	.4040	31/32	.9688
No. 50	.0700	4.00mm	.1575	17/64	.2686	13/32	.4062	25.0mm	.9843
1.80mm	.0709	No. 21	.1590	6.75mm	.2657	z	.4130	63/64	.9844
1.85mm	.0728	No. 20	.1610	H	.2860	10.5mm	.4134	l	1.0000

TABLE 4-2 Drill Information

Drill information for different materials (High Speed Drills)

MATERIAL	CUTTING SPEEDS 1.		POINT ANGLE	LIP CLEARANCE	COOLANTS
	(METERS/MINUTE)	(FEET/MINUTE)			
	MPM	FPM			
Aluminum And Alloys	61.00 - 91.50	200 - 300	90 - 130 deg	12 - 15 deg	Kerosene/Kerosene & Lard Oil/ Soluble Oil
Armor Plate	12.20 - 18.25	40 - 50	135 - 140 deg	6 - 9 deg	Light Machine Oil
Brass	61.00 - 91.50	200 - 300	118 - 118 deg	12 - 15 deg	Dry/ Soluble Oil/Kerosene/Lard Oil
Bronze	61.00 - 91.50	200 - 300	110 - 118 deg	12 - 15 deg	Dry/ Soluble Oil/Mineral Oil/Lard Oil
Bronze, High Tensile	21.35 - 45.75	70 - 150	100 - 110 deg	12 - 15 deg	Dry/ Soluble Oil/Mineral Oil/Lard Oil
Cast Iron, Soft	30.50 - 45.75	100 - 150	90 - 100 deg	12 - 15 deg	Air Jet Dry/ Soluble Oil
Cast Iron, Medium	21.35 - 30.50	70 - 100	100 - 110 deg	12 - 15 deg	Air Jet Dry/ Soluble Oil
Cast Iron, Hard	21.35 - 30.50	70 - 100	100 - 118 deg	8 - 12 deg	Air Jet Dry/ Soluble Oil
Cast Iron, Chilled	9.15 - 12.20	30 - 40	118 - 135 deg	5 - 9 deg	Air Jet Dry/ Soluble Oil
Copper	61.00 - 91.50	200 - 300	100 - 118 deg	12 - 15 deg	Air Jet Dry/ Soluble Oil
Copper Graphite Alloy (Carbon Drills)	18.30 - 21.35	60 - 70	**_**	**_**	Soluble Oil/Dry/Mineral Oil/Kerosene
Glass (Carbon Drills)	6.10 - 9.15	20 - 30	**_**	**_**	Soluble Oil/Dry/Mineral Oil/Kerosene
Iron, Malleable	15.25 - 27.45	50 - 90	90 - 100 deg	12 - 15 deg	Light Machine Oil
Magnesium And Alloys	76.25 - 122.0	250 - 400	70 - 118 deg	12 - 15 deg	Soluble Oil
Monel Nickel	4.15 - 15.28	30 - 50	118 - 125 deg	10 - 12 deg	Compressed Air/Mineral Oil
Nickel Alloys	12.20 - 18.30	40 - 60	135 - 140 deg	5 - 7 deg	Lard Oil/Soluble Oil
Plastic, Hot Set	30.50 - 91.50	100 - 300	60 - 90 deg	10 - 12 deg	Lard Oil/Soluble Oil
Plastic, Cold Set	30.50 - 91.50	100 - 300	118 - 135 deg	12 - 20 deg	Soap Solution
Steel, Low Carbon, 0.2-0.3ct	24.40 - 33.55	80 - 110	110 - 118 deg	7 - 9 deg	Soap Solution
Steel, Medium Carbon 0.4-0.5c	21.35 - 24.40	70 - 80	118 - 125 deg	7 - 9 deg	Soluble Oil/Mineral Oil/Sulfur Oil/Lard Oil
Steel (High Carbon 1.2c)	15.25 - 18.30	50 - 60	118 - 145 deg	7 - 9 deg	Soluble Oil/Mineral Oil/Sulfur Oil/Lard Oil
Steel, Forged	15.25 - 18.30	50 - 60	118 - 145 deg	7 - 12 deg	Soluble Oil/Mineral Oil/Sulfur Oil/Lard Oil
Steel, Alloy	15.25 - 21.35	50 - 70	118 - 125 deg	10 - 12 deg	Mineral Lard Oil
Steel, Alloy 300 To 400 Brinell	6.10 - 9.15	20 - 30	130 - 140 deg	7 - 10 deg	Soluble Oil
Steel, Stainless, Free Machining	9.15 - 24.40	30 - 80	110 - 118 deg	8 - 12 deg	Soluble Oil
Steel, Stainless, Hard	4.57 - 15.25	15 - 50	118 - 135 deg	6 - 8 deg	Soluble Oil
Steel, Manganese	3.66 - 4.57	12 - 15	140 - 150 deg	7 - 10 deg	Soluble Oil
Stone (Carbide Drills)	7.63 - 9.15	25 - 30	**_**	**_**	Water Solution
Wood	91.50 - 122.2	300 - 400	60 - 70 deg	10 - 15 deg	Dry

1. Cutting speeds are for high speed steel drills except as indicated. Carbon drills are approximately 200 to 300% than high speed steel drills.  
 \*\* Carbide drill point angles and lip clearance angles vary with different manufacturers. Consult the manufacturers data on the type of material being drilled for correct point and clearance angles

Table 4-3 Recommended Cutting Fluids For Various Materials

MATERIAL	DRILLING	REAMING	TAPPING	TURNING	THREADING	MILLING
Aluminum	Soluble Oil Kerosene Kerosene & Lard Oil	Soluble Oil Kerosene Mineral Oil	Soluble Oil Mineral Oil	Soluble Oil	Soluble Oil Kerosene & Lard Oil	Soluble Oil Lard Oil Lard Or Mineral Oil
Brass	Dry Soluble Oil Kerosene & Lard Oil	Soluble Oil Dry	Soluble Oil Lard Oil Dry	Soluble Oil	Soluble Oil Lard Oil	Soluble Oil Dry
Bronze	Dry Soluble Oil Lard Oil Mineral Oil	Soluble Oil Lard Oil Dry	Soluble Oil Lard Oil Dry	Soluble Oil	Soluble Oil Lard Oil	Soluble Oil Lard Oil Dry
Cast Iron	Dry Soluble Oil Air Jet	Soluble Oil Mineral Lard Oil	Mineral Lard Oil	Soluble Oil Mineral Lard Oil Dry	Dry Sulfurized Oil	Dry Soluble Oil
Copper	Dry Soluble Or Lard Oil Kerosene Mineral Lard Oil	Soluble Oil Lard Oil Dry	Soluble Oil Mineral Lard Oil	Soluble Oil	Soluble Oil Lard Oil	Soluble Oil Dry
Malleable Iron	Dry Soda Water	Dry Soda Water	Soluble Oil	Soluble Oil	Lard Oil Soda Water	Dry Soda Water
Monel Metal	Soluble Oil Lard Oil	Soluble Oil Lard Oil	Mineral Lard Oil Sulfurized Oil	Soluble Oil	Lard Oil	Soluble Oil
Steel Alloys	Soluble Oil Sulfurized Oil Mineral Lard Oil	Soluble Oil Mineral Lard Oil	Sulfurized Oil Mineral Oil	Soluble Oil	Lard Oil Sulfurized Oil	Soluble Oil Mineral Lard Oil
Steel Forgings Low Carbon	Soluble Oil Sulfurized Lard Oil Lard Oil Mineral Lard Oil	Soluble Oil Mineral Lard Oil	Soluble Oil Lard Oil	Soluble Oil	Soluble Oil Mineral Lard Oil	Soluble Oil Mineral Lard Oil
Tool Steel	Soluble Oil Sulfurized Oil Mineral Lard Oil	Soluble Oil Sulfurized Oil Lard Oil	Mineral Lard Oil Sulfurized Oil	Soluble Oil	Lard Oil Sulfurized Oil	Soluble Oil Lard Oil

TABLE 4-4. Rotational speeds and feeds for high-speed twist drills

MATERIAL AND CUTTING SPEED (FT PER MINUTE)											
Diameter of drill (in.)	Aluminum	Brass & Bronze	Cast iron	Mild steel 0.2-0.3 carbon (LOW)	Steel 0.4-0.5 carbon (MED)	Tool steel 1.2 carbon and drop forgings	Conn. rod molybdenum steel	3.5 nickel steel	Stainless steel and monel metal	Malleable iron	Feed per revolution (in.)
	300	200	100	110	80	80	55	60	50	85	
Revolutions per minute											
1/16	18,338	12,224	6,112	6,724	4,883	3,668	3,404	3,978	3,056	5,192	0.0015
1/8	9,168	6,112	3,056	3,362	2,444	1,834	1,702	1,988	1,528	2,596	0.002-0.003
3/16	6,108	4,072	2,036	2,242	1,630	1,222	1,120	1,324	1,018	1,734	0.004
1/4	4,584	3,056	1,528	1,681	1,222	917	851	994	764	1,298	0.005
5/16	3,668	2,444	1,222	1,344	978	733	672	794	611	1,039	0.005
3/8	3,054	2,036	1,018	1,121	815	611	560	662	509	867	0.006
7/16	2,622	1,748	874	921	699	524	481	568	437	742	0.007
1/2	2,292	1,528	764	840	611	459	420	497	382	649	0.008
9/16	2,037	1,358	679	747	543	407	373	441	340	577	0.008
5/8	1,836	1,224	612	673	489	367	337	398	306	520	0.009
11/16	1,665	1,110	555	611	444	333	300	360	273	472	0.009
3/4	1,524	1,016	508	559	408	306	279	330	254	433	0.010
13/16	1,422	948	474	521	379	285	261	308	237	403	0.010
7/8	1,314	876	438	482	349	262	241	285	219	371	0.011
15/16	1,221	814	407	448	328	244	224	265	204	346	0.012
1	1,146	764	382	420	308	229	210	258	191	325	0.013
1 1/16	1,077	718	359	395	287	215	197	233	180	305	0.013
1 1/8	1,020	680	340	374	272	204	187	221	170	288	0.014
1 3/16	966	644	322	354	258	193	177	209	161	274	0.014
1 1/4	918	612	306	337	245	183	168	199	153	260	0.015
1 5/16	873	582	291	320	233	175	160	189	146	248	0.015
1 3/8	834	556	278	306	222	167	153	180	139	236	0.015
1 7/16	795	530	265	292	212	159	146	172	133	225	0.015
1 1/2	762	508	254	279	204	153	140	165	127	216	0.015
1 9/16	732	488	244	268	195	146	134	159	122	207	0.016
1 5/8	702	468	234	257	188	141	129	152	117	201	0.016
1 11/16	678	452	226	249	181	136	124	147	113	192	0.016
1 3/4	654	436	218	240	175	131	120	142	109	186	0.016
1 13/16	630	420	210	231	168	126	116	137	105	179	0.016
1 7/8	612	408	204	224	163	122	112	133	102	173	0.016
1 15/16	591	394	197	216	158	118	108	128	99	168	0.016
2	573	382	191	210	153	115	105	124	96	162	0.016

1. Rotational speed value for carbide twist drills are 200 to 300 percent higher than H.S.S.

TABLE 4-5. Screw thread pitches and tap drill sizes.

Screw Thread Size and Pitch	Outside Diameter of Screw (in.)	Tap Drill Size	Decimal Equivalent of Drill Size
<b>National Coarse (NC) Series</b>			
No. 1-64.....	0.073	53	0.0595
No. 2-56.....	0.086	50	0.0700
No. 3-48.....	0.099	47	0.0785
No. 4-40.....	0.112	43	0.0890
No. 5-40.....	0.125	38	0.1015
No. 6-32.....	0.138	36	0.1065
No. 8-32.....	0.164	29	0.1360
No. 10-24.....	0.190	25	0.1495
No. 12-24.....	0.216	16	0.1770
No. 1/4-20.....	0.250	07	0.2010
No. 5/16-18.....	0.3125	F	0.2570
No. 3/8-16.....	0.375	5/16	0.3125
No. 7/16-14.....	0.4375	U	0.3680
No. 1/2-13.....	0.500	27/64	0.4219
No. 9/16-12.....	0.5625	31/64	0.4843
No. 5/8-11.....	0.625	17/32	0.5312
No. 3/4-10.....	0.750	21/32	0.6562
No. 7/8-9.....	0.875	49/64	0.7656
No. 1-8.....	1.000	7/8	0.875
<b>National Fine (NF) Series</b>			
No. 0-80.....	0.060	3/64	0.0469
No. 1-72.....	0.073	53	0.0595
No. 2-64.....	0.086	50	0.0700
No. 3-56.....	0.099	45	0.0820
No. 4-48.....	0.112	42	0.0935
No. 5-44.....	0.125	37	0.1040
No. 6-40.....	0.138	33	0.1130
No. 8-36.....	0.164	29	0.1360
No. 10-32.....	0.190	21	0.1590
No. 12-18.....	0.216	14	0.1820
No. 1/4-28.....	0.250	3	0.2130
No. 5/16-24.....	0.3125	I	0.2720
No. 3/8-24.....	0.375	Q	0.3320
No. 7/16-20.....	0.4375	25/64	0.3906
No. 1/2-20.....	0.500	29/64	0.4531
No. 9/16-18.....	0.5625	33/64	0.5156
No. 5/8-18.....	0.625	37/64	0.5781
No. 3/4-16.....	0.750	11/16	0.6875
No. 7/8-16.....	0.875	13/16	0.8125
No. 1-14.....	1.000	15/16	0.9375
<b>METRIC SERIES</b>			
1.6mm x .35.....	.0630	1.20mm	.0472
2.0mm x .40.....	.0787	1.60mm	.0630
2.5mm x .45.....	.0984	2.05mm	.0807
3.0mm x .50.....	.1181	2.50mm	.0984
3.5mm x .60.....	.1378	2.90mm	.1142

TABLE 4-5. Screw thread pitches and tap drill sizes (cont.).

METRIC SERIES				
Screw thread size and pitch	Outside diameter of screw (in.)	Tap drill size	Decimal equivalent of drill size	
4.0mm x .70.....	.1575	3.30mm	.1299	
5.0mm x .80.....	.1968	4.20mm	.1654	
6.3mm x 1.00.....	.2480	5.30mm	.2087	
8.0mm x 1.25.....	.3150	6.80mm	.2677	
10.0mm x 1.50.....	.3937	8.50mm	.3346	
12.0mm x 1.75.....	.4724	10.20mm	.4016	
14.0mm x 2.00.....	.5512	12.00mm	.4724	
16.0mm x 2.00.....	.6299	14.00mm	.5512	
20.0mm x 2.50.....	.7874	17.50mm	.6890	
24.0mm x 3.00.....	.9449	21.00mm	.8268	
30.0mm x 3.50.....	1.1811	26.50mm	1.0433	
36.0mm x 4.00.....	1.4173	32.00mm	1.2598	
42.0mm x 4.50.....	1.6535	37.50mm	1.4764	
48.0mm x 5.00.....	1.8898	43.00mm	1.6929	
56.0mm x 5.50.....	2.2047	50.50mm	1.9882	
64.0mm x 6.00.....	2.5197	58.00mm	2.2837	
72.0mm x 6.00.....	2.8346	66.00mm	2.5984	
80.0mm x 6.00.....	3.1456	74.00mm	2.9134	
90.0mm x 6.00.....	3.5433	84.00mm	3.3071	
100.0mm x 6.00.....	3.9370	94.00mm	3.7008	
NATIONAL TAPER PIPE THREAD PITCHES AND TAP DRILL SIZES				
Nominal thread size (in.)	Threads per inch	Major pipe diameter (in.)	Tap drill size (in.)	Decimal equivalent of drill size (in.)
1/8.....	27	0.405	21/64	0.32813
1/4.....	18	0.540	29/64	0.45313
3/8.....	18	0.675	19/32	0.59375
1/2.....	14	0.840	23/32	0.71875
3/4.....	14	1.050	15/16	0.9375
1.....	11 1/2	1.315	1 3/16	1.1875
1 1/4.....	11 1/2	1.660	1 15/32	1.46875
1 1/2.....	11 1/2	1.900	1 23/32	1.71875
2.....	11 1/2	2.375	2 3/16	2.1875
2 1/2.....	8	2.875	2 11/16	2.6875
3.....	8	3.500	3 5/16	3.3125
3 1/2.....	8	4.00	3 13/16	3.8125
4.....	8	4.500	4 3/16	4.1875

Table\_\_\_ Formulas for calculating the tap drill size for inch and metric threads.

$$TDS = OD - \frac{1}{N}$$

- TDS = Tap Drill size ( in Inches)
- OD = Outside Diameter
- 1 = Constant
- N = Number of threads per inch

NOTE: This formula will determine a recommended decimal size, then use the numbered, lettered, or fractional size drill th at is closest to thje computed size.



**FOR METRIC SIZES:**

The recommended tap drill size is equal to the outside diameter minus the pitch. Metric tap sizes are designated by a capital M, the outside diameter in millimeters, and by the pitch in millimeters; such as M22 x 1.5. To find the recommended tap drill size, subtract 1.5 from 22, to get 20.5, which is the recommended tap drill size. If a metric or inch is not available for the recommended tap drill size, the round up to the nearest available drill.

TABLE 5-1. Grinding wheel selection and application.

<b>GRINDING WHEEL SELECTION AND APPLICATION</b>			
<b>SUITABLE FOR</b>	<b>WHEEL MATERIAL</b>	<b>GRAIN</b>	<b>GRADE</b>
<b>External Cylindrical Grinding</b>			
Good all-around wheels; best adapted to soft steel Hardened steel Soft steel of small diam. Reamers, drills and general tool work Hard steel, dry grinding Cast iron and bronze	Aluminox	2946	L
	Alundum	3836	L
	Aloxite	401	N
	Aluminox or Alundum	46	K
	Aluminox or Alundum	36	M½
	Aluminox or Alundum	80	K
	Aluminox or Alundum	100	I
	Crystolon	45	L
<b>Facing Shoulders</b>			
Ordinary work	Aluminox or Alundum	60	H or I
Fine finish	Aluminox or Alundum	80	I½
<b>Surface Grinding</b>			
Hardened steel	Alundum or Aluminox	46	H
	Alundum or Aluminox	46	G²
Hardened high-speed steel or very thin pieces of hardened carbon steel	Alundum or Aluminox	60	F²
	Aloxite	367	U
	Alundum or Aluminox	46	G
Cast iron	Carborundum or Crystolon	36	M J
<b>Disk Grinding</b>			
Thick pieces, wet grinding	Aluminox or Alundum	30	K
Thin pieces, wet grinding	Aluminox or Alundum	30	J
High-speed steel, dry grinding	Aluminox or Alundum	60 or 80	H or I
Washers and similar pieces	Aluminox or Alundum	60	I
<b>Internal Cylindrical Grinding</b>			
Good all around wheel	Aluminox or Alundum	46	2½ I½
Roughing hardened steel	Aluminox or Alundum	46	J or K
Finishing hardened steel	Aluminox or Alundum	120	J or K
Ordinary finishing without roughing	Aluminox or Alundum	80 & 90	J or K
Roughing brass	Crystolon	36	H or I
Finishing brass	Crystolon	80	H
Automobile cylinders	Crystolon	46	K
Automobile cylinders	Carborundum	36	M or P
Automobile cylinders, roughing or fair finish	Carbolite	36	H or I
Automobile cylinders, fine finish	Carbolite	60	H
<b>Sharpening Carbon-Steel Cutters, Dry Grinding</b>			
Milling cutters	Aluminox or Alundum	46 or 60	I
Formed and gear cutters	Aluminox or Alundum		

TABLE 7-1. Rake and Relief Angles in Degrees for High-Speed Steel Lathe Tools.

MATERIAL	SIDE RELIEF	FRONT RELIEF	SIDE RAKE	BACK RAKE
ALUMINUM	12	8	15	35
BRASS	10	8	5 to -4	0
BRONZE	10	8	5 to -4	0
CAST IRON	10	8	12	5
COPPER	12	10	20	16
MACHINE STEEL	10 to 12	8	12 to 18	8 to 15
TOOL STEEL	10	8	12	8
STAINLESS STEEL	10	8	15 to 20	8

TABLE 7-2. Cutting speeds for Straight Turning and Threading With HSS Tool Bits.

MATERIAL	STRAIGHT TURNING SPEED		THREADING SPEED	
	FEET PER MINUTE	METERS PER MINUTE	FEET PER MINUTE	METERS PER MINUTE
LOW-CARBON STEEL	80-100	24.4-30.5	35-40	10.7-12.2
MEDIUM-CARBON STEEL	60-80	18.3-24.4	25-30	7.6-9.1
HIGH-CARBON STEEL	35-40	10.7-12.2	15-20	4.6-6.1
STAINLESS STEEL	40-50	12.2-15.2	15-20	4.6-6.1
ALUMINUM AND ITS ALLOYS	200-300	61.0-91.4	50-60	15.2-18.3
ORDINARY BRASS AND BRONZE	100-200	30.5-61.0	40-50	12.2-15.2
HIGH-TENSILE BRONZE	40-60	12.2-18.3	20-25	6.1-7.6
CAST IRON	50-80	15.2-24.4	20-25	6.1-7.6
COPPER	60-80	18.3-24.4	20-25	6.1-7.6

NOTE: Speeds for carbide-tipped bits can be 2 to 3 times the speed recommended for high-speed steel

Simple formulas to use for English and Metric calculations:

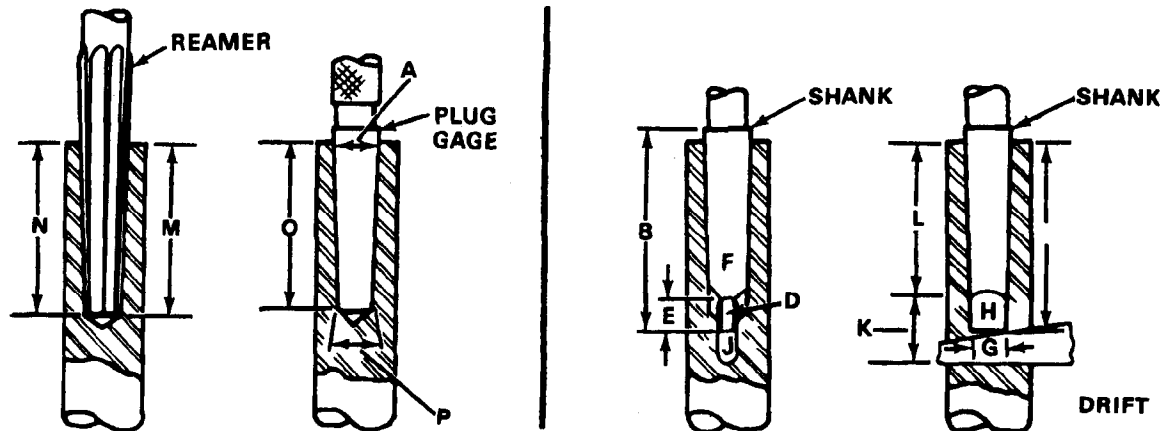
ENGLISH	METRIC
$\frac{cs \text{ (in feet)} \times 4}{D \text{ (in inches)}}$	$\frac{cs \text{ (in meters)} \times 320}{D \text{ (in millimeters)}}$
RPM = revolutions per minute CS = recommended cutting speed 4 = a constant for this calculation in feet per minute D = diameter of workpiece in inches	RPM = revolutions per minute CS = recommended cutting speed 320 = a constant for this calculation in meters per minute D = diameter of workpiece in millimeters

TABLE 7-3. Feeds for various materials (using high-speed steel or carbide-tipped tool bits).

MATERIAL	FINISHING CUTS		ROUGHING CUTS	
	Inches	Millimeters	Inches	Millimeters
LOW-CARBON STEEL	.012	0.3	.025	0.6
MEDIUM-CARBON STEEL	.012	0.3	.015	0.4
HIGH-CARBON STEEL	.005	0.1	.012	0.3
STAINLESS STEEL	.020	0.5	.010	0.2
ALUMINUM (AND ALLOYS)	.003	0.08	.020	0.5
BRASS AND BRONZE	.003	0.08	.020	0.5
HIGH-TENSILE BRONZE	.003	0.08	.020	0.5
CAST IRON	.003	0.08	.020	0.5
COPPER	.003	0.08	.020	0.5

NOTE: Use less feed on thin, long work to avoid bending the work.

TABLE 7-4. Morse Tapers.



Dia of plug at small end P	Dia of gage line A	Whole length B	Depth of drilled hole C	Depth of reamed hole M	Standard plug depth N	Standard plug depth O	Taper D	TANG			TAND SLOT			End of socket to tang slot L	Taper per inch inch	Taper per foot foot	No of drift	No of taper
								Length E	Radius F	Depth G	Radius H	Width J	Length K					
0**	0.252	0.356	2-11/32	2-7/32	2-1/16	2-1/32	Z	0.156	1/4	5/32	15/64	3/64	0.166	9/16	1-15/16	0.0520	0.6240	0**
1	0.369	0.475	2-9/16	2-7/16	2-3/16	2-5/32	2-1/8	0.203	3/8	3/16	11/32	3/64	0.213	3/4	2-1/16	0.0498	0.5985	1
2	0.572	0.700	3-1/8	2-15/16	2-21/32	2-39/64	2-9/16	0.280	7/16	1/4	17/32	1/16	0.280	7/8	2-1/2	0.0499	0.5984	2
3	0.778	0.938	3-7/8	3-11/16	3-5/16	3-1/4	3-3/16	0.312	9/16	9/32	23/32	5/64	0.322	1-3/16	3-1/16	0.0501	0.6023	3
4	1.020	1.231	4-7/8	4-5/8	4-3/16	4-1/8	4-1/16	0.469	5/8	5/16	31/32	3/32	0.479	1-1/4	3-7/8	0.0519	0.6232	4
5	1.475	1.748	6-1/8	5-7/8	5/8	5-1/4	5-3/16	0.625	3/4	3/8	1-13/32	1/8	0.636	1-1/2	4-15/16	0.0526	0.6315	5
6	2.116	2.494	8-9/16	8-1/4	7-13/32	7-21/64	7-1/4	0.750	1-1/8	1/2	2	5/32	0.760	1-3/4	7	0.0521	0.6256	5**
7	2.750	3.270	11-5/8	11-1/4	10-5/32	10-5/64	10	1.125	1-3/8	3/4	2-5/8	3/16	1.135	2-5/8	9-1/2	0.0520	0.6240	

\* THE DIMENSIONS AGREE ESSENTIALLY WITH DIMENSIONS OF THE AMERICAN STANDARD ON MACHINE TAPERS.  
 \*\* THE SIZE 0 TAPER IS NOT LISTED IN THE AMERICAN STANDARD ON MACHINE TAPERS.  
 \*\*\* THE NO 6 DRIFT WILL ALSO EJECT NO 6 TAPER SHANK TOOLS.

TABLE 7-5. Self-holding tapers basic dimensions.

NO. OF TAPER	TAPER PER FT.	DIA. AT GAGE LINE A	ORIGIN OF SERIES
0.239	0.50200	0.23922	Brown & Sharpe taper series
0.299	0.50200	0.29968	
0.375	0.50200	0.37525	
1	0.59858	0.47500	Morse taper series
2	0.59941	0.70000	
3	0.60235	0.93800	
4	0.62326	1.23100	
4-1/2	0.62400	1.50000	
5	0.63151	1.74800	
6*	0.62565	2.49400	
7*	0.62400	3.27000	
200	0.750	2.000	3/4 in. per ft. taper series
250	0.750	2.500	
300	0.750	3.000	
350	0.750	3.500	
400	0.750	4.000	
450	0.750	4.500	
500	0.750	5.000	
600	0.750	6.000	
800	0.750	8.000	
1000	0.750	10.000	
1200	0.750	12.000	

\* These sizes are continued in the tang drive series for the present to meet special needs.

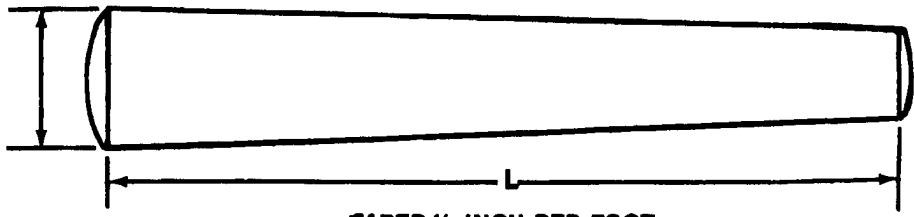
TABLE 7-6. Dimensions for steep machine tapers.

NO. OF TAPER	TAPER PER FT.*	DIA. AT GAGE LINE	LENGTH ALONG AXIS
5	3.500	1/2 0.500	11/16 0.6875
10	3.500	5/8 0.625	7/8 0.8750
15	3.500	3/4 0.750	1- 1/16 1.0625
20	3.500	7/8 0.875	1- 5/16 1.3125
25	3.500	1 1.000	1- 9/16 1.5625
30	3.500	1-1/4 1.250	1- 7/8 1.8750
35	3.500	1-1/2 1.500	2- 1/4 2.2500
40	3.500	1-3/4 1.750	2-11/16 2.6875
45	3.500	2-1/4 2.250	3- 5/16 3.3125
50	3.500	2-3/4 2.750	4 4.0000
55	3.500	3-1/2 3.500	5- 3/16 5.1875
60	3.500	4-1/4 4.250	6- 3/8 6.3750

Note: The tapers numbered 10,20,30,40,50, and 60 are designated as the "Preferred Series."  
The tapers numbered 5,15,25,35, and 45 are designated as the "Intermediate Series."

\*This taper corresponds to an included angle of 16° 35' 33.4".

TABLE 7-7. American Standard Taper Pins.



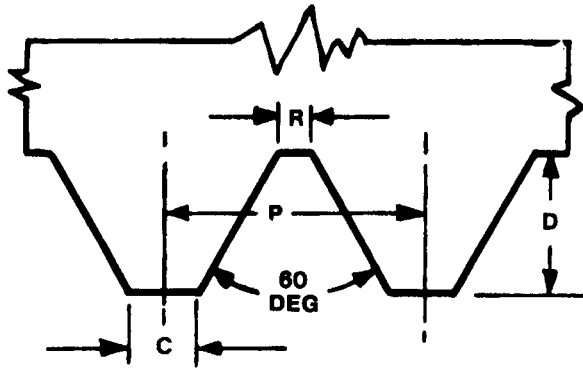
**TAPER 1/4 INCH PER FOOT.**

No. of Taper Pin	Diameter Large End D	Approx. Size D	Range of Lengths L	No. of Taper Pin	Diameter Large End D	Approx. Size D	Range of Lengths L
7/0	0.0625	1/16	3/8 to 5/8	3	0.219	7/32	3/4 to 1-3/4
6/0	0.078	5/64	3/8 to 3/4	4	0.250	1/4	3/4 to 2
5/0	0.094	3/32	1/2 to 1	5	0.289	19/64	1 to 2-1/4
4/0	0.109	7/64	1/2 to 1	6	0.341	11/32	1-1/4 to 3
3/0	0.125	1/8	1/2 to 1	7	0.409	13/32	2 to 3-3/4
2/0	0.141	9/64	1/2 to 1-1/4	8	0.492	1/2	2 to 4-1/2
0	0.156	5/32	1/2 to 1-1/4	9	0.591	19/32	2-3/4 to 5-1/4
1	0.172	11/64	5/8 to 1-1/4	10	0.706	45/64	3-1/2 to 6
2	0.193	3/16	3/4 to 1-1/2				

TABLE 7-8. ISO Metric Pitch & Diameter Combinations.

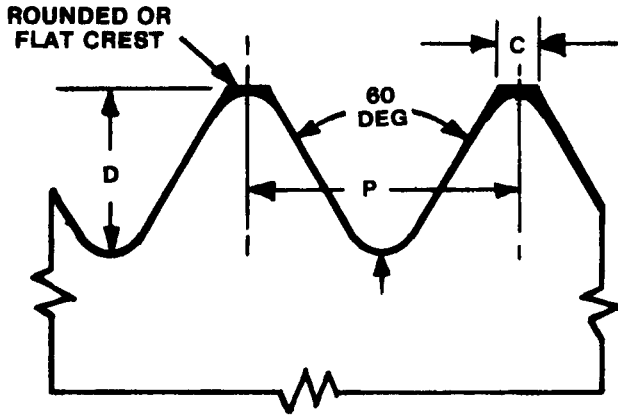
NOMINAL DIA.		THREAD PITCH	NOMINAL DIA.		THREAD PITCH
MM	INCHES	MM	MM	INCHES	MM
1.6	.0630	0.35	20	.7874	2.5
2	.0787	0.40	24	.9449	3.0
2.5	.0984	0.45	30	1.1811	3.5
3	.1181	0.50	36	1.4173	4.0
3.5	.1378	0.60	42	1.6535	4.5
4	.1575	0.70	48	1.8898	5.0
5	.1969	0.80	56	2.2047	5.5
6.3	.2480	1.00	64	2.5197	6.0
8	.3150	1.25	72	2.8346	6.0
10	.3937	1.50	80	3.1496	6.0
12	.4724	1.75	90	3.5433	6.0
14	.5512	2.00	100	3.9370	6.0
16	.6299	2.00			

TABLE 7-9. General Form Dimensions for Standard Screw Threads.



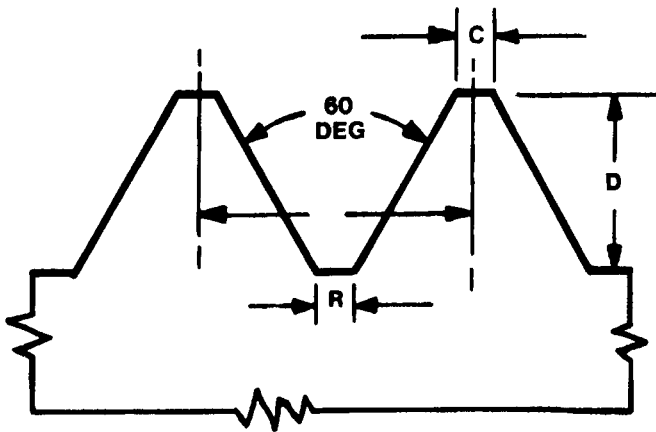
$D = \text{DEPTH} = 0.54127 \times \text{PITCH}$   
 $C = \text{CREST} = \text{PITCH} + 4$

**UNIFIED SCREW THREAD  
 (INTERNAL THREAD)**



$D = \text{DEPTH} = 0.61344 \times \text{PITCH}$   
 $C = \text{CREST} = \text{PITCH} + 8$

**UNIFIED SCREW THREAD  
 (EXTERNAL THREAD)**



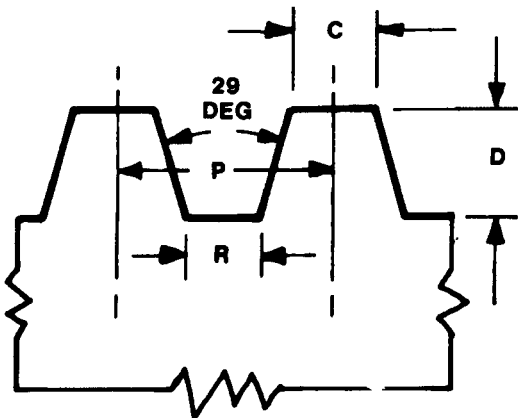
$D = \text{DEPTH} = 0.64952 \times \text{PITCH}$   
 $C = \text{CREST} = \text{PITCH} + 8$

$D = \text{DEPTH} = 0.64952 \times \text{PITCH}$   
 $C = \text{CREST} = \text{PITCH} + 8$

**AMERICAN NATIONAL STANDARD THREAD**

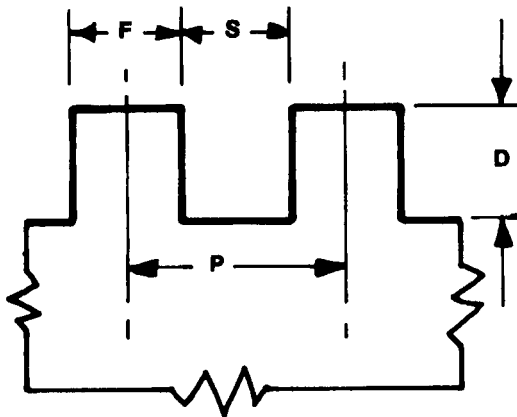
FOR ABOVE THREAD FORMS,  $P = \text{PITCH} = 1 \div \text{THREADS PER INCH}$ , AND  $R = \text{ROOT} = \text{PITCH} + 8$

TABLE 7-9. General Form Dimensions for Standard Screw Threads(cont).



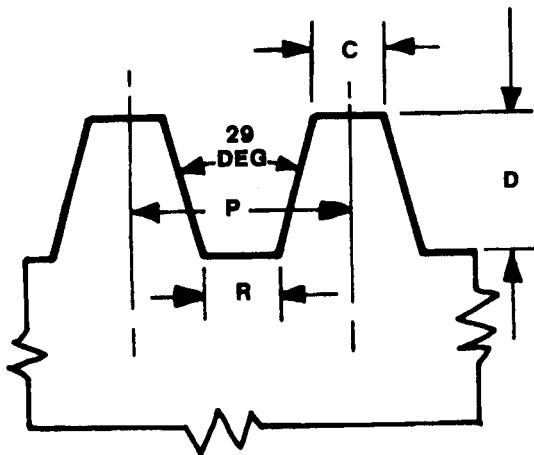
D = DEPTH =  $1/2$  PITCH + 0.01 INCH  
 C = CREST =  $0.03707 \times$  PITCH  
 R = ROOT = CREST - 0.0052 INCH

**ACME SCREW THREAD**



D = DEPTH =  $1/2$  PITCH  
 F = FLAT =  $1/2$  PITCH  
 S = SPACE =  
 FOR SCREW :  $1/2$  PITCH  
 FOR NUT :  $1/2$  PITCH + 0.001  
 TO 0.002 INCH  
 CLEARANCE

**SQUARE SCREW THREAD**

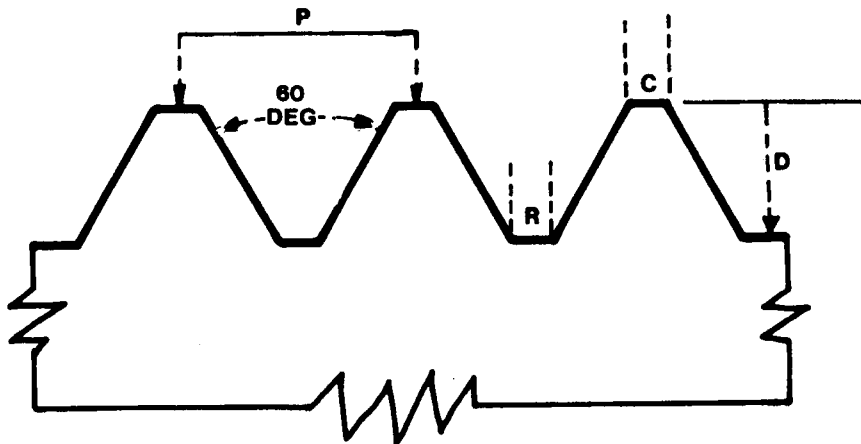


D = DEPTH =  $0.6866 \times$  PITCH  
 C = CREST =  $0.335 \times$  PITCH  
 R = ROOT =  $0.310 \times$  PITCH

**29-DEG WORM SCREW THREAD  
 (BROWN AND SHARPE)**

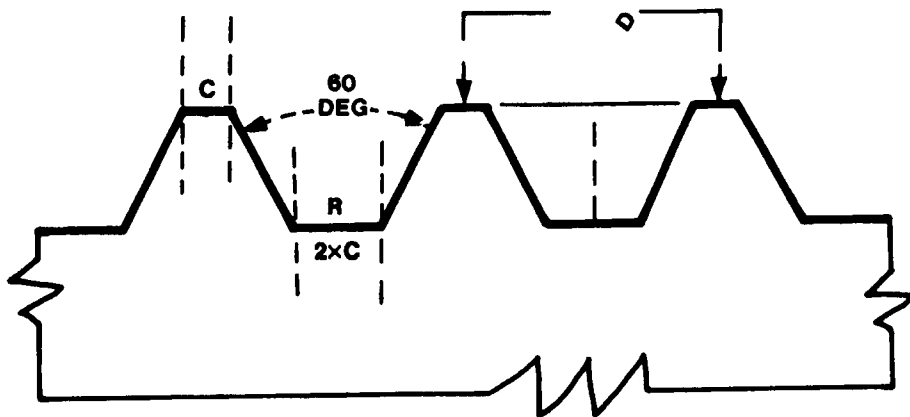
FOR ABOVE THREAD FORMS, P = PITCH =  $1 \div$  THREADS PER INCH

TABLE 7-9. General Form Dimensions for Standard Screw Threads(cont).



**D = DEPTH = 0.7035 × P (max)**  
**= 0.6855 × P (min)**  
**C = CREST = ROOT = P ÷ 8**

**INTERNATIONAL METRIC THREAD  
 (SPARK PLUG THREAD)**



**D = DEPTH = 0.54127 × P**  
**C = CREST = P ÷ 8**  
**R = ROOT = P ÷ 4**

**ISO METRIC THREAD STANDARD**



TABLE 7-10. Standard Series Limits of Size-Unified and American Screw Threads

Nominal size and threads per inch	Series designation	External										Internal												
		Class	Allowance	Major diameter limits			Pitch diameter limits			Minor diameter	Class	Minor diameter limits			Pitch diameter limits			Major diameter						
				Max	Min	Min	Max	Min	Tolerance			Min	Max	Min	Max	Tolerance								
0-80	NF	2A	0.0005	in.	0.0563	in.	0.0514	in.	0.0496	in.	0.0018	in.	0.0465	in.	0.0514	in.	0.0519	in.	0.0542	in.	0.0023	in.	0.0600	in.
1-64	NC	3A	0.0000	0.600	0.568	0.519	0.506	0.013	0.0447	0.0465	0.017	0.0447	0.0465	0.017	0.0514	0.0519	0.536	0.017	0.536	0.017	0.0600	0.017	0.600	0.017
1-72	NF	2A	0.0006	0.724	0.686	0.623	0.603	0.020	0.532	0.561	0.015	0.532	0.561	0.015	0.623	0.629	0.655	0.026	0.655	0.026	0.730	0.026	0.730	0.026
2-56	NC	3A	0.0000	0.724	0.689	0.615	0.615	0.019	0.554	0.580	0.014	0.554	0.580	0.014	0.634	0.640	0.665	0.025	0.665	0.025	0.730	0.025	0.730	0.025
2-64	NF	2A	0.0006	0.854	0.813	0.738	0.728	0.021	0.635	0.667	0.016	0.635	0.667	0.016	0.737	0.744	0.772	0.028	0.772	0.028	0.860	0.028	0.860	0.028
3-48	NC	2A	0.0007	0.983	0.938	0.848	0.825	0.023	0.727	0.764	0.015	0.727	0.764	0.015	0.849	0.855	0.885	0.030	0.885	0.030	0.990	0.030	0.990	0.030
3-56	NF	3A	0.0000	0.990	0.945	0.855	0.838	0.017	0.734	0.764	0.022	0.734	0.764	0.022	0.874	0.885	0.911	0.028	0.911	0.028	0.990	0.028	0.990	0.028
4-40	NC	2A	0.0008	1.112	1.061	0.950	0.925	0.025	0.805	0.849	0.016	0.805	0.849	0.016	0.939	0.958	0.991	0.021	0.991	0.021	1.120	0.021	1.120	0.021
4-48	NF	3A	0.0000	1.120	1.069	0.958	0.939	0.019	0.813	0.849	0.024	0.813	0.849	0.024	0.968	0.982	1.016	0.033	1.016	0.033	1.120	0.033	1.120	0.033
5-40	NC	2A	0.0008	1.242	1.191	1.075	1.054	0.026	0.935	0.979	0.018	0.935	0.979	0.018	1.062	1.088	1.121	0.023	1.121	0.023	1.250	0.023	1.250	0.023
5-44	NF	3A	0.0000	1.250	1.199	1.088	1.069	0.019	0.943	0.979	0.025	0.943	0.979	0.025	1.062	1.088	1.113	0.025	1.113	0.025	1.250	0.025	1.250	0.025
6-32	NC	2A	0.0008	1.372	1.312	1.141	1.119	0.028	0.989	1.024	0.025	0.989	1.024	0.025	1.119	1.134	1.166	0.032	1.166	0.032	1.250	0.032	1.250	0.032
6-40	NF	3A	0.0000	1.380	1.320	1.177	1.156	0.021	0.997	1.040	0.028	0.997	1.040	0.028	1.141	1.177	1.214	0.024	1.214	0.024	1.380	0.024	1.380	0.024
8-32	NC	2A	0.0009	1.631	1.571	1.428	1.399	0.029	1.248	1.283	0.026	1.248	1.283	0.026	1.399	1.437	1.475	0.034	1.475	0.034	1.640	0.034	1.640	0.034
8-36	NF	3A	0.0000	1.640	1.580	1.437	1.415	0.022	1.257	1.291	0.029	1.257	1.291	0.029	1.399	1.437	1.475	0.038	1.475	0.038	1.640	0.038	1.640	0.038
10-24	NC	2A	0.0010	1.890	1.818	1.619	1.586	0.033	1.379	1.415	0.028	1.379	1.415	0.028	1.429	1.460	1.496	0.036	1.496	0.036	1.640	0.036	1.640	0.036
10-32	NF	3A	0.0000	1.900	1.828	1.604	1.566	0.025	1.389	1.429	0.033	1.389	1.429	0.033	1.439	1.460	1.487	0.043	1.487	0.043	1.900	0.043	1.900	0.043
12-24	NC	2A	0.0010	2.150	2.078	1.879	1.845	0.034	1.639	1.674	0.026	1.639	1.674	0.026	1.771	1.807	1.843	0.044	1.843	0.044	2.160	0.044	2.160	0.044
12-28	NF	3A	0.0000	2.160	2.088	1.889	1.856	0.032	1.649	1.684	0.026	1.649	1.684	0.026	1.811	1.849	1.885	0.050	1.885	0.050	2.160	0.050	2.160	0.050
12-32	NEF	2A	0.0009	2.151	2.091	1.948	1.917	0.031	1.768	1.804	0.024	1.768	1.804	0.024	1.882	1.917	1.953	0.041	1.953	0.041	2.160	0.041	2.160	0.041

NOTE.—The following seven sizes have been standardized as between American, Canadian, and British military services or industry for purposes of attachment, e.g., an instrument or accessory to a panel: 0-80 NF, 2-56 NC, 4-40 NC, 8-32 NC, 10-24 NC, and 10-32 NF, with 10-32 NF preferred over 10-24.

TABLE 7-10. Standard Series Limits of Size-Unified and American Screw Threads(cont.).

Nominal size and threads per inch	Series designation	External					Internal									
		Class	Allow- ance	Major diameter limits		Pitch diameter limits			Minor diam- eter	Class	Minor diam- eter limits		Pitch diameter limits			Major diam- eter
				Max	Min	Min	Max	Toler- ance			Min	Max	Toler- ance	Min	Max	
1/4-20	UNC	1A	.0011	.2367	.2108	.2164	.2108	.0056	.1876	1B	.196	.207	.2175	.2248	.0073	.2500
	2A	.0011	.2489	.2164	.2164	.2127	.0037	.1876	2B	.196	.207	.2175	.2223	.0048	.2500	
	3A	.0000	.2500	.2419	.2155	.2147	.0028	.1887	3B	.1960	.2067	.2211	.2211	.0036	.2500	
1/4-28	UNC	1A	.0010	.2392	.2208	.2258	.2208	.0050	.2052	1B	.211	.220	.2268	.2333	.0065	.2500
	2A	.0010	.2490	.2425	.2258	.2225	.0033	.2052	2B	.211	.220	.2268	.2311	.0043	.2500	
	3A	.0000	.2500	.2435	.2268	.2243	.0025	.2062	3B	.2110	.2190	.2268	.2300	.0032	.2500	
1/4-32	UNC	1A	.0010	.2430	.2287	.2287	.2255	.0032	.2107	1B	.216	.224	.2297	.2339	.0042	.2500
	2A	.0000	.2490	.2440	.2297	.2273	.0024	.2117	2B	.216	.224	.2297	.2328	.0031	.2500	
	3A	.0000	.2500	.2440	.2297	.2273	.0024	.2117	3B	.216	.224	.2297	.2328	.0031	.2500	
5/16-18	UNC	1A	.0012	.3113	.2982	.2752	.2691	.0061	.2431	1B	.252	.265	.2764	.2843	.0079	.3125
	2A	.0012	.3113	.3026	.2752	.2712	.0040	.2431	2B	.252	.265	.2764	.2817	.0053	.3125	
	3A	.0000	.3125	.3038	.2764	.2734	.0030	.2443	3B	.2520	.2630	.2764	.2803	.0039	.3125	
5/16-24	UNC	1A	.0011	.3006	.2843	.2788	.2788	.0055	.2603	1B	.267	.277	.2854	.2925	.0071	.3125
	2A	.0011	.3114	.3042	.2843	.2806	.0037	.2603	2B	.267	.277	.2854	.2902	.0048	.3125	
	3A	.0000	.3125	.3053	.2854	.2827	.0027	.2614	3B	.2670	.2754	.2854	.2890	.0036	.3125	
5/16-32	NEF	2A	.0010	.3055	.2912	.2912	.2880	.0032	.2732	2B	.279	.286	.2922	.2964	.0042	.3125
	3A	.0000	.3125	.3065	.2922	.2898	.0024	.2742	3B	.2790	.2847	.2922	.2953	.0031	.3125	
	UNC	1A	.0013	.3595	.3331	.3266	.0065	.2970	1B	.307	.321	.3344	.3429	.0085	.3750	
3/8-16	UNC	2A	.0013	.3643	.3331	.3287	.0044	.2970	2B	.307	.321	.3344	.3401	.0057	.3750	
	3A	.0000	.3750	.3656	.3344	.3311	.0033	.2983	3B	.3070	.3182	.3344	.3387	.0043	.3750	
	UNC	1A	.0011	.3739	.3631	.3468	.0057	.3228	1B	.330	.340	.3479	.3553	.0074	.3750	
3/8-24	UNC	2A	.0011	.3739	.3667	.3468	.0038	.3228	2B	.330	.340	.3479	.3528	.0049	.3750	
	3A	.0000	.3750	.3678	.3479	.3450	.0029	.3239	3B	.3300	.3372	.3479	.3516	.0037	.3750	
	NEF	2A	.0010	.3740	.3680	.3537	.0034	.3357	2B	.341	.349	.3547	.3591	.0044	.3750	
3/8-32	NEF	3A	.0000	.3750	.3690	.3547	.0025	.3367	3B	.3410	.3469	.3547	.3580	.0033	.3750	
	UNC	1A	.0014	.4206	.3897	.3826	.0071	.3485	1B	.360	.376	.3911	.4003	.0092	.4375	
	2A	.0014	.4361	.4258	.3897	.3850	.0047	.3485	2B	.360	.376	.3911	.3972	.0061	.4375	
7/16-14	UNC	3A	.0000	.4375	.4272	.3911	.0035	.3499	3B	.3600	.3717	.3911	.3957	.0046	.4375	
	UNC	1A	.0013	.4362	.4240	.4037	.0062	.3749	1B	.383	.395	.4050	.4131	.0081	.4375	
	2A	.0013	.4362	.4281	.4037	.3995	.0042	.3749	2B	.383	.395	.4050	.4104	.0054	.4375	
7/16-20	UNC	3A	.0000	.4375	.4294	.4050	.0031	.3762	3B	.3830	.3916	.4050	.4091	.0041	.4375	
	UNC	2A	.0011	.4364	.4299	.4132	.0036	.3926	2B	.399	.407	.4143	.4189	.0046	.4375	
	3A	.0000	.4375	.4310	.4143	.4116	.0027	.3937	3B	.3990	.4051	.4143	.4178	.0035	.4375	
1/2-12	N	2A	.0016	.4984	.4870	.4443	.0054	.3962	2B	.410	.428	.4459	.4511	.0052	.5000	
	UNC	3A	.0000	.5000	.4886	.4459	.0040	.3978	3B	.4100	.4223	.4459	.4511	.0052	.5000	
	1A	.0015	.4985	.4822	.4485	.4411	.0074	.4041	1B	.417	.434	.4500	.4597	.0097	.5000	
1/2-13	UNC	2A	.0015	.4985	.4876	.4485	.0050	.4041	2B	.417	.434	.4500	.4565	.0065	.5000	
	3A	.0000	.5000	.4891	.4500	.4463	.0037	.4056	3B	.4170	.4284	.4500	.4548	.0048	.5000	

TABLE 7-10. Standard Series Limits of Size-Unified and American Screw Threads(cont.).

Nominal size and threads per inch	Series designation	External				Internal									
		Class	Allowance	Major diameter limits		Pitch diameter limits	Pitch diameter	Minor diameter limits		Pitch diameter limits		Major diameter	Min		
				Max	Min			Max	Min	Max	Min			Max	Min
1/2-20	UNF	1A	.0013	.4865	.4662	.4598	.0064	.4374	.416	.457	.4675	.4759	.4731	.0084	.5000
		2A	.0013	.4906	.4662	.4619	.0043	.4374	.446	.457	.4675	.4731	.4717	.0056	.5000
		3A	.0000	.4919	.4675	.4643	.0032	.4387	.4460	.4537	.4675	.4717	.4717	.0042	.5000
1/2-28	JNEF	2A	.0011	.4989	.4924	.4720	.0037	.4551	.461	.470	.4768	.4816	.4816	.0048	.5000
		3A	.0000	.5000	.4935	.4740	.0028	.4562	.4610	.4676	.4768	.4804	.4804	.0036	.5000
		1A	.0016	.5609	.5437	.4990	.0078	.4587	.472	.490	.5084	.5186	.5186	.0102	.5625
9/16-12	UNC	2A	.0016	.5609	.5495	.5016	.0052	.4587	.472	.490	.5084	.5152	.5152	.0068	.5625
		3A	.0000	.5625	.5511	.5045	.0039	.4603	.4720	.4843	.5084	.5135	.5135	.0051	.5625
		1A	.0014	.5611	.5480	.5182	.0068	.4929	.502	.515	.5264	.5353	.5353	.0089	.5625
9/16-18	UNF	2A	.0014	.5611	.5524	.5205	.0045	.4929	.5020	.5106	.5264	.5308	.5308	.0044	.5625
		3A	.0000	.5625	.5538	.5230	.0034	.4943	.5020	.5106	.5264	.5308	.5308	.0044	.5625
		2A	.0012	.5613	.5342	.5303	.0039	.5102	.517	.527	.5354	.5405	.5405	.0051	.5625
9/16-24	NEF	3A	.0000	.5625	.5354	.5325	.0029	.5114	.5170	.5244	.5354	.5392	.5392	.0038	.5625
		1A	.0016	.6234	.6062	.5561	.0083	.5119	.527	.546	.5660	.5767	.5767	.0107	.6250
		2A	.0016	.6234	.6113	.5589	.0055	.5119	.527	.546	.5660	.5732	.5732	.0072	.6250
5/8-12	N	3A	.0000	.6250	.6129	.5619	.0041	.5135	.5270	.5391	.5660	.5714	.5714	.0054	.6250
		2A	.0016	.6234	.6120	.5639	.0054	.5212	.535	.553	.5709	.5780	.5780	.0071	.6250
		3A	.0000	.6250	.6136	.5668	.0041	.5228	.5350	.5463	.5709	.5762	.5762	.0053	.6250
5/8-18	UNF	1A	.0014	.6236	.6105	.5805	.0070	.5554	.565	.578	.5889	.5890	.5890	.0091	.6250
		2A	.0014	.6236	.6149	.5828	.0047	.5554	.565	.578	.5889	.5949	.5949	.0060	.6250
		3A	.0000	.6250	.6163	.5854	.0035	.5568	.5650	.5730	.5889	.5934	.5934	.0045	.6250
5/8-24	NEF	2A	.0012	.6238	.6166	.5927	.0040	.5727	.580	.590	.5979	.6031	.6031	.0052	.6250
		3A	.0000	.6250	.6178	.5949	.0030	.5739	.5800	.5869	.5979	.6018	.6018	.0039	.6250
		2A	.0016	.6859	.6745	.6318	.0054	.5837	.597	.615	.6334	.6405	.6405	.0071	.6875
11/16-12	N	3A	.0000	.6875	.6761	.6293	.0041	.5853	.5970	.6085	.6334	.6387	.6387	.0053	.6875
		2A	.0012	.6863	.6791	.6552	.0040	.6352	.642	.652	.6604	.6656	.6656	.0052	.6875
		3A	.0000	.6875	.6803	.6574	.0030	.6364	.6420	.6494	.6604	.6643	.6643	.0039	.6875
3/4-10	UNC	1A	.0018	.7482	.7288	.6744	.0088	.6255	.642	.663	.6850	.6965	.6965	.0115	.7500
		2A	.0018	.7482	.7353	.6773	.0059	.6255	.642	.663	.6850	.6927	.6927	.0077	.7500
		3A	.0000	.7500	.7371	.6806	.0044	.6273	.6420	.6545	.6850	.6907	.6907	.0057	.7500
3/4-12	N	2A	.0017	.7483	.7369	.6918	.0055	.6461	.660	.678	.6959	.7031	.7031	.0072	.7500
		3A	.0000	.7500	.7386	.6918	.0041	.6478	.6600	.6707	.6959	.7013	.7013	.0054	.7500
		1A	.0015	.7485	.7473	.7004	.0075	.6718	.682	.696	.7094	.7192	.7192	.0098	.7500
3/4-16	UNF	2A	.0015	.7485	.7391	.7029	.0050	.6718	.682	.696	.7094	.7159	.7159	.0049	.7500
		3A	.0000	.7500	.7406	.7056	.0038	.6733	.6820	.6908	.7094	.7143	.7143	.0045	.7500
		2A	.0013	.7487	.7406	.7118	.0044	.6874	.696	.707	.7175	.7232	.7232	.0057	.7500
3/4-20	UNEF	3A	.0000	.7500	.7419	.7142	.0033	.6887	.6960	.7037	.7175	.7218	.7218	.0043	.7500
		2A	.0017	.8108	.7994	.7512	.0055	.7086	.722	.740	.7584	.7656	.7656	.0072	.8125
		3A	.0000	.8125	.8011	.7543	.0041	.7103	.7220	.7329	.7584	.7638	.7638	.0054	.8125
13/16-12	N	2A	.0015	.8110	.7704	.7655	.0049	.7343	.745	.759	.7719	.7782	.7782	.0063	.8125
		3A	.0000	.8125	.8031	.7683	.0036	.7358	.7450	.7533	.7719	.7766	.7766	.0047	.8125
		2A	.0015	.8110	.8016	.7655	.0049	.7343	.745	.759	.7719	.7782	.7782	.0063	.8125

TABLE 7-10. Standard Series Limits of Size-Unified and American Screw Threads (cont.)

Nominal size and threads per inch	Series designation	Class		Allowance	External												Internal					
		Major diameter limits	Pitch diameter limits		Minor diameter limits	Class	Minor diameter limits	Pitch diameter limits	Major diameter limits	Minor diameter limits	Pitch diameter limits	Major diameter limits	Minor diameter limits	Pitch diameter limits	Major diameter limits	Pitch diameter limits	Minor diameter limits					
																		Max	Min	Min	Max	Min
13/16—20	UNEF	2A	0013	in	8112	8031	7787	7743	0044	7498	770	7800	7857	0057	8125							
					8125	8044	7800	7767	0033	7512	7662	7800	7843	0043	8125							
					8731	8523	8009	7914	0095	7368	778	8028	8110	0082	8750							
1/8—9	UNC	1A	0019	in	8731	8592	8009	7946	0063	7368	778	8028	8110	0082	8750							
					8750	8611	8028	7981	0047	7387	7681	8089	8089	0061	8750							
					8733	8619	8192	8137	0055	7711	803	8209	8281	0072	8750							
7/8—12	N	2A	0017	in	8733	8619	8192	8137	0055	7711	803	8209	8281	0072	8750							
					8750	8636	8209	8168	0041	7728	7952	8263	8356	0054	8750							
					8734	8579	8270	8189	0081	7858	814	8286	8392	0106	8750							
7/8—14	UNF	1A	0016	in	8734	8631	8270	8189	0081	7858	814	8286	8356	0070	8750							
					8750	8647	8286	8245	0054	7874	8068	8339	8356	0053	8750							
					8735	8656	8329	8280	0049	807	8344	8407	8407	0063	8750							
7/8—16	UN	3A	0015	in	8735	8656	8344	8308	0036	7968	807	8344	8407	0063	8750							
					8750	8669	8412	8368	0044	8124	832	8425	8482	0057	8750							
					8737	8656	8425	8392	0033	8210	8287	8425	8468	0074	8750							
7/8—20	UNEF	2A	0013	in	8737	8656	8425	8392	0033	8210	8287	8425	8468	0074	8750							
					8750	8669	8425	8392	0033	8210	8287	8425	8468	0074	8750							
					9358	9244	8817	8760	0057	865	8834	8908	8908	0055	9375							
15/16—12	UN	2A	0017	in	9358	9244	8817	8760	0057	865	8834	8908	8908	0055	9375							
					9375	9358	8834	8793	0041	8470	8889	8889	0055	9375								
					9360	9266	8954	8904	0050	870	884	8969	9034	0065	9375							
15/16—16	UN	2A	0015	in	9360	9266	8954	8904	0050	870	884	8969	9034	0065	9375							
					9375	9281	8969	8932	0037	8608	8783	8969	9018	0049	9375							
					9361	9280	9036	8991	0045	8748	895	9050	9109	0059	9375							
15/16—20	UNEF	2A	0014	in	9361	9280	9036	8991	0045	8748	895	9050	9109	0059	9375							
					9375	9294	9050	9016	0034	8762	8912	9094	9094	0044	9375							
					9980	9755	9168	9067	0101	8446	890	9320	9320	0132	10000							
1—8	UNC	1A	0020	in	9980	9755	9168	9067	0101	8446	890	9320	9320	0132	10000							
					9980	9830	9168	9100	0068	8446	890	9188	9276	0088	10000							
					10000	9850	9188	9137	0051	8466	8650	9188	9254	0066	10000							
1—12	UNF	1A	0018	in	9982	9810	9441	9382	0059	8960	910	928	9459	0114	10000							
					9982	9810	9441	9382	0059	8960	910	928	9459	0114	10000							
					10000	9868	9415	9382	0044	8978	9100	9198	9495	0076	10000							
1—16	UN	2A	0018	in	10000	9868	9415	9382	0044	8978	9100	9198	9495	0076	10000							
					10000	9886	9459	9415	0044	8978	9100	9198	9495	0076	10000							
					9985	9891	9579	9529	0050	9218	946	9594	9643	0065	10000							
1—20	UNEF	2A	0014	in	9985	9891	9579	9529	0050	9218	946	9594	9643	0065	10000							
					9986	9906	9594	9557	0037	9323	9408	9594	9643	0049	10000							
					10000	9919	9661	9616	0045	9373	9675	9734	9734	0059	10000							
1-1/16—12	UN	2A	0017	in	10000	9919	9661	9616	0045	9373	9675	9734	9734	0059	10000							
					10608	10494	10067	10010	0057	9586	990	10084	10158	0074	10625							
					10625	10511	10084	10042	0042	9603	9823	10084	10139	0055	10625							
1-1/16—16	UN	2A	0015	in	10608	10494	10067	10010	0057	9586	990	10084	10158	0074	10625							
					10625	10516	10204	10154	0050	9843	1009	10219	10284	0065	10625							
					10625	10531	10219	10182	0037	9858	9950	10033	10268	0049	10625							
1-1/16—18	NEF	3A	0000	in	10625	10531	10219	10182	0037	9858	9950	10033	10268	0049	10625							
					10625	10538	10250	10203	0047	9929	1002	1015	10264	0062	10625							
					10625	10538	10250	10203	0047	9929	1002	1015	10264	0062	10625							
1-1/8—7	UNC	1A	0022	in	10625	10538	10250	10203	0047	9929	1002	1015	10264	0062	10625							
					11228	10982	10300	10191	0109	9475	998	10322	10463	0141	11250							
					11228	11064	10300	10191	0109	9475	998	10322	10463	0141	11250							
1-1/8—8	N	2A	0021	in	11228	11064	10300	10191	0109	9475	998	10322	10463	0141	11250							
					11250	11086	10322	10268	0054	9875	9700	10322	10393	0071	11250							
					11229	11079	10417	10348	0069	9695	990	1015	10438	0090	11250							
1-1/8—12	UNF	1A	0018	in	11250	11100	10438	10386	0052	9716	9900	10047	10505	0067	11250							
					11232	11060	10691	10601	0090	1035	1053	10709	10826	0117	11250							
					11232	11118	10691	10631	0060	10210	1053	10709	10826	0117	11250							
1-1/8—12	UNC	2A	0018	in	11232	11118	10691	10631	0060	10210	1053	10709	10826	0117	11250							
					11250	11136	10709	10664	0045	10228	10350	10448	10768	0059	11250							
					11250	11136	10709	10664	0045	10228	10350	10448	10768	0059	11250							

TABLE 7-10. Standard Series Limits of Size-Unified and American Screw Threads (cont.)

Nominal size and threads per inch	Series designation	Class		Allowance	External						Internal					
		Class	Pitch diameter limits		Major diameter limits		Minor diameter	Class	Minor diameter limits		Pitch diameter limits		Major diameter			
					Max	Min			Min	Max	Min	Max		Tolerance		
1-1/8-16	UN	2A	1.1235	1.1141	.....	1.0829	1.0779	1.0468	2B	1.057	1.071	1.0844	1.0909	1.1250	1.0065	
		3A	0.0000	1.1156	.....	1.0844	1.0807	1.0483	3B	1.0570	1.0658	1.0844	1.0893	1.1250	0.0049	
		2A	0.014	1.1149	.....	1.0875	1.0828	1.0554	2B	1.065	1.078	1.0889	1.0951	1.1250	0.0062	
1-1/8-18	NEF	3A	0.0000	1.1163	.....	1.0889	1.0853	1.0568	3B	1.0650	1.0730	1.0889	1.0935	1.1250	0.0046	
		2A	0.0017	1.1174	.....	1.1317	1.1259	1.0836	2B	1.097	1.115	1.1334	1.1409	1.1875	0.0075	
		3A	0.0000	1.1761	.....	1.1334	1.1291	1.0853	3B	1.0970	1.1073	1.1334	1.1390	1.1875	0.0056	
1-3/16-16	UN	2A	0.0015	1.1766	.....	1.1454	1.1403	1.1093	2B	1.120	1.134	1.1469	1.1535	1.1875	0.0066	
		3A	0.0000	1.1781	.....	1.1469	1.1431	1.1108	3B	1.1200	1.1283	1.1469	1.1519	1.1875	0.0050	
		2A	0.0015	1.1773	.....	1.1499	1.1450	1.1178	2B	1.127	1.140	1.1514	1.1577	1.1875	0.0063	
1-3/16-18	NEF	3A	0.0000	1.1788	.....	1.1514	1.1478	1.1193	3B	1.1270	1.1355	1.1514	1.1561	1.1875	0.0047	
		1A	0.0022	1.2478	1.2232	1.1550	1.1439	1.0725	1B	1.095	1.123	1.1572	1.1716	1.2500	0.144	
		2A	0.0022	1.2478	1.2314	1.1550	1.1476	1.0725	2B	1.095	1.123	1.1572	1.1668	1.2500	0.096	
1-1/4-8	N	3A	0.0000	1.2336	1.2254	1.1667	1.1597	1.0945	3B	1.115	1.140	1.1688	1.1780	1.2500	0.072	
		2A	0.0021	1.2479	1.2329	1.1688	1.1635	1.0966	2B	1.115	1.140	1.1688	1.1780	1.2500	0.092	
		3A	0.0000	1.2350	1.2310	1.1941	1.1849	1.1460	3B	1.1150	1.1297	1.1688	1.1757	1.2500	0.069	
1-1/4-12	UNF	1A	0.0018	1.2482	1.2386	1.1941	1.1879	1.1478	1B	1.160	1.178	1.1959	1.2079	1.2500	0.120	
		2A	0.0018	1.2482	1.2368	1.1941	1.1879	1.1460	2B	1.160	1.178	1.1959	1.2039	1.2500	0.080	
		3A	0.0000	1.2500	1.2386	1.1959	1.1913	1.1478	3B	1.1600	1.1698	1.1959	1.2019	1.2500	0.060	
1-1/4-16	UN	2A	0.0015	1.2485	1.2391	1.2079	1.2028	1.1718	2B	1.182	1.196	1.2094	1.2160	1.2500	0.066	
		3A	0.0000	1.2500	1.2406	1.2094	1.2056	1.1733	3B	1.1820	1.1908	1.2094	1.2144	1.2500	0.050	
		2A	0.0015	1.2485	1.2398	1.2124	1.2075	1.1803	2B	1.190	1.203	1.2139	1.2202	1.2500	0.063	
1-1/4-18	NEF	3A	0.0000	1.2413	1.2139	1.2139	1.2103	1.1818	3B	1.1900	1.1980	1.2139	1.2186	1.2500	0.047	
		2A	0.0017	1.3108	1.2994	1.2567	1.2509	1.2086	2B	1.222	1.240	1.2584	1.2659	1.3125	0.075	
		3A	0.0000	1.3125	1.3011	1.2584	1.2541	1.2103	3B	1.2220	1.2323	1.2584	1.2640	1.3125	0.056	
1-5/16-16	UN	2A	0.0015	1.3110	1.3016	1.2704	1.2653	1.2343	2B	1.245	1.259	1.2719	1.2785	1.3125	0.066	
		3A	0.0000	1.3125	1.3031	1.2719	1.2681	1.2358	3B	1.2450	1.2533	1.2719	1.2769	1.3125	0.050	
		2A	0.0015	1.3110	1.3023	1.2749	1.2700	1.2428	2B	1.252	1.265	1.2764	1.2827	1.3125	0.063	
1-5/16-18	NEF	3A	0.0000	1.3125	1.3038	1.2764	1.2728	1.2443	3B	1.2520	1.2605	1.2764	1.2811	1.3125	0.047	
		2A	0.0024	1.3726	1.3453	1.2643	1.2523	1.1681	1B	1.195	1.225	1.2667	1.2823	1.3750	0.156	
		3A	0.0000	1.3726	1.3544	1.2643	1.2563	1.1681	3B	1.195	1.225	1.2667	1.2771	1.3750	0.104	
1-3/8-6	UNC	2A	0.0024	1.3726	1.3544	1.2643	1.2563	1.1705	2B	1.195	1.2146	1.2667	1.2745	1.3750	0.078	
		3A	0.0000	1.3750	1.3568	1.2667	1.2607	1.1705	3B	1.1950	1.2146	1.2667	1.2745	1.3750	0.093	
		2A	0.0022	1.3728	1.3578	1.2916	1.2844	1.2194	2B	1.240	1.265	1.2938	1.3031	1.3750	0.078	
1-3/8-8	N	3A	0.0000	1.3750	1.3600	1.2938	1.2884	1.2216	3B	1.2400	1.2547	1.2938	1.3008	1.3750	0.070	
		1A	0.0019	1.3731	1.3559	1.3190	1.3096	1.2709	1B	1.285	1.303	1.3209	1.3332	1.3750	0.123	
		2A	0.0019	1.3731	1.3617	1.3190	1.3127	1.2709	2B	1.285	1.303	1.3209	1.3291	1.3750	0.082	
1-3/8-12	UNF	3A	0.0000	1.3750	1.3636	1.3209	1.3162	1.2728	3B	1.2850	1.2948	1.3209	1.3270	1.3750	0.061	
		2A	0.0015	1.3735	1.3641	1.329	1.3278	1.2968	2B	1.307	1.321	1.3344	1.3410	1.3750	0.066	
		3A	0.0000	1.3750	1.3656	1.3344	1.3306	1.2983	3B	1.3070	1.3158	1.3344	1.3394	1.3750	0.050	
1-3/8-18	NEF	2A	0.0015	1.3735	1.3648	1.3374	1.3325	1.3053	2B	1.315	1.328	1.3389	1.3452	1.3750	0.063	
		3A	0.0000	1.3750	1.3663	1.3389	1.3353	1.3068	3B	1.3150	1.3230	1.3389	1.3436	1.3750	0.047	
		2A	0.0018	1.4357	1.4243	1.3816	1.3757	1.3335	2B	1.347	1.365	1.3834	1.3910	1.4375	0.076	
1-7/16-12	UN	3A	0.0000	1.4375	1.4261	1.3834	1.3790	1.3353	3B	1.3470	1.3573	1.3834	1.3891	1.4375	0.057	
		2A	0.0016	1.4359	1.4265	1.3953	1.3901	1.3592	2B	1.370	1.384	1.3969	1.4037	1.4375	0.068	
		3A	0.0000	1.4375	1.4281	1.3969	1.3930	1.3608	3B	1.3700	1.3783	1.3969	1.4020	1.4375	0.051	

TABLE 7-10. Standard Series Limits of Self-Unified and American Screw Threads (cont.).

Nominal size and threads per inch	Series designation	Class	Allowance	External								Internal										
				Major diameter limits				Pitch diameter limits				Minor diameter	Class	Minor diameter limits				Pitch diameter limits				Major diameter
				Max	Min	Min	Max	Min	Max	Min	Max			Min	Max	Min	Max	Min	Max	Min	Max	
1-7/16-18	NEF	2A	.0015	1.4360	1.4273	in.	1.3999	1.3949	.0050	1.3678	2B	1.377	1.390	1.4014	1.4079	in.	1.4375	.0065				
1-1/2-6	3A	.0000	1.4375	1.4288	.....	1.4014	1.3977	0037	1.3693	3B	1.3770	1.3855	1.4014	1.4062	0048	1.4375						
	1A	.0024	1.4976	1.4703	.....	1.3893	1.3772	0121	1.2931	1B	1.320	1.350	1.3917	1.4075	0158	1.5000						
	2A	.0024	1.4976	1.4794	1.4703	1.3893	1.3812	0081	1.2931	2B	1.320	1.350	1.3917	1.4022	0105	1.5000						
1-1/2-8	3A	.0000	1.5000	1.4818	.....	1.3917	1.3856	0061	1.2955	3B	1.3200	1.3396	1.3917	1.3996	0079	1.5000						
	2A	.0022	1.4978	1.4828	1.4753	1.4166	1.4093	0073	1.3444	2B	1.365	1.390	1.4188	1.4283	0095	1.5000						
	3A	.0000	1.5000	1.4850	.....	1.4188	1.4133	0055	1.3466	3B	1.3650	1.3797	1.4188	1.4259	0071	1.5000						
1-1/2-12	1A	.0019	1.4981	1.4809	.....	1.4440	1.4344	0096	1.3959	1B	1.410	1.428	1.4459	1.4584	0125	1.5000						
	2A	.0019	1.4981	1.4867	.....	1.4440	1.4376	0064	1.3959	2B	1.410	1.428	1.4459	1.4542	0083	1.5000						
	3A	.0000	1.5000	1.4886	.....	1.4459	1.4411	0048	1.3978	3B	1.4100	1.4198	1.4459	1.4522	0063	1.5000						
1-1/2-16	2A	.0016	1.4984	1.4890	.....	1.4578	1.4526	0052	1.4217	2B	1.432	1.446	1.4594	1.4662	0068	1.5000						
	3A	.0000	1.5000	1.4906	.....	1.4594	1.4555	0039	1.4233	3B	1.4320	1.4408	1.4594	1.4645	0051	1.5000						
	2A	.0015	1.4985	1.4898	.....	1.4624	1.4574	0050	1.4303	2B	1.440	1.452	1.4639	1.4704	0065	1.5000						
1-9/16-16	3A	.0000	1.5000	1.4913	.....	1.4639	1.4602	0037	1.4318	3B	1.4400	1.4480	1.4639	1.4687	0048	1.5000						
	2A	.0016	1.5609	1.5515	.....	1.5203	1.5151	0052	1.4842	2B	1.495	1.509	1.5219	1.5287	0068	1.5625						
	3A	.0000	1.5625	1.5531	.....	1.5219	1.5180	0039	1.4858	3B	1.4950	1.5033	1.5219	1.5270	0051	1.5625						
1-9/16-18	NEF	2A	.0015	1.5610	1.5523	.....	1.5249	1.5199	0050	1.4928	2B	1.502	1.515	1.5264	1.5329	0065	1.5625					
	3A	.0000	1.5625	1.5538	.....	1.5264	1.5227	0037	1.4943	3B	1.5020	1.5105	1.5264	1.5312	0048	1.5625						
	2A	.0022	1.6228	1.6078	1.6003	1.5416	1.5342	0074	1.4694	2B	1.490	1.515	1.5438	1.5535	0097	1.6250						
1-5/8-8	3A	.0000	1.6250	1.6100	.....	1.5438	1.5382	0056	1.4716	3B	1.4900	1.5047	1.5438	1.5510	0072	1.6250						
	2A	.0018	1.6232	1.6118	.....	1.5691	1.5632	0059	1.5210	2B	1.535	1.553	1.5709	1.5785	0076	1.6250						
	3A	.0000	1.6250	1.6136	.....	1.5709	1.5665	0044	1.5228	3B	1.5350	1.5448	1.5709	1.5766	0057	1.6250						
1-5/8-16	UN	2A	.0016	1.6234	1.6140	.....	1.5828	1.5776	0052	1.5167	2B	1.557	1.571	1.5844	1.5912	0068	1.6250					
	3A	.0000	1.6250	1.6156	.....	1.5844	1.5805	0039	1.5483	3B	1.5570	1.5658	1.5844	1.5895	0051	1.6250						
	NEF	2A	.0015	1.6235	1.6148	.....	1.5874	1.5824	0050	1.5553	2B	1.565	1.578	1.5889	1.5954	0065	1.6250					
1-11/16-16	3A	.0000	1.6250	1.6163	.....	1.5889	1.5852	0037	1.5568	3B	1.5650	1.5730	1.5889	1.5937	0048	1.6250						
	2A	.0016	1.6859	1.6765	.....	1.6453	1.6400	0053	1.6092	2B	1.620	1.634	1.6469	1.6538	0069	1.6875						
	3A	.0000	1.6875	1.6781	.....	1.6469	1.6429	0040	1.6108	3B	1.6200	1.6283	1.6469	1.6521	0052	1.6875						
1-11/16-18	NEF	2A	.0015	1.6860	1.6773	.....	1.6499	1.6448	0051	1.6178	2B	1.627	1.640	1.6514	1.6580	0066	1.6875					
	3A	.0000	1.6875	1.6788	.....	1.6514	1.6476	0038	1.6193	3B	1.6270	1.6355	1.6514	1.6563	0049	1.6875						
	1A	.0027	1.7473	1.7165	.....	1.6174	1.6040	0134	1.5019	1B	1.534	1.568	1.6201	1.6375	0174	1.7500						
1-3/4-5	2A	.0027	1.7473	1.7268	1.7165	1.6174	1.6089	0089	1.5019	2B	1.534	1.568	1.6201	1.6375	0116	1.7500						
	3A	.0000	1.7500	1.7295	.....	1.6201	1.6134	0067	1.5046	3B	1.5340	1.5575	1.6201	1.6288	0087	1.7500						
	2A	.0023	1.7477	1.7327	1.7252	1.6655	1.6590	0075	1.5943	2B	1.615	1.640	1.6688	1.6786	0098	1.7500						
1-3/4-8	3A	.0000	1.7500	1.7350	.....	1.6688	1.6632	0056	1.5966	3B	1.6150	1.6297	1.6688	1.6762	0074	1.7500						
	2A	.0018	1.7482	1.7368	.....	1.6941	1.6881	0060	1.6460	2B	1.660	1.678	1.6959	1.7037	0078	1.7500						
	3A	.0000	1.7500	1.7386	.....	1.6959	1.6914	0045	1.6478	3B	1.6600	1.6698	1.6959	1.7017	0058	1.7500						

TABLE 7-10. Standard Series Limits of Self-Unified and American Screw Threads (cont.)

Nominal size and threads per inch	Series designation	External										Internal									
		Class	Allowance	Major diameter limits			Pitch diameter limits			Minor diameter	Class	Minor diameter limits			Pitch diameter limits			Major diameter			
				Max	Min	Min	Max	Min	Max			Min	Max	Min	Max	Min	Max		Tolerance		
1-3/4-16	UNEF	2A	.0016	1.7484	1.7390	1.7078	1.7025	0.0053	1.6717	2B	1.682	1.696	1.7094	1.7163	0.0069	1.7500					
		3A	.0000	1.7500	1.7406	1.7094	1.7054	.0040	1.6733	3B	1.6820	1.6908	1.7094	1.7146	.0052	1.7500					
		2A	.0016	1.8109	1.8015	1.7703	1.7650	.0053	1.7342	2B	1.745	1.759	1.7719	1.7788	.0069	1.8125					
1-13/16-16	N	3A	.0000	1.8125	1.8031	1.7719	1.7679	.0040	1.7358	2B	1.7450	1.7533	1.7719	1.7771	.0052	1.8125					
		2A	.0023	1.8727	1.8577	1.7915	1.7838	.0077	1.7193	2B	1.740	1.765	1.7938	1.8038	.0100	1.8750					
		3A	.0000	1.8750	1.8600	1.7938	1.7881	.0057	1.7216	3B	1.7400	1.7547	1.7938	1.8013	.0075	1.8750					
1-7/8-12	UN	2A	.0018	1.8732	1.8618	1.8191	1.8131	.0060	1.7710	2B	1.785	1.803	1.8209	1.8287	.0078	1.8750					
		3A	.0000	1.8750	1.8636	1.8209	1.8164	.0045	1.7728	3B	1.7850	1.7948	1.8209	1.8287	.0058	1.8750					
		2A	.0016	1.8734	1.8640	1.8328	1.8275	.0053	1.7967	2B	1.807	1.821	1.8344	1.8413	.0069	1.8750					
1-7/8-16	UN	3A	.0000	1.8750	1.8656	1.8344	1.8304	.0040	1.7983	3B	1.8070	1.8158	1.8344	1.8396	.0052	1.8750					
		2A	.0016	1.9359	1.9265	1.8953	1.8899	.0054	1.8592	2B	1.870	1.884	1.8969	1.9039	.0070	1.9375					
		3A	.0000	1.9375	1.9281	1.8969	1.8929	.0040	1.8608	3B	1.8700	1.8783	1.8969	1.9021	.0052	1.9375					
2-4 1/2	UNC	1A	.0029	1.9971	1.9641	1.8528	1.8385	.0143	1.7245	1B	1.759	1.795	1.8557	1.8743	.0186	2.0000					
		2A	.0029	1.9971	1.9751	1.9641	1.9433	.0095	1.7245	2B	1.759	1.795	1.8557	1.8681	.0124	2.0000					
		3A	.0000	2.0000	1.9780	1.8557	1.8486	.0071	1.7274	3B	1.7590	1.7861	1.8557	1.8650	.0093	2.0000					
2-8	N	2A	.0023	1.9977	1.9827	1.9165	1.9087	.0078	1.8443	2B	1.865	1.890	1.9188	1.9289	.0101	2.0000					
		3A	.0000	2.0000	1.9850	1.9188	1.9130	.0058	1.8466	3B	1.8650	1.8797	1.9188	1.9264	.0076	2.0000					
		2A	.0018	1.9982	1.9868	1.9441	1.9380	.0061	1.8960	2B	1.910	1.928	1.9459	1.9538	.0079	2.0000					
2-12	UN	3A	.0000	2.0000	1.9886	1.9459	1.9414	.0045	1.8978	3B	1.9100	1.9198	1.9459	1.9518	.0059	2.0000					
		2A	.0016	1.9984	1.9890	1.9578	1.9524	.0054	1.9217	2B	1.932	1.946	1.9594	1.9664	.0070	2.0000					
		3A	.0000	2.0000	1.9906	1.9594	1.9554	.0040	1.9233	3B	1.9320	1.9408	1.9594	1.9646	.0052	2.0000					
2-1/16-16	N	2A	.0016	2.0609	2.0515	2.0203	2.0149	.0054	1.9842	2B	1.995	2.009	2.0219	2.0289	.0070	2.0625					
		3A	.0000	2.0625	2.0531	2.0219	2.0179	.0040	1.9858	3B	1.9950	2.0033	2.0219	2.0271	.0052	2.0625					
		2A	.0024	2.1226	2.1076	2.0414	2.0335	.0079	1.9692	2B	1.990	2.015	2.0438	2.0540	.0102	2.1250					
2-1/8-8	N	3A	.0000	2.1250	2.1100	2.0438	2.0379	.0059	1.9716	3B	1.9900	2.0047	2.0438	2.0515	.0077	2.1250					
		2A	.0018	2.1232	2.1118	2.0691	2.0630	.0061	2.0210	2B	2.035	2.053	2.0709	2.0788	.0079	2.1250					
		3A	.0000	2.1250	2.1136	2.0709	2.0664	.0045	2.0228	3B	2.0350	2.0448	2.0709	2.0768	.0059	2.1250					
2-1/8-12	UN	2A	.0016	2.1234	2.1140	2.0828	2.0774	.0054	2.0467	2B	2.057	2.071	2.0844	2.0914	.0070	2.1250					
		3A	.0000	2.1250	2.1156	2.0844	2.0803	.0041	2.0483	3B	2.0570	2.0658	2.0844	2.0896	.0052	2.1250					
		2A	.0016	2.1859	2.1765	2.1453	2.1399	.0054	2.1092	2B	2.120	2.134	2.1469	2.1539	.0070	2.1875					
2-3/16-16	N	3A	.0000	2.1875	2.1781	2.1469	2.1428	.0041	2.1108	3B	2.1200	2.1283	2.1469	2.1521	.0052	2.1875					
		2A	.0016	2.2471	2.2377	2.2078	2.2024	.0054	2.1747	2B	2.182	2.196	2.2094	2.2164	.0070	2.2500					
		3A	.0000	2.2500	2.2406	2.2094	2.2053	.0041	2.1733	3B	2.1820	2.1908	2.2094	2.2146	.0052	2.2500					
2-1/4-4 1/2	UNC	1A	.0029	2.2471	2.2141	2.1078	2.0882	.0146	1.9745	1B	2.009	2.045	2.1057	2.1247	.0190	2.2500					
		2A	.0029	2.2471	2.2251	2.1078	2.0931	.0097	1.9745	2B	2.009	2.045	2.1057	2.1183	.0126	2.2500					
		3A	.0000	2.2500	2.2280	2.1057	2.0984	.0073	1.9774	3B	2.0090	2.0361	2.1057	2.1152	.0095	2.2500					
2-1/4-8	N	2A	.0024	2.2476	2.2326	2.1664	2.1584	.0080	2.0942	2B	2.115	2.140	2.1688	2.1792	.0104	2.2500					
		3A	.0000	2.2500	2.2350	2.1688	2.1628	.0060	2.0966	3B	2.1150	2.1297	2.1688	2.1766	.0078	2.2500					
		2A	.0018	2.2482	2.2368	2.1941	2.1880	.0061	2.1460	2B	2.160	2.178	2.1959	2.2038	.0079	2.2500					
2-1/4-12	UN	2A	.0016	2.2484	2.2386	2.1959	2.1914	.0045	2.1478	3B	2.1600	2.1698	2.1959	2.2018	.0059	2.2500					
		3A	.0000	2.2500	2.2386	2.1959	2.1914	.0045	2.1478	3B	2.1600	2.1698	2.1959	2.2018	.0059	2.2500					
		2A	.0016	2.2484	2.2390	2.2078	2.2024	.0054	2.1717	2B	2.182	2.196	2.2094	2.2164	.0070	2.2500					
2-1/4-16	UN	3A	.0000	2.2484	2.2406	2.2094	2.2053	.0041	2.1733	3B	2.1820	2.1908	2.2094	2.2146	.0052	2.2500					
		2A	.0016	2.3108	2.3014	2.2702	2.2647	.0055	2.2341	2B	2.245	2.259	2.2719	2.2791	.0072	2.3125					
		3A	.0000	2.3125	2.3031	2.2719	2.2678	.0041	2.2358	3B	2.2450	2.2533	2.2719	2.2773	.0054	2.3125					

TABLE 7-10. Standard Series Limits of Self-Unified and American Screw Threads (cont.)

Nominal size and threads per inch	Series designation	External										Internal													
		Class	Allowance	Major diameter limits				Pitch diameter limits				Minor diameter	Class	Minor diameter limits				Pitch diameter limits				Major diameter			
				Max	Min	Min	Max	Min	Max	Min	Max			Min	Max	Min	Max	Min	Max	Min	Max				
2-3/8-12	UN	2A	.0019	in.	2.3617	in.	2.3190	in.	2.3128	in.	2.2709	in.	2B		in.	2.285	in.	2.303	in.	2.3209	in.	2.3290	in.	in.	2.3750
		3A	.0000		2.3636		2.3209		2.3163		2.2728		3B			2.2850		2.2948		2.2309		2.3269		2.3750	
		2A	.0017		2.3639		2.3327		2.3272		2.2966		2B			2.307		2.321		2.3344		2.3416		2.3750	
2-3/8-16	UN	3A	.0000		2.3656		2.3344		2.3303		2.2983		3B			2.3070		2.3158		2.3344		2.3398		2.3750	
		2A	.0017		2.4358		2.3952		2.3897		2.3591		2B			2.370		2.384		2.3969		2.4041		2.4375	
		3A	.0000		2.4375		2.3969		2.3928		2.3608		3B			2.3700		2.3783		2.3969		2.4023		2.4375	
2-1/2-4	UNC	1A	.0031		2.4612		2.3345		2.3190		2.1902		1B			2.229		2.267		2.3376		2.3578		2.5000	
		2A	.0031		2.4731		2.3345		2.3298		2.1902		2B			2.2290		2.2594		2.3376		2.3511		2.5000	
		3A	.0024		2.4826		2.4164		2.4082		2.3442		3B			2.365		2.390		2.4188		2.4294		2.5000	
2-1/2-8	N	3A	.0000		2.4850		2.4188		2.4127		2.3466		3B			2.3650		2.3797		2.4188		2.4268		2.5000	
		2A	.0019		2.4867		2.4440		2.4378		2.3959		2B			2.410		2.428		2.4459		2.4540		2.5000	
		3A	.0000		2.4886		2.4459		2.4413		2.3978		3B			2.4100		2.4198		2.4459		2.4519		2.5000	
2-1/2-16	UN	2A	.0017		2.4983		2.4577		2.4522		2.4216		2B			2.432		2.446		2.4594		2.4666		2.5000	
		3A	.0000		2.5000		2.4594		2.4553		2.4233		3B			2.4320		2.4408		2.4594		2.4648		2.5000	
		2A	.0019		2.6231		2.5690		2.5628		2.5209		2B			2.553		2.5709		2.5709		2.5790		2.6250	
2-5/8-12	UN	3A	.0000		2.6136		2.5709		2.5663		2.5228		3B			2.5350		2.5448		2.5709		2.5769		2.6250	
		2A	.0017		2.6233		2.5827		2.5772		2.5466		2B			2.557		2.571		2.5844		2.5916		2.6250	
		3A	.0000		2.6156		2.5844		2.5803		2.5483		3B			2.570		2.5844		2.5844		2.5916		2.6250	
2-3/4-4	UNC	1A	.0032		2.7111		2.5844		2.5686		2.4401		1B			2.479		2.517		2.5876		2.6082		2.7500	
		2A	.0032		2.7230		2.5844		2.5739		2.4401		2B			2.479		2.517		2.5876		2.6013		2.7500	
		3A	.0000		2.7262		2.5876		2.5797		2.4433		3B			2.4790		2.5094		2.5876		2.5979		2.7500	
2-3/4-8	N	2A	.0025		2.7325		2.6663		2.6580		2.5941		2B			2.615		2.540		2.6688		2.6796		2.7500	
		3A	.0000		2.7350		2.6688		2.6626		2.5966		3B			2.6150		2.6297		2.6688		2.6769		2.7500	
		2A	.0019		2.7367		2.6940		2.6878		2.6459		2B			2.660		2.678		2.6959		2.7040		2.7500	
2-3/4-12	UN	3A	.0000		2.7386		2.6959		2.6913		2.6478		3B			2.6600		2.6698		2.6959		2.7019		2.7500	
		2A	.0017		2.7483		2.7077		2.7022		2.682		2B			2.682		2.696		2.7094		2.7166		2.7500	
		3A	.0000		2.7406		2.7094		2.7053		2.6733		3B			2.6820		2.6908		2.7094		2.7148		2.7500	
2-7/8-12	UN	2A	.0019		2.8617		2.8190		2.8127		2.7709		2B			2.785		2.803		2.8209		2.8291		2.8750	
		3A	.0000		2.8636		2.8209		2.8162		2.7728		3B			2.7850		2.7948		2.8209		2.8271		2.8750	
		2A	.0017		2.8639		2.8327		2.8271		2.7966		2B			2.807		2.821		2.8344		2.8417		2.8750	
2-7/8-16	UN	3A	.0000		2.8656		2.8344		2.8307		2.7983		3B			2.8070		2.8158		2.8344		2.8399		2.8750	
		2A	.0032		2.9968		2.8344		2.8183		2.6901		1B			2.729		2.767		2.8376		2.8585		3.0000	
		3A	.0000		2.9968		2.8344		2.8237		2.6901		2B			2.729		2.767		2.8376		2.8515		3.0000	
3-8	N	3A	.0000		2.9762		2.8376		2.8296		2.6933		3B			2.7290		2.7594		2.8376		2.8480		3.0000	
		2A	.0026		2.9974		2.9162		2.9077		2.8440		2B			2.865		2.890		2.9188		2.9299		3.0000	
		3A	.0000		2.9850		2.9188		2.9124		2.8466		3B			2.8650		2.8797		2.9188		2.9271		3.0000	
3-12	UN	2A	.0019		2.9981		2.9440		2.9377		2.8959		2B			2.910		2.928		2.9459		2.9541		3.0000	
		3A	.0000		3.0000		2.9459		2.9412		2.8978		3B			2.9100		2.9198		2.9459		2.9521		3.0000	
		2A	.0017		2.9983		2.9577		2.9521		2.9216		2B			2.932		2.946		2.9594		2.9667		3.0000	
3-16	UN	3A	.0000		2.9906		2.9594		2.9552		2.9233		3B			2.9320		2.9408		2.9594		2.9649		3.0000	



TABLE 7-10. Standard Series Limits of Unified and American Screw Threads (cont.)

Nominal size and threads per inch	Series designation	External						Internal									
		Class	Allowance	Major diameter limits			Pitch diameter limits			Minor diameter	Class	Pitch diameter limits			Major diameter		
				Max	Min	Min	Max	Min	Max			Min	Max	Min		Max	Min
3-1/8-12	UN	2A	0.0019	3.1117	3.0627	0.0063	3.0209	3.0709	3.0209	2B	3.035	3.053	3.0709	3.0709	3.0709	0.0082	3.1250
		3A	0.0000	3.1136	3.0662	0.047	3.0228	3.0728	3.0228	3B	3.0350	3.0448	3.0709	3.0709	3.0709	0.062	3.1250
		2A	0.017	3.1139	3.0771	0.056	3.0466	3.0466	3.0466	2B	3.057	3.071	3.0844	3.0844	3.0844	0.073	3.1250
3-1/4-4	UNC	3A	0.0000	3.1156	3.0802	0.042	3.0483	3.0483	3.0483	3B	3.0570	3.0658	3.0844	3.0844	3.0844	0.055	3.1250
		1A	0.0333	3.2110	3.0680	0.163	2.9400	2.9400	2.9400	1B	2.979	3.017	3.0876	3.0876	3.1088	0.212	3.2500
		2A	0.0333	3.2229	3.0734	0.109	2.9400	2.9400	2.9400	2B	2.979	3.017	3.0876	3.1017	3.1017	0.141	3.2500
3-1/4-8	N	3A	0.0000	3.2262	3.0794	0.082	2.9433	2.9433	2.9433	3B	2.9790	3.0094	3.0876	3.0876	3.0982	0.106	3.2500
		2A	0.026	3.2474	3.1662	0.087	2.9433	2.9433	2.9433	2B	2.9790	3.0094	3.0876	3.1158	3.1158	0.113	3.2500
		3A	0.0000	3.2324	3.1575	0.087	3.0940	3.0940	3.0940	3B	3.115	3.140	3.1688	3.1688	3.1772	0.084	3.2500
3-1/4-12	UN	2A	0.0000	3.2350	3.1688	0.065	3.0966	3.0966	3.0966	3B	3.1150	3.1297	3.1688	3.1688	3.1772	0.082	3.2500
		3A	0.0000	3.2367	3.1877	0.063	3.1459	3.1459	3.1459	2B	3.160	3.178	3.1959	3.1959	3.2041	0.082	3.2500
		2A	0.019	3.2386	3.1912	0.047	3.1478	3.1478	3.1478	3B	3.1600	3.1698	3.1959	3.1959	3.2021	0.062	3.2500
3-1/4-16	UN	2A	0.017	3.2389	3.2077	0.056	3.1716	3.1716	3.1716	2B	3.182	3.196	3.2094	3.2094	3.2167	0.073	3.2500
		3A	0.0000	3.2406	3.2052	0.042	3.1733	3.1733	3.1733	3B	3.1820	3.1908	3.2094	3.2094	3.2149	0.055	3.2500
		2A	0.019	3.3617	3.3126	0.064	3.2709	3.2709	3.2709	2B	3.285	3.303	3.3209	3.3209	3.3293	0.084	3.3750
3-3/8-12	UN	3A	0.0000	3.3636	3.3209	0.048	3.2728	3.2728	3.2728	3B	3.2850	3.2948	3.3209	3.3209	3.3272	0.063	3.3750
		2A	0.017	3.3733	3.3327	0.058	3.2966	3.2966	3.2966	2B	3.307	3.321	3.344	3.344	3.3419	0.075	3.3750
		3A	0.0000	3.3656	3.3301	0.043	3.2983	3.2983	3.2983	3B	3.3070	3.3158	3.3344	3.3344	3.3400	0.056	3.3750
3-1/2-4	UNC	1A	0.0333	3.4610	3.3177	0.166	3.1900	3.1900	3.1900	1B	3.229	3.267	3.3376	3.3376	3.3519	0.215	3.5000
		2A	0.0333	3.4729	3.3343	0.110	3.1900	3.1900	3.1900	2B	3.229	3.267	3.3376	3.3376	3.3519	0.143	3.5000
		3A	0.0000	3.4762	3.3376	0.083	3.1933	3.1933	3.1933	3B	3.2290	3.2594	3.3376	3.3376	3.3484	0.108	3.5000
3-1/2-8	N	2A	0.026	3.4824	3.4162	0.088	3.3440	3.3440	3.3440	2B	3.365	3.390	3.4188	3.4188	3.4303	0.115	3.5000
		3A	0.0000	3.4850	3.4122	0.066	3.3466	3.3466	3.3466	3B	3.3650	3.3797	3.4188	3.4188	3.4274	0.086	3.5000
		2A	0.019	3.4867	3.4376	0.064	3.3959	3.3959	3.3959	2B	3.410	3.428	3.459	3.459	3.4543	0.084	3.5000
3-1/2-12	UN	3A	0.0000	3.4886	3.4411	0.048	3.3978	3.3978	3.3978	3B	3.4100	3.4198	3.4459	3.4459	3.4522	0.063	3.5000
		2A	0.017	3.4889	3.4577	0.058	3.4216	3.4216	3.4216	2B	3.432	3.446	3.4594	3.4594	3.4669	0.075	3.5000
		3A	0.0000	3.4906	3.4594	0.043	3.4233	3.4233	3.4233	3B	3.4320	3.4408	3.4594	3.4594	3.4650	0.056	3.5000
3-5/8-12	UN	2A	0.019	3.6117	3.5626	0.064	3.5209	3.5209	3.5209	2B	3.535	3.553	3.5709	3.5709	3.5793	0.084	3.6250
		3A	0.0000	3.6136	3.5661	0.048	3.5228	3.5228	3.5228	3B	3.5350	3.5448	3.5709	3.5709	3.5772	0.063	3.6250
		2A	0.017	3.6139	3.5769	0.058	3.5466	3.5466	3.5466	2B	3.557	3.571	3.5844	3.5844	3.5919	0.075	3.6250
3-3/4-4	UNC	3A	0.0000	3.6156	3.5801	0.043	3.5483	3.5483	3.5483	3B	3.5570	3.5658	3.5844	3.5844	3.5900	0.056	3.6250
		1A	0.034	3.7109	3.5842	0.168	3.4399	3.4399	3.4399	1B	3.479	3.517	3.5876	3.5876	3.6094	0.218	3.7500
		2A	0.034	3.7228	3.5842	0.112	3.4399	3.4399	3.4399	2B	3.479	3.517	3.5876	3.6021	3.6021	0.145	3.7500
3-3/4-8	N	3A	0.0000	3.7262	3.5876	0.084	3.4433	3.4433	3.4433	3B	3.4790	3.5094	3.5876	3.5876	3.5985	0.109	3.7500
		2A	0.027	3.7473	3.6661	0.090	3.5939	3.5939	3.5939	2B	3.615	3.640	3.6688	3.6688	3.6805	0.117	3.7500
		3A	0.0000	3.7350	3.6688	0.067	3.5966	3.5966	3.5966	3B	3.6150	3.6297	3.6688	3.6688	3.6776	0.088	3.7500
3-3/4-12	UN	2A	0.019	3.7367	3.6940	0.064	3.6459	3.6459	3.6459	2B	3.660	3.678	3.6959	3.6959	3.7043	0.084	3.7500
		3A	0.0000	3.7386	3.6911	0.048	3.6478	3.6478	3.6478	3B	3.6600	3.6698	3.6959	3.6959	3.7022	0.063	3.7500
		2A	0.017	3.7483	3.7019	0.058	3.6716	3.6716	3.6716	2B	3.682	3.696	3.7094	3.7094	3.7169	0.075	3.7500
3-7/8-12	UN	3A	0.0000	3.7406	3.7094	0.043	3.6733	3.6733	3.6733	3B	3.6820	3.6908	3.7094	3.7094	3.7150	0.056	3.7500
		2A	0.020	3.8130	3.8124	0.065	3.7708	3.7708	3.7708	2B	3.785	3.803	3.8209	3.8209	3.8294	0.085	3.8750
		3A	0.0000	3.8616	3.8160	0.049	3.7728	3.7728	3.7728	3B	3.7850	3.7948	3.8209	3.8209	3.8273	0.064	3.8750
3-7/8-16	UN	2A	0.018	3.8636	3.8209	0.049	3.7965	3.7965	3.7965	2B	3.807	3.821	3.8344	3.8344	3.8420	0.076	3.8750
		3A	0.0000	3.8732	3.8267	0.059	3.7965	3.7965	3.7965	3B	3.8070	3.8158	3.8344	3.8344	3.8401	0.057	3.8750
		1A	0.034	3.9966	3.8342	0.170	3.6899	3.6899	3.6899	1B	3.729	3.767	3.8376	3.8376	3.8597	0.221	4.0000
4-4	UNC	2A	0.034	3.9728	3.8342	0.113	3.6899	3.6899	3.6899	2B	3.729	3.767	3.8376	3.8376	3.8523	0.147	4.0000
		3A	0.0000	3.9762	3.8376	0.085	3.6933	3.6933	3.6933	3B	3.7290	3.7594	3.8376	3.8376	3.8487	0.111	4.0000
		2A	0.019	3.9762	3.8376	0.067	3.6933	3.6933	3.6933	3B	3.7290	3.7594	3.8376	3.8376	3.8487	0.111	4.0000

TABLE 7-10. Standard Series Limits of Self-Unified and American Screw Threads (cont).

Nominal thread size per inch	Series designation	External					Internal										
		Class	Allowance	Major diameter limits			Pitch diameter limits			Minor diameter	Class	Pitch diameter limits			Major diameter		
				Max	Min	Tolerance	Max	Min	Tolerance			Max	Min	Tolerance			
4-8	N	2A	.0027	3.9973	3.9823	3.9748	3.9161	3.9070	.0091	3.8439	2B	3.890	3.9188	3.9307	3.9307	.0119	4.0000
	3A	.0000	4.0000	3.9850	.....	3.9188	3.9120	.0068	3.8466	3B	3.8650	3.9188	3.9277	3.9277	.0089	4.0000	
	UN	.0020	3.9980	3.9866	.....	3.9439	3.9374	.0065	3.8958	2B	3.910	3.9459	3.9544	3.9544	.0085	4.0000	
4-12	N	2A	.0000	4.0000	3.9886	.....	3.9459	3.9410	.0049	3.8978	2B	3.9198	3.9459	3.9523	3.9523	.0064	4.0000
	3A	.0018	3.9982	3.9888	.....	3.9576	3.9517	.0059	3.9215	3B	3.932	3.9594	3.9670	3.9670	.0076	4.0000	
	UN	.0000	4.0000	3.9906	.....	3.9594	3.9550	.0044	3.9233	2B	3.9320	3.9408	3.951	3.951	.0057	4.0000	
4-1/4-8	N	2A	.0028	4.2472	4.2322	4.2247	4.1660	4.1567	.0093	4.0938	2B	4.115	4.1688	4.1809	4.1809	.0121	4.2500
	3A	.0000	4.2500	4.2350	.....	4.1688	4.1618	.0070	4.0966	3B	4.1150	4.1297	4.1778	4.1778	.0090	4.2500	
	UN	.0020	4.2480	4.2366	.....	4.1939	4.1874	.0065	4.1458	2B	4.160	4.178	4.1959	4.2044	.0085	4.2500	
4-1/4-12	N	2A	.0000	4.2500	4.2386	.....	4.1959	4.1910	.0049	4.1478	3B	4.1600	4.1698	4.2023	4.2023	.0064	4.2500
	3A	.0018	4.2482	4.2388	.....	4.2076	4.2017	.0059	4.1715	2B	4.182	4.2094	4.2170	4.2170	.0076	4.2500	
	UN	.0000	4.2500	4.2406	.....	4.2094	4.2050	.0044	4.1733	3B	4.1820	4.1908	4.2151	4.2151	.0057	4.2500	
4-1/2-8	N	2A	.0028	4.4972	4.4822	4.4747	4.4160	4.4066	.0094	4.3438	2B	4.365	4.4188	4.4310	4.4310	.0122	4.5000
	3A	.0000	4.5000	4.4850	.....	4.4188	4.4117	.0071	4.3466	3B	4.3650	4.3797	4.4188	4.4280	.0092	4.5000	
	UN	.0020	4.4980	4.4866	.....	4.4439	4.4374	.0065	4.3958	2B	4.410	4.428	4.459	4.4544	.0085	4.5000	
4-1/2-12	N	2A	.0020	4.5000	4.4886	.....	4.4459	4.4410	.0049	4.3978	3B	4.4100	4.4459	4.4523	4.4523	.0064	4.5000
	3A	.0018	4.4982	4.4888	.....	4.4576	4.4517	.0059	4.4215	2B	4.432	4.446	4.4594	4.4670	.0076	4.5000	
	UN	.0000	4.5000	4.4906	.....	4.4594	4.50	.0044	4.4233	3B	4.4320	4.4408	4.4651	4.4651	.0057	4.5000	
4-3/4-8	N	2A	.0029	4.7471	4.7321	4.7246	4.6659	4.6564	.0095	4.5937	2B	4.615	4.640	4.6688	4.6812	.0124	4.7500
	3A	.0000	4.7500	4.7350	.....	4.6688	4.6616	.0072	4.5966	3B	4.6150	4.6297	4.6688	4.6781	.0093	4.7500	
	UN	.0020	4.7480	4.7366	.....	4.6939	4.6872	.0067	4.6458	2B	4.660	4.678	4.6959	4.7046	.0087	4.7500	
4-3/4-12	N	2A	.0018	4.7482	4.7388	.....	4.7076	4.7015	.0061	4.6478	3B	4.6600	4.6698	4.7025	4.7025	.0066	4.7500
	3A	.0000	4.7500	4.7386	.....	4.7076	4.7015	.0061	4.6478	2B	4.682	4.696	4.7094	4.7133	.0079	4.7500	
	UN	.0020	4.7480	4.7366	.....	4.7094	4.7049	.0045	4.6733	3B	4.6820	4.6908	4.7094	4.7153	.0059	4.7500	
5-8	N	2A	.0029	4.9971	4.9821	4.9746	4.9159	4.9062	.0097	4.8137	2B	4.865	4.890	4.9188	4.9314	.0126	5.0000
	3A	.0000	5.0000	4.9850	.....	4.9188	4.9116	.0072	4.8466	3B	4.8650	4.8797	4.9188	4.9282	.0094	5.0000	
	UN	.0020	4.9980	4.9866	.....	4.9459	4.9409	.0050	4.8978	2B	4.910	4.928	4.9459	4.9546	.0087	5.0000	
5-12	N	2A	.0018	4.9982	4.9888	.....	4.9576	4.9515	.0061	4.9215	3B	4.932	4.946	4.9594	4.9673	.0079	5.0000
	3A	.0000	5.0000	4.9906	.....	4.9594	4.9549	.0045	4.9233	2B	4.9320	4.9408	4.9594	4.9653	.0059	5.0000	
	UN	.0020	4.9980	4.9866	.....	4.9576	4.9515	.0061	4.9215	3B	4.9320	4.9408	4.9594	4.9653	.0059	5.0000	
5-1/4-8	N	2A	.0029	5.2471	5.2321	5.2246	5.1659	5.1561	.0098	5.0937	2B	5.115	5.140	5.1688	5.1815	.0127	5.2500
	3A	.0000	5.2500	5.2350	.....	5.1688	5.1615	.0073	5.0966	3B	5.1150	5.1297	5.1688	5.1783	.0095	5.2500	
	UN	.0020	5.2480	5.2366	.....	5.1939	5.1872	.0067	5.1458	2B	5.160	5.178	5.1959	5.2046	.0087	5.2500	
5-1/4-12	N	2A	.0000	5.2500	5.2386	.....	5.1959	5.1909	.0050	5.1478	3B	5.1600	5.1698	5.2025	5.2025	.0066	5.2500
	3A	.0018	5.2482	5.2388	.....	5.2076	5.2017	.0059	5.1715	2B	5.182	5.2094	5.2170	5.2170	.0076	5.2500	
	UN	.0020	5.2480	5.2366	.....	5.2094	5.2050	.0044	5.1733	3B	5.1820	5.1908	5.2151	5.2151	.0057	5.2500	

TABLE 7-10. Standard Series Limits of Self-Unified and American Screw Threads (cont.).

Nominal size and threads per inch	Series designation	Class	External										Internal					
			Allowance	Major diameter limits				Pitch diameter limits				Minor diameter	Class	Minor diameter limits		Pitch diameter limits		Major diameter
				Max	Min	Min	Max	Min	Max	Min	Max			Min	Max	Min	Max	
5-1/4-16	UN	2A	0.0018	5.2482	5.2388	.....	5.2076	5.2015	0.0061	5.1715	2B	5.182	5.196	5.2094	5.2173	5.2079	5.2500	
5-1/2-8	N	3A	.0000	5.2500	5.2406	.....	5.2094	5.2049	0.0045	5.1733	3B	5.1820	5.1908	5.2094	5.2153	0.0059	5.2500	
5-1/2-12	UN	2A	.0000	5.4970	5.4820	5.4745	5.4158	5.4059	0.0099	5.3436	2B	5.365	5.390	5.4188	5.4317	0.129	5.5000	
5-1/2-16	UN	3A	.0000	5.5000	5.4850	.....	5.4188	5.4114	0.0074	5.3466	3B	5.3650	5.3797	5.4188	5.4285	0.097	5.5000	
5-3/4-8	N	2A	.0018	5.4980	5.4866	.....	5.4439	5.4372	0.0067	5.3958	2B	5.410	5.428	5.4459	5.4546	0.087	5.5000	
5-3/4-12	UN	3A	.0000	5.5000	5.4888	.....	5.4409	5.4350	0.0050	5.3978	3B	5.4100	5.4198	5.4459	5.4525	0.066	5.5000	
5-3/4-16	UN	2A	.0000	5.4982	5.4888	.....	5.4576	5.4515	0.0061	5.4215	2B	5.432	5.446	5.4594	5.4673	0.079	5.5000	
5-3/4-8	N	3A	.0000	5.5000	5.4906	.....	5.4594	5.4549	0.0045	5.4233	3B	5.4320	5.4408	5.4594	5.4653	0.059	5.5000	
5-3/4-12	UN	2A	.0030	5.7470	5.7320	5.7245	5.6658	5.6558	0.100	5.5936	2B	5.615	5.640	5.6688	5.6818	0.130	5.7500	
5-3/4-16	UN	3A	.0000	5.7500	5.7350	.....	5.6688	5.6613	0.0075	5.5966	3B	5.6150	5.6297	5.6688	5.6786	0.098	5.7500	
6-8	UN	2A	.0021	5.7479	5.7365	.....	5.6938	5.6869	0.0069	5.6457	2B	5.660	5.678	5.6959	5.7049	0.090	5.7500	
6-12	UN	3A	.0000	5.7500	5.7386	.....	5.6959	5.6907	0.0052	5.6478	3B	5.6600	5.6698	5.6959	5.7026	0.067	5.7500	
6-16	UN	2A	.0019	5.7481	5.7387	.....	5.7075	5.7013	0.0062	5.6714	2B	5.682	5.696	5.7094	5.7175	0.081	5.7500	
6-8	N	3A	.0000	5.7500	5.7406	.....	5.7094	5.7047	0.0047	5.6733	3B	5.6820	5.6908	5.7094	5.7155	0.061	5.7500	
6-12	UN	2A	.0030	5.9970	5.9820	5.9745	5.9158	5.9056	0.102	5.8436	2B	5.865	5.890	5.9188	5.9320	0.132	6.0000	
6-16	UN	3A	.0000	6.0000	5.9850	.....	5.9188	5.9112	0.0076	5.8466	3B	5.8650	5.8797	5.9188	5.9287	0.099	6.0000	
6-8	UN	2A	.0021	5.9979	5.9865	.....	5.9438	5.9369	0.0069	5.8957	2B	5.910	5.928	5.9459	5.9549	0.090	6.0000	
6-12	UN	3A	.0000	6.0000	5.9886	.....	5.9459	5.9407	0.0052	5.8978	3B	5.9100	5.9198	5.9459	5.9526	0.067	6.0000	
6-16	UN	2A	.0019	5.9981	5.9887	.....	5.9575	5.9513	0.0062	5.9214	2B	5.932	5.946	5.9594	5.9675	0.081	6.0000	
6-8	UN	3A	.0000	6.0000	5.9906	.....	5.9594	5.9547	0.0047	5.9233	3B	5.9320	5.9408	5.9594	5.9655	0.061	6.0000	

TABLE 7-11. Three Wire Measurement for Metric Threads.

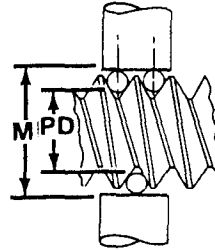
**THREE WIRE THREAD MEASUREMENT**  
(60° Metric Thread)

$M = PD + C$     $PD = M - C$

M = Measurement over wires

PD = Pitch diameter

C = Constant



PITCH		BEST WIRE SIZE		CONSTANT	
MM	INCHES	MM	INCHES	MM	INCHES
0.35	.01378	0.2021	.00796	0.3031	.01193
0.4	.01575	0.2309	.00909	0.3464	.01364
0.45	.01772	0.2598	.01023	0.3897	.01534
0.5	.01969	0.2887	.01137	0.4330	.01705
0.6	.02362	0.3464	.01364	0.5196	.02046
0.7	.02756	0.4041	.01591	0.6062	.02387
0.8	.03150	0.4619	.01818	0.6928	.02728
1.0	.03937	0.5774	.02273	0.8660	.03410
1.25	.04921	0.7217	.02841	1.0815	.04262
1.5	.05906	0.8660	.03410	1.2990	.05114
1.75	.06890	1.0104	.03978	1.5155	.05967
2.0	.07874	1.1547	.04546	1.7321	.06819
2.5	.09843	1.4434	.05683	2.1651	.08524
3.0	.11811	1.7321	.06819	2.5981	.10229
3.5	.13780	2.0207	.07956	3.0311	.11933
4.0	.15748	2.3094	.09092	3.4641	.13638
4.5	.17717	2.5981	.10229	3.8971	.15343
5.0	.19685	2.8868	.11365	4.3301	.17048
5.5	.21654	3.1754	.12502	4.7631	.18753
6.0	.23622	3.4641	.13638	5.1962	.20457

TABLE 8-1. Milling Machine Cutting Speeds for High-Speed Steel Milling Cutters.

MATERIAL	CUTTING SPEED (sfpm) <sup>1, 2</sup>			
	PLAIN MILLING CUTTERS		END MILLING CUTTERS	
	Roughing	Finishing	Roughing	Finishing
Aluminum.....	400 to 1,000	400 to 1,000	400 to 1,000	400 to 1,000
Brass, composition.....	125 to 200	90 to 200	90 to 150	90 to 150
Brass, yellow.....	150 to 200	100 to 250	100 to 200	100 to 200
Bronze, phosphor and manganese.....	30 to 80	25 to 100	30 to 80	30 to 80
Cast iron (hard).....	25 to 40	10 to 30	25 to 40	20 to 45
Cast iron (soft and medium).....	40 to 75	25 to 80	35 to 65	30 to 80
Monel metal.....	50 to 75	50 to 75	40 to 60	40 to 60
Steel, hard.....	25 to 50	25 to 70	25 to 50	25 to 70
Steel, soft.....	60 to 120	45 to 110	50 to 85	45 to 100

<sup>1</sup> For carbon steel cutters, decrease values by 50 percent.

<sup>2</sup> For carbide-tipped cutters, increase values by 100 percent.

TABLE 8-2. Milling Cutter Rotational Speeds.

CUTTING SPEED (sfpm)														
dia. of cutter (in.)	25	30	35	40	50	60	70	80	90	100	120	140	160	200
	CUTTER REVOLUTIONS PER MINUTE													
1/4 .....	382	458	535	611	764	917	1,070	1,222	1,376	1,528	1,834	2,139	2,445	3,056
5/16 .....	306	367	428	489	611	733	856	978	1,100	1,222	1,466	1,711	1,955	2,444
3/8 .....	255	306	357	408	509	611	713	815	916	1,018	1,222	1,425	1,629	2,036
7/16 .....	218	262	306	349	437	524	611	699	786	874	1,049	1,224	1,398	1,748
1/2 .....	191	229	268	306	382	459	535	611	688	764	917	1,070	1,222	1,528
5/8 .....	153	184	214	245	306	367	428	489	552	612	736	857	979	1,224
3/4 .....	127	153	178	203	254	306	357	408	458	508	610	711	813	1,016
7/8 .....	109	131	153	175	219	262	306	349	392	438	526	613	701	876
1 .....	95.5	115	134	153	191	229	267	306	344	382	458	535	611	764
1 1/4 .....	76.3	91.8	107	123	153	183	214	245	274	306	367	428	490	612
1 1/2 .....	63.7	76.3	89.2	102	127	153	178	204	230	254	305	356	406	508
1 3/4 .....	54.5	65.5	76.4	87.3	109	131	153	175	196	218	262	305	349	438
2 .....	47.8	57.3	66.9	76.4	95.5	115	134	153	172	191	229	267	306	382
2 1/2 .....	38.2	45.8	53.5	61.2	76.3	91.7	107	122	138	153	184	213	245	306
3 .....	31.8	38.2	44.6	51	63.7	76.4	89.1	102	114	127	152	178	203	254
3 1/2 .....	27.3	32.7	38.2	43.6	54.5	65.5	76.4	87.4	98.1	109	131	153	174	218
4 .....	23.9	28.7	33.4	38.2	47.8	57.3	66.9	76.4	86	95.8	115	134	153	191
5 .....	19.1	22.9	26.7	30.6	38.2	45.9	53.5	61.1	68.8	76.4	91.7	107	122	153
6 .....	15.9	19.1	22.3	25.5	31.8	38.2	44.6	51.0	57.2	63.6	76.3	89	102	127
7 .....	13.6	16.4	19.1	21.8	27.3	32.7	38.2	43.7	49.1	54.6	65.5	76.4	87.4	109
8 .....	11.9	14.3	16.7	19.1	23.9	28.7	33.4	38.2	43	47.8	57.4	66.9	76.5	95.6

TABLE 8-3. Chip Sizes Per Tooth for Various Milling Cutters.

TYPE OF CUTTER	ALUMINUM		BRONZE		CAST IRON		FREE MACHINING STEEL		ALLOY STEEL	
	HSS	CAR BIDE	HSS	CAR BIDE	HSS	CAR BIDE	HSS	CAR BIDE	HSS	CAR BIDE
	FACE MILLS	.007 to .022	.007 to .020	.005 to .014	.004 to .012	.004 to .016	.006 to .020	.003 to .012	.004 to .016	.002 to .008
HELICAL MILLS	.006 to .018	.006 to .016	.003 to .011	.004 to .010	.004 to .018	.002 to .018	.002 to .010	.003 to .013	.002 to .007	.003 to .012
SIDE CUTTING MILLS	.004 to .013	.004 to .012	.003 to .008	.003 to .007	.002 to .009	.003 to .012	.002 to .007	.003 to .009	.001 to .005	.002 to .008
END MILLS	.003 to .011	.003 to .010	.003 to .007	.002 to .006	.002 to .008	.003 to .010	.001 to .006	.002 to .008	.001 to .004	.002 to .007
FORM RELIEVED CUTTERS	.002 to .007	.002 to .006	.001 to .004	.001 to .004	.002 to .005	.002 to .006	.001 to .004	.002 to .005	.001 to .003	.001 to .004
CIRCULAR SAWS	.002 to .005	.002 to .005	.001 to .003	.001 to .003	.001 to .004	.002 to .006	.001 to .003	.001 to .004	.005 to .002	.001 to .004

TABLE 8-4. Sizes of Woodruff Keys.

KEY NUMBER	KEY DIMENSIONS		SHAFT DIAMETER		HEIGHT OF KEY ABOVE SHAFT	DEPTH OF KEYWAY
	DIAMETER	WIDTH	MINIMUM	MAXIMUM		
204 .....	1/2	1/16	5/16	3/8	0.0312	0.1718
304 .....	1/2	3/32	7/16	1/2	0.0469	0.1561
404 .....	1/2	1/8	9/16	3/4	0.0625	0.1405
405 .....	5/8	1/8	9/16	3/4	0.0625	0.1875
505 .....	5/8	5/32	13/16	15/16	0.0781	0.1719
406 .....	3/4	1/8	11/16	3/4	0.0625	0.2505
606 .....	3/4	3/16	1	1 1/8	0.0937	0.2193
507 .....	7/8	5/32	7/8	15/16	0.0781	0.2969
807 .....	7/8	1/4	15/16	1 1/8	0.1250	0.2500
608 .....	1	3/16	1	1 7/16	0.0937	0.3443
1008 .....	1	5/16	1 1/16	1 5/8	0.1562	0.2818
609 .....	1 1/8	3/16	1 1/16	1 7/16	0.0937	0.3903
810 .....	1 1/4	1/4	1 1/4	1 3/4	0.1250	0.4220
1210 .....	1 1/4	3/8	1 1/2	1 7/8	0.1875	0.3595
1011 .....	1 3/8	5/10	1 13/16	2	0.1562	0.4378

TABLE 8-5. Dimensions of Square-Ends Machine Keys.

SHAFT DIAMETER (in.)	SQUARE SECTION KEYS		FLAT SECTION KEYS		
	Width and thickness (in.)	Bottom of keyway to opposite side of shaft (in.)	Width (in.)	Thickness (in.)	Bottom of keyway to opposite side of shaft (in.)
1/2 .....	1/8	0.430	1/8	3/32	0.455
9/16 .....	1/8	0.493	1/8	3/32	0.509
5/8 .....	3/16	0.517	3/16	1/8	0.548
11/16 .....	3/16	0.581	3/16	1/8	0.612
3/4 .....	3/16	0.644	3/16	1/8	0.676
13/16 .....	3/16	0.708	3/16	1/8	0.739
7/8 .....	3/16	0.771	3/16	1/8	0.802
15/16 .....	1/4	0.796	1/4	3/16	0.827
1 .....	1/4	0.859	1/4	3/16	0.890
1 1/16 .....	1/4	0.923	1/4	3/16	0.954
1 1/8 .....	1/4	0.986	1/4	3/16	1.017
1 3/16 .....	1/4	1.049	1/4	3/16	1.081
1 1/4 .....	1/4	1.112	1/4	3/16	1.144
1 5/16 .....	5/16	1.137	5/16	1/4	1.169
1 3/8 .....	5/16	1.201	5/16	1/4	1.232
1 7/16 .....	3/8	1.225	3/8	1/4	1.288
1 1/2 .....	3/8	1.289	3/8	1/4	1.351
1 9/16 .....	3/8	1.352	3/8	1/4	1.415
1 5/8 .....	3/8	1.416	3/8	1/4	1.478
1 11/16 .....	3/8	1.479	3/8	1/4	1.542
1 3/4 .....	3/8	1.542	3/8	1/4	1.605
1 13/16 .....	1/2	1.527	1/2	3/8	1.590
1 7/8 .....	1/2	1.591	1/2	3/8	1.654
1 15/16 .....	1/2	1.655	1/2	3/8	1.717
2 .....	1/2	1.718	1/2	3/8	1.781

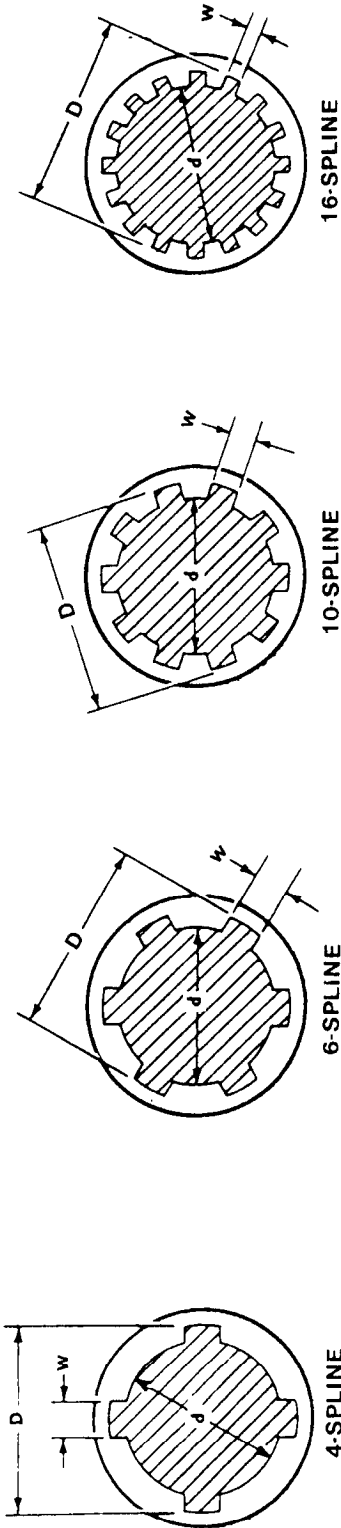
TABLE 8-6. Dimensions of T-Slots.

T-BOLT SIZE (DIAMETER IN in.)	THROAT WIDTH (in.)	THROAT DEPTH (in.)		HEAD SPACE (in.)	
		MAX.	MIN.	WIDTH	DEPTH
1/4 .....	9/32	3/8	1/8	9/16	15/64
5/16 .....	11/32	7/16	5/32	21/32	17/64
3/8 .....	7/16	9/16	7/32	25/32	31/64
1/2 .....	9/16	11/16	5/16	31/32	35/64
3/8 .....	11/16	7/8	7/16	1 1/4	31/64
3/4 .....	1/16	1 1/16	9/16	1 15/32	1 3/32

TABLE 8-7. Series of Involute Milling Cutters for each Pitch.

<b>NUMBER OF CUTTER</b>	<b>WILL CUT GEAR FROM:</b>	<b>NUMBER OF CUTTER</b>	<b>WILL CUT GEAR FROM:</b>
1	135 teeth to a rack	5	21 to 25 teeth
2	55 to 134 teeth	6	17 to 20 teeth
3	35 to 54 teeth	7	14 to 16 teeth
4	26 to 34 teeth	8	12 to 13 teeth
NOTE: THE REGULAR CUTTERS LISTED ABOVE ARE USED ORDINARILY. THE CUTTERS LISTED BELOW (AN INTERMEDIATE SERIES HAVING HALF-NUMBERS) MAY BE USED WHEN GREATER ACCURACY OF TOOTH SPACE IS ESSENTIAL IN CASES WHERE THE NUMBER OF TEETH ARE BETWEEN THE NUMBER FOR WHICH THE REGULAR CUTTERS ARE INTENDED.			
<b>NUMBER OF CUTTER</b>	<b>WILL CUT GEAR FROM:</b>	<b>NUMBER OF CUTTER</b>	<b>WILL CUT GEAR FROM:</b>
1-1/2	80 to 134 teeth	5-1/2	19 to 20 teeth
2-1/2	42 to 54 teeth	6-1/2	15 to 16 teeth
3-1/2	30 to 34 teeth	7-1/2	13 teeth
4-1/2	23 to 25 teeth		

TABLE 8-8. Standard Spline Dimensions.



spline shaft	Width of spline (all fits)*				Permanent fit ** Minor diameter			Sliding fit when not under load** Minor diameter			Sliding fit when under load** Minor diameter				
	4-Spline (0.241 D)	6-Spline (0.250 D)	10-Spline (0.156 D)	16-Spline (0.098 D)	4-Spline (0.850 D)	6-Spline (0.900 D)	10-Spline (0.910 D)	16-Spline (0.860 D)	4-Spline (0.750 D)	6-Spline (0.850 D)	10-Spline (0.860 D)	16-Spline (0.810 D)	6-Spline (0.800 D)	10-Spline (0.810 D)	16-Spline (0.810 D)
3/4 (.750) . . . . .	0.181	0.188	0.117	. . . . .	0.637	0.675	0.683	. . . . .	0.562	0.638	0.645	. . . . .	0.600	0.608	. . . . .
7/8 (.875) . . . . .	0.211	0.219	0.137	. . . . .	0.744	0.788	0.796	. . . . .	0.656	0.744	0.753	. . . . .	0.700	0.709	. . . . .
1 (1.000) . . . . .	0.241	0.250	0.156	. . . . .	0.850	0.900	0.910	. . . . .	0.750	0.850	0.860	. . . . .	0.800	0.810	. . . . .
1 1/8 (1.125) . . . . .	0.271	0.281	0.176	. . . . .	0.956	1.013	1.024	. . . . .	0.844	0.956	0.968	. . . . .	0.900	0.911	. . . . .
1 1/4 (1.250) . . . . .	0.301	0.313	0.195	. . . . .	1.062	1.125	1.138	. . . . .	0.937	1.063	1.075	. . . . .	1.000	1.013	. . . . .
1 3/8 (1.375) . . . . .	0.331	0.344	0.215	. . . . .	1.169	1.238	1.251	. . . . .	1.031	1.169	1.183	. . . . .	1.100	1.114	. . . . .
1 1/2 (1.500) . . . . .	0.361	0.375	0.234	. . . . .	1.275	1.350	1.365	. . . . .	1.125	1.275	1.290	. . . . .	1.200	1.215	. . . . .
1 5/8 (1.625) . . . . .	0.391	0.406	0.254	. . . . .	1.381	1.463	1.479	. . . . .	1.219	1.381	1.398	. . . . .	1.300	1.316	. . . . .
1 3/4 (1.750) . . . . .	0.422	0.438	0.273	. . . . .	1.487	1.575	1.593	. . . . .	1.312	1.488	1.505	. . . . .	1.400	1.418	. . . . .
2 (2.000) . . . . .	0.482	0.500	0.312	0.196	1.700	1.800	1.820	1.820	1.500	1.700	1.720	1.720	1.600	1.620	1.020
2 1/4 (2.250) . . . . .	0.542	0.563	0.351	. . . . .	1.912	2.025	2.043	. . . . .	1.687	1.913	1.935	. . . . .	1.800	1.823	. . . . .
2 1/2 (2.500) . . . . .	0.602	0.625	0.390	0.245	2.125	2.250	2.275	2.275	1.875	2.125	2.150	2.150	2.000	2.025	2.025
3 (3.000) . . . . .	0.723	0.750	0.468	0.294	2.550	2.700	2.730	2.730	2.250	2.550	2.580	2.580	2.400	2.430	2.430
3 1/2 (3.500) . . . . .	. . . . .	. . . . .	0.546	0.343	. . . . .	. . . . .	3.185	3.185	. . . . .	. . . . .	3.010	3.010	. . . . .	2.835	2.835
4 (4.000) . . . . .	. . . . .	. . . . .	0.624	0.392	. . . . .	. . . . .	3.640	3.640	. . . . .	. . . . .	3.440	3.440	. . . . .	3.240	3.240
4 1/2 (4.500) . . . . .	. . . . .	. . . . .	0.702	0.441	. . . . .	. . . . .	4.095	4.095	. . . . .	. . . . .	3.870	3.870	. . . . .	3.645	3.645
5 (5.000) . . . . .	. . . . .	. . . . .	0.780	0.490	. . . . .	. . . . .	4.550	4.550	. . . . .	. . . . .	4.300	4.300	. . . . .	4.050	4.050
5 1/2 (5.500) . . . . .	. . . . .	. . . . .	0.858	0.539	. . . . .	. . . . .	5.005	5.005	. . . . .	. . . . .	4.730	4.730	. . . . .	4.455	4.455
6 (6.000) . . . . .	. . . . .	. . . . .	0.936	0.588	. . . . .	. . . . .	5.460	5.460	. . . . .	. . . . .	5.160	5.160	. . . . .	4.860	4.860

\*Tolerance allowed is - 0.002 inch for shafts 3/4 to 1 1/4 inches in diameter inclusive, and - 0.003 inch for larger sizes.  
 \*\*Tolerance allowed is - 0.001 inch for shafts 3/4 to 1 1/4 inches in diameter inclusive, - 0.002 inch for shafts 2 to 3 inches in diameter inclusive, and - 0.003 inch for larger sizes.



TABLE 9-1. Versa-Mil Cutting Speeds.

1. To determine the cutting speed of the material:
  - a. Locate the column for the operation to be performed.
  - b. Determine the type of cutter being used.
  - c. Follow down the column to the type of material being used.
  - d. Select the desired cutting speed from the chart.  
(lower speeds are for roughing while higher speeds are for finishing)
  
2. After the cutting speed has been selected from the chart, select the pulley ratio from the ratio chart.
  - a. Locate the column the speed selected (determined from cutting speed chart) is located in.
  - b. Follow the column down to the diameter closest to the cutter being used.
  - c. Select the pulley ratio to be used.
  - d. Ratio selected will determine the head to use.

MATERIAL	END MILLING		MILLING SHELL/SIDE/Form			DRILLING	FLY CUTTING	
	HSS	CARBIDE	HSS	CARBIDE	HSS	CARBIDE	HSS	CARBIDE
ALUMINUM	400-1000	600 & UP	400-1000	600 & UP	200-300	300-400	200-300	400-600
BRASS	100-200	150-300	150-200	200-500	200-300	300-450	150-200	300-400
BRONZE	30-80	45-120	25-100	50-200	200-300	300-400	30-100	60-200
CAST IRON	30-80	45-120	25-80	500-160	100-150	150-225	50-80	100-160
COPPER	60-80	90-120	125-175	250-350	60-70	90-105	60-80	120-160
MACHINERY STEEL	60-80	90-120	25-150	50-100	80-100	120-150	60-80	120-160
STEEL (HARD)	25-70	40-105	25-70	50-140	20-30	30-45	35-40	70-80
STEEL (SOFT)	45-100	70-150	45-110	90-220	50-60	75-90	80-100	160-200
STEEL STAINLESS	20-40	30-60	35-105	70-210	30-40	45-60	40-50	80-100
TOOL STEEL	40-60	60-90	70-105	140-210	50-60	75-90	35-40	70-80

TABLE 9-2. Versa-Mil Pulley Combinations.

DIAM. OF CUTTER	20-40 PULLEY RATIO	40-60 PULLEY RATIO	60-100 PULLEY RATIO	100-140 PULLEY RATIO	140-180 PULLEY RATIO	180-230 PULLEY RATIO	230-280 PULLEY RATIO	280-330 PULLEY RATIO	330-400 PULLEY RATIO	400-600 PULLEY RATIO	600-1000 PULLEY RATIO	HEAD
6"	*	*	(2:6) (2:5)	(3:6) (3:5)	(3:4) (4:5)	(4:4)	(5:4)	(4:3)	(5:3)	(6:3) (5:2)	(6:2)	BASIC UNIT/UNIVERSAL HEAD
	*	*	*	*	*	*	*	*	*	*	(2:6)	HIGH SPEED HEAD
5"	*	(2:6)	(2:5) (3:6)	(3:5) (3:4)	(4:5)	(4:4)	(5:4) (4:3)	(5:3)	(6:3)	(5:2) (6:2)	*	BASIC UNIT/UNIVERSAL HEAD
	*	*	*	*	*	*	*	*	*	*	(2:6) (2:5)	HIGH SPEED HEAD
4"	*	(2:6) (2:5)	(3:6) (3:5)	(3:4) (4:5)	(4:4)	(5:4) (4:3)	(5:3)	(6:3)	(5:2)	(6:2)	*	BASIC UNIT/UNIVERSAL HEAD
	*	*	*	*	*	*	*	*	*	(2:6)	(2:5) (3:6)	HIGH SPEED HEAD
3"	(2:6)	(2:5) (3:6)	(3:5) (3:4) (4:5)	(4:4) (5:4)	(4:3)	(5:3) (6:3)	*	(5:2)	(6:2)	*	*	BASIC UNIT/UNIVERSAL HEAD
	*	*	*	*	*	*	*	*	*	(2:6) (2:5)	(3:6) (3:5)	HIGH SPEED HEAD
2½"	(2:6) (2:5)	(3:6) (3:5)	(3:4) (4:5) (4:4)	(5:4) (4:3)	(5:3)	(6:3)	(5:2)	(6:2)	*	*	*	BASIC UNIT/UNIVERSAL HEAD
	*	*	*	*	*	*	*	*	(2:6)	(2:5) (3:6)	(3:5) (3:4) (4:5)	HIGH SPEED HEAD
2"	(2:6) (2:5) (3:6)	(3:5) (3:4) (4:5)	(4:4) (5:4) (4:3)	(5:3)	(6:3)	(5:2)	(6:2)	*	*	*	*	BASIC UNIT/UNIVERSAL HEAD
	*	*	*	*	*	*	*	(2:6)	(2:5)	(3:6) (3:5)	(3:4) (4:5) (4:4)	HIGH SPEED HEAD
1½"	(2:5) (3:6) (3:5)	(3:4) (4:5) (4:4)	(5:4) (4:3) (5:3)	(6:3)	(5:2) (6:2)	*	*	*	*	*	*	BASIC UNIT/UNIVERSAL HEAD
	*	*	*	*	*	(2:6)	(2:5)	(3:6) (3:5)	(3:4) (4:5)	(4:4) (4:3)	(4:4) (5:4) (4:3)	HIGH SPEED HEAD

TABLE 9-2. Versa-Mil Pulley Combinations (cont).

DIAM. OF CUTTER	20-40 PULLEY RATIO	40-60 PULLEY RATIO	60-100 PULLEY RATIO	100-140 PULLEY RATIO	140-180 PULLEY RATIO	180-230 PULLEY RATIO	230-280 PULLEY RATIO	280-330 PULLEY RATIO	330-400 PULLEY RATIO	400-600 PULLEY RATIO	600-1000 PULLEY RATIO	HEAD
	1 1/4"	(3:6) (3:5) (3:4) (4:5) *	(4:4) (5:4) *	(4:3) (5:3) (6:3) *	(5:2) *	(6:2) (2:6) *	(2:5) (3:5) *	*	(3:6) *	*	(3:4) (4:5) (4:4) *	
1"	(3:5) (3:4) (4:5) (4:4) *	(5:4) (4:3) *	(5:3) (6:3) (5:2) *	(6:2) *	(2:6) (2:5) *	(3:6) (3:5) *	(3:5) *	*	(3:5) (4:5) *	(4:4) (5:4) *	(4:3) (5:3) (6:3) *	BASIC UNIT/UNIVERSAL HEAD  HIGH SPEED HEAD
3/4"	(4:5) (4:4) (5:4) (4:3) *	(5:3) (6:3) *	(5:2) (6:2) *	(2:6) (2:5) *	(3:6) *	(3:5) *	(3:4) (4:5) *	*	(4:4) *	(5:4) (4:3) (5:3) *	(6:3) (5:2) *	BASIC UNIT/UNIVERSAL HEAD  HIGH SPEED HEAD
5/8"	(4:4) (5:4) (4:3) (5:3) *	(6:3) *	(5:2) (6:2) *	(2:5) *	(3:5) *	(3:4) (4:5) *	*	(4:4) *	(5:4) (4:3) *	(5:3) (6:3) *	(5:2) (6:2) *	BASIC UNIT/UNIVERSAL HEAD  HIGH SPEED HEAD
1/2"	(5:4) (4:3) (5:3) (6:3) *	(5:2) (6:2) *	(2:6) (2:5) *	(3:5) *	(3:4) *	(4:5) *	(4:4) *	(5:4) (4:3) *	(5:3) *	(6:3) *	(5:2) (6:2) *	BASIC UNIT/UNIVERSAL HEAD  HIGH SPEED HEAD
3/8"	(5:3) (6:3) (5:2) *	(6:2) *	(2:5) *	(3:5) *	(4:4) *	(5:4) (4:3) *	*	(5:3) *	(6:3) *	(5:2) (6:2) *	(5:2) (6:2) *	BASIC UNIT/UNIVERSAL HEAD  HIGH SPEED HEAD

TABLE 9-2. Versa-Mil Pulley Combinations (cont.).

DIAM. OF CUTTER	20-40 PULLEY RATIO	40-60 PULLEY RATIO	60-100 PULLEY RATIO	100-140 PULLEY RATIO	140-180 PULLEY RATIO	180-230 PULLEY RATIO	230-280 PULLEY RATIO	280-330 PULLEY RATIO	330-400 PULLEY RATIO	400-600 PULLEY RATIO	600-1000 PULLEY RATIO	HEAD
	1/4"	(5:2) (6:2)	*	*	*	*	*	*	*	*	*	
1/8"	(2:6)	(2:5)	(3:5) (3:4) (4:5)	(4:4)	(5:4) (4:3)	(5:3) (6:3)	*	(5:2)	(6:2)	*	*	HIGH SPEED HEAD
	(2:5) (3:5)	(3:4) (4:4) (4:4)	(5:4) (4:3) (5:3)	(6:3)	(5:2)	(6:2)	*	*	*	*	*	HIGH SPEED HEAD
	(3:4) (4:5) (4:4) (5:4) (4:3)	(5:3) (6:3)	(5:2) (6:2)	*	*	*	*	*	*	*	*	HIGH SPEED HEAD

NOTE: An "\*" indicates a pulley ratio is not available for that size cutter and cutter speed.