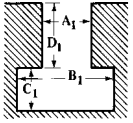
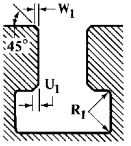
T-SLOTS, BOLTS, AND NUTS

Table 1. American National Standard T-Slots *ANSI/ASME B5.1M-1985 (R1998)*

T-SLOTS



Basic Dimensions



Suggested Approximate Dimensions For Rounding Or Breaking Of Corners

Nominal T-Bolt Size[a]		Width of Throat A_1[b]		Headspace Dimensions								Depth of Throat D_1				Rounding or Breaking of Corners[c]					
				Width B_1				Depth C_1								inch			mm		
				inch		mm		inch		mm		inch		mm							
inch	mm	inch	mm	min	max	min	max	min	max	min	max	min	max	min	max	R_1 max	W_1 max	U_1 max	R_1 max	W_1 max	U_1 max
	4		5			10	11			3	3.5			4.5	7				0.5	0.8	0.8
	5		6			11	12.5			5	6			5	8				0.5	0.8	0.8
0.250	6	0.282	8	0.500	0.562	14.5	16	0.203	0.234	7	8	0.125	0.375	7	11	0.02	0.02	0.03	0.5	0.8	0.8
0.312	8	0.344	10	0.594	0.656	16	18	0.234	0.266	7	8	0.156	0.438	9	14	0.02	0.03	0.03	0.5	0.8	0.8
0.375	10	0.438	12	0.719	0.781	19	21	0.297	0.328	8	9	0.219	0.562	11	17	0.02	0.03	0.03	0.5	0.8	0.8
0.500	12	0.562	14	0.906	0.969	23	25	0.359	0.391	9	11	0.312	0.688	12	19	0.02	0.03	0.03	0.5	0.8	0.8
0.625	16	0.688	18	1.188	1.250	30	32	0.453	0.484	12	14	0.438	0.875	16	24	0.03	0.03	0.05	0.8	0.8	1.3
0.750	20	0.812	22	1.375	1.469	37	40	0.594	0.625	16	18	0.562	1.062	20	29	0.03	0.03	0.05	0.8	0.8	1.3
1.000	24	1.062	28	1.750	1.844	46	50	0.781	0.828	20	22	0.750	1.250	26	36	0.03	0.06	0.05	0.8	1.5	1.3
1.250	30	1.312	36	2.125	2.219	56	60	1.031	1.094	25	28	1.000	1.562	33	46	0.03	0.06	0.05	0.8	1.5	1.3
1.500	36	1.562	42	2.562	2.656	68	72	1.281	1.344	32	35	1.250	1.938	39	53	0.03	0.06	0.05	0.8	1.5	1.3
	42		48			80	85			36	40			44	59				1.5	2.5	2
	48		54			90	95			40	44			50	66				1.5	2.5	2

[a] Width of tongue (tenon) to be used with the above T-Slots will be found in the complete standard, B5.1M.

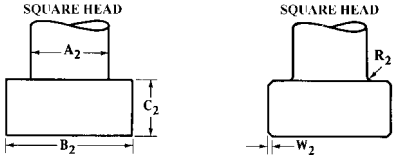
[b] Throat dimensions are basic. When slots are intended to be used for holding only, tolerances can be 0.0 + 0.010 inch or H12 Metric (ISO/R286); when intended for location, tolerance can be 0.0 + 0.001 inch or H8 Metric (see page 648).

[c] Corners of T-Slots may be square or may be rounded or broken to the indicated maximum dimensions at the manufacturer's option.

For the dimensions of tongue seats, inserted tongues, and solid tongues refer to the complete standard, B5.1M.

Table 2. American National Standard T-Bolts *ANSI/ASME B5.1M-1985 (R1998)*

T-BOLTS



Nominal T-Bolt Size and Thread A_2[ab]		Bolt Head Dimensions										Rounding of Corners[c]			
		Width Across Flats B_2				Width Across Corners		Height C_2				R_2		W_2	
inch	metric	inch		mm		inch	mm	inch		mm		inch	mm	inch	mm
UNC-2A	ISO[d]	max	min	max	min	max	max	max	min	max	min	max	max	max	max
	M4			9	8.5		12.7			2.5	2.1		0.3		0.5
	M5			10	9.5		14.1			4	3.6		0.3		0.5
0.250–20	M6	0.469	0.438	13	12	0.663	18.4	0.156	0.141	6	5.6	0.02	0.5	0.03	0.8
0.312–18	M8	0.562	0.531	15	14	0.796	21.2	0.188	0.172	6	5.6	0.02	0.5	0.03	0.8
0.375–16	M10	0.688	0.656	18	17	0.972	25.5	0.250	0.234	7	6.6	0.02	0.5	0.03	0.8
0.500–13	M12	0.875	0.844	22	21	1.238	31.1	0.312	0.297	8	7.6	0.02	0.5	0.06	1.5
0.625–11	M16	1.125	1.094	28	27	1.591	39.6	0.406	0.391	10	9.6	0.03	0.8	0.06	1.5
0.750–10	M20	1.312	1.281	34	33	1.856	48.1	0.531	0.500	14	13.2	0.03	0.8	0.06	1.5
1.000–8	M24	1.688	1.656	43	42	2.387	60.8	0.688	0.656	18	17.2	0.03	0.8	0.06	1.5
1.250–7	M30	2.062	2.031	53	52	2.917	75	0.938	0.906	23	22.2	0.03	0.8	0.06	1.5
1.500–6	M36	2.500	2.469	64	63	3.536	90.5	1.188	1.156	28	27.2	0.03	0.8	0.06	1.5
	M42			75	74		106.1			32	30.5		1		2
	M48			85	84		120.2			36	34.5		1		2

[a] For inch tolerances for thread diameters of bolts or studs and for threads see page 1716.

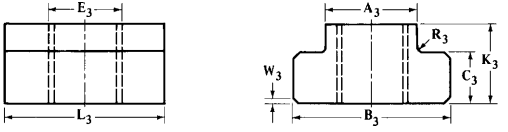
[b] T-slots to be used with these bolts will be found in Table 1.

[c] Corners of T-bolts may be square or may be rounded or broken to the indicated maximum dimensions at the manufacturer's option.

[d] Metric thread grade and tolerance position is 5g 6g (see page 1764).

Table 3. American National Standard T-Nuts *ANSI/ASME B5.1M-1985 (R1998)*

T-NUTS



Nominal T-Bolt Size[a]		Width of Tongue A_3				Tap for Stud[b] E_3		Width of Nut B_3				Height of Nut C_3				Total Thickness Including Tongue[c] K_3		Length of Nut[c] L_3		Rounding of Corners			
		inch		mm		inch	mm	inch		mm		inch		mm						R_3		W_3	
inch	mm	max	min	max	min	UNC-3B	ISO[d]	max	min	max	min	max	min	max	min	inch	mm	inch	mm	inch max	mm max	inch max	mm max
	4		…		…		…		…	…	…			…	…		…		…		…		…
	5		…		…		…		…	…	…			…	…		…		…		…		…
0.250	6	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
0.312	8	0.330	0.320	8.7	8.5	0.250–20	M6	0.562	0.531	15	14	0.188	0.172	6	5.6	0.281	9	0.562	18	0.02	0.5	0.03	0.8
0.375	10	0.418	0.408	11	10.75	0.312–18	M8	0.688	0.656	18	17	0.250	0.234	7	6.6	0.375	10.5	0.688	20	0.02	0.5	0.03	0.8
0.500	12	0.543	0.533	13.5	13.25	0.375–1	6M10	0.875	0.844	22	21	0.312	0.297	8	7.6	0.531	12	0.875	23	0.02	0.5	0.06	1.5
0.625	16	0.668	0.658	17.25	17	0.500–13	M12	1.125	1.094	28	27	0.406	0.391	10	9.6	0.625	15	1.125	27	0.03	0.8	0.06	1.5
0.750	20	0.783	0.773	20.5	20.25	0.625–11	M16	1.312	1.281	34	33	0.531	0.500	14	13.2	0.781	21	1.312	35	0.03	0.8	0.06	1.5
1.000	24	1.033	1.018	26.5	26	0.750–10	M20	1.688	1.656	43	42	0.688	0.656	18	17.2	1.000	27	1.688	46	0.03	0.8	0.06	1.5
1.250	30	1.273	1.258	33	32.5	1.000–8	M24	2.062	2.031	53	52	0.938	0.906	23	22.2	1.312	34	2.062	53	0.03	0.8	0.06	1.5
1.500	36	1.523	1.508	39.25	38.75	1.250–7	M30	2.500	2.469	64	63	1.188	1.156	28	27.2	1.625	42	2.500	65	0.03	0.8	0.06	1.5
	42			46.75	46.25		M36			75	74			32	30.5		48		75		1		2
	48			52.5	51.75		M42			85	84			36	34.5		54		85		1		2

[a] T-slot dimensions to fit the above nuts will be found in Table 1.

[b] For tolerances of inch threads see page 1716.

[c] No tolerances are given for "Total Thickness" or "Nut Length" as they need not be held to close limits.

[d] Metric tapped thread grade and tolerance position is 5H (see page 1764).

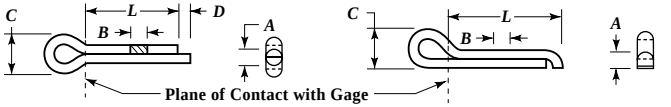
PINS AND STUDS

Dowel-Pins.—Dowel-pins are used either to retain parts in a fixed position or to preserve alignment. Under normal conditions a properly fitted dowel-pin is subjected solely to shearing strain, and this strain occurs only at the junction of the surfaces of the two parts which are being held by the dowel-pin. It is seldom necessary to use more than two dowel-pins for holding two pieces together and frequently one is sufficient. For parts that have to be taken apart frequently, and where driving out of the dowel-pins would tend to wear the holes, and also for very accurately constructed tools and gages that have to be taken apart, or that require to be kept in absolute alignment, the taper dowel-pin is preferable. The taper dowel-pin is most commonly used for average machine work, but the straight type is given the preference on tool and gage work, except where extreme accuracy is required, or where the tool or gage is to be subjected to rough handling.

The size of the dowel-pin is governed by its application. For locating nests, gage plates, etc., pins from $\frac{1}{8}$ to $\frac{3}{16}$ inch in diameter are satisfactory. For locating dies, the diameter of the dowel-pin should never be less than $\frac{1}{4}$ inch; the general rule is to use dowel-pins of the same size as the screws used in fastening the work. The length of the dowel-pin should be about one and one-half to two times its diameter in each plate or part to be doweled.

When hardened cylindrical dowel-pins are inserted in soft parts, ream the hole about 0.001 inch smaller than the dowel-pin. If the doweled parts are hardened, grind (or lap) the hole 0.0002 to 0.0003 inch under size. The hole should be ground or lapped straight, that is, without taper or "bell-mouth."

American National Standard Cotter Pins *ANSI B18.8.1-1972 (R1994)*

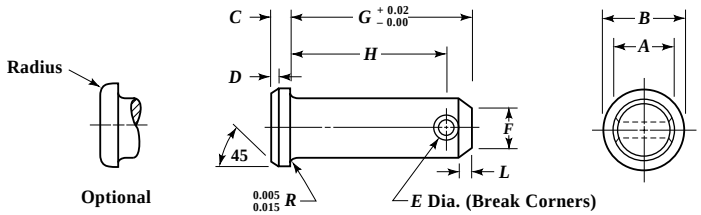


Nom. Size	Dia. *A*[a] & Width *B* Max.	Wire Width *B* Min.	Head Dia. *C* Min.	Prong Length *D* Min.	Hole Size	Nom. Size	Dia. *A*[a] & Width *B* Max.	Wire Width *B* Min.	Head Dia. *C* Min.	Prong Length *D* Min.	Hole Size
1/32	0.032	0.022	0.06	0.01	0.047	3/16	0.176	0.137	0.38	0.09	0.203
3/64	0.048	0.035	0.09	0.02	0.062	7/32	0.207	0.161	0.44	0.10	0.234
1/16	0.060	0.044	0.12	0.03	0.078	1/4	0.225	0.176	0.50	0.11	0.266
5/64	0.076	0.057	0.16	0.04	0.094	5/16	0.280	0.220	0.62	0.14	0.312
3/32	0.090	0.069	0.19	0.04	0.109	3/8	0.335	0.263	0.75	0.16	0.375
7/64	0.104	0.080	0.22	0.05	0.125	7/16	0.406	0.320	0.88	0.20	0.438
1/8	0.120	0.093	0.25	0.06	0.141	1/2	0.473	0.373	1.00	0.23	0.500
9/64	0.134	0.104	0.28	0.06	0.156	5/8	0.598	0.472	1.25	0.30	0.625
5/32	0.150	0.116	0.31	0.07	0.172	3/4	0.723	0.572	1.50	0.36	0.750

[a] Tolerances are: –0.004 inch for the 1/32- to 3/16-inch sizes, incl.; –0.005 inch for the 7/32- to 5/16-inch sizes, incl.; –0.006 inch for the 3/8- to 1/2-inch sizes, incl.; and –0.008 inch for the 5/8- and 3/4-inch sizes. Note: Tolerances for length are: up to 1 inch ± 0.030 inch, over 1 inch ±0.060 inch.

All dimensions are in inches.

American National Standard Clevis Pins *ANSI B18.8.1-1972 (R1994)*



Nom.Size (Basic Pin Dia.)	Shank Dia.*A* Max	Head Dia.*B* Max.[a]	Head Hgt.*C* Max.[b]	Head Chamfer *D* Nom.[c]	Hole Dia.*E* Max.[d]	Point Dia.*F* Max.[e]	Pin Lgth.*G* Basic[f]	Head to HoleCenter *H* Max.[g]	Point Length *L* Max.	Point Length *L* Min.	Cotter Pin Size for Hole
3/16	0.186	0.32	0.07	0.02	0.088	0.15	0.58	0.504	0.055	0.035	1/16
1/4	0.248	0.38	0.10	0.03	0.088	0.21	0.77	0.692	0.055	0.035	1/16
5/16	0.311	0.44	0.10	0.03	0.119	0.26	0.94	0.832	0.071	0.049	3/32
3/8	0.373	0.51	0.13	0.03	0.119	0.33	1.06	0.958	0.071	0.049	3/32
7/16	0.436	0.57	0.16	0.04	0.119	0.39	1.19	1.082	0.071	0.049	3/32
1/2	0.496	0.63	0.16	0.04	0.151	0.44	1.36	1.223	0.089	0.063	1/8
5/8	0.621	0.82	0.21	0.06	0.151	0.56	1.61	1.473	0.089	0.063	1/8
1/4	0.746	0.94	0.26	0.07	0.182	0.68	1.91	1.739	0.110	0.076	5/32
7/8	0.871	1.04	0.32	0.09	0.182	0.80	2.16	1.989	0.110	0.076	5/32
1	0.996	1.19	0.35	0.10	0.182	0.93	2.41	2.239	0.110	0.076	5/32

[a] Tolerance is –0.05 inch.
[b] Tolerance is –0.02 inch.
[c] Tolerance is ±0.01 inch.
[d] Tolerance is –0.015 inch.
[e] Tolerance is –0.01 inch.
[f] Lengths tabulated are intended for use with standard clevises, without spacers. When other lengths are required, it is recommended that they be limited wherever possible to nominal lengths in 0.06-inch increments.
[g] Tolerance is –0.020 inch.

All dimensions are in inches.

British Standard for Metric Series Dowel Pins.—Steel parallel dowel pins specified in British Standard 1804:Part 2:1968 are divided into three grades which provide different degrees of pin accuracy.

Grade 1 is a precision ground pin made from En 32A or En 32B low carbon steel (BS 970) or from high carbon steel to BS 1407 or BS 1423. Pins below 4 mm diameter are unhardened. Those of 4 mm diameter and above are hardened to a minimum of 750 HV 30 in accordance with BS 427, but if they are made from steels to BS 1407 or BS 1423 then the hardness shall be within the range 600 to 700 HV 30, in accordance with BS 427. The values of other hardness scales may be used in accordance with BS 860.

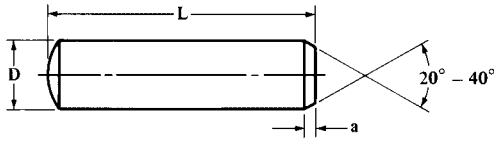
Grade 2 is a ground pin made from any of the steels used for Grade 1. The pins are normally supplied unhardened, unless a different condition is agreed on between the purchaser and supplier.

Grade 3 pins are made from En 1A free cutting steel (BS 970) and are supplied with a machined, bright rolled or drawn finish. They are normally supplied unhardened unless a different condition is agreed on between the purchaser and supplier.

Pins of any grade may be made from different steels in accordance with BS 970, by mutual agreement between the purchaser and manufacturer. If steels other than those in the

standard range are used, the hardness of the pins shall also be decided on by mutual agreement between purchaser and supplier. As shown in the illustration at the head of the accompanying table, one end of each pin is chamfered to provide a lead. The other end may be similarly chamfered, or domed.

British Standard Parallel Steel Dowel Pins — Metric Series *BS 1804: Part 2: 1968*



Nom. Length *L*, mm	Nominal Diameter *D*, mm												
	1	1.5	2	2.5	3	4	5	6	8	10	12	16	20	25
	Chamfer *a* max, mm													
	0.3	0.3	0.3	0.4	0.45	0.6	0.75	0.9	1.2	1.5	1.8	2.5	3	4
	Standard Sizes													
4	0	0												
6	0	0	0	0										
8	0	0	0	0	0									
10		0	0	0	0	0								
12		0	0	0	0	0	0							
16			0	0	0	0	0	0	0					
20				0	0	0	0	0	0	0				
25					0	0	0	0	0	0	0			
30						0	0	0	0	0	0	0		
35							0	0	0	0	0	0		
40							0	0	0	0	0	0	0	
45								0	0	0	0	0	0	
50									0	0	0	0	0	0
60									0	0	0	0	0	0
70										0	0	0	0	0
80										0	0	0	0	0
90											0	0	0	0
100												0	0	0
110												0	0	0
120													0	0

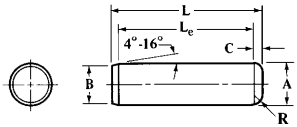
Nom. Dia., mm		Limits of Tolerance on Diameter					
		Grade[a]					
		1		2		3	
		Tolerance Zone					
		m5		h7		h11	
Over	To & Incl.	Limits of Tolerance, 0.001 mm					
	3	+7	+2	0	−12[b]	0	−60
3	6	+9	+4	0	−12	0	−75
6	10	+12	+6	0	−15	0	−90
10	14	+15	+7	0	−18	0	−110
14	18	+15	+7	0	−18	0	−110
18	24	+17	+8	0	−21	0	−130
24	30	+17	+8	0	−21	0	−130

[a] The limits of tolerance for grades 1 and 2 dowel pins have been chosen to provide satisfactory assembly when used in standard reamed holes (H7 and H8 tolerance zones). If the assembly is not satisfactory, refer to B.S. 1916: Part 1, Limits and Fits for Engineering, and select a different class of fit.

[b] This tolerance is larger than that given in BS 1916, and has been included because the use of a closer tolerance would involve precision grinding by the manufacturer, which is uneconomic for a grade 2 dowel pin.

The tolerance limits on the overall length of all grades of dowel pin up to and including 50 mm long are +0.5, –0.0 mm, and for pins over 50 mm long are +0.8, –0.0 mm. The Standard specifies that the roughness of the cylindrical surface of grades 1 and 2 dowel pins, when assessed in accordance with BS 1134, shall not be greater than 0.4 μm CLA (16 CLA).

Table 1. American National Standard Hardened Ground Machine Dowel Pins *ANSI/ASME B18.8.2-1995*



Nominal Size[a] or Nominal Pin Diameter		Pin Diameter, *A*						Point Diameter, *B*		Crown Height, *C*	Crown Radius, *R*	Range of Preferred Lengths,[b] *L*	Single Shear Load, for Carbon or Alloy Steel, Calculated lb	Suggested Hole Diameter[c]	
		Standard Series Pins			Oversize Series Pins										
		Basic	Max	Min	Basic	Max	Min	Max	Min	Max	Min			Max	Min
1/16	0.0625	0.0627	0.0628	0.0626	0.0635	0.0636	0.0634	0.058	0.048	0.020	0.008	3/16–3/4	400	0.0625	0.0620
5/64[d]	0.0781	0.0783	0.0784	0.0782	0.0791	0.0792	0.0790	0.074	0.064	0.026	0.010	…	620	0.0781	0.0776
3/32	0.0938	0.0940	0.0941	0.0939	0.0948	0.0949	0.0947	0.089	0.079	0.031	0.012	5/16–1	900	0.0937	0.0932
1/8	0.1250	0.1252	0.1253	0.1251	0.1260	0.1261	0.1259	0.120	0.110	0.041	0.016	3/8–2	1,600	0.1250	0.1245
5/32[d]	0.1562	0.1564	0.1565	0.1563	0.1572	0.1573	0.1571	0.150	0.140	0.052	0.020	…	2,500	0.1562	0.1557
3/16	0.1875	0.1877	0.1878	0.1876	0.1885	0.1886	0.1884	0.180	0.170	0.062	0.023	1/2–2	3,600	0.1875	0.1870
1/4	0.2500	0.2502	0.2503	0.2501	0.2510	0.2511	0.2509	0.240	0.230	0.083	0.031	1/2–2 1/2	6,400	0.2500	0.2495
5/16	0.3125	0.3127	0.3128	0.3126	0.3135	0.3136	0.3134	0.302	0.290	0.104	0.039	1/2–2 1/2	10,000	0.3125	0.3120
3/8	0.3750	0.3752	0.3753	0.3751	0.3760	0.3761	0.3759	0.365	0.350	0.125	0.047	1/2–3	14,350	0.3750	0.3745
7/16	0.4375	0.4377	0.4378	0.4376	0.4385	0.4386	0.4384	0.424	0.409	0.146	0.055	7/8–3	19,550	0.4375	0.4370
1/2	0.5000	0.5002	0.5003	0.5001	0.5010	0.5011	0.5009	0.486	0.471	0.167	0.063	3/4, 1–4	25,500	0.5000	0.4995
5/8	0.6250	0.6252	0.6253	0.6251	0.6260	0.6261	0.6259	0.611	0.595	0.208	0.078	1 1/4–5	39,900	0.6250	0.6245
3/4	0.7500	0.7502	0.7503	0.7501	0.7510	0.7511	0.7509	0.735	0.715	0.250	0.094	1 1/2–6	57,000	0.7500	0.7495
7/8	0.8750	0.8752	0.8753	0.8751	0.8760	0.8761	0.8759	0.860	0.840	0.293	0.109	2,2 1/2–6	78,000	0.8750	0.8745
1	1.0000	1.0002	1.0003	1.0001	1.0010	1.0011	1.0009	0.980	0.960	0.333	0.125	2,2 1/2–5,6	102,000	1.0000	0.9995

[a] Where specifying nominal size as basic diameter, zeros preceding decimal and in the fourth decimal place are omitted.

[b] Lengths increase in 1/16-inch steps up to 3/8 inch, in 1/8-inch steps from 3/8 inch to 1 inch, in 1/4-inch steps from 1 inch to 2 1/2 inches, and in 1/2-inch steps above 2 1/2 inches. Tolerance on length is ±0.010 inch.

[c] These hole sizes have been commonly used for press fitting Standard Series machine dowel pins into materials such as mild steels and cast iron. In soft materials such as aluminum or zinc die castings, hole size limits are usually decreased by 0.0005 inch to increase the press fit.

[d] Nonpreferred sizes, not recommended for use in new designs.

All dimensions are in inches.

If a dowel pin is driven into a blind hole where no provision is made for releasing air, the worker assembling the pin may be endangered, and damage may be caused to the associated component, or stresses may be set up. The appendix of the Standard describes one method of overcoming this problem by providing a small flat surface along the length of a pin to permit the release of air.

For purposes of marking, the Standard states that each package or lot of dowel pins shall bear the manufacturer's name or trademark, the BS number, and the grade of pin.

American National Standard Hardened Ground Machine Dowel Pins.—Hardened ground machine dowel pins are furnished in two diameter series: Standard Series having basic diameters 0.0002 inch over the nominal diameter, intended for initial installations; and Oversize Series having basic diameters 0.001 inch over the nominal diameter, intended for replacement use.

Preferred Lengths and Sizes: The preferred lengths and sizes in which these pins are normally available are given in Table 1. Other sizes and lengths are produced as required by the purchaser.

Effective Length: The effective length, L_e, must not be less than 75 per cent of the overall length of the pin.

Shear Strength: Single shear strength values are listed in Table 1. Prior versions of ANSI/ASME B18.8.2-1995 had listed double shear load minimum values and had specified a minimum single shear strength of 130,000 psi. See ANSI/ASME B18.8.2-1995, Appendix B for a description of the double shear test.

Designation: These pins are designated by the following data in the sequence shown: Product name (noun first), including pin series, nominal pin diameter (fraction or decimal equivalent), length (fraction or decimal equivalent), material, and protective finish, if required.

Examples: Pins, Hardened Ground Machine Dowel — Standard Series, $\frac{3}{8} \times 1\frac{1}{2}$, Steel, Phosphate Coated.
Pins, Hardened Ground Machine Dowel — Oversize Series, 0.625×2.500, Steel

Installation Precaution: Pins should not be installed by striking or hammering and when installing with a press, a shield should be used and safety glasses worn.

American National Standard Hardened Ground Production Dowel Pins.—Hardened ground production dowel pins have basic diameters that are 0.0002 inch over the nominal pin diameter.

Preferred Lengths and Sizes: The preferred lengths and sizes in which these pins are available are given in Table 2. Other sizes and lengths are produced as required by the purchaser.

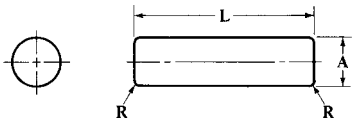
Shear Strength: Single shear strength values are listed in Table 2. Prior versions of ANSI/ASME B18.8.2-1995 had listed double shear load minimum values and had specified a minimum single shear strength of 102,000 psi. See ANSI/ASME B18.8.2-1995, Appendix B for a description of the double shear test.

Ductility: These standard pins are sufficiently ductile to withstand being pressed into holes 0.0005 inch smaller than the nominal pin diameter in hardened steel without cracking or shattering.

Designation: These pins are designated by the following data in the sequence shown: Product name (noun first), nominal pin diameter (fraction or decimal equivalent), length (fraction or decimal equivalent), material, and protective finish, if required.

Examples: Pins, Hardened Ground Production Dowel, $\frac{1}{8} \times \frac{3}{4}$, Steel, Phosphate Coated
Pins, Hardened Ground Production Dowel, 0.375×1.500, Steel

Table 2. American National Standard Hardened Ground Production Dowel Pins
ANSI/ASME B18.8.2-1995



Nominal Size[a] or Nominal Pin Diameter		Pin Diameter, *A*			Corner Radius, *R*		Range of Preferred Lengths,[b] *L*	Single Shear Load, Calculated,lb	Suggested Hole Diameter[c]	
		Basic	Max	Min	Max	Min			Max	Min
1/16	0.0625	0.0627	0.0628	0.0626	0.020	0.010	3/16–1	395	0.0625	0.0620
3/32	0.0938	0.0939	0.0940	0.0938	0.020	0.010	3/16–2	700	0.0937	0.0932
7/64	0.1094	0.1095	0.1096	0.1094	0.020	0.010	3/16–2	950	0.1094	0.1089
1/8	0.1250	0.1252	0.1253	0.1251	0.020	0.010	3/16–2	1,300	0.1250	0.1245
5/32	0.1562	0.1564	0.1565	0.1563	0.020	0.010	3/16–2	2,050	0.1562	0.1557
3/16	0.1875	0.1877	0.1878	0.1876	0.020	0.010	3/16–2	2,950	0.1875	0.1870
7/32	0.2188	0.2189	0.2190	0.2188	0.020	0.010	1/4–2	3,800	0.2188	0.2183
1/4	0.2500	0.2502	0.2503	0.2501	0.020	0.010	1/4–1 1/2, 1 3/4, 2–2 1/2	5,000	0.2500	0.2495
5/16	0.3125	0.3127	0.3128	0.3126	0.020	0.010	5/16–1 1/2, 1 3/4, 2–2 1/2	8,000	0.3125	0.3120
3/8	0.3750	0.3752	0.3753	0.3751	0.020	0.010	3/8–1 1/2, 1 3/4, 2–3	11,500	0.3750	0.3745

[a] Where specifying nominal pin size in decimals, zeros preceding decimal and in the fourth decimal place are omitted.

[b] Lengths increase in 1/16-inch steps up to 1 inch, in 1/8-inch steps from 1 inch to 2 inches and then are 2 1/4, 2 1/2, and 3 inches.

[c] These hole sizes have been commonly used for press fitting production dowel pins into materials such as mild steels and cast iron. In soft materials such as aluminum or zinc die castings, hole size limits are usually decreased by 0.0005 inch to increase the press fit.

All dimensions are in inches.

American National Standard Unhardened Ground Dowel Pins.— Unhardened ground dowel pins are normally produced by grinding the outside diameter of commercial wire or rod material to size. Consequently, the maximum diameters of the pins, as specified in Table 3, are below the minimum commercial stock sizes by graduated amounts from 0.0005 inch on the 1/16-inch nominal pin size to 0.0028 inch on the 1-inch nominal pin size.

Preferred Lengths and Sizes: The preferred lengths and sizes in which unhardened ground pins are normally available are given in Table 3. Other sizes and lengths are produced as required by the purchaser.

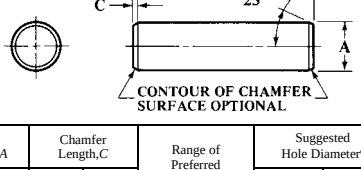
Shear Strength: These pins must have a single shear strength of 64,000 psi minimum for pins made from steel and 40,000 psi minimum for pins made from brass and must be capable of withstanding the minimum double shear loads given in Table 3 when tested in accordance with the procedure outlined in ANSI/ASME B18.8.2-1995, Appendix B.

Designation: These pins are designated by the following data in the order shown: Product name (noun first), nominal pin diameter (fraction or decimal equivalent), length (fraction or decimal equivalent), material, and protective finish, if required.

Examples: Pins, Unhardened Ground Dowel, 1/8 × 3/4, Steel

Pins, Unhardened Ground Dowel, 0.250 × 2.500, Steel, Zinc Plated

Table 3. American National Standard Unhardened Ground Dowel Pins
ANSI/ASME B18.8.2-1995



Nominal Size[a] or Basic Pin Diameter		Pin Diameter, *A*		Chamfer Length, *C*		Range of Preferred Lengths,[b] *L*	Suggested Hole Diameter[c]		Double Shear Load Min, lb.	
		Max	Min	Max	Min		Max	Min	Carbon-Steel	Brass
1/16	0.0625	0.0600	0.0595	0.025	0.005	1/4–1	0.0595	0.0580	350	220
3/32	0.0938	0.0912	0.0907	0.025	0.005	1/4–1 1/2	0.0907	0.0892	820	510
[d]7/64	0.1094	0.1068	0.1063	0.025	0.005	…	0.1062	0.1047	1,130	710
1/8	0.1250	0.1223	0.1218	0.025	0.005	1/4–2	0.1217	0.1202	1,490	930
5/32	0.1562	0.1535	0.1530	0.025	0.005	1/4–2	0.1528	0.1513	2,350	1,470
3/16	0.1875	0.1847	0.1842	0.025	0.005	1/4–2	0.1840	0.1825	3,410	2,130
7/32	0.2188	0.2159	0.2154	0.025	0.005	1/4–2	0.2151	0.2136	4,660	2,910
1/4	0.2500	0.2470	0.2465	0.025	0.005	1/4–1 1/2, 1 3/4, 2–2 1/2	0.2462	0.2447	6,120	3,810
5/16	0.3125	0.3094	0.3089	0.040	0.020	5/16–1 1/2, 1 3/4, 2–2 1/2	0.3085	0.3070	9,590	5,990
3/8	0.3750	0.3717	0.3712	0.040	0.020	3/8–1 1/2, 1 3/4, 2–2 1/2	0.3708	0.3693	13,850	8,650
7/16	0.4375	0.4341	0.4336	0.040	0.020	7/16–5/8, 3/4, 7/8–1 1/2, 1 3/4, 2–2 1/2	0.4331	0.4316	18,900	11,810
1/2	0.5000	0.4964	0.4959	0.040	0.020	1/2, 5/8, 3/4, 7/8, 1–1 1/2, 1 3/4, 2–3	0.4954	0.4939	24,720	15,450
5/8	0.6250	0.6211	0.6206	0.055	0.035	5/8, 3/4, 7/8, 1–1 1/2, 1 3/4, 2, 2 1/2–4	0.6200	0.6185	38,710	24,190
3/4	0.7500	0.7458	0.7453	0.055	0.035	3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/2–4	0.7446	0.7431	55,840	34,900
7/8	0.8750	0.8705	0.8700	0.070	0.050	7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/2–4	0.8692	0.8677	76,090	47,550
1	1.0000	0.9952	0.9947	0.070	0.050	1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/2–4	0.9938	0.9923	99,460	62,160

[a] Where specifying pin size in decimals, zeros preceding decimal and in the fourth decimal place are omitted.

[b] Lengths increase in 1/16-inch increments from 1/4 to 1 inch, in 1/8-inch increments from 1 inch to 2 inches, and in 1/4-inch increments from 2 to 2 1/2 inches, and in 1/2-inch increments from 2 1/2 to 4 inches.

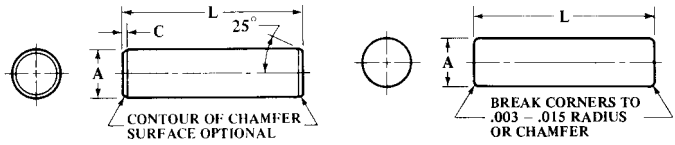
[c] These hole sizes have been found to be satisfactory for press fitting pins into mild steel and cast and malleable irons. In soft materials such as aluminum alloys or zinc die castings, hole size limits are usually decreased by 0.0005 inch to increase the press fit.

[d] Nonpreferred size, not recommended for use in new designs.

All dimensions are in inches.

American National Standard Straight Pins.—The diameter of both chamfered and square end straight pins is that of the commercial wire or rod from which the pins are made. The tolerances shown in Table 4 are applicable to carbon steel and some deviations in the diameter limits may be necessary for pins made from other materials.

Table 4. American National Standard Chamfered and Square End Straight Pins
ANSI/ASME B18.8.2-1995



CHAMFERED STRAIGHT PIN — SQUARE END STRAIGHT PIN

Nominal Size[a] or Basic Pin Diameter	Pin Diameter, *A*		Chamfer Length, *C*		Nominal Size[b] or Basic Pin Diameter	Pin Diameter, *A*		Chamfer Length, *C*	
	Max	Min	Max	Min		Max	Min	Max	Min
1/16 0.062	0.0625	0.0605	0.025	0.005	5/16 0.312	0.3125	0.3105	0.040	0.020
3/32 0.094	0.0937	0.0917	0.025	0.00	3/8 0.375	0.3750	0.3730	0.040	0.020
7/64 0.109	0.1094	0.1074	0.025	0.005	7/16 0.438	0.4375	0.4355	0.040	0.020
1/8 0.125	0.1250	0.1230	0.025	0.005	1/2 0.500	0.5000	0.4980	0.040	0.020
5/32 0.156	0.1562	0.1542	0.025	0.005	5/8 0.625	0.6250	0.6230	0.055	0.035
3/16 0.188	0.1875	0.1855	0.025	0.005	3/4 0.750	0.7500	0.7480	0.055	0.035
7/32 0.219	0.2187	0.2167	0.025	0.005	7/8 0.875	0.8750	0.8730	0.055	0.035
1/4 0.250	0.2500	0.2480	0.025	0.005	1 1.000	1.0000	0.9980	0.055	0.035

[a] Where specifying nominal size in decimals, zeros preceding decimal point are omitted.

[b] Where specifying nominal size in decimals, zeros preceding decimal point are omitted.

All dimensions are in inches.

Length Increments: Lengths are as specified by the purchaser; however, it is recommended that nominal pin lengths be limited to increments of not less than 0.062 inch.

Material: Straight pins are normally made from cold drawn steel wire or rod having a maximum carbon content of 0.28 per cent. Where required, pins may also be made from corrosion resistant steel, brass, or other metals.

Designation: Straight pins are designated by the following data, in the sequence shown: Product name (noun first), nominal size (fraction or decimal equivalent), material, and protective finish, if required.

Examples: Pin, Chamfered Straight, $\frac{1}{8} \times 1.500$, Steel

Pin, Square End Straight, 0.250×2.250, Steel, Zinc Plated

American National Standard Taper Pins.—Taper pins have a uniform taper over the pin length with both ends crowned. Most sizes are supplied in commercial and precision classes, the latter having generally tighter tolerances and being more closely controlled in manufacture.

Diameters: The major diameter of both commercial and precision classes of pins is the diameter of the large end and is the basis for pin size. The diameter at the small end is computed by multiplying the nominal length of the pin by the factor 0.02083 and subtracting the result from the basic pin diameter. See also Table 5.

Taper: The taper on commercial class pins is 0.250 ± 0.006 inch per foot and on the precision class pins is 0.250 ± 0.004 inch per foot of length.

Materials: Unless otherwise specified, taper pins are made from SAE 1211 steel or cold drawn SAE 1212 or 1213 steel or equivalents, and no mechanical property requirements apply.

Hole Sizes: Under most circumstances, holes for taper pins require taper reaming. Sizes and lengths of taper pins for which standard reamers are available are given in Table 6. Drilling specifications for taper pins are given below.

Designation: Taper pins are designated by the following data in the sequence shown: Product name (noun first), class, size number (or decimal equivalent), length (fraction or three-place decimal equivalent), material, and protective finish, if required.

Examples: Pin, Taper (Commercial Class) No. $0 \times \frac{3}{4}$, Steel

Pin, Taper (Precision Class) 0.219×1.750, Steel, Zinc Plated

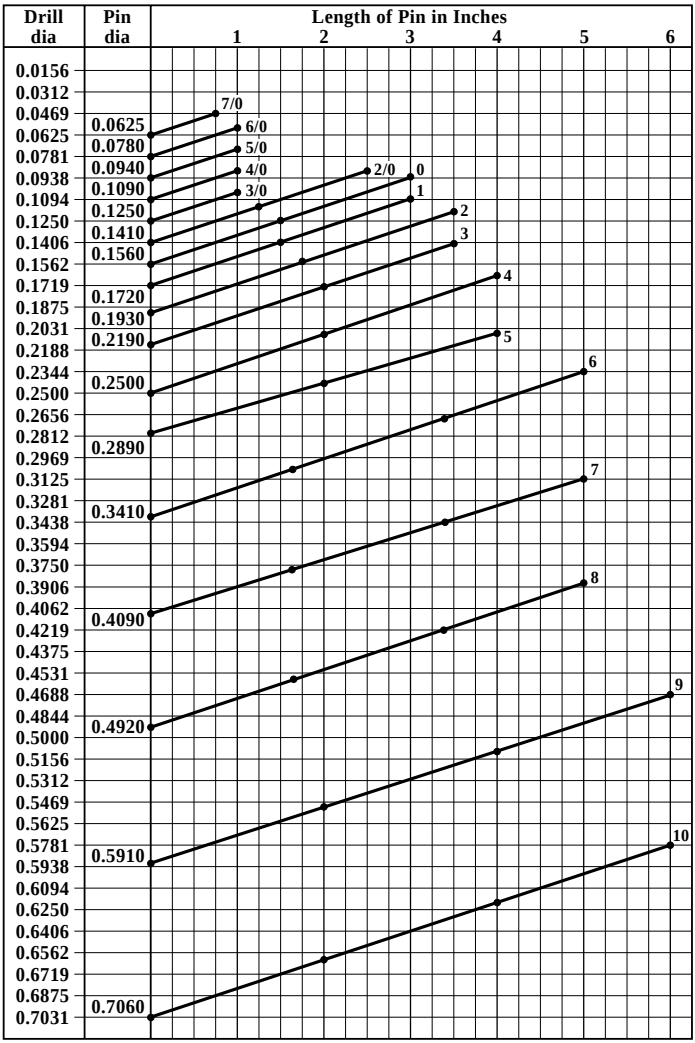
Table 5. Nominal Diameter at Small Ends of Standard Taper Pins

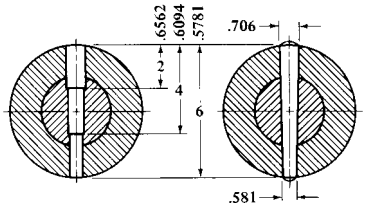
Pin Length in inches	Pin Number and Small End Diameter for Given Length										
	0	1	2	3	4	5	6	7	8	9	10
¾	0.140	0.156	0.177	0.203	0.235	0.273	0.325	0.393	0.476	0.575	0.690
1	0.135	0.151	0.172	0.198	0.230	0.268	0.320	0.388	0.471	0.570	0.685
1¼	0.130	0.146	0.167	0.192	0.224	0.263	0.315	0.382	0.466	0.565	0.680
1½	0.125	0.141	0.162	0.187	0.219	0.258	0.310	0.377	0.460	0.560	0.675
1¾	0.120	0.136	0.157	0.182	0.214	0.252	0.305	0.372	0.455	0.554	0.669
2	0.114	0.130	0.151	0.177	0.209	0.247	0.299	0.367	0.450	0.549	0.664
2¼	0.109	0.125	0.146	0.172	0.204	0.242	0.294	0.362	0.445	0.544	0.659
2½	0.104	0.120	0.141	0.166	0.198	0.237	0.289	0.356	0.440	0.539	0.654
2¾	0.099	0.115	0.136	0.161	0.193	0.232	0.284	0.351	0.434	0.534	0.649
3	0.094	0.110	0.131	0.156	0.188	0.227	0.279	0.346	0.429	0.528	0.643
3¼	…	…	…	0.151	0.182	0.221	0.273	0.340	0.424	0.523	0.638
3½	…	…	…	0.146	0.177	0.216	0.268	0.335	0.419	0.518	0.633
3¾	…	…	…	0.141	0.172	0.211	0.263	0.330	0.414	0.513	0.628
4	…	…	…	0.136	0.167	0.206	0.258	0.326	0.409	0.508	0.623
4¼	…	…	…	0.131	0.162	0.201	0.253	0.321	0.403	0.502	0.617
4½	…	…	…	0.125	0.156	0.195	0.247	0.315	0.398	0.497	0.612
5	…	…	…	…	0.146	0.185	0.237	0.305	0.389	0.487	0.602
5½	…	…	…	…	…	…	…	0.294	0.377	0.476	0.591
6	…	…	…	…	…	…	…	0.284	0.367	0.466	0.581

Drilling Specifications for Taper Pins.—When helically fluted taper pin reamers are used, the diameter of the through hole drilled prior to reaming is equal to the diameter at the small end of the taper pin. (See Table 5.) However, when straight fluted taper reamers are to be used, it may be necessary, for long pins, to step drill the hole before reaming, the number and sizes of the drills to be used depending on the depth of the hole (pin length).

To determine the number and sizes of step drills required: Find the length of pin to be used at the top of the chart on page 1657 and follow this length down to the intersection with that heavy line which represents the size of taper pin (see taper pin numbers at the right-hand end of each heavy line). If the length of pin falls between the first and second dots, counting from the left, only one drill is required. Its size is indicated by following the nearest horizontal line from the point of intersection (of the pin length) on the heavy line over to the drill diameter values at the left. If the intersection of pin length comes between the second and third dots, then two drills are required. The size of the smaller drill then corresponds to the intersection of the pin length and the heavy line and the larger is the corresponding drill diameter for the intersection of one-half this length with the heavy line. Should the pin length fall between the third and fourth dots, three drills are required. The smallest drill will have a diameter corresponding to the intersection of the total pin length with the heavy line, the next in size will have a diameter corresponding to the intersection of two-thirds of this length with the heavy line and the largest will have a diameter corresponding to the intersection of one-third of this length with the heavy line. Where the intersection falls between two drill sizes, use the smaller.

Chart to Facilitate Selection of Number and Sizes of Drills for Step-Drilling Prior to Taper Reaming

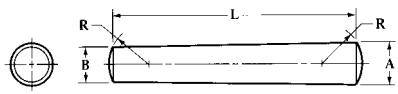




Examples: For a No. 10 taper pin 6-inches long, three drills would be used, of the sizes and for the depths shown in the accompanying diagram.

For a No. 10 taper pin 3-inches long, two drills would be used because the 3-inch length falls between the second and third dots. The first or through drill will be 0.6406 inch and the second drill, 0.6719 inch for a depth of 1½ inches.

Table 6. American National Standard Taper Pins *ANSI/ASME B18.8.2-1995*



Pin Size Number and Basic Pin Dia.[a]		Major Diameter (Large End), *A*				End Crown Radius, *R*		Range of Lengths,[b] *L*	
		Commercial Class		Precision Class					
		Max	Min	Max	Min	Max	Min	Stand. Reamer Avail.[c]	Other
7/0	0.0625	0.0638	0.0618	0.0635	0.0625	0.072	0.052	…	¼–1
6/0	0.0780	0.0793	0.0773	0.0790	0.0780	0.088	0.068	…	¼–½
5/0	0.0940	0.0953	0.0933	0.0950	0.0940	0.104	0.084	¼–1	1⅛, 1½
4/0	0.1090	0.1103	0.1083	0.1100	0.1090	0.119	0.099	¼–1	1¼–2
3/0	0.1250	0.1263	0.1243	0.1260	0.1250	0.135	0.115	¼–1	1¼–2
2/0	0.1410	0.1423	0.1403	0.1420	0.1410	0.151	0.131	½–1¼	1½–2½
0	0.1560	0.1573	0.1553	0.1570	0.1560	0.166	0.146	½–1¼	1½–3
1	0.1720	0.1733	0.1713	0.1730	0.1720	0.182	0.162	¾–1¼	1½–3
2	0.1930	0.1943	0.1923	0.1940	0.1930	0.203	0.183	¾–1½	1¾–3
3	0.2190	0.2203	0.2183	0.2200	0.2190	0.229	0.209	¾–1¾	2–4
4	0.2500	0.2513	0.2493	0.2510	0.2500	0.260	0.240	¾–2	2¼–4
5	0.2890	0.2903	0.2883	0.2900	0.2890	0.299	0.279	1–2½	2¾–6
6	0.3410	0.3423	0.3403	0.3420	0.3410	0.351	0.331	1¼–3	3½–6
7	0.4090	0.4103	0.4083	0.4100	0.4090	0.419	0.399	1¼–3¾	4–8
8	0.4920	0.4933	0.4913	0.4930	0.4920	0.502	0.482	1¼–4½	4¾–8
9	0.5910	0.5923	0.5903	0.5920	0.5910	0.601	0.581	1¼–5¼	5½–8
10	0.7060	0.7073	0.7053	0.7070	0.7060	0.716	0.696	1½–6	6½–8
11	0.8600	0.8613	0.8593	…	…	0.870	0.850	…	2–8
12	1.0320	1.0333	1.0313	…	…	1.042	1.022	…	2–9
13	1.2410	1.2423	1.2403	…	…	1.251	1.231	…	3–11
14	1.5210	1.5223	1.5203	…	…	1.531	1.511	…	3–13

[a] When specifying nominal pin size in decimals, zeros preceding the decimal and in the fourth decimal place are omitted.

[b] Lengths increase in ⅛-inch steps up to 1 inch and in ¼-inch steps above 1 inch.

[c] Standard reamers are available for pin lengths in this column.

All dimensions are in inches.

For nominal diameters, B, see Table 5.

American National Standard Grooved Pins.—These pins have three equally spaced longitudinal grooves and an expanded diameter over the crests of the ridges formed by the material displaced when the grooves are produced. The grooves are aligned with the axes of the pins. There are seven types of grooved pins as shown in the illustration on page 1660.

Standard Sizes and Lengths: The standard sizes and lengths in which grooved pins are normally available are given in Table 7.

Materials: Grooved pins are normally made from cold drawn low carbon steel wire or rod. Where additional performance is required, carbon steel pins may be supplied surface hardened and heat treated to a hardness consistent with the performance requirements. Pins may also be made from alloy steel, corrosion resistant steel, brass, Monel and other non-ferrous metals having chemical properties as agreed upon between manufacturer and purchaser.

Performance Requirements: Grooved pins are required to withstand the minimum double shear loads given in Table 7 for the respective materials shown, when tested in accordance with the Double Shear Testing of Pins as set forth in ANSI/ASME B18.8.2-1995, Appendix B.

Hole Sizes: To obtain maximum product retention under average conditions, it is recommended that holes for the installation of grooved pins be held as close as possible to the limits shown in Table 7. The minimum limits correspond to the drill size, which is the same as the basic pin diameter. The maximum limits are generally suitable for length-diameter ratios of not less than 4 to 1 nor greater than 10 to 1. For smaller length-to-diameter ratios, the hole should be held closer to the minimum limits where retention is critical. Conversely for larger ratios where retention requirements are less important, it may be desirable to increase the hole diameters beyond the maximum limits shown.

Designation: Grooved pins are designated by the following data in the sequence shown: Product name (noun first) including type designation, nominal size (number, fraction or decimal equivalent), length (fraction or decimal equivalent), material, including specification or heat treatment where necessary, protective finish, if required.

Examples: Pin, Type A Grooved, $\frac{3}{32} \times \frac{3}{4}$, Steel, Zinc Plated

Pin, Type F Grooved, 0.250×1.500, Corrosion Resistant Steel

American National Standard Grooved T-Head Cotter Pins and Round Head Grooved Drive Studs.— The cotter pins have a T-head and the studs a round head. Both pins and studs have three equally spaced longitudinal grooves and an expanded diameter over the crests of the raised ridges formed by the material displaced when the grooves are formed.

Standard Sizes and Lengths: The standard sizes and range of standard lengths are given in Tables 8 and 9.

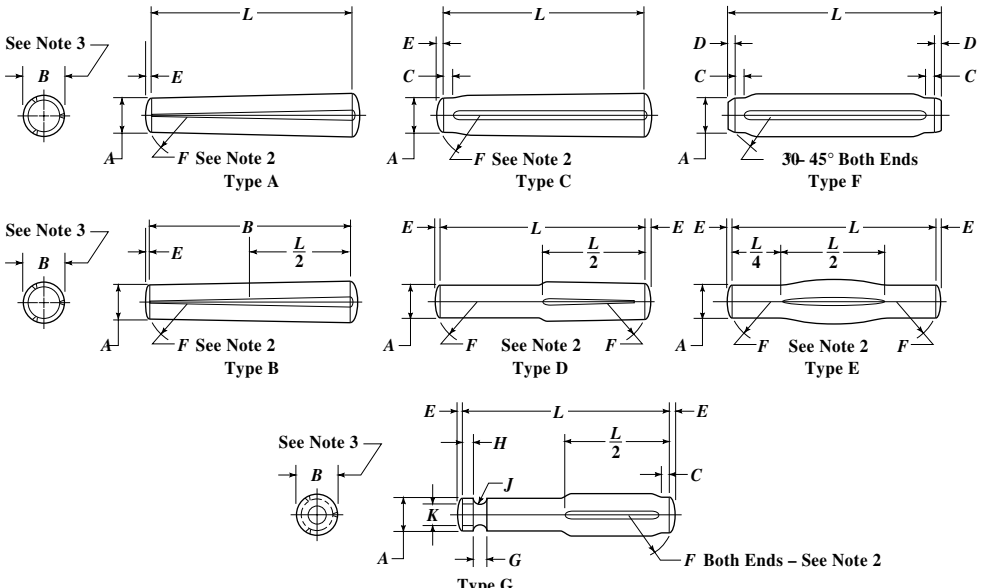
Material: Unless otherwise specified these pins are made from low carbon steel. Where so indicated by the purchaser they may be made from corrosion resistant steel, brass or other non-ferrous alloys.

Hole Sizes: To obtain optimum product retention under average conditions, it is recommended that holes for the installation of grooved T-head cotter pins and grooved drive studs be held as close as possible to the limits tabulated. The minimum limits given correspond to the drill size, which is equivalent to the basic shank diameter. The maximum limits shown are generally suitable for length-diameter ratios of not less than 4 to 1 and not greater than 10 to 1. For smaller length-to-diameter ratios, the holes should be held closer to minimum limits where retention is critical. Conversely, for larger length-to-diameter ratios or where retention requirements are not essential, it may be desirable to increase the hole diameter beyond the maximum limits shown.

Designation: Grooved T-head cotter pins and round head grooved drive studs are designated by the following data, in the order shown: Product name (noun first), nominal size (number, fraction or decimal equivalent), length (fraction or decimal equivalent), material including specification or heat treatment where necessary, and protective finish, if required.

Examples: Pin, Grooved T-Head Cotter, $\frac{1}{4} \times 1\frac{1}{4}$, Steel, Zinc Plated

Drive Stud, Round Head Grooved, No. $10 \times \frac{1}{2}$, Corrosion Resistant Steel



Types of American National Standard Grooved Pins, ANSI/ASME B18.8.2-1995 (For notes see bottom of Table 7.)

Table 7. American National Standard Grooved Pins *ANSI/ASME B18.8.2-1995*

Nominal Size or Basic Pin Diameter		Pin Diameter,[a] *A*		Pilot Length, *C*	Chamfer Length,[b] *D*	Crown Height,[b] *E*		Crown Radius,[b] *F*		Neck Width, *G*		Shoulder Length, *H*		Neck Radius, *J*	Neck Diameter, *K*		Range of Standard Lengths[c]
		Max	Min	Ref	Min	Max	Min	Max	Min	Max	Min	Max	Min	Ref	Max	Min	
1/32[d]	0.0312	0.0312	0.0302	0.015	…	…	…	…	…	…	…	…	…	…	…	…	1/8–1/2
3/64[d]	0.0469	0.0469	0.0459	0.031	…	…	…	…	…	…	…	…	…	…	…	…	1/8–5/8
1/16	0.0625	0.0625	0.0615	0.031	0.016	0.0115	0.0015	0.088	0.068	…	…	…	…	…	…	…	1/8–1
5/64[d]	0.0781	0.0781	0.0771	0.031	0.016	0.0137	0.0037	0.104	0.084	…	…	…	…	…	…	…	1/4–1
3/32	0.0938	0.0938	0.0928	0.031	0.016	0.0141	0.0041	0.135	0.115	0.038	0.028	0.041	0.031	0.016	0.067	0.057	1/4–1 1/4
7/64[d]	0.1094	0.1094	0.1074	0.031	0.016	0.0160	0.0060	0.150	0.130	0.038	0.028	0.041	0.031	0.016	0.082	0.072	1/4–1 1/4
1/8	0.1250	0.1250	0.1230	0.031	0.016	0.0180	0.0080	0.166	0.146	0.069	0.059	0.041	0.031	0.031	0.088	0.078	1/4–1 1/2
5/32	0.1563	0.1563	0.1543	0.062	0.031	0.0220	0.0120	0.198	0.178	0.069	0.059	0.057	0.047	0.031	0.109	0.099	3/8–2
3/16	0.1875	0.1875	0.1855	0.062	0.031	0.0230	0.0130	0.260	0.240	0.069	0.059	0.057	0.047	0.031	0.130	0.120	3/8–2 1/4
7/32	0.2188	0.2188	0.2168	0.062	0.031	0.0270	0.0170	0.291	0.271	0.101	0.091	0.072	0.062	0.047	0.151	0.141	1/2–3
1/4	0.2500	0.2500	0.2480	0.062	0.031	0.0310	0.0210	0.322	0.302	0.101	0.091	0.072	0.062	0.047	0.172	0.162	1/2–3 1/4
5/16	0.3125	0.3125	0.3105	0.094	0.047	0.0390	0.0290	0.385	0.365	0.132	0.122	0.104	0.094	0.062	0.214	0.204	5/8–3 1/2
3/8	0.3750	0.3750	0.3730	0.094	0.047	0.0440	0.0340	0.479	0.459	0.132	0.122	0.135	0.125	0.062	0.255	0.245	3/4–4 1/4
7/16	0.4375	0.4375	0.4355	0.094	0.047	0.0520	0.0420	0.541	0.521	0.195	0.185	0.135	0.125	0.094	0.298	0.288	7/8–4 1/2
1/2	0.5000	0.5000	0.4980	0.094	0.047	0.0570	0.0470	0.635	0.615	0.195	0.185	0.135	0.125	0.094	0.317	0.307	1–4 1/2

[a] For expanded diameters, *B*, see ANSI/ASME B18.8.2-1995.

[b] Pins in 1/32- and 3/64-inch sizes of any length and all sizes of 1/4-inch nominal length or shorter are not crowned or chamfered.

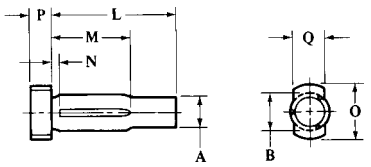
[c] Standard lengths increase in 1/8-inch steps from 1/8 to 1 inch, and in 1/4-inch steps above 1 inch. Standard lengths for the 1/32-, 3/64-, 1/16-, and 5/64-inch sizes and the 1/4-inch length for the 3/32-, 7/64-, and 1/8-inch sizes do not apply to Type G grooved pins.

[d] Non-stock items, not recommended for new designs.

Pin Material	Nominal Pin Size														
	1/32	3/64	1/16	5/64	3/32	7/64	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2
Steels	Double Shear Load, Min, lb														
Low Carbon	100	220	410	620	890	1,220	1,600	2,300	3,310	4,510	5,880	7,660	11,000	15,000	19,600
Alloy (R_c 40 – 48 hardness)	180	400	720	1,120	1,600	2,180	2,820	4,520	6,440	8,770	11,500	17,900	26,000	35,200	46,000
Corrosion Resistant	140	300	540	860	1,240	1,680	2,200	3,310	4,760	6,480	8,460	12,700	18,200	24,800	32,400
Brass	60	140	250	390	560	760	990	1,540	2,220	3,020	3,950	6,170	9,050	12,100	15,800
	Recommended Hole Sizes for Unplated Pins (The minimum drill size is the same as the pin size. See also text on page 1659.)														
Maximum Diameter	0.0324	0.0482	0.0640	0.0798	0.0956	0.1113	0.1271	0.1587	0.1903	0.2219	0.2534	0.3166	0.3797	0.4428	0.5060
Minimum Diameter	0.0312	0.0469	0.0625	0.0781	0.0938	0.1094	0.1250	0.1563	0.1875	0.2188	0.2500	0.3125	0.3750	0.4375	0.5000

All dimensions are in inches.

Table 8. American National Standard Grooved T-Head Cotter Pins
ANSI/ASME B18.8.2-1995



Nominal Size[a] or Basic Shank Dia.		Shank Diameter, *A*		Length, *N*	Head Dia., *O*		Head Height, *P*		Head Width, *Q*		Range of Standard Lengths,[b] *L*	Recommended Hole Size	
		Max	Min	Max	Max	Min	Max	Min	Max	Min		Max	Min
5/32	0.156	0.154	0.150	0.08	0.26	0.24	0.11	0.09	0.18	0.15	3/4–1 1/8	0.161	0.156
3/16	0.187	0.186	0.182	0.09	0.30	0.28	0.13	0.11	0.22	0.18	3/4–1 1/4	0.193	0.187
1/4	0.250	0.248	0.244	0.12	0.40	0.38	0.17	0.15	0.28	0.24	1–1 1/2	0.257	0.250
5/16	0.312	0.310	0.305	0.16	0.51	0.48	0.21	0.19	0.34	0.30	1 1/8–2	0.319	0.312
23/64	0.359	0.358	0.353	0.18	0.57	0.54	0.24	0.22	0.38	0.35	1 1/4–2	0.366	0.359
1/2	0.500	0.498	0.493	0.25	0.79	0.76	0.32	0.30	0.54	0.49	2–3	0.508	0.500

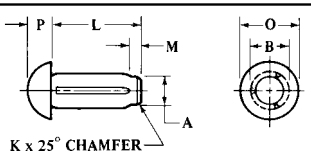
[a] When specifying nominal size in decimals, zeros preceding decimal point and in the fourth decimal place are omitted.

[b] Lengths increase in 1/8-inch steps from 3/4 to 1 1/4 inch and in 1/4-inch steps above 1 1/4 inches. For groove length, *M*, dimensions see ANSI/ASME B18.8.2-1995.

All dimensions are in inches.

For expanded diameter, *B*, dimensions, see ANSI/ASME B18.8.2-1995.

Table 9. American National Standard Round Head Grooved Drive Studs
ANSI/ASME B18.8.2-1995



Stud Size Number and Basic Shank Diameter[a]		Shank Diameter, *A*		Head Diameter, *O*		Head Height, *P*		Range of Standard Lengths,[b] *L*	Recommended Hole Size		Drill Size
		Max	Min	Max	Min	Max	Min		Max	Min	
0	0.067	0.067	0.065	0.130	0.120	0.050	0.040	1/8–1/4	0.0686	0.0670	51
2	0.086	0.086	0.084	0.162	0.146	0.070	0.059	1/8–1/4	0.0877	0.0860	44
4	0.104	0.104	0.102	0.211	0.193	0.086	0.075	3/16–5/16	0.1059	0.1040	37
6	0.120	0.120	0.118	0.260	0.240	0.103	0.091	1/4–3/8	0.1220	0.1200	31
7	0.136	0.136	0.134	0.309	0.287	0.119	0.107	5/16–1/2	0.1382	0.1360	29
8	0.144	0.144	0.142	0.309	0.287	0.119	0.107	3/8–5/8	0.1463	0.1440	27
10	0.161	0.161	0.159	0.359	0.334	0.136	0.124	3/8–5/8	0.1636	0.1610	20
12	0.196	0.196	0.194	0.408	0.382	0.152	0.140	1/2–3/4	0.1990	0.1960	9
14	0.221	0.221	0.219	0.457	0.429	0.169	0.156	1/2–3/4	0.2240	0.2210	2
16	0.250	0.250	0.248	0.472	0.443	0.174	0.161	1/2	0.2534	0.2500	1/4

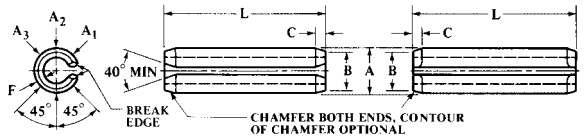
[a] Where specifying nominal size in decimals, zeros preceding decimal point and in the fourth decimal place are omitted.

[b] Lengths increase in 1/16-inch steps from 1/8 to 3/8 inch and in 1/8-inch steps above 3/8 inch.

All dimensions are in inches.

For pilot length, *M*, and expanded diameter, *B*, dimensions see ANSI/ASME B18.8.2-1995.

Table 10. American National Standard Slotted Type Spring Pins
ANSI/ASME B18.8.2-1995



STYLE 1 STYLE 2

Nominal Size[a] or Basic Pin Diameter		Average Pin Diameter, *A*		Chamfer Dia., *B*	Chamfer Length, *C*		Stock Thickness, *F*	Recommended Hole Size		Material			Range of Practical Lengths[b]
		Max	Min	Max	Max	Min	Basic	Max	Min	SAE 1070 – 1095 and SAE 51420	SAE 30302 and 30304	Beryllium Copper	
										Double Shear Load, Min, lb			
1/16	0.062	0.069	0.066	0.059	0.028	0.007	0.012	0.065	0.062	430	250	270	3/16–1
5/64	0.078	0.086	0.083	0.075	0.032	0.008	0.018	0.081	0.078	800	460	500	3/16–1 1/2
3/32	0.094	0.103	0.099	0.091	0.038	0.008	0.022	0.097	0.094	1,150	670	710	3/16–1 1/2
1/8	0.125	0.135	0.131	0.122	0.044	0.008	0.028	0.129	0.125	1,875	1,090	1,170	5/16–2
9/64	0.141	0.149	0.145	0.137	0.044	0.008	0.028	0.144	0.140	2,175	1,260	1,350	3/8–2
5/32	0.156	0.167	0.162	0.151	0.048	0.010	0.032	0.160	0.156	2,750	1,600	1,725	7/16–2 1/2
3/16	0.188	0.199	0.194	0.182	0.055	0.011	0.040	0.192	0.187	4,150	2,425	2,600	1/2–2 1/2
7/32	0.219	0.232	0.226	0.214	0.065	0.011	0.048	0.224	0.219	5,850	3,400	3,650	1/2–3
1/4	0.250	0.264	0.258	0.245	0.065	0.012	0.048	0.256	0.250	7,050	4,100	4,400	1/2–3 1/2
5/16	0.312	0.330	0.321	0.306	0.080	0.014	0.062	0.318	0.312	10,800	6,300	6,750	3/4–4
3/8	0.375	0.395	0.385	0.368	0.095	0.016	0.077	0.382	0.375	16,300	9,500	10,200	3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, 2–4
7/16	0.438	0.459	0.448	0.430	0.095	0.017	0.077	0.445	0.437	19,800	11,500	12,300	1, 1 1/4, 1 1/2, 1 3/4, 2–4
1/2	0.500	0.524	0.513	0.485	0.110	0.025	0.094	0.510	0.500	27,100	15,800	17,000	1 1/4, 1 1/2, 1 3/4, 2–4
5/8	0.625	0.653	0.640	0.608	0.125	0.030	0.125	0.636	0.625	46,000	18,800	…	2–6
3/4	0.750	0.784	0.769	0.730	0.150	0.030	0.150	0.764	0.750	66,000	23,200	…	2–6

[a] Where specifying nominal size in decimals, zeros preceding decimal point are omitted.

[b] Length increments are 1/16 inch from 1/8 to 1 inch; 1/8 from 1 inch to 2 inches; and 1/4 inch from 2 inches to 6 inches.

All dimensions are in inches.

American National Standard Spring Pins.— These pins are made in two types: one type has a slot throughout its length; the other is shaped into a coil.

Preferred Lengths and Sizes: The preferred lengths and sizes in which these pins are normally available are given in Tables 10 and 11.

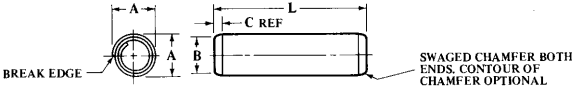
Materials: Spring pins are normally made from SAE 1070–1095 carbon steel, SAE 6150H alloy steel, SAE types 51410 through 51420, 30302 and 30304 corrosion resistant steels, and beryllium copper alloy, heat treated or cold worked to attain the hardness and performance characteristics set forth in ANSI/ASME B18.8.2-1995.

Designation: Spring pins are designated by the following data in the sequence shown:

Examples: Pin, Coiled Spring, 1/4 × 1 1/4, Standard Duty, Steel, Zinc Plated

Pin, Slotted Spring, 1/2 × 3, Steel, Phosphate Coated

Table 11. American National Standard Coiled Type Spring Pins *ANSI/ASME B18.8.2-1995*



Nominal Size or Basic Pin Diameter	Pin Diameter, *A*						Chamfer		Recommended Hole Size		SAE Material Number					
	Standard Duty		Heavy Duty		Light Duty		Dia., *B*	Length, *C*			1070–1095 and 51420	30302 and 30304	1070–1095 and 51420	30302 and 30304	1070–1095 and 51420	30302 and 30304
											Double Shear Load, Min, lb					
	Max	Min	Max	Min	Max	Min	Max	Ref	Max	Min	Standard Duty		Heavy Duty		Light Duty	
1/32 0.031	0.035	0.033	…	…	…	…	0.029	0.024	0.032	0.031	90[a]	65	…	…	…	…
0.039	0.044	0.041	…	…	…	…	0.037	0.024	0.040	0.039	135[a]	100	…	…	…	…
3/64 0.047	0.052	0.049	…	…	…	…	0.045	0.024	0.048	0.046	190[a]	145	…	…	…	…
0.052	0.057	0.054	…	…	…	…	0.050	0.024	0.053	0.051	250[a]	190	…	…	…	…
1/16 0.062	0.072	0.067	0.070	0.066	0.073	0.067	0.059	0.028	0.065	0.061	330	265	475	360	205	160
5/64 0.078	0.088	0.083	0.086	0.082	0.089	0.083	0.075	0.032	0.081	0.077	550	425	800	575	325	250
3/32 0.094	0.105	0.099	0.103	0.098	0.106	0.099	0.091	0.038	0.097	0.093	775	600	1,150	825	475	360
7/64 0.109	0.120	0.114	0.118	0.113	0.121	0.114	0.106	0.038	0.112	0.108	1,050	825	1,500	1,150	650	500
1/8 0.125	0.138	0.131	0.136	0.130	0.139	0.131	0.121	0.044	0.129	0.124	1,400	1,100	2,000	1,700	825	650
5/32 0.156	0.171	0.163	0.168	0.161	0.172	0.163	0.152	0.048	0.160	0.155	2,200	1,700	3,100	2,400	1,300	1,000
3/16 0.188	0.205	0.196	0.202	0.194	0.207	0.196	0.182	0.055	0.192	0.185	3,150	2,400	4,500	3,500	1,900	1,450
7/32 0.219	0.238	0.228	0.235	0.226	0.240	0.228	0.214	0.065	0.224	0.217	4,200	3,300	5,900	4,600	2,600	2,000
1/4 0.250	0.271	0.260	0.268	0.258	0.273	0.260	0.243	0.065	0.256	0.247	5,500	4,300	7,800	6,200	3,300	2,600
5/16 0.312	0.337	0.324	0.334	0.322	0.339	0.324	0.304	0.080	0.319	0.308	8,700	6,700	12,000	9,300	5,200	4,000
3/8 0.375	0.403	0.388	0.400	0.386	0.405	0.388	0.366	0.095	0.383	0.370	12,600	9,600	18,000	14,000	…	…
7/16 0.438	0.469	0.452	0.466	0.450	0.471	0.452	0.427	0.095	0.446	0.431	17,000	13,300	23,500	18,000	…	…
1/2 0.500	0.535	0.516	0.532	0.514	0.537	0.516	0.488	0.110	0.510	0.493	22,500	17,500	32,000	25,000	…	…
5/8 0.625	0.661	0.642	0.658	0.640	…	…	0.613	0.125	0.635	0.618	35,000[b]	…	48,000[b]	…	…	…
3/4 0.750	0.787	0.768	0.784	0.766	…	…	0.738	0.150	0.760	0.743	50,000[b]	…	70,000[b]	…	…	…

[a] Sizes 1/32 inch through 0.052 inch are not available in SAE 1070–1095 carbon steel.

[b] Sizes 5/8 inch and larger are produced from SAE 6150H alloy steel, not SAE 1070–1095 carbon steel. Practical lengths, *L*, for sizes 1/32 through 0.052 inch are 1/8 through 5/8 inch and for the 7/64-inch size, 1/4 through 1 3/4 inches. For lengths of other sizes see Table 10.

All dimensions are in inches.

RETAINING RINGS

Retaining Rings.—The purpose of a retaining ring is to act as an artificial shoulder that will retain an object in a housing (internal ring), as shown in Fig. 1, or on a shaft (external ring). Two types of retaining ring are common, the stamped ring and the spiral-wound ring. The stamped type of retaining ring, or snap ring, is stamped from tempered sheet metal and has a nonuniform cross-section. The typical spiral-wound retaining ring has a uniform cross-section and is made up of two or more turns of coiled, spring-tempered steel, although one-turn spiral-wound rings are common. Spiral-wound retaining rings provide a continuous gapless shoulder to a housing or shaft. Most stamped rings can only be installed at or near the end of a shaft or housing. The spiral-wound design generally requires installation from the end of a shaft or housing. Both types, stamped and spiral, are usually installed into grooves on the shaft or housing.

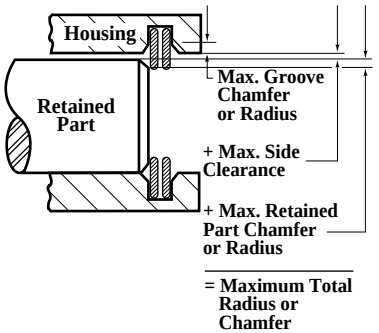


Fig. 1. Typical Retaining Ring Installation Showing Maximum Total Radius or Chamfer (*Courtesy Spirolox Retaining Rings*)

In the section that follows, Tables 1 through 6 give dimensions and data on general-purpose tapered and reduced cross-section metric retaining rings (stamped type) covered by ANSI B27.7M-1977, R1983. Tables 1 and 4 cover Type 3AM1 tapered external retaining rings, Tables 2 and 5 cover Type 3BM1 tapered internal rings, and Tables 3 and 6 cover Type 3CM1 reduced cross-section external rings. Tables 7 through 10 cover inch sizes of internal and external spiral retaining rings corresponding to MIL-R-27426 Types A (external) and B (internal), Class 1 (medium duty) and Class 2 (heavy duty). Tables 11 through 17 cover stamped retaining rings in inch sizes.

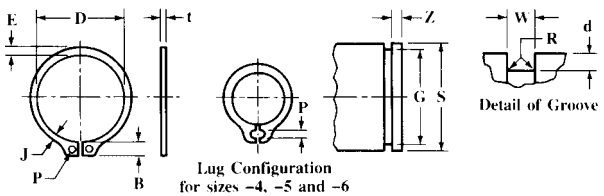


Table 1. American National Standard Metric Tapered Retaining Rings — Basic External Series — 3AM1 *ANSI B27.7M-1977, R1983*

Shaft Diam.	Ring		Groove				Shaft Diam	Ring		Groove			
	Free Diam.	Thickness	Diam.	Width	Depth	Edge Margin		Free Diam.	Thickness	Diam.	Width	Depth	Edge Margin
S	*D*	*t*	*G*	*W*	*d* ref	*Z* min	*S*	*D*	*t*	*G*	*W*	*d* ref	*Z* min
4	3.60	0.25	3.80	0.32	0.1	0.3	36	33.25	1.3	33.85	1.4	1.06	3.2
5	4.55	0.4	4.75	0.5	0.13	0.4	38	35.20	1.3	35.8	1.4	1.10	3.3
6	5.45	0.4	5.70	0.5	0.15	0.5	40	36.75	1.6	37.7	1.75	1.15	3.4
7	6.35	0.6	6.60	0.7	0.20	0.6	42	38.80	1.6	39.6	1.75	1.20	3.6
8	7.15	0.6	7.50	0.7	0.25	0.8	43	39.65	1.6	40.5	1.75	1.25	3.8
9	8.15	0.6	8.45	0.7	0.28	0.8	45	41.60	1.6	42.4	1.75	1.30	3.9
10	9.00	0.6	9.40	0.7	0.30	0.9	46	42.55	1.6	43.3	1.75	1.35	4.0
11	10.00	0.6	10.35	0.7	0.33	1.0	48	44.40	1.6	45.2	1.75	1.40	4.2
12	10.85	0.6	11.35	0.7	0.33	1.0	50	46.20	1.6	47.2	1.75	1.40	4.2
13	11.90	0.9	12.30	1.0	0.35	1.0	52	48.40	2.0	49.1	2.15	1.45	4.3
14	12.90	0.9	13.25	1.0	0.38	1.2	54	49.9	2.0	51.0	2.15	1.50	4.5
15	13.80	0.9	14.15	1.0	0.43	1.3	55	50.6	2.0	51.8	2.15	1.60	4.8
16	14.70	0.9	15.10	1.0	0.45	1.4	57	52.9	2.0	53.8	2.15	1.60	4.8
17	15.75	0.9	16.10	1.0	0.45	1.4	58	53.6	2.0	54.7	2.15	1.65	4.9
18	16.65	1.1	17.00	1.2	0.50	1.5	60	55.8	2.0	56.7	2.15	1.65	4.9
19	17.60	1.1	17.95	1.2	0.53	1.6	62	57.3	2.0	58.6	2.15	1.70	5.1
20	18.35	1.1	18.85	1.2	0.58	1.7	65	60.4	2.0	61.6	2.15	1.70	5.1
21	19.40	1.1	19.80	1.2	0.60	1.8	68	63.1	2.0	64.5	2.15	1.75	5.3
22	20.30	1.1	20.70	1.2	0.65	1.9	70	64.6	2.4	66.4	2.55	1.80	5.4
23	21.25	1.1	21.65	1.2	0.67	2.0	72	66.6	2.4	68.3	2.55	1.85	5.5
24	22.20	1.1	22.60	1.2	0.70	2.1	75	69.0	2.4	71.2	2.55	1.90	5.7
25	23.10	1.1	23.50	1.2	0.75	2.3	78	72.0	2.4	74.0	2.55	2.00	6.0
26	24.05	1.1	24.50	1.2	0.75	2.3	80	74.2	2.4	75.9	2.55	2.05	6.1
27	24.95	1.3	25.45	1.4	0.78	2.3	82	76.4	2.4	77.8	2.55	2.10	6.3
28	25.80	1.3	26.40	1.4	0.80	2.4	85	78.6	2.4	80.6	2.55	2.20	6.6
30	27.90	1.3	28.35	1.4	0.83	2.5	88	81.4	2.8	83.5	2.95	2.25	6.7
32	29.60	1.3	30.20	1.4	0.90	2.7	90	83.2	2.8	85.4	2.95	2.30	6.9
34	31.40	1.3	32.00	1.4	1.00	3.0	95	88.1	2.8	90.2	2.95	2.40	7.2
35	32.30	1.3	32.90	1.4	1.05	3.1	100	92.5	2.8	95.0	2.95	2.50	7.5

All dimensions are in millimeters. Sizes –4, –5, and –6 are available in beryllium copper only.

These rings are designated by series symbol and shaft diameter, thus: for a 4 mm diameter shaft, 3AM1-4; for a 20 mm diameter shaft, 3AM1-20; etc.

Ring Free Diameter Tolerances: For ring sizes –4 through –6, +0.05, –0.10 mm; for sizes –7 through –12, +0.05, –0.15 mm; for sizes –13 through – 26, +0.15, –0.25 mm; for sizes –27 through –38, +0.25, –0.40 mm; for sizes –40 through –50, +0.35, –0.50 mm; for sizes –52 through –62, +0.35, –0.65 mm; and for sizes –65 through –100, +0.50, –0.75 mm.

Groove Diameter Tolerances: For ring sizes –4 through –6, –0.08 mm; for sizes –7 through –10, –0.10 mm; for sizes –11 through –15, –0.12 mm; for sizes –16 through –26, –0.15 mm; for sizes –27 through – 36, –0.20 mm; for sizes –38 through –55, –0.30 mm; and for sizes –57 through –100, –0.40 mm.

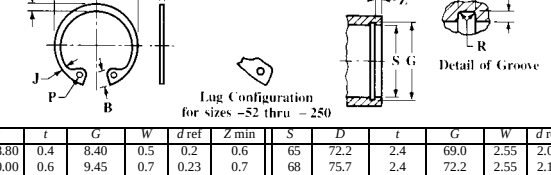
Groove Diameter F.I.M. (full indicator movement) or maximum allowable deviation of concentricity between groove and shaft: For ring sizes –4 through –6, 0.03 mm; for ring sizes –7 through –12, 0.05 mm; for sizes –13 through –28, 0.10 mm; for sizes –30 through –55, 0.15 mm; and for sizes –57 through – 00, 0.20 mm.

Groove Width Tolerances: For ring size –4, +0.05 mm; for sizes –5 and –6, +0.10 mm, for sizes –7 through –38, +0.15 mm; and for sizes –40 through – 100, +0.20 mm.

Groove Maximum Bottom Radii, R: For ring sizes –4 through –6, none; for sizes –7 through –18, 0.1 mm; for sizes –19 through –30, 0.2 mm; for sizes –32 through –50, 0.3 mm; and for sizes –52 through –100, 0.4 mm. For manufacturing details not shown, including materials, see ANSI B27.7M-1977, R1983.

Table 2. American National Standard Metric Tapered Retaining Rings — Basic Internal Series — 3BM1 *ANSI B27.7M-1977, R1983*

Shaft Diam.	Ring		Groove				Shaft Diam.	Ring		Groove			
	Free Diam.	Thickness	Diam.	Width	Depth	Edge Margin		Free Diam.	Thickness	Diam.	Width	Depth	Edge Margin
S	*D*	*t*	*G*	*W*	*d* ref	Z min	*S*	*D*	*t*	*G*	*W*	*d* ref	Z min
8	8.80	0.4	8.40	0.5	0.2	0.6	65	72.2	2.4	69.0	2.55	2.00	6.0
9	10.00	0.6	9.45	0.7	0.23	0.7	68	75.7	2.4	72.2	2.55	2.10	6.3
10	11.10	0.6	10.50	0.7	0.25	0.8	70	77.5	2.4	74.4	2.55	2.20	6.6
11	12.20	0.6	11.60	0.7	0.3	0.9	72	79.6	2.4	76.5	2.55	2.25	6.7
12	13.30	0.6	12.65	0.7	0.33	1.0	75	83.3	2.4	79.7	2.55	2.35	7.1
13	14.25	0.9	13.70	1.0	0.35	1.1	78	86.8	2.8	82.8	2.95	2.40	7.2
14	15.45	0.9	14.80	1.0	0.40	1.2	80	89.1	2.8	85.0	2.95	2.50	7.5
15	16.60	0.9	15.85	1.0	0.43	1.3	82	91.1	2.8	87.2	2.95	2.60	7.8
16	17.70	0.9	16.90	1.0	0.45	1.4	85	94.4	2.8	90.4	2.95	2.70	8.1
17	18.90	0.9	18.00	1.0	0.50	1.5	88	97.9	2.8	93.6	2.95	2.80	8.4
18	20.05	0.9	19.05	1.0	0.53	1.6	90	100.0	2.80	95.7	2.95	2.85	8.6
19	21.10	0.9	20.10	1.0	0.55	1.7	92	102.2	2.8	97.8	2.95	2.90	8.7
20	22.25	0.9	21.15	1.0	0.57	1.7	95	105.6	2.8	101.0	2.95	3.00	9.0
21	23.30	0.9	22.20	1.0	0.60	1.8	98	109.0	2.8	104.2	2.95	3.10	9.3
22	24.40	1.1	23.30	1.2	0.65	1.9	100	110.7	2.8	106.3	2.95	3.15	9.5
23	25.45	1.1	24.35	1.2	0.67	2.0	102	112.4	2.8	108.4	2.95	3.20	9.6
24	26.55	1.1	25.4	1.2	0.70	2.1	105	115.8	2.8	111.5	2.95	3.25	9.8
25	27.75	1.1	26.6	1.2	0.80	2.4	108	119.2	2.8	114.6	2.95	3.30	9.9
26	28.85	1.1	27.7	1.2	0.85	2.6	110	120.8	2.8	116.7	2.95	3.35	10.1
27	29.95	1.3	28.8	1.4	0.90	2.7	115	126.0	2.8	121.9	2.95	3.45	10.4
28	31.10	1.3	29.8	1.4	0.90	2.7	120	132.4	2.8	127.0	2.95	3.50	10.5
30	33.40	1.3	31.9	1.4	0.95	2.9	125	137.1	2.8	132.1	2.95	3.55	10.7
32	35.35	1.3	33.9	1.4	0.95	2.9	130	142.5	2.8	137.2	2.95	3.60	10.8
34	37.75	1.3	36.1	1.4	1.05	3.2	135	148.5	3.2	142.3	3.40	3.65	11.0
35	38.75	1.3	37.2	1.4	1.10	3.3	140	154.1	3.2	147.4	3.40	3.70	11.1
36	40.00	1.3	38.3	1.4	1.15	3.5	145	159.5	3.2	152.5	3.40	3.75	11.3
37	41.05	1.3	39.3	1.4	1.15	3.5	150	164.5	3.2	157.6	3.40	3.80	11.4
38	42.15	1.3	40.4	1.4	1.20	3.6	155	168.8	3.2	162.7	3.40	3.85	11.6
40	44.25	1.6	42.4	1.75	1.20	3.6	160	175.1	4.0	167.8	4.25	3.90	11.7
42	46.60	1.6	44.5	1.75	1.25	3.7	165	180.3	4.0	172.9	4.25	3.95	11.9
45	49.95	1.6	47.6	1.75	1.30	3.9	170	185.6	4.0	178.0	4.25	4.00	12.0
46	51.05	1.6	48.7	1.75	1.35	4.0	175	191.3	4.0	183.2	4.25	4.10	12.3
47	52.15	1.6	49.8	1.75	1.40	4.2	180	196.6	4.0	188.4	4.25	4.20	12.6
48	53.30	1.6	50.9	1.75	1.45	4.3	185	202.7	4.8	193.6	5.10	4.30	12.9
50	55.35	1.6	53.1	1.75	1.55	4.6	190	207.7	4.8	198.8	5.10	4.40	13.2
52	57.90	2.0	55.3	2.15	1.65	5.0	200	217.8	4.8	209.0	5.10	4.50	13.5
55	61.10	2.0	58.4	2.15	1.70	5.1	210	230.3	4.8	219.4	5.10	4.70	14.1
57	63.25	2.0	60.5	2.15	1.75	5.3	220	240.5	4.8	230.0	5.10	5.00	15.0
58	64.4	2.0	61.6	2.15	1.80	5.4	230	251.4	4.8	240.6	5.10	5.30	15.9
60	66.8	2.0	63.8	2.15	1.90	5.7	240	262.3	4.8	251.0	5.10	5.50	16.5
62	68.6	2.0	65.8	2.15	1.90	5.7	250	273.3	4.8	261.4	5.10	5.70	17.1
63	69.9	2.0	66.9	2.15	1.95	5.9	…	…	…	…	…	…	…



All dimensions are in millimeters.

These rings are designated by series symbol and shaft diameter, thus: for a 9 mm diameter shaft, 3BM1-9; for a 22 mm diameter shaft, 3BM1-22; etc.

Ring Free Diameter Tolerances: For ring sizes –8 through –20, +0.25, –0.13 mm; for sizes –21 through –26, +0.40, –0.25 mm; for sizes –27 through –38, +0.65, –0.50 mm; for sizes –40 through –50, +0.90, –0.65 mm; for sizes –52 through –75, +1.00, –0.75 mm; for sizes –78 through –92, +1.40,

–1.40 mm; for sizes –95 through –155, +1.65, –1.65 mm; for sizes –160 through –180, +2.05, –2.05 mm; and for sizes –185 through –250, +2.30, –2.30 mm.

Groove Diameter Tolerances: For ring sizes –8 and –9, +0.06 mm; for sizes –10 through –18, +0.10 mm; for sizes –19 through – 28, +0.15 mm; for sizes –30 through –50, +0.20 mm; for sizes – 52 through –98, +0.30; for sizes –100 through –160, +0.40 mm; and for sizes –165 through –250, +0.50 mm.

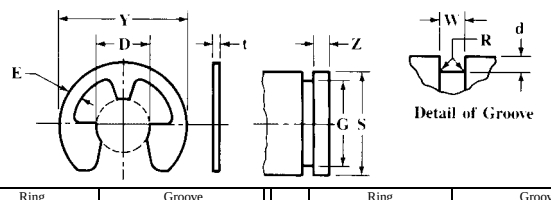
Groove Diameter F.I.M. (full indicator movement) or maximum allowable deviation of concentricity between groove and shaft: For ring sizes –8 through –10, 0.03 mm; for sizes –11 through –15, 0.05 mm; for sizes –16 through –25, 0.10 mm; for sizes –26 through –45, 0.15 mm; for sizes –46 through –80, 0.20 mm; for sizes –82 through –150, 0.25 mm; and for sizes –155 through –250, 0.30 mm.

Groove Width Tolerances: For ring size –8, +0.10 mm; for sizes –9 through –38, +0.15 mm; for sizes –40 through –130, +0.20 mm; and for sizes –135 through –250, +0.25 mm.

Groove Maximum Bottom Radii: For ring sizes –8 through –17, 0.1 mm; for sizes –18 through – 30, 0.2 mm; for sizes –32 through –55, 0.3 mm; and for sizes –56 through –250, 0.4 mm.

For manufacturing details not shown, including materials, see ANSI B27.7M-1977, R1983.

Table 3. American National Standard Metric Reduced Cross Section Retaining Rings — E Ring External Series —3CM1 *ANSI B27.7M-1977, R1983*



Shaft Diam.	Ring			Groove				Shaft Diam.	Ring			Groove			
	Free Diam.	Thickness	Outer Diam.	Diam.	Width	Depth	Edge Margin		Free Diam.	Thickness	Outer Diam.	Diam.	Width	Depth	Edge Margin
S	*D*	*t*	*Y* nom	*G*	*W*	*d* ref	*Z* min	*S*	*D*	*t*	*Y* nom	*G*	*W*	*d* ref	*Z* min
1	0.64	0.25	2.0	0.72	0.32	0.14	0.3	11	8.55	0.9	17.4	8.90	1.0	1.05	2.1
2	1.30	0.25	4.0	1.45	0.32	0.28	0.6	12	9.20	1.1	18.6	9.60	1.2	1.20	2.4
3	2.10	0.4	5.6	2.30	0.5	0.35	0.7	13	9.95	1.1	20.3	10.30	1.2	1.35	2.7
4	2.90	0.6	7.2	3.10	0.7	0.45	0.9	15	11.40	1.1	22.8	11.80	1.2	1.60	3.2
5	3.70	0.6	8.5	3.90	0.7	0.55	1.1	16	12.15	1.1	23.8	12.50	1.2	1.75	3.5
6	4.70	0.6	11.1	4.85	0.7	0.58	1.2	18	13.90	1.3	27.2	14.30	1.4	1.85	3.7
7	5.25	0.6	13.4	5.55	0.7	0.73	1.5	20	15.60	1.3	30.0	16.00	1.4	2.00	4.0
8	6.15	0.6	14.6	6.40	0.7	0.80	1.6	22	17.00	1.3	33.0	17.40	1.4	2.30	4.6
9	6.80	0.9	15.8	7.20	1.0	0.90	1.8	25	19.50	1.3	37.1	20.00	1.4	2.50	5.0
10	7.60	0.9	16.8	8.00	1.0	1.00	2.0	…	…	…	…	…	…	…	…

All dimensions are in millimeters. Size –1 is available in beryllium copper only.

These rings are designated by series symbol and shaft diameter, thus: for a 2 mm diameter shaft, 3CM1-2; for a 13 mm shaft, 3CMI -13; etc.

Ring Free Diameter Tolerances: For ring sizes – 1 through –7, +0.03, –0.08 mm; for sizes –8 through –13, +0.05, –0.10 mm; and for sizes –15 through –25, +0.10, –0.15 mm.

Groove Diameter Tolerances: For ring sizes –1 and –2, –0.05 mm; for sizes –3 through –6, –0.08; for sizes –7 through –11, –0.10 mm; for sizes –12 through –18, – 0.15 mm; and for sizes –20 through –25, – 0.20 mm.

Groove Diameter F.I.M. (Full Indicator Movement) or maximum allowable deviation of concentricity between groove and shaft: For ring sizes –1 through –3, 0.04 mm; for –4 through –6, 0.05 mm; for –7 through –10, 0.08 mm; for –11 through –25, 0.10 mm.

Groove Width Tolerances: For ring sizes – 1 and –2, +0.05 mm; for size –3, +0.10 mm; and for sizes –4 through – 25, +0.15 mm.

Groove Maximum Bottom Radii: For ring sizes –1 and –2, 0.05 mm; for –3 through –7, 0.15 mm; for –8 through –13, 0.25 mm; and for –15 through –25, 0.4 mm.

For manufacturing details not shown, including materials, see ANSI B27.7M-1977, R1983.

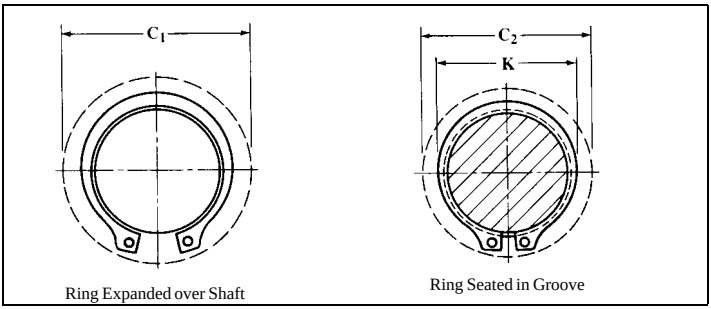


Table 4. American National Standard Metric Basic External Series 3AM1 Retaining Rings—Checking and Performance Data

Ring Series and Size No.	Clearance Diam.		Gaging Diameter[a]	Allowable Thrust Loads Sharp Corner Abutment		Maximum Allowable Corner Radii and Chamfers		Allowable Assembly Speed[b]
	Ring Over Shaft	Ring in Groove						
3AM1	C_1	C_2	K max	P_r[c]	P_g[d]	R max	Ch max	…
No.	mm	mm	mm	kN	kN	mm	mm	rpm
–4[a]	7.0	6.8	4.90	0.6	0.2	0.35	0.25	70 000
–5[a]	8.2	7.9	5.85	1.1	0.3	0.35	0.25	70 000
–6[a]	9.1	8.8	6.95	1.4	0.4	0.35	0.25	70 000
–7	12.3	11.8	8.05	2.6	0.7	0.45	0.3	60 000
–8	13.6	13.0	9.15	3.1	1.0	0.5	0.35	55 000
–9	14.5	13.8	10.35	3.5	1.2	0.6	0.35	48 000
–10	15.5	14.7	11.50	3.9	1.5	0.7	0.4	42 000
–11	16.4	15.6	12.60	4.3	1.8	0.75	0.45	38 000
–12	17.4	16.6	13.80	4.7	2.0	0.8	0.45	34 000
–13	19.7	18.8	15.05	7.5	2.2	0.8	0.5	31 000
–14	20.7	19.7	15.60	8.1	2.6	0.9	0.5	28 000
–15	21.7	20.6	17.20	8.7	3.2	1.0	0.6	27 000
–16	22.7	21.6	18.35	9.3	3.5	1.1	0.6	25 000
–17	23.7	22.6	19.35	9.9	4.0	1.1	0.6	24 000
–18	26.2	25.0	20.60	16.0	4.4	1.2	0.7	23 000
–19	27.2	25.9	21.70	16.9	4.9	1.2	0.7	21 500
–20	28.2	26.8	22.65	17.8	5.7	1.2	0.7	20 000
–21	29.2	27.7	23.80	18.6	6.2	1.3	0.7	19 000
–22	30.3	28.7	24.90	19.6	7.0	1.3	0.8	18 500
–23	31.3	29.6	26.00	20.5	7.6	1.3	0.8	18 000
–24	34.1	32.4	27.15	21.4	8.2	1.4	0.8	17 500
–25	35.1	33.3	28.10	22.3	9.2	1.4	0.8	17 000
–26	36.0	34.2	29.25	23.2	9.6	1.5	0.9	16 500
–27	37.8	35.9	30.35	28.4	10.3	1.5	0.9	16 300
–28	38.8	36.9	31.45	28.4	11.0	1.6	1.0	15 800
–30	40.8	38.8	33.6	31.6	12.3	1.6	1.0	15 000
–32	42.8	40.7	35.9	33.6	14.1	1.7	1.0	14 800
–34	44.9	42.5	37.9	36	16.7	1.7	1.1	14 000

Table 4. *(Continued)* **American National Standard Metric Basic External Series 3AM1 Retaining Rings—Checking and Performance Data**

Ring Series and Size No.	Clearance Diam.		Gaging Diameter[a]	Allowable Thrust Loads Sharp Corner Abutment		Maximum Allowable Corner Radii and Chamfers		Allowable Assembly Speed[b]
	Ring Over Shaft	Ring in Groove						
3AM1	C_1	C_2	K max	P_r[c]	P_g[d]	R max	Ch max	…
No.	mm	mm	mm	kN	kN	mm	mm	rpm
–35	45.9	43.4	39.0	37	18.1	1.8	1.1	13 500
–36	48.6	46.1	40.2	38	18.9	1.9	1.2	13 300
–38	50.6	48.0	42.5	40	20.5	2.0	1.2	12 700
–40	54.0	51.3	44.5	52	22.6	2.1	1.2	12 000
–42	56.0	53.2	46.9	54	24.8	2.2	1.3	11 000
–43	57.0	54.0	47.9	55	26.4	2.3	1.4	10 800
–45	59.0	55.9	50.0	58	28.8	2.3	1.4	10 000
–46	60.0	56.8	50.9	59	30.4	2.4	1.4	9 500
–48	62.4	59.1	53.0	62	33	2.4	1.4	8 800
–50	64.4	61.1	55.2	64	35	2.4	1.4	8 000
–52	67.6	64.1	57.4	84	37	2.5	1.5	7 700
–54	69.6	66.1	59.5	87	40	2.5	1.5	7 500
–55	70.6	66.9	60.4	89	44	2.5	1.5	7 400
–57	72.6	68.9	62.7	91	45	2.6	1.5	7 200
–58	73.6	69.8	63.6	93	46	2.6	1.6	7 100
–60	75.6	71.8	65.8	97	49	2.6	1.6	7 000
–62	77.6	73.6	67.9	100	52	2.7	1.6	6 900
–65	80.6	76.6	71.2	105	54	2.8	1.7	6 700
–68	83.6	79.5	74.5	110	58	2.9	1.7	6 500
–70	88.1	83.9	76.4	136	62	2.9	1.7	6 400
–72	90.1	85.8	78.5	140	65	2.9	1.7	6 200
–75	93.1	88.7	81.7	147	69	3.0	1.8	5 900
–78	95.4	92.1	84.6	151	76	3.0	1.8	5 600
–80	97.9	93.1	87.0	155	80	3.1	1.9	5 400
–82	100.0	95.1	89.0	159	84	3.2	1.9	5 200
–85	103.0	97.9	92.1	165	91	3.2	1.9	5 000
–88	107.0	100.8	95.1	199	97	3.2	1.9	4 800
–90	109.0	103.6	97.1	204	101	3.2	1.9	4 500
–95	114.0	108.6	102.7	215	112	3.4	2.1	4 350
–100	119.5	113.7	108.0	227	123	3.5	2.1	4 150

[a] For checking when ring is seated in groove.

[b] These values have been calculated for steel rings.

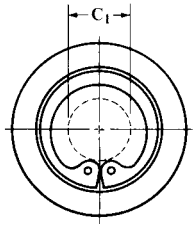
[c] These values apply to rings made from SAE 1060–1090 steels and PH 15-7 Mo stainless steel used on shafts hardened to R_c 50 minimum, with the exception of sizes –4, –5, and –6 which are supplied in beryllium copper only. Values for other sizes made from beryllium copper can be calculated by multiplying the listed values by 0.75. The values listed include a safety factor of 4.

[d] These values are for all standard rings used on low carbon steel shafts. They include a safety factor of 2.

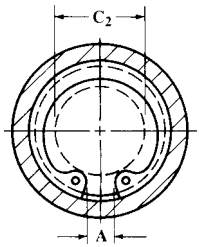
Maximum allowable assembly loads with R max or Ch max are: For rings sizes –4, 0.2 kN; for sizes –5 and –6, 0.5 kN; for sizes –7 through –12, 2.1 kN; for sizes –13 through –17, 4.0 kN; for sizes –18 through –26, 6.0 kN; for sizes –27 through –38, 8.6 kN; for sizes –40 through – 50, 13.2 kN; for sizes –52 through –68, 22.0 kN; for sizes –70 through –85, 32 kN; and for sizes –88 through –100, 47 kN.

Source: Appendix to American National Standard ANSI B27.7M-1977, R1983.

Table 5. American National Standard Metric Basic Internal Series 3BMI Retaining Rings — Checking and Performance Data

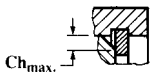


Ring Compressed in Bore



Ring Seated in Groove

Max Allowable Radius of Retained Part



Max Allowable Chamfer of Retained Part

Ring Series and Size No.	Clearance Diam.		Gaging Diameter[a]	Allowable Thrust Loads Sharp Corner Abutment		Maximum Allowable Corner Radii and Chamfers	
	Ring in Bore	Ring in Groove					
3BMI	C_1	C_2	A min	P_r[b]	P_g[c]	R max	Ch max
No.	mm	mm	mm	kN	kN	mm	mm
–8	4.4	4.8	1.40	2.4	1.0	0.4	0.3
–9	4.6	5.0	1.50	4.4	1.2	0.5	0.35
–10	5.5	6.0	1.85	4.9	1.5	0.5	0.35
–11	5.7	6.3	1.95	5.4	2.0	0.6	0.4
–12	6.7	7.3	2.25	5.8	2.4	0.6	0.4
–13	6.8	7.5	2.35	8.9	2.6	0.7	0.5
–14	6.9	7.7	2.65	9.7	3.2	0.7	0.5
–15	7.9	8.7	2.80	10.4	3.7	0.7	0.5
–16	8.8	9.7	2.80	11.0	4.2	0.7	0.5
–17	9.8	10.8	3.35	11.7	4.9	0.75	0.6
–18	10.3	11.3	3.40	12.3	5.5	0.75	0.6
–19	11.4	12.5	3.40	13.1	6.0	0.8	0.65
–20	11.6	12.7	3.8	13.7	6.6	0.9	0.7
–21	12.6	13.8	4.2	14.5	7.3	0.9	0.7
–22	13.5	14.8	4.3	22.5	8.3	0.9	0.7
–23	14.5	15.9	4.9	23.5	8.9	1.0	0.8
–24	15.5	16.9	5.2	24.8	9.7	1.0	0.8
–25	16.5	18.1	6.0	25.7	11.6	1.0	0.8
–26	17.5	19.2	5.7	26.8	12.7	1.2	1.0
–27	17.4	19.2	5.9	33	14.0	1.2	1.0
–28	18.2	20.0	6.0	34	14.6	1.2	1.0
–30	20.0	21.9	6.0	37	16.5	1.2	1.0
–32	22.0	23.9	7.3	39	17.6	1.2	1.0
–34	24.0	26.1	7.6	42	20.6	1.2	1.0
–35	25.0	27.2	8.0	43	22.3	1.2	1.0
–36	26.0	28.3	8.3	44	23.9	1.2	1.0
–37	27.0	29.3	8.4	45	24.6	1.2	1.0
–38	28.0	30.4	8.6	46	26.4	1.2	1.0
–40	29.2	31.6	9.7	62	27.7	1.7	1.3
–42	29.7	32.2	9.0	65	30.2	1.7	1.3
–45	32.3	34.9	9.6	69	33.8	1.7	1.3
–46	33.3	36.0	9.7	71	36	1.7	1.3
–47	34.3	37.1	10.0	72	38	1.7	1.3
–48	35.0	37.9	10.5	74	40	1.7	1.3
–50	36.9	40.0	12.1	77	45	1.7	1.3
–52	38.6	41.9	11.7	99	50	2.0	1.6
–55	40.8	44.2	11.9	105	54	2.0	1.6
–57	42.2	45.7	12.5	109	58	2.0	1.6

Table 5. *(Continued)* **American National Standard Metric Basic Internal Series 3BMI Retaining Rings — Checking and Performance Data**

–58	43.2	46.8	13.0	111	60	2.0	1.6
–60	45.5	49.3	12.7	115	66	2.0	1.6
–62	47.0	50.8	14.0	119	68	2.0	1.6
–63	47.8	51.7	14.2	120	71	2.0	1.6
–65	49.4	53.4	14.2	149	75	2.0	1.6
–68	52.0	56.2	14.4	156	82	2.3	1.8
–70	53.8	58.2	16.1	161	88	2.3	1.8
–72	55.9	60.4	17.4	166	93	2.3	1.8
–75	58.2	62.9	16.8	172	101	2.3	1.8
–78	61.2	66.0	17.6	209	108	2.5	2.0
–80	63.0	68.0	17.2	215	115	2.5	2.0
–82	63.5	68.7	18.8	220	122	2.6	2.1
–85	66.8	72.2	19.1	228	131	2.6	2.1
–88	69.6	75.2	20.4	236	141	2.8	2.2
–90	71.6	77.3	21.4	241	147	2.8	2.2
–92	73.6	79.4	22.2	247	153	2.9	2.4
–95	76.7	82.7	22.6	255	164	3.0	2.5
–98	78.3	84.5	22.6	263	174	3.0	2.5
–100	80.3	86.6	24.1	269	181	3.1	2.5
–102	82.2	88.6	25.5	273	187	3.2	2.6
–105	85.1	91.6	26.0	281	196	3.3	2.6
–108	88.1	94.7	26.4	290	205	3.5	2.7
–110	88.4	95.1	27.5	295	212	3.6	2.8
–115	93.2	100.1	29.4	309	227	3.7	2.9
–120	98.2	105.2	27.2	321	241	3.9	3.1
–125	103.1	110.2	30.3	335	255	4.0	3.2
–130	108.0	115.2	31.0	349	269	4.0	3.2
–135	110.4	117.7	30.4	415	283	4.3	3.4
–140	115.3	122.7	30.4	429	298	4.3	3.4
–145	120.4	127.9	31.6	444	313	4.3	3.4
–150	125.3	132.9	33.5	460	327	4.3	3.4
–155	130.4	138.1	37.0	475	343	4.3	3.4
–160	133.8	141.6	35.0	613	359	4.5	3.6
–165	138.7	146.6	33.1	632	374	4.6	3.7
–170	143.6	151.6	38.2	651	390	4.6	3.7
–175	146.0	154.2	37.7	670	403	4.8	3.8
–180	151.4	159.8	39.0	690	434	5.0	4.0
–185	154.7	163.3	37.3	851	457	5.1	4.1
–190	159.5	168.3	35.0	873	480	5.3	4.3
–200	169.2	178.2	43.9	919	517	5.4	4.3
–210	177.5	186.9	40.6	965	566	5.8	4.6
–220	184.1	194.1	38.3	1000	608	6.1	4.9
–230	194.0	204.6	49.0	1060	686	6.3	5.1
–240	200.4	211.4	45.4	1090	725	6.6	5.3
–250	210.0	221.4	53.0	1150	808	6.7	5.4

[a] For checking when ring is seated in groove.

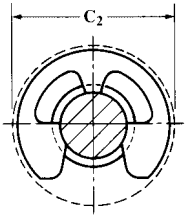
[b] These values apply to rings made from SAE 1060-1090 steels and PH 15-7 Mo stainless steel used in bores hardened to R_c 50 minimum. Values for rings made from beryllium copper can be calculated by multiplying the listed values by 0.75. The values listed include a safety factor of 4.

[c] These values are for standard rings used in low carbon steel bores. They include a safety factor of 2.

Maximum allowable assembly loads for *R* max or *Ch* max are: For ring size –8, 0.8 kN; for sizes –9 through –12, 2.0 kN; for sizes –13 through –21, 4.0 kN; for sizes –22 through –26, 7.4 kN; for sizes –27 through –38, 10.8 kN; for sizes –40 through –50, 17.4 kN; for sizes –52 through –63, 27.4 kN; for size –65, 42.0 kN; for sizes –68 through –72, 39 kN; for sizes –75 through –130, 54 kN; for sizes –135 through –155, 67 kN; for sizes –160 through –180, 102 kN; and for sizes –185 through –250, 151 kN.

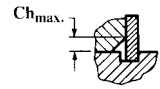
Source: Appendix to American National Standard ANSI B27.7M-1977, R1983.

Table 6. American National Standard Metric E-Type External Series 3CM1 Retaining Rings — Checking and Performance Data



Ring Seated in Groove

Max. Allowable Radius of Retained Part



Max. Allowable Chamfer of Retained Part

Ring Series and Size No.	Clearance Diameter Ring in Groove	Allowable Thrust Loads Sharp Corner Abutment		Maximum Allowable Corner Radii and Chamfers		Allowable Assembly Speed[a]
3CM1	C_2	P_r[b]	P_g[c]	*R* max	*Ch* max	…
No.	mm	kN	kN	mm	mm	rpm
–1	2.2	0.06	0.02	0.4	0.25	40 000
–2	4.3	0.13	0.09	0.8	0.5	40 000
–3	6.0	0.3	0.17	1.1	0.7	34 000
–4	7.6	0.7	0.3	1.6	1.2	31 000
–5	8.9	0.9	0.4	1.6	1.2	27 000
–6	11.5	1.1	0.6	1.6	1.2	25 000
–7	14.0	1.2	0.8	1.6	1.2	23 000
–8	15.1	1.4	1.0	1.7	1.3	21 500
–9	16.5	3.0	1.3	1.7	1.3	19 500
–10	17.5	3.4	1.6	1.7	1.3	18 000
–11	18.0	3.7	1.9	1.7	1.3	16 500
–12	19.3	4.9	2.3	1.9	1.4	15 000
–13	21.0	5.4	2.9	2.0	1.5	13 000
–15	23.5	6.2	4.0	2.0	1.5	11 500
–16	24.5	6.6	4.5	2.0	1.5	10 000
–18	27.9	8.7	5.4	2.1	1.6	9 000
–20	30.7	9.8	6.5	2.2	1.7	8 000
–22	33.7	10.8	8.1	2.2	1.7	7 000
–25	37.9	12.2	10.1	2.4	1.9	5 000

[a] These values have been calculated for steel rings.

[b] These values apply to rings made from SAE 1060-1090 steels and PH 15-7 Mo stainless steel used on shafts hardened to R_c 50 minimum, with the exception of size –1 which is supplied in beryllium copper only. Values for other sizes made from beryllium copper can be calculated by multiplying the listed values by 0.75. The values listed include a safety factor of 4.

[c] These values apply to all standard rings used on low carbon steel shafts. They include a safety factor of 2.

Maximum allowable assembly loads with *R* max or *Ch* max are as follows:

Ring Size No.	Maximum Allowable Load,kN	Ring Size No.	Maximum AllowableLoad, kN	Ring Size No.	Maximum AllowableLoad, kN
–1	0.06	–8	1.4	–16	6.6
–2	0.13	–9	3.0	–18	8.7
–3	0.3	–10	3.4	–20	9.8
–4	0.7	–11	3.7	–22	10.8
–5	0.9	–12	4.9	–25	12.2
–6	1.1	–13	5.4	…	…
–7	1.2	–15	6.2	…	…

Source: Appendix to American National Standard ANSI B27.7M-1977, R1983.

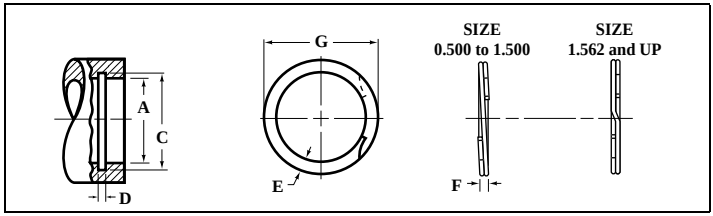


Table 7. Medium Duty Internal Spiral Retaining Rings *MIL-R-27426*

Bore Dia. A	Ring		Groove		Static Thrust Load (lb)		Bore Dia. A	Ring		Groove		Static Thrust Load (lb)	
	Dia. G	Wall E	Dia. C	Width D	Ring	Groove		Dia. G	Wall E	Dia. C	Width D	Ring	Groove
0.500	0.532	0.045	0.526	0.030	2000	405	3.437	3.574	0.188	3.543	0.068	27660	18240
0.512	0.544	0.045	0.538	0.030	2050	420	3.500	3.636	0.188	3.606	0.068	28170	18575
0.531	0.564	0.045	0.557	0.030	2130	455	3.543	3.684	0.198	3.653	0.068	28520	19515
0.562	0.594	0.045	0.588	0.030	2250	495	3.562	3.703	0.198	3.672	0.068	28670	19620
0.594	0.626	0.045	0.619	0.030	2380	535	3.625	3.769	0.198	3.737	0.068	29180	20330
0.625	0.658	0.045	0.651	0.030	2500	610	3.687	3.832	0.198	3.799	0.068	29680	20675
0.656	0.689	0.045	0.682	0.030	2630	670	3.740	3.885	0.198	3.852	0.068	30100	20975
0.687	0.720	0.045	0.713	0.030	2750	725	3.750	3.894	0.198	3.862	0.068	30180	21030
0.718	0.751	0.045	0.744	0.030	2870	790	3.812	3.963	0.208	3.930	0.068	30680	22525
0.750	0.790	0.065	0.782	0.036	3360	800	4.437	4.611	0.238	4.573	0.068	35710	30215
0.777	0.817	0.065	0.808	0.036	3480	835	4.500	4.674	0.238	4.636	0.068	36220	30645
0.781	0.821	0.065	0.812	0.036	3500	840	4.527	4.701	0.238	4.663	0.068	36440	30830
0.812	0.853	0.065	0.843	0.036	3640	915	4.562	4.737	0.238	4.698	0.079	36720	31065
0.843	0.889	0.065	0.880	0.036	3780	1155	4.625	4.803	0.250	4.765	0.079	43940	32420
0.866	0.913	0.065	0.903	0.036	3880	1250	4.687	4.867	0.250	4.827	0.079	44530	32855
0.875	0.922	0.065	0.912	0.036	3920	1250	4.724	4.903	0.250	4.864	0.079	44880	33115
0.906	0.949	0.065	0.939	0.036	4060	1335	4.750	4.930	0.250	4.890	0.079	45130	33300
0.938	0.986	0.065	0.975	0.036	4200	1430	4.812	4.993	0.250	4.952	0.079	45710	33735
0.968	1.025	0.075	1.015	0.042	4340	1950	4.875	5.055	0.250	5.015	0.079	46310	34175
0.987	1.041	0.075	1.030	0.042	4420	1865	4.921	5.102	0.250	5.061	0.079	46750	34495
1.000	1.054	0.075	1.043	0.042	4480	1910	4.937	5.122	0.250	5.081	0.079	46900	35595
1.023	1.078	0.075	1.066	0.042	5470	1660	5.000	5.185	0.250	5.144	0.079	47500	36050
1.031	1.084	0.075	1.074	0.042	5510	1650	5.118	5.304	0.250	5.262	0.079	48620	36905
1.062	1.117	0.075	1.104	0.042	5680	1745	5.125	5.311	0.250	5.269	0.079	48690	36955
1.093	1.147	0.075	1.135	0.042	5840	1820	5.250	5.436	0.250	5.393	0.079	49880	37590
1.125	1.180	0.075	1.167	0.042	6010	1935	5.375	5.566	0.250	5.522	0.079	51050	39565
1.156	1.210	0.075	1.198	0.042	6180	2020	5.500	5.693	0.250	5.647	0.079	52250	40485
1.188	1.249	0.085	1.236	0.048	7380	2115	5.511	5.703	0.250	5.658	0.079	52350	40565
1.218	1.278	0.085	1.266	0.048	7570	2195	5.625	5.818	0.250	5.772	0.079	53440	41405
1.250	1.312	0.085	1.298	0.048	7770	2510	5.708	5.909	0.250	5.861	0.079	54230	43730
1.281	1.342	0.085	1.329	0.048	7960	2425	5.750	5.950	0.250	5.903	0.079	54630	44050
1.312	1.374	0.085	1.360	0.048	8150	2532	5.875	6.077	0.250	6.028	0.079	55810	45010
1.343	1.408	0.085	1.395	0.048	8340	2875	5.905	6.106	0.250	6.058	0.079	56100	45240
1.375	1.442	0.095	1.427	0.048	8540	3070	6.000	6.202	0.312	6.153	0.079	57000	45965
1.406	1.472	0.095	1.458	0.048	8740	3180	6.125	6.349	0.312	6.297	0.094	69500	52750
1.437	1.504	0.095	1.489	0.048	8930	3330	6.250	6.474	0.312	6.422	0.094	70920	53825
1.456	1.523	0.095	1.508	0.048	9050	3410	6.299	6.524	0.312	6.471	0.094	71480	54250
1.468	1.535	0.095	1.520	0.048	9120	3460	6.375	6.601	0.312	6.547	0.094	72340	54905
1.500	1.567	0.095	1.552	0.048	9320	3605	6.500	6.726	0.312	6.672	0.094	73760	55980
1.562	1.634	0.108	1.617	0.056	10100	3590	6.625	6.863	0.312	6.807	0.094	75180	60375
1.574	1.649	0.108	1.633	0.056	10180	3640	6.692	6.931	0.312	6.874	0.094	75940	60985
1.625	1.701	0.108	1.684	0.056	10510	3875	6.750	6.987	0.312	6.932	0.094	76590	61515
1.653	1.730	0.108	1.712	0.056	10690	4020	6.875	7.114	0.312	7.057	0.094	78010	62655
1.687	1.768	0.118	1.750	0.056	10910	4510	7.000	7.239	0.312	7.182	0.094	79430	63790
1.750	1.834	0.118	1.813	0.056	11310	4895	7.086	7.337	0.312	7.278	0.094	80410	68125
1.813	1.894	0.118	1.875	0.056	11720	5080	7.125	7.376	0.312	7.317	0.094	80850	68500

Table 7. *(Continued)* **Medium Duty Internal Spiral Retaining Rings** *MIL-R-27426*

Bore Dia.	Ring		Groove		Static Thrust Load (lb)		Bore Dia.	Ring		Groove		Static Thrust Load (lb)	
	Dia.	Wall	Dia.	Width				Dia.	Wall	Dia.	Width		
A	G	E	C	D	Ring	Groove	A	G	E	C	D	Ring	Groove
1.850	1.937	0.118	1.917	0.056	11960	5735	7.250	7.501	0.312	7.442	0.094	82270	69700
1.875	1.960	0.118	1.942	0.056	12120	5825	7.375	7.628	0.312	7.567	0.094	83690	70900
1.938	2.025	0.118	2.005	0.056	12530	6250	7.480	7.734	0.312	7.672	0.094	84880	71910
2.000	2.091	0.128	2.071	0.056	12930	7090	7.500	7.754	0.312	7.692	0.094	85110	72105
2.047	2.138	0.128	2.118	0.056	13230	7275	7.625	7.890	0.312	7.827	0.094	86520	77125
2.062	2.154	0.128	2.132	0.056	13330	7225	7.750	8.014	0.312	7.952	0.094	87940	78390
2.125	2.217	0.128	2.195	0.056	13740	7450	7.875	8.131	0.312	8.077	0.094	89360	79655
2.165	2.260	0.138	2.239	0.056	14000	8020	8.000	8.266	0.312	8.202	0.094	90780	80920
2.188	2.284	0.138	2.262	0.056	14150	8105	8.250	8.528	0.375	8.462	0.094	93620	87575
2.250	2.347	0.138	2.324	0.056	14550	8335	8.267	8.546	0.375	8.479	0.094	93810	87755
2.312	2.413	0.138	2.390	0.056	14950	9030	8.464	8.744	0.375	8.676	0.094	96040	89850
2.375	2.476	0.138	2.453	0.056	15350	9275	8.500	8.780	0.375	8.712	0.094	96450	90230
2.437	2.543	0.148	2.519	0.056	15760	10005	8.750	9.041	0.375	8.972	0.094	99290	97265
2.440	2.546	0.148	2.522	0.056	15780	10015	8.858	9.151	0.375	9.080	0.094	100520	98465
2.500	2.606	0.148	2.582	0.056	16160	10625	9.000	9.293	0.375	9.222	0.094	102130	100045
2.531	2.641	0.148	2.617	0.056	16360	10900	9.055	9.359	0.375	9.287	0.094	102750	105190
2.562	2.673	0.148	2.648	0.056	16560	11030	9.250	9.555	0.375	9.482	0.094	104960	107455
2.625	2.736	0.148	2.711	0.056	16970	11305	9.448	9.755	0.375	9.680	0.094	107210	109755
2.677	2.789	0.158	2.767	0.056	17310	12065	9.500	9.806	0.375	9.732	0.094	107800	110360
2.688	2.803	0.158	2.778	0.056	17380	12115	9.750	10.068	0.375	9.992	0.094	110640	118145
2.750	2.865	0.158	2.841	0.056	17780	12530	10.000	10.320	0.375	10.242	0.094	113470	121175
2.813	2.929	0.158	2.903	0.056	18190	12675	10.250	10.582	0.375	10.502	0.094	116310	129340
2.834	2.954	0.168	2.928	0.056	18320	13340	10.500	10.834	0.375	10.752	0.094	119150	132490
2.875	2.995	0.168	2.969	0.056	18590	13530	10.750	11.095	0.375	11.012	0.094	121980	141030
2.937	3.058	0.168	3.031	0.056	18990	13825	11.000	11.347	0.375	11.262	0.094	124820	144310
2.952	3.073	0.168	3.046	0.056	19090	13890	3.875	4.025	0.208	3.993	0.068	30680	22525
3.000	3.122	0.168	3.096	0.068	24150	14420	3.938	4.089	0.208	4.056	0.068	31700	23265
3.062	3.186	0.168	3.158	0.068	24640	14720	4.000	4.157	0.218	5.124	0.068	32190	24835
3.125	3.251	0.178	3.223	0.068	25150	15335	4.063	4.222	0.218	4.187	0.068	32700	25225
3.149	3.276	0.178	3.247	0.068	25340	15450	4.125	4.284	0.218	4.249	0.068	33200	25610
3.187	3.311	0.178	3.283	0.068	25650	15640	4.188	4.347	0.218	4.311	0.068	33710	25795
3.250	3.379	0.178	3.350	0.068	26160	16270	4.250	4.416	0.228	4.380	0.068	34210	27665
3.312	3.446	0.188	3.416	0.068	26660	17245	4.312	4.479	0.228	4.442	0.068	34710	28065
3.346	3.479	0.188	3.450	0.068	26930	17425	4.330	4.497	0.228	4.460	0.068	34850	28185
3.375	3.509	0.188	3.479	0.068	27160	17575	4.375	4.543	0.228	4.505	0.068	32210	28475

Source: Spirolox Retaining Rings, RR Series. All dimensions are in inches. Depth of groove $d = (C - A)/2$. Standard material: carbon spring steel (SAE 1070-1090).

Ring Thickness, F: For shaft sizes 0.500 through 0.718, 0.025; for sizes 0.750 through 0.938, 0.031; for sizes 0.968 through 1.156, 0.037; for sizes 1.188 through 1.500, 0.043; for sizes 1.562 through 2.952, 0.049; for sizes 3.000 through 4.562, 0.061; for sizes 4.625 through 6.000, 0.072; for sizes 6.125 through 11.000, 0.086.

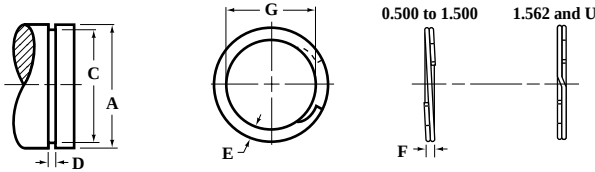
Ring Free Diameter Tolerances: For housing sizes 0.500 through 1.031, +0.013, –0.000; for sizes 1.062 through 1.500, +0.015, –0.000; for sizes 1.562 through 2.047, +0.020, –0.000; for sizes 2.062 through 3.000, +0.025, –0.000; for sizes 3.062 through 4.063, +0.030, –0.000; for sizes 4.125 through 5.125, +0.035, –0.000; for sizes 5.250 through 6.125, +0.045, –0.000; for sizes 6.250 through 7.125, +0.055, –0.000; for sizes 7.250 through 11.000, +0.065, –0.000.

Ring Thickness Tolerances: Thickness indicated is for unplated rings; add 0.002 to upper thickness tolerance for plated rings. For housing sizes 0.500 through 1.500, ±0.002; for sizes 1.562 through 4.562, ±0.003; for sizes 4.625 through 11.000, ±0.004.

Groove Diameter Tolerances: For housing sizes 0.500 through 0.750, ±0.002; for sizes 0.777 through 1.031, ±0.003; for sizes 1.062 through 1.500, ±0.004; for sizes 1.562 through 2.047, ±0.005; for sizes 2.062 through 5.125, ±0.006; for sizes 5.250 through 6.000, ±0.007; for sizes 6.125 through 11.000, ±0.008.

Groove Width Tolerances: For housing sizes 0.500 through 1.156, +0.003, –0.000; for sizes 1.188 through 2.952, +0.004, –0.000; for sizes 3.000 through 6.000, +0.005, –0.000; for sizes 6.125 through 11.000, +0.006, –0.000.

Table 8. Medium Duty External Spiral Retaining Rings *MIL-R-27426*



Shaft Dia. A	Ring		Groove		Static Thrust Load (lb)		Shaft Dia. A	Ring		Groove		Static Thrust Load (lb)	
	Dia. G	Wall E	Dia. C	Width D	Ring	Groove		Dia. G	Wall E	Dia. C	Width D	Ring	Groove
0.500	0.467	0.045	0.474	0.030	2000	550	3.343	3.210	0.188	3.239	0.068	26910	17410
0.531	0.498	0.045	0.505	0.030	2130	640	3.375	3.242	0.188	3.271	0.068	27160	17570
0.551	0.518	0.045	0.525	0.030	2210	700	3.437	3.301	0.188	3.331	0.068	27660	18240
0.562	0.529	0.045	0.536	0.030	2250	730	3.500	3.363	0.188	3.394	0.068	28170	18580
0.594	0.561	0.045	0.569	0.030	2380	740	3.543	3.402	0.198	3.433	0.068	28520	19510
0.625	0.585	0.055	0.594	0.030	2500	970	3.562	3.422	0.198	3.452	0.068	28670	19620
0.656	0.617	0.055	0.625	0.030	2630	1020	3.625	3.483	0.198	3.515	0.068	29180	19970
0.669	0.629	0.055	0.638	0.030	2680	1040	3.687	3.543	0.198	3.575	0.068	29680	20680
0.687	0.647	0.055	0.656	0.030	2750	1060	3.740	3.597	0.198	3.628	0.068	30100	20970
0.718	0.679	0.055	0.687	0.030	2870	1110	3.750	3.606	0.198	3.638	0.068	30180	21030
0.750	0.710	0.065	0.719	0.036	3360	1100	3.812	3.668	0.198	3.700	0.068	30680	21380
0.781	0.741	0.065	0.750	0.036	3500	1210	3.875	3.724	0.208	3.757	0.068	31190	22890
0.812	0.771	0.065	0.781	0.036	3640	1260	3.938	3.784	0.208	3.820	0.068	31700	23270
0.843	0.803	0.065	0.812	0.036	3780	1310	4.000	3.842	0.218	3.876	0.068	32190	24840
0.875	0.828	0.065	0.838	0.036	3920	1620	4.063	3.906	0.218	3.939	0.068	32700	25230
0.906	0.860	0.065	0.869	0.036	4060	1680	4.125	3.967	0.218	4.000	0.068	33200	25820
0.937	0.889	0.065	0.900	0.036	4200	1740	4.134	3.975	0.218	4.010	0.068	33270	25670
0.968	0.916	0.075	0.925	0.042	5180	2080	4.188	4.030	0.218	4.058	0.068	33710	27260
0.984	0.930	0.075	0.941	0.042	5260	2120	4.250	4.084	0.228	4.120	0.068	34210	27660
1.000	0.946	0.075	0.957	0.042	5350	2150	4.312	4.147	0.218	4.182	0.068	34710	28070
1.023	0.968	0.075	0.980	0.042	5470	2200	4.331	4.164	0.218	4.200	0.068	34860	28410
1.031	0.978	0.075	0.988	0.042	5510	2220	4.375	4.208	0.218	4.245	0.068	35210	28480
1.062	1.007	0.075	1.020	0.042	5680	2230	4.437	4.271	0.218	4.307	0.068	35710	28880
1.093	1.040	0.075	1.051	0.042	5840	2300	4.500	4.326	0.238	4.364	0.068	36220	30640
1.125	1.070	0.075	1.083	0.042	6010	2370	4.562	4.384	0.250	4.422	0.079	43340	31980
1.156	1.102	0.075	1.114	0.042	6180	2430	4.625	4.447	0.250	4.485	0.079	43940	32420
1.188	1.127	0.085	1.140	0.048	7380	2850	4.687	4.508	0.250	4.457	0.079	44530	32860
1.218	1.159	0.085	1.170	0.048	7570	2930	4.724	4.546	0.250	4.584	0.079	44880	33120
1.250	1.188	0.085	1.202	0.048	7770	3000	4.750	4.571	0.250	4.610	0.079	45130	33300
1.281	1.221	0.085	1.233	0.048	7960	3080	4.812	4.633	0.250	4.672	0.079	45710	33730
1.312	1.251	0.095	1.264	0.048	8150	3150	4.875	4.695	0.250	4.735	0.079	46310	34170
1.343	1.282	0.095	1.295	0.048	8340	3230	4.937	4.757	0.250	4.797	0.079	46900	34610
1.375	1.308	0.095	1.323	0.048	8540	3580	5.000	4.820	0.250	4.856	0.079	47500	36050
1.406	1.340	0.095	1.354	0.048	8740	3660	5.118	4.934	0.250	4.974	0.079	48620	36900
1.437	1.370	0.095	1.385	0.048	8930	3740	5.125	4.939	0.250	4.981	0.079	48690	36950
1.468	1.402	0.095	1.416	0.048	9120	3820	5.250	5.064	0.250	5.107	0.079	49880	37590
1.500	1.433	0.095	1.448	0.048	9320	3910	5.375	5.187	0.250	5.228	0.079	51060	39560
1.562	1.490	0.108	1.507	0.056	10100	4300	5.500	5.308	0.250	5.353	0.079	52250	40480
1.575	1.503	0.108	1.520	0.056	10190	4340	5.511	5.320	0.250	5.364	0.079	52350	40560
1.625	1.549	0.108	1.566	0.056	10510	4800	5.625	5.433	0.250	5.478	0.079	53440	41400

Table 8. *(Continued)* **Medium Duty External Spiral Retaining Rings** *MIL-R-27426*

1.687	1.610	0.118	1.628	0.056	10910	4980	5.750	5.550	0.250	5.597	0.079	54630	44050
1.750	1.673	0.118	1.691	0.056	11310	5170	5.875	5.674	0.250	5.722	0.079	55810	45010
1.771	1.690	0.118	1.708	0.056	11450	5590	5.905	5.705	0.250	5.752	0.079	56100	45240
1.813	1.730	0.118	1.749	0.056	11720	5810	6.000	5.798	0.250	5.847	0.079	57000	45970
1.875	1.789	0.128	1.808	0.056	12120	6290	6.125	5.903	0.312	5.953	0.094	69500	52750
1.938	1.844	0.128	1.861	0.056	12530	7470	6.250	6.026	0.312	6.078	0.094	70920	53830
1.969	1.882	0.128	1.902	0.056	12730	6610	6.299	6.076	0.312	6.127	0.094	71480	54250
2.000	1.909	0.128	1.992	0.056	12930	7110	6.375	6.152	0.312	6.203	0.094	72340	54900
2.062	1.971	0.128	2.051	0.056	13330	7870	6.500	6.274	0.312	6.328	0.094	73760	55980
2.125	2.029	0.128	2.082	0.056	13740	7990	6.625	6.390	0.312	6.443	0.094	75180	60380
2.156	2.060	0.138	2.091	0.056	13940	8020	6.750	6.513	0.312	6.568	0.094	76590	61515
2.188	2.070	0.138	2.113	0.056	14150	8220	6.875	6.638	0.312	6.693	0.094	78010	62650
2.250	2.092	0.138	2.176	0.056	14550	8340	7.000	6.761	0.312	6.818	0.094	79430	63790
2.312	2.153	0.138	2.234	0.056	14950	9030	7.125	6.877	0.312	6.933	0.094	80850	68500
2.362	2.211	0.138	2.284	0.056	15270	9230	7.250	6.999	0.312	7.058	0.094	82270	69700
2.375	2.273	0.138	2.297	0.056	15350	9280	7.375	7.125	0.312	7.183	0.094	83690	70900
2.437	2.331	0.148	2.355	0.056	15760	10000	7.500	7.250	0.312	7.308	0.094	85110	72100
2.500	2.394	0.148	2.418	0.056	16160	10260	7.625	7.363	0.312	7.423	0.094	86520	77120
2.559	2.449	0.148	2.473	0.056	16540	11020	7.750	7.486	0.312	7.548	0.094	87940	78390
2.562	2.452	0.148	2.476	0.056	16560	11030	7.875	7.611	0.312	7.673	0.094	89360	79650
2.625	2.514	0.148	2.539	0.056	16970	11300	8.000	7.734	0.312	7.798	0.094	90780	80920
2.688	2.572	0.158	2.597	0.056	17380	12250	8.250	7.972	0.375	8.038	0.094	93620	87580
2.750	2.635	0.158	2.660	0.056	17780	12390	8.500	8.220	0.375	8.288	0.094	96450	90230
2.813	2.696	0.168	2.722	0.056	18190	12820	8.750	8.459	0.375	8.528	0.094	99290	97270
2.875	2.755	0.168	2.781	0.056	18590	13530	9.000	8.707	0.375	8.778	0.094	102130	100050
2.937	2.817	0.168	2.843	0.056	18990	13820	9.250	8.945	0.375	9.018	0.094	104960	107560
2.952	2.831	0.168	2.858	0.056	19090	13890	9.500	9.194	0.375	9.268	0.094	107800	110360
3.000	2.877	0.168	2.904	0.068	24150	14420	9.750	9.432	0.375	9.508	0.094	110640	118150
3.062	2.938	0.168	2.966	0.068	24640	14720	10.000	9.680	0.375	9.758	0.094	113470	121180
3.125	3.000	0.178	3.027	0.068	25150	15335	10.250	9.918	0.375	9.998	0.094	116310	129340
3.149	3.023	0.178	3.051	0.068	25340	15450	10.500	10.166	0.375	10.248	0.094	119150	132490
3.187	3.061	0.178	3.089	0.068	25650	15640	10.750	10.405	0.375	10.488	0.094	121980	141030
3.250	3.121	0.178	3.150	0.068	26160	16270	11.000	10.653	0.375	10.738	0.094	124820	144310
3.312	3.180	0.188	3.208	0.068	26660	17250							

Source: Spirolox Retaining Rings, RS Series. All dimensions are in inches. Depth of groove $d = (A - C)/2$. Standard material: carbon spring steel (SAE 1070–1090).

Ring Thickness, F: For shaft sizes 0.500 through 0.718, 0.025; for sizes 0.750 through 0.937, 0.031; for sizes 0.968 through 1.156, 0.037; for sizes 1.188 through 1.500, 0.043; for sizes 1.562 through 2.952, 0.049; for sizes 3.000 through 4.500, 0.061; for sizes 4.562 through 6.000, 0.072; for sizes 6.125 through 11.000, 0.086.

Ring Free Diameter Tolerances: For shaft sizes 0.500 through 1.031, +0.000, + 0.000, –0.013; for sizes 1.062 through 1.500, +0.000, –0.015; for sizes 1.562 through 2.125, +0.000, –0.020; for sizes 2.156 through 2.688, +0.000, –0.025; for sizes 2.750 through 3.437, +0.000, –0.030; for sizes 3.500 through 5.125, +0.000, –0.040; for sizes 5.250 through 6.125, +0.000, –0.050; for sizes 6.250 through 7.375, +0.000, –0.060; for sizes 7.500 through 11.000, +0.000, –0.070.

Ring Thickness Tolerances: Thickness indicated is for unplated rings; add 0.002 to upper tolerance for plated rings. For shaft sizes 0.500 through 1.500, ± 0.002; for sizes 1.562 through 4.500, ± 0.003; for sizes 4.562 through 11.000, ± 0.004.

Groove Diameter Tolerances: For shaft sizes 0.500 through 0.562, ±0.002; for sizes 0.594 through 1.031, ± 0.003; for sizes 1.062 through 1.500, ± 0.004; for sizes 1.562 through 2.000, ± 0.005; for sizes 2.062 through 5.125, ±0.006; for sizes 5.250 through 6.000, ± 0.007; for sizes 6.125 through 11.000, ± 0.008.

Groove Width Tolerances: For shaft sizes 0.500 through 1.156, +0.003, –0.000; for sizes 1.188 through 2.952, +0.004, –0.000; for sizes 3.000 through 6.000, +0.005, –0.000; for sizes 6.125 through 11.000, +0.006, –0.000.

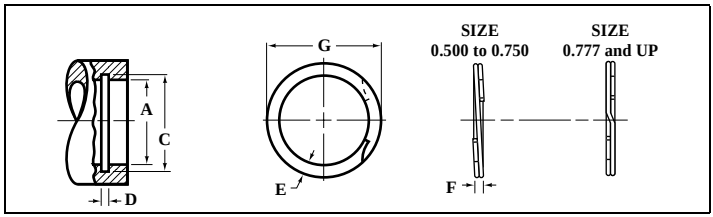


Table 9. Heavy Duty Internal Spiral Retaining Rings *MIL-R-27426*

Bore Dia. A	Ring		Groove		Static Thrust Load (lb)		Bore Dia. A	Ring		Groove		Static Thrust Load (lb)	
	Dia. G	Wall E	Dia. C	Width D	Ring	Groove		Dia. G	Wall E	Dia. C	Width D	Ring	Groove
0.500	0.538	0.045	0.530	0.039	2530	310	3.543	3.781	0.281	3.755	0.120	49420	28250
0.512	0.550	0.045	0.542	0.039	2590	325	3.562	3.802	0.281	3.776	0.120	49680	28815
0.562	0.605	0.055	0.596	0.039	2840	455	3.625	3.868	0.281	3.841	0.120	50560	30160
0.625	0.675	0.055	0.655	0.039	3160	655	3.750	4.002	0.312	3.974	0.120	52310	33720
0.688	0.743	0.065	0.732	0.039	3480	965	3.875	4.136	0.312	4.107	0.120	54050	37250
0.750	0.807	0.065	0.796	0.039	3790	1065	3.938	4.203	0.312	4.174	0.120	54930	39045
0.777	0.836	0.075	0.825	0.046	4720	1026	4.000	4.270	0.312	4.240	0.120	55790	41025
0.812	0.873	0.075	0.862	0.046	4930	1150	4.125	4.369	0.312	4.339	0.120	57540	38495
0.866	0.931	0.075	0.920	0.046	5260	1395	4.250	4.501	0.312	4.470	0.120	59280	41955
0.875	0.943	0.085	0.931	0.046	5310	1520	4.330	4.588	0.312	4.556	0.120	60400	44815
0.901	0.972	0.085	0.959	0.046	5470	1675	4.500	4.768	0.312	4.735	0.120	62770	50290
0.938	1.013	0.085	1.000	0.046	5690	1925	4.625	4.899	0.312	4.865	0.120	64510	54155
1.000	1.080	0.085	1.066	0.046	6070	2310	4.750	5.030	0.312	4.995	0.120	66260	58270
1.023	1.105	0.085	1.091	0.046	6210	2480	5.000	5.297	0.312	5.260	0.120	69740	65095
1.062	1.138	0.103	1.130	0.056	7010	1940	5.250	5.559	0.350	5.520	0.139	83790	68315
1.125	1.205	0.103	1.197	0.056	7420	2280	5.375	5.690	0.350	5.650	0.139	85780	72840
1.188	1.271	0.103	1.262	0.056	7840	2615	5.500	5.810	0.350	5.770	0.139	87780	74355
1.250	1.339	0.103	1.330	0.056	8250	3110	5.750	6.062	0.350	6.020	0.139	91770	77735
1.312	1.406	0.118	1.396	0.056	8650	3650	6.000	6.314	0.350	6.270	0.139	95760	81120
1.375	1.471	0.118	1.461	0.056	9070	4075	6.250	6.576	0.380	6.530	0.174	122520	80655
1.439	1.539	0.118	1.528	0.056	9490	4670	6.500	6.838	0.380	6.790	0.174	127420	90295
1.456	1.559	0.118	1.548	0.056	9600	4890	6.625	6.974	0.380	6.925	0.174	129870	92060
1.500	1.605	0.118	1.594	0.056	9900	5275	6.750	7.105	0.380	7.055	0.174	132320	102475
1.562	1.675	0.128	1.658	0.068	12780	4840	7.000	7.366	0.380	7.315	0.174	137220	110410
1.625	1.742	0.128	1.725	0.068	13290	5415	7.250	7.628	0.418	7.575	0.209	170370	103440
1.653	1.772	0.128	1.755	0.068	13520	5695	7.500	7.895	0.418	7.840	0.209	176240	115780
1.688	1.810	0.128	1.792	0.068	13810	6070	7.750	8.157	0.418	8.100	0.209	182120	127270
1.750	1.876	0.128	1.858	0.068	14320	7635	8.000	8.419	0.418	8.360	0.209	187990	139370
1.812	1.940	0.128	1.922	0.068	14820	7305	8.250	8.680	0.437	8.620	0.209	193870	152695
1.850	1.981	0.158	1.962	0.068	15130	7960	8.500	8.942	0.437	8.880	0.209	199740	161735
1.875	2.008	0.158	1.989	0.068	15340	8305	8.750	9.209	0.437	9.145	0.209	205620	173065
1.938	2.075	0.158	2.056	0.068	15850	9125	9.000	9.471	0.437	9.405	0.209	211490	182515
2.000	2.142	0.158	2.122	0.068	16360	10040	9.250	9.737	0.437	9.669	0.209	217370	194070
2.062	2.201	0.168	2.186	0.086	21220	8280	9.500	10.000	0.500	9.930	0.209	223240	204550

Table 9. *(Continued)* **Heavy Duty Internal Spiral Retaining Rings** *MIL-R-27426*

Bore Dia. A	Ring		Groove		Static Thrust Load (lb)		Bore Dia. A	Ring		Groove		Static Thrust Load (lb)	
	Dia. G	Wall E	Dia. C	Width D	Ring	Groove		Dia. G	Wall E	Dia. C	Width D	Ring	Groove
2.125	2.267	0.168	2.251	0.086	21870	8935	9.750	10.260	0.500	10.189	0.209	229120	214325
2.188	2.334	0.168	2.318	0.086	22520	9745	10.000	10.523	0.500	10.450	0.209	234990	225330
2.250	2.399	0.168	2.382	0.086	23160	10455	10.250	10.786	0.500	10.711	0.209	240870	236605
2.312	2.467	0.200	2.450	0.086	23790	11700	10.500	11.047	0.500	10.970	0.209	246740	247110
2.357	2.535	0.200	2.517	0.086	24440	12715	10.750	11.313	0.500	11.234	0.209	252620	260530
2.440	2.602	0.200	2.584	0.086	25110	13550	11.000	11.575	0.500	11.495	0.209	258490	272645
2.500	2.667	0.200	2.648	0.086	25730	14640	11.250	11.838	0.500	11.756	0.209	264360	285040
2.531	2.700	0.200	2.681	0.086	26050	15185	11.500	12.102	0.562	12.018	0.209	270240	298285
2.562	2.733	0.225	2.714	0.103	29940	12775	11.750	12.365	0.562	12.279	0.209	276120	311240
2.625	2.801	0.225	2.781	0.103	30680	13780	12.000	12.628	0.562	12.540	0.209	281990	324475
2.688	2.868	0.225	2.848	0.103	31410	14775	12.250	12.891	0.562	12.801	0.209	287860	337980
2.750	2.934	0.225	2.914	0.103	32140	15790	12.500	13.154	0.562	13.063	0.209	293740	352390
2.813	3.001	0.225	2.980	0.103	32870	16845	12.750	13.417	0.562	13.324	0.209	299610	366460
2.834	3.027	0.225	3.006	0.103	33120	17595	13.000	13.680	0.662	13.585	0.209	305490	380805
2.875	3.072	0.225	3.051	0.103	33600	18505	13.250	13.943	0.662	13.846	0.209	311360	395430
3.000	3.204	0.225	3.182	0.103	35060	20795	13.500	14.207	0.662	14.108	0.209	317240	411000
3.062	3.271	0.281	3.248	0.120	42710	18735	13.750	14.470	0.662	14.369	0.209	323110	426185
3.125	3.338	0.281	3.315	0.120	43590	19865	14.000	14.732	0.662	14.630	0.209	328990	441645
3.157	3.371	0.281	3.348	0.120	44020	20345	14.250	14.995	0.662	14.891	0.209	334860	457380
3.250	3.470	0.281	3.446	0.120	45330	22120	14.500	15.259	0.750	15.153	0.209	340740	474120
3.346	3.571	0.281	3.546	0.120	46670	23905	14.750	15.522	0.750	15.414	0.209	346610	490415
3.469	3.701	0.281	3.675	0.120	48390	26405	15.000	15.785	0.750	15.675	0.209	352490	506990
3.500	3.736	0.281	3.710	0.120	48820	27370							

Source: Spirolox Retaining Rings, RRN Series. All dimensions are in inches. Depth of groove $d = (C - A)/2$. Thickness indicated is for unplated rings; add 0.002 to upper thickness tolerance for plated rings. Standard material: carbon spring steel (SAE 1070–1090).

Ring Thickness, F: For housing sizes 0.500 through 0.750, 0.035; for sizes 0.777 through 1.023, 0.042; for sizes 1.062 through 1.500, 0.050; for sizes 1.562 through 2.000, 0.062; for sizes 2.062 through 2.531, 0.078; for sizes 2.562 through 3.000, 0.093; for sizes 3.062 through 5.000, 0.111; for sizes 5.250 through 7.000, 0.156; for sizes 7.250 through 15.000, 0.187.

Ring Free Diameter Tolerances: For housing sizes 0.500 through 1.500, +0.013, –0.000; for sizes 1.562 through 2.000, +0.020, –0.000; for sizes 2.062 through 2.531, + 0.025, –0.000; for sizes 2.562 through 3.000, +0.030, –0.000; for sizes 3.062 through 5.000, +0.035, –0.000; for sizes 5.250 through 6.000, +0.050, –0.000; for sizes 6.250 through 7.000, +0.055. –0.000; for sizes 7.250 through 10.500, +0.070, –0.000; for sizes 10.750 through 12.750, +0.120, –0.000; for sizes 13.000 through 15.000, +0.140, –0.000.

Ring Thickness Tolerances: For housing sizes 0.500 through 1.500, ± 0.002; for sizes 1.562 through 5.000, ± 0.003; for sizes 5.250 through 6.000, ± 0.004; for sizes 6.250 through 15.000, ± 0.005.

Groove Diameter Tolerances: For housing sizes 0.500 through 0.750, ± 0.002; for sizes 0.777 through 1.023, ± 0.003; for sizes 1.062 through 1.500, ± 0.004; for sizes 1.562 through 2.000, ± 0.005; for sizes 2.062 through 5.000, ± 0.006; for sizes 5.250 through 6.000, ± 0.007; for sizes 6.250 through 10.500, ± 0.008; for sizes 10.750 through 12.500, ± 0.010; for sizes 12.750 through 15.000, ± 0.012.

Groove Width Tolerances: For housing sizes 0.500 through 1.023, +0.003, –0.000; for sizes 1.062 through 2.000, +0.004, –0.000; for sizes 2.062 through 5.000, +0.005, –0.000; for sizes 5.250 through 6.000, +0.006, –0.000; for sizes 6.250 through 7.000, +0.008, –0.000; for sizes 7.250 through 15.000, +0.008, –0.000.

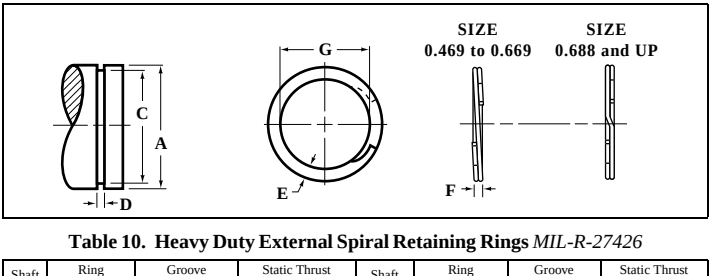


Table 10. Heavy Duty External Spiral Retaining Rings *MIL-R-27426*

Shaft Dia.	Ring		Groove		Static Thrust Load (lb)		Shaft Dia.	Ring		Groove		Static Thrust Load (lb)	
	Dia.	Wall	Dia.	Width				Dia.	Wall	Dia.	Width		
A	G	E	C	D	Ring	Groove	A	G	E	C	D	Ring	Groove
0.469	0.439	0.045	0.443	0.029	1880	510	3.500	3.293	0.270	3.316	0.120	48820	32250
0.500	0.464	0.050	0.468	0.039	2530	440	3.543	3.333	0.270	3.357	0.120	49420	33000
0.551	0.514	0.050	0.519	0.039	2790	540	3.625	3.411	0.270	3.435	0.120	50560	34490
0.562	0.525	0.050	0.530	0.039	2840	560	3.687	3.469	0.270	3.493	0.120	51430	35820
0.594	0.554	0.050	0.559	0.039	3000	700	3.750	3.527	0.270	3.552	0.120	52310	37180
0.625	0.583	0.055	0.588	0.039	3160	820	3.875	3.647	0.270	3.673	0.120	54050	39190
0.669	0.623	0.055	0.629	0.039	3380	1070	3.938	3.708	0.270	3.734	0.120	54930	40230
0.688	0.641	0.065	0.646	0.046	4170	960	4.000	3.765	0.270	3.792	0.120	55790	41660
0.750	0.698	0.065	0.704	0.046	4550	1250	4.250	4.037	0.270	4.065	0.120	59280	39370
0.781	0.727	0.065	0.733	0.046	4740	1430	4.375	4.161	0.270	4.190	0.120	61020	40530
0.812	0.756	0.065	0.762	0.046	4930	1620	4.500	4.280	0.270	4.310	0.120	62770	42810
0.875	0.814	0.075	0.821	0.046	5310	2000	4.750	4.518	0.270	4.550	0.120	66260	47570
0.938	0.875	0.075	0.882	0.046	5690	2440	5.000	4.756	0.270	4.790	0.120	69740	52580
0.984	0.919	0.085	0.926	0.046	5970	2790	5.250	4.995	0.350	5.030	0.139	83790	57830
1.000	0.932	0.085	0.940	0.046	6070	2950	5.500	5.228	0.350	5.265	0.139	87780	64720
1.023	0.953	0.085	0.961	0.046	6210	3170	5.750	5.466	0.350	5.505	0.139	91770	70540
1.062	0.986	0.103	0.998	0.056	7010	2810	6.000	5.705	0.350	5.745	0.139	95760	76610
1.125	1.047	0.103	1.059	0.056	7420	2890	6.250	5.938	0.418	5.985	0.174	122520	82930
1.188	1.105	0.103	1.118	0.056	7840	3450	6.500	6.181	0.418	6.225	0.174	127420	89510
1.250	1.163	0.103	1.176	0.056	8250	4110	6.750	6.410	0.418	6.465	0.174	132320	96330
1.312	1.218	0.118	1.232	0.056	8650	4810	7.000	6.648	0.418	6.705	0.174	137220	103400
1.375	1.277	0.118	1.291	0.056	9070	5650	7.250	6.891	0.418	6.942	0.174	142130	111810
1.438	1.336	0.118	1.350	0.056	9490	6340	7.500	7.130	0.437	7.180	0.209	176240	120170
1.500	1.385	0.118	1.406	0.056	9900	7060	7.750	7.368	0.437	7.420	0.209	182120	128060
1.562	1.453	0.128	1.468	0.068	12780	6600	8.000	7.606	0.437	7.660	0.209	187990	136200
1.625	1.513	0.128	1.529	0.068	13290	7330	8.250	7.845	0.437	7.900	0.209	193870	144590
1.687	1.573	0.128	1.589	0.068	13800	8190	8.500	8.083	0.437	8.140	0.209	199740	153220
1.750	1.633	0.128	1.650	0.068	14320	8760	8.750	8.324	0.437	8.383	0.209	205620	160800
1.771	1.651	0.128	1.669	0.068	14490	9040	9.000	8.560	0.500	8.620	0.209	211490	171250
1.812	1.690	0.128	1.708	0.068	14820	9440	9.250	8.798	0.500	8.860	0.209	217370	180640
1.875	1.751	0.158	1.769	0.068	15340	9950	9.500	9.036	0.500	9.100	0.209	223240	190280
1.969	1.838	0.158	1.857	0.068	16110	11040	9.750	9.275	0.500	9.338	0.209	229120	201140
2.000	1.867	0.158	1.886	0.068	16360	11420	10.000	9.508	0.500	9.575	0.209	234990	212810
2.062	1.932	0.168	1.946	0.086	21220	11820	10.250	9.745	0.500	9.814	0.209	240870	223780
2.125	1.989	0.168	2.003	0.086	21870	12980	10.500	9.984	0.500	10.054	0.209	246740	234490
2.156	2.018	0.168	2.032	0.086	22190	13390	10.750	10.221	0.500	10.293	0.209	252620	246000
2.250	2.105	0.168	2.120	0.086	23160	14650	11.000	10.459	0.500	10.533	0.209	258490	257230
2.312	2.163	0.168	2.178	0.086	23790	15510	11.250	10.692	0.500	10.772	0.209	264360	269270
2.375	2.223	0.200	2.239	0.086	24440	16170	11.500	10.934	0.562	11.011	0.209	270240	281590
2.437	2.283	0.200	2.299	0.086	25080	16840	11.750	11.171	0.562	11.250	0.209	276120	294180
2.500	2.343	0.200	2.360	0.086	25730	17530	12.000	11.410	0.562	11.490	0.209	281990	306450
2.559	2.402	0.200	2.419	0.086	26340	17940	12.250	11.647	0.562	11.729	0.209	287860	319580
2.625	2.464	0.200	2.481	0.086	27020	18930	12.500	11.885	0.562	11.969	0.209	293740	332360
2.687	2.523	0.200	2.541	0.086	27650	19640	12.750	12.124	0.562	12.208	0.209	299610	346030
2.750	2.584	0.225	2.602	0.103	32140	20380	13.000	12.361	0.662	12.448	0.209	305490	359330
2.875	2.702	0.225	2.721	0.103	33600	22170	13.250	12.598	0.662	12.687	0.209	311360	373530
2.937	2.760	0.225	2.779	0.103	34320	23240	13.500	12.837	0.662	12.927	0.209	317240	387340

Table 10. *(Continued)* **Heavy Duty External Spiral Retaining Rings** *MIL-R-27426*

Shaft Dia. A	Ring		Groove		Static Thrust Load (lb)		Shaft Dia. A	Ring		Groove		Static Thrust Load (lb)	
	Dia. G	Wall E	Dia. C	Width D	Ring	Groove		Dia. G	Wall E	Dia. C	Width D	Ring	Groove
3.000	2.818	0.225	2.838	0.103	35060	24340	13.750	13.074	0.662	13.166	0.209	323110	402090
3.062	2.878	0.225	2.898	0.103	35780	25140	14.000	13.311	0.662	13.405	0.209	328990	417110
3.125	2.936	0.225	2.957	0.103	36520	26290	14.250	13.548	0.662	13.644	0.209	334860	432410
3.156	2.965	0.225	2.986	0.103	36880	26860	14.500	13.787	0.750	13.884	0.209	340740	447250
3.250	3.054	0.225	3.076	0.103	37980	28320	14.750	14.024	0.750	14.123	0.209	346610	463090
3.344	3.144	0.225	3.166	0.103	39080	29800	15.000	14.262	0.750	14.363	0.209	352490	478450
3.437	3.234	0.225	3.257	0.103	40170	30980							

Source: Spirolox Retaining Rings, RSN Series. All dimensions are in inches. Depth of groove $d = (A - C)/2$. Thickness indicated is for unplated rings; add 0.002 to upper tolerance for plated rings. Standard material: carbon spring steel (SAE 1070-1090).

Ring Thickness, F: For shaft size 0.469, 0.025; for sizes 0.500 through 0.669, 0.035; for sizes 0.688 through 1.023, 0.042; for sizes 1.062 through 1.500, 0.050; for sizes 1.562 through 2.000, 0.062; for sizes 2.062 through 2.687, 0.078; for sizes 2.750 through 3.437, 0.093; for sizes 3.500 through 5.000, 0.111; for sizes 5.250 through 6.000, 0.127; for sizes 6.250 through 7.250, 0.156; for sizes 7.500 through 15.000, 0.187.

Ring Free Diameter Tolerances: For shaft sizes 0.469 through 1.500, +0.000, –0.013; for sizes 1.562 through 2.000, +0.000, –0.020; for sizes 2.062 through 2.687, + 0.000, –0.025; for sizes 2.750 through 3.437, +0.000, –0.030; for sizes 3.500 through 5.000, +0.000, –0.035; for sizes 5.250 through 6.000, +0.000, –0.050; for sizes 6.250 through 7.000, +0.000, –0.060; for sizes 7.250 through 10.000, +0.000, –0.070; for sizes 10.250 through 12.500, +0.000, –0.090; for sizes 12.750 through 15.000, +0.000, –0.110.

Ring Thickness Tolerances: For shaft sizes 0.469 through 1.500, ±0.002; for sizes 1.562 through 5.000, ±0.003; for sizes 5.250 through 6.000, ±0.004; for sizes 6.250 through 15.000, ±0.005.

Groove Diameter Tolerances: For shaft sizes 0.469 through 0.562, ±0.002; for sizes 0.594 through 1.023, ±0.003; for sizes 1.062 through 1.500, ±0.004; for sizes 1.562 through 2.000, ±0.005; for sizes 2.062 through 5.000, ±0.006; for sizes 5.250 through 6.000, ±0.007; for sizes 6.250 through 10.000, ±0.008; for sizes 10.250 through 12.500, ±0.010; for sizes 12.750 through 15.000, ±0.012.

Groove Width Tolerances: For shaft sizes 0.469 through 1.023, +0.003, –0.000; for sizes 1.062 through 2.000, +0.004, –0.000; for sizes 2.062 through 5.000, +0.005, –0.000; for sizes 5.250 through 6.000, +0.006; –0.000; for sizes 6.250 through 7.250, + 0.008, –0.000; for sizes 7.500 through 15.000, +0.008, –0.000.

Thrust Load Capacity: The most important criterion in determining which ring is best suited for a specific application is thrust load capacity. The strength of the retaining ring and groove must both be considered when analyzing the thrust load capacity of an application to determine whether the groove or the retaining ring is likely to fail first. When a retaining ring application fails, the fault will usually be with the groove, unless the groove material is of very high strength.

Ring Material: The standard materials for spiral-wound retaining rings are SAE 1070 to 1090 carbon spring steels and 18-8 type 302 stainless steels. The 1070 to 1090 carbon spring steels provide high-strength retaining rings at low cost. Type 302 stainless steel withstands ordinary rusting. Other materials are used for specialized applications, such as the type 316 stainless frequently used in the food industry. For high-temperature use, superalloy A286 rings can be used at up to 900°F and Inconel X-750 at up to 1200°F. Other materials, such as 316 stainless steel, 17-7PH and Inconel stainless steels are sometimes used for special-purpose and custom-made rings. Standard ring are typically supplied uncoated, however, special finishes such as cadmium, phosphate, zinc, or black oxide coatings for carbon spring steel rings and passivation of stainless steel rings are available.

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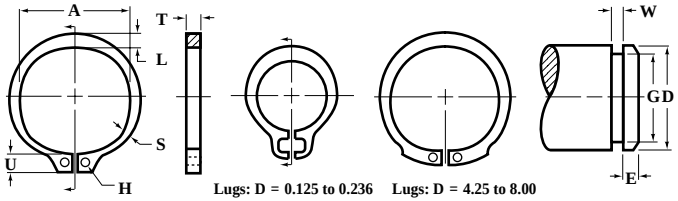
Table 11. Important Dimensions of Inch Series External Retaining Rings

MS 16624



Lugs: D = 0.125 to 0.236 **Lugs: D = 4.25 to 8.00**

Shaft Dia. D	Ring Dia. A	Ring Thick. T	Groove Dia. G	Groove Width W	Groove Margin E	Shaft Dia. D	Ring Dia. A	Ring Thick. T	Groove Dia. G	Groove Width W	Groove Margin E
0.125	0.112	0.010	0.117	0.012	0.012	1.812	1.675	0.062	1.708	0.068	0.156
0.156	0.142	0.010	0.146	0.012	0.015	1.875	1.735	0.062	1.769	0.068	0.159
0.188	0.168	0.015	0.175	0.018	0.018	1.969	1.819	0.062	1.857	0.068	0.168
0.197	0.179	0.015	0.185	0.018	0.018	2.000	1.850	0.062	1.886	0.068	0.171
0.219	0.196	0.015	0.205	0.018	0.021	2.062	1.906	0.078	1.946	0.086	0.174
0.236	0.215	0.015	0.222	0.018	0.021	2.125	1.964	0.078	2.003	0.086	0.183
0.250	0.225	0.025	0.230	0.029	0.030	2.156	1.993	0.078	2.032	0.086	0.186
0.276	0.250	0.025	0.255	0.029	0.030	2.250	2.081	0.078	2.120	0.086	0.195
0.281	0.256	0.025	0.261	0.029	0.030	2.312	2.139	0.078	2.178	0.086	0.201
0.312	0.281	0.025	0.290	0.029	0.033	2.375	2.197	0.078	2.239	0.086	0.204
0.344	0.309	0.025	0.321	0.029	0.033	2.438	2.255	0.078	2.299	0.086	0.207
0.354	0.320	0.025	0.330	0.029	0.036	2.500	2.313	0.078	2.360	0.086	0.210
0.375	0.338	0.025	0.352	0.029	0.036	2.559	2.377	0.078	2.419	0.086	0.210
0.394	0.354	0.025	0.369	0.029	0.036	2.625	2.428	0.078	2.481	0.086	0.216
0.406	0.366	0.025	0.382	0.029	0.036	2.688	2.485	0.078	2.541	0.086	0.219
0.438	0.395	0.025	0.412	0.029	0.039	2.750	2.543	0.093	2.602	0.103	0.222
0.469	0.428	0.025	0.443	0.029	0.039	2.875	2.659	0.093	2.721	0.103	0.231
0.500	0.461	0.035	0.468	0.039	0.048	2.938	2.717	0.093	2.779	0.103	0.237
0.551	0.509	0.035	0.519	0.039	0.048	3.000	2.775	0.093	2.838	0.103	0.243
0.562	0.521	0.035	0.530	0.039	0.048	3.062	2.832	0.093	2.898	0.103	0.246
0.594	0.550	0.035	0.559	0.039	0.051	3.125	2.892	0.093	2.957	0.103	0.252
0.625	0.579	0.035	0.588	0.039	0.054	3.156	2.920	0.093	2.986	0.103	0.255
0.669	0.621	0.035	0.629	0.039	0.060	3.250	3.006	0.093	3.076	0.103	0.261
0.672	0.621	0.035	0.631	0.039	0.060	3.346	3.092	0.093	3.166	0.103	0.270
0.688	0.635	0.042	0.646	0.046	0.063	3.438	3.179	0.093	3.257	0.103	0.270
0.750	0.693	0.042	0.704	0.046	0.069	3.500	3.237	0.109	3.316	0.120	0.276
0.781	0.722	0.042	0.733	0.046	0.072	3.543	3.277	0.109	3.357	0.120	0.279
0.812	0.751	0.042	0.762	0.046	0.075	3.625	3.352	0.109	3.435	0.120	0.285
0.844	0.780	0.042	0.791	0.046	0.080	3.688	3.410	0.109	3.493	0.120	0.291
0.875	0.810	0.042	0.821	0.046	0.081	3.750	3.468	0.109	3.552	0.120	0.297
0.938	0.867	0.042	0.882	0.046	0.084	3.875	3.584	0.109	3.673	0.120	0.303
0.984	0.910	0.042	0.926	0.046	0.087	3.938	3.642	0.109	3.734	0.120	0.306
1.000	0.925	0.042	0.940	0.046	0.090	4.000	3.700	0.109	3.792	0.120	0.312
1.023	0.946	0.042	0.961	0.046	0.093	4.250	3.989	0.109	4.065	0.120	0.276
1.062	0.982	0.050	0.998	0.056	0.096	4.375	4.106	0.109	4.190	0.120	0.276
1.125	1.041	0.050	1.059	0.056	0.099	4.500	4.223	0.109	4.310	0.120	0.285
1.188	1.098	0.050	1.118	0.056	0.105	4.750	4.458	0.109	4.550	0.120	0.300
1.250	1.156	0.050	1.176	0.056	0.111	5.000	4.692	0.109	4.790	0.120	0.315
1.312	1.214	0.050	1.232	0.056	0.120	5.250	4.927	0.125	5.030	0.139	0.330
1.375	1.272	0.050	1.291	0.056	0.126	5.500	5.162	0.125	5.265	0.139	0.351
1.438	1.333	0.050	1.350	0.056	0.132	5.750	5.396	0.125	5.505	0.139	0.366
1.500	1.387	0.050	1.406	0.056	0.141	6.000	5.631	0.125	5.745	0.139	0.381
1.562	1.446	0.062	1.468	0.068	0.141	6.250	5.866	0.156	5.985	0.174	0.396
1.625	1.503	0.062	1.529	0.068	0.144	6.500	6.100	0.156	6.225	0.174	0.411
1.687	1.560	0.062	1.589	0.068	0.147	6.750	6.335	0.156	6.465	0.174	0.426
1.750	1.618	0.062	1.650	0.068	0.150	7.000	6.570	0.156	6.705	0.174	0.441
1.772	1.637	0.062	1.669	0.068	0.153	7.500	7.009	0.187	7.180	0.209	0.480

Source: Industrial Retaining Rings, 3100 Series. All dimensions are in inches. Depth of groove $d = (D - G)/2$. Thickness indicated is for unplated rings; for most plated rings, the maximum ring thickness will not exceed the minimum groove width (W) minus 0.0002 inch. Standard material: carbon spring steel (SAE 1060-1090).

Ring Free Diameter Tolerances: For shaft sizes 0.125 through 0.250, +0.002, –0.004; for sizes 0.276 through 0.500, +0.002, –0.005; for sizes 0.551 through 1.023, +0.005, –0.010; for sizes 1.062 through 1.500, +0.010, –0.015; for sizes 1.562 through 2.000, +0.013, –0.020; for sizes 2.062 through 2.500, +0.015, –0.025; for sizes 2.559 through 5.000, +0.020, –0.030; for sizes 5.250 through 6.000, +0.020, –0.040; for sizes 6.250 through 6.750, +0.020, –0.050; for sizes 7.000 and 7.500, +0.050, –0.130.

Ring Thickness Tolerances: For shaft sizes 0.125 and 0.156, ±0.001; for sizes 0.188 through 1.500, ±0.002; for sizes 1.562 through 5.000, ±0.003; for sizes 5.250 through 6.000, ±0.004; for sizes 6.250 through 7.500, ±0.005.

Groove Diameter Tolerances: For shaft sizes 0.125 through 0.250, ±0.0015; for sizes 0.276 through 0.562, ±0.002; for sizes 0.594 through 1.023, ±0.003; for sizes 1.062 though 1.500, ±0.004; for sizes 1.562 through 2.000, ±0.005; for sizes 2.062 through 5.000, ±0.006; for sizes 5.250 through 6.000, ±0.007; for sizes 6.250 through 7.500, ±0.008.

Groove Width Tolerances: For shaft sizes 0.125 through 0.236, +0.002, –0.000; for sizes 0.250 through 1.023, +0.003, –0.000; for sizes 1.062 through 2.000, +0.004, –0.000; for sizes 2.062 through 5.000, +0.005, –0.000; for sizes 5.250 through 6.000, +0.006, –0.000; for sizes 6.250 through 7.500, +0.008, –0.000.

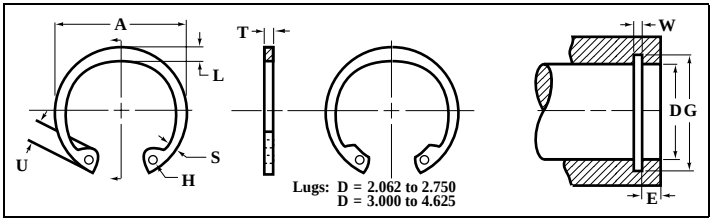


Table 12. Important Dimensions of Inch Series Internal Retaining Rings

Housing Dia. D	Ring		Groove			Housing Dia. D	Ring		Groove		
	Dia. A	Thick. T	Dia. G	Width W	Margin E		Dia. A	Thick. T	Dia. G	Width W	Margin E
0.250	0.280	0.015	0.268	0.018	0.027	2.500	2.775	0.078	2.648	0.086	0.222
0.312	0.346	0.015	0.330	0.018	0.027	2.531	2.775	0.078	2.681	0.086	0.225
0.375	0.415	0.025	0.397	0.029	0.033	2.562	2.844	0.093	2.714	0.103	0.228
0.438	0.482	0.025	0.461	0.029	0.036	2.625	2.910	0.093	2.781	0.103	0.234
0.453	0.498	0.025	0.477	0.029	0.036	2.677	2.980	0.093	2.837	0.103	0.240
0.500	0.548	0.035	0.530	0.039	0.045	2.688	2.980	0.093	2.848	0.103	0.240
0.512	0.560	0.035	0.542	0.039	0.045	2.750	3.050	0.093	2.914	0.103	0.246
0.562	0.620	0.035	0.596	0.039	0.051	2.812	3.121	0.093	2.980	0.103	0.252
0.625	0.694	0.035	0.665	0.039	0.060	2.835	3.121	0.093	3.006	0.103	0.255
0.688	0.763	0.035	0.732	0.039	0.066	2.875	3.191	0.093	3.051	0.103	0.264
0.750	0.831	0.035	0.796	0.039	0.069	2.953	3.325	0.093	3.135	0.103	0.273
0.777	0.859	0.042	0.825	0.046	0.072	3.000	3.325	0.093	3.182	0.103	0.273
0.812	0.901	0.042	0.862	0.046	0.075	3.062	3.418	0.109	3.248	0.120	0.279
0.866	0.961	0.042	0.920	0.046	0.081	3.125	3.488	0.109	3.315	0.120	0.285
0.875	0.971	0.042	0.931	0.046	0.084	3.149	3.523	0.109	3.341	0.120	0.288
0.901	1.000	0.042	0.959	0.046	0.087	3.156	3.523	0.109	3.348	0.120	0.288
0.938	1.041	0.042	1.000	0.046	0.093	3.250	3.623	0.109	3.446	0.120	0.294
1.000	1.111	0.042	1.066	0.046	0.099	3.346	3.734	0.109	3.546	0.120	0.300
1.023	1.136	0.042	1.091	0.046	0.102	3.469	3.857	0.109	3.675	0.120	0.309
1.062	1.180	0.050	1.130	0.056	0.102	3.500	3.890	0.109	3.710	0.120	0.315

Table 12. *(Continued)* **Important Dimensions of Inch Series Internal Retaining Rings**

Housing Dia. D	Ring		Groove			Housing Dia. D	Ring		Groove		
	Dia. A	Thick. T	Dia. G	Width W	Margin E		Dia. A	Thick. T	Dia. G	Width W	Margin E
1.125	1.249	0.050	1.197	0.056	0.108	3.543	3.936	0.109	3.755	0.120	0.318
1.181	1.319	0.050	1.255	0.056	0.111	3.562	3.936	0.109	3.776	0.120	0.321
1.188	1.319	0.050	1.262	0.056	0.111	3.625	4.024	0.109	3.841	0.120	0.324
1.250	1.388	0.050	1.330	0.056	0.120	3.740	4.157	0.109	3.964	0.120	0.336
1.259	1.388	0.050	1.339	0.056	0.120	3.750	4.157	0.109	3.974	0.120	0.336
1.312	1.456	0.050	1.396	0.056	0.126	3.875	4.291	0.109	4.107	0.120	0.348
1.375	1.526	0.050	1.461	0.056	0.129	3.938	4.358	0.109	4.174	0.120	0.354
1.378	1.526	0.050	1.464	0.056	0.129	4.000	4.424	0.109	4.240	0.120	0.360
1.438	1.596	0.050	1.528	0.056	0.135	4.125	4.558	0.109	4.365	0.120	0.360
1.456	1.616	0.050	1.548	0.056	0.138	4.250	4.691	0.109	4.490	0.120	0.360
1.500	1.660	0.050	1.594	0.056	0.141	4.331	4.756	0.109	4.571	0.120	0.360
1.562	1.734	0.062	1.658	0.068	0.144	4.500	4.940	0.109	4.740	0.120	0.360
1.575	1.734	0.062	1.671	0.068	0.144	4.625	5.076	0.109	4.865	0.120	0.360
1.625	1.804	0.062	1.725	0.068	0.150	4.724	5.213	0.109	4.969	0.120	0.366
1.653	1.835	0.062	1.755	0.068	0.153	4.750	5.213	0.109	4.995	0.120	0.366
1.688	1.874	0.062	1.792	0.068	0.156	5.000	5.485	0.109	5.260	0.120	0.390
1.750	1.942	0.062	1.858	0.068	0.162	5.250	5.770	0.125	5.520	0.139	0.405
1.812	2.012	0.062	1.922	0.068	0.165	5.375	5.910	0.125	5.650	0.139	0.405
1.850	2.054	0.062	1.962	0.068	0.168	5.500	6.066	0.125	5.770	0.139	0.405
1.875	2.054	0.062	1.989	0.068	0.171	5.750	6.336	0.125	6.020	0.139	0.405
1.938	2.141	0.062	2.056	0.068	0.177	6.000	6.620	0.125	6.270	0.139	0.405
2.000	2.210	0.062	2.122	0.068	0.183	6.250	6.895	0.156	6.530	0.174	0.420
2.047	2.280	0.078	2.171	0.086	0.186	6.500	7.170	0.156	6.790	0.174	0.435
2.062	2.280	0.078	2.186	0.086	0.186	6.625	7.308	0.156	6.925	0.174	0.450
2.125	2.350	0.078	2.251	0.086	0.189	6.750	7.445	0.156	7.055	0.174	0.456
2.165	2.415	0.078	2.295	0.086	0.195	7.000	7.720	0.156	7.315	0.174	0.471
2.188	2.415	0.078	2.318	0.086	0.195	7.250	7.995	0.187	7.575	0.209	0.486
2.250	2.490	0.078	2.382	0.086	0.198	7.500	8.270	0.187	7.840	0.209	0.510
2.312	2.560	0.078	2.450	0.086	0.207	7.750	8.545	0.187	8.100	0.209	0.525
2.375	2.630	0.078	2.517	0.086	0.213	8.000	8.820	0.187	8.360	0.209	0.540
2.440	2.702	0.078	2.584	0.086	0.216	8.250	9.095	0.187	8.620	0.209	0.555

Source: Industrial Retaining Rings, 3000 Series. All dimensions are in inches. Depth of groove $d = (G - D)/2$. Thickness indicated is for unplated rings. Standard material: carbon spring steel (SAE 1060-1090).

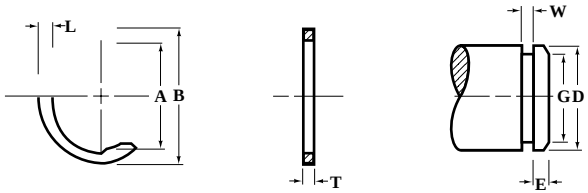
Ring Free Diameter Tolerances: For housing sizes 0.250 through 0.777, +0.010, –0.005; for sizes 0.812 through 1.023, +0.015, – 0.010; for sizes 1.062 through 1.500, + 0.025, – 0.020; for sizes 1.562 through 2.000, +0.035, –0.025; for sizes 2.047 through 3.000, +0.040, –0.030; for sizes 3.062 through 3.625, ±0.055; for sizes 3.740 through 6.000, ±0.065; for sizes 6.250 through 7.000, ±0.080; for sizes 7.250 through 8.250, ±0.090.

Ring Thickness Tolerances: For housing sizes 0.250 through 1.500, ±0.002; for sizes 1.562 through 5.000, ±0.003; for sizes 5.250 through 6.000, ±0.004; for sizes 6.250 through 8.250, ±0.005.

Groove Diameter Tolerances: For housing sizes 0.250 and 0.312, ±0.001; for sizes 0.375 through 0.750, ±0.002; for sizes 0.777 through 1.023 ±0.003; for sizes 1.062 through 1.500, ±0.004; for sizes 1.562 through 2.000, ±0.005; for sizes 2.047 through 5.000 ±0.006; for sizes 5.250 through 6.000, ±0.007; for sizes 6.250 through 8.250, ±0.008.

Groove Width Tolerances: For housing sizes 0.250 and 0.312, +0.002, – 0.000; for sizes 0.375 through 1.023, +0.003, –0.000; for sizes 1.062 through 2.000, +0.004, –0.000; for sizes 2.047 through 5.000, +0.005; –0.000; for sizes 5.250 through 6.000, +0.006, –0.000; for sizes 6.250 through 8.250, +0.008, –0.000.

Table 13. Important Dimensions of Inch Series External Retaining Rings *MS16632*



Shaft Diameter D	Ring			Groove			[a]Static Thrust Load (lb)	
	Free Dia. A	Thickness T	Diameter B	Diameter G	Width W	Margin E	Ring	Groove
0.125	0.102	0.015	0.164	0.106	0.018	0.020	85	40
0.156	0.131	0.015	0.205	0.135	0.018	0.020	110	55
0.188	0.161	0.015	0.245	0.165	0.018	0.022	130	70
0.219	0.187	0.025	0.275	0.193	0.029	0.026	260	100
0.236	0.203	0.025	0.295	0.208	0.029	0.028	280	115
0.250	0.211	0.025	0.311	0.220	0.029	0.030	295	130
0.281	0.242	0.025	0.344	0.247	0.029	0.034	330	170
0.312	0.270	0.025	0.376	0.276	0.029	0.036	370	200
0.375	0.328	0.025	0.448	0.335	0.029	0.040	440	265
0.406	0.359	0.025	0.485	0.364	0.029	0.042	480	300
0.437	0.386	0.025	0.516	0.393	0.029	0.044	515	340
0.500	0.441	0.035	0.581	0.450	0.039	0.050	825	440
0.562	0.497	0.035	0.653	0.507	0.039	0.056	930	550
0.625	0.553	0.035	0.715	0.563	0.039	0.062	1030	690
0.687	0.608	0.042	0.780	0.619	0.046	0.068	1700	820
0.750	0.665	0.042	0.845	0.676	0.046	0.074	1850	985
0.812	0.721	0.042	0.915	0.732	0.046	0.080	2010	1150
0.875	0.777	0.042	0.987	0.789	0.046	0.086	2165	1320
0.937	0.830	0.042	1.054	0.843	0.046	0.094	2320	1550
1.000	0.887	0.042	1.127	0.900	0.046	0.100	2480	1770
1.125	0.997	0.050	1.267	1.013	0.056	0.112	3300	2200
1.188	1.031	0.050	1.321	1.047	0.056	0.140	3500	2900
1.250	1.110	0.050	1.410	1.126	0.056	0.124	3600	2700
1.375	1.220	0.050	1.550	1.237	0.056	0.138	4000	3300
1.500	1.331	0.050	1.691	1.350	0.056	0.150	4400	4000
1.750	1.555	0.062	1.975	1.576	0.068	0.174	6400	5300
2.000	1.777	0.062	2.257	1.800	0.068	0.200	7300	7000

[a] *Thrust Load Safety Factors:* Ring, 4; groove, 2. Groove wall thrust loads are for grooves machined in cold-rolled steel with a tensile yield strength of 45,000 psi; for other shaft materials, the thrust load varies proportionally with the yield strength.

Source: Industrial Retaining Rings, 2000 Series. All dimensions are in inches. Depth of groove $d = (D - G)/2$. Standard material: carbon spring steel (SAE 1060-1090). Thickness indicated is for unplated rings; for most plated rings with shaft sizes less than 1.000 inch, the maximum thickness will not exceed the minimum groove width (W) minus 0.0002 inch; for larger rings, the ring thickness may increase by 0.002 inch.

Groove Maximum Bottom Radii: For shaft diameters less than 0.500 inch, 0.005 inch; for shaft sizes 0.500 through 1.000 inch, 0.010 inch; all larger sizes, 0.015 inch.

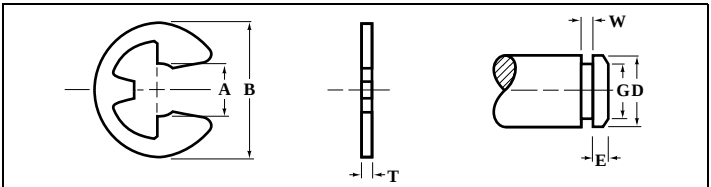
Ring Free Diameter Tolerances: For shaft sizes 0.125 through 0.188, +0.002, –0.004; for sizes 0.219 through 0.437, +0.003, –0.005; for sizes 0.500 through 0.625, ±0.006; for sizes 0.687 through 1.000, ±0.007; for sizes 1.125 through 1.500, ±0.008; for sizes 1.750 and 2.000, ±0.010.

Ring Thickness Tolerances: For shaft sizes 0.125 through 1.500, ±0.002; for sizes 1.750 and 2.000, ±0.003.

Groove Diameter Tolerances: For shaft sizes 0.125 through 0.188, ±0.0015; for sizes 0.219 through 0.437, ±0.002; for sizes 0.500 through 1.000, ±0.003; for sizes 1.125 through 1.500, ±0.004; for sizes 1.750 and 2.000, ±0.005.

Groove Width Tolerances: For shaft sizes 0.125 through 0.188, +0.002, –0.000; for sizes 0.219 through 1.000, +0.003, –0.000; for sizes 1.125 through 2.000, +0.004, –0.000.

Table 14. Important Dimensions of Inch Series External Retaining Rings *MS16633*



Shaft Diameter D	Ring			Groove			[a]Static Thrust Load (lb)	
	Free Dia. A	Thickness T	Diameter B	Diameter G	Width W	Margin E	Ring	Groove
0.040	0.025	0.010	0.079	0.026	0.012	0.014	13	7
0.062	0.051	0.010	0.140	0.052	0.012	0.010	20	7
0.062[a]	0.051	0.010	0.156	0.052	0.012	0.010	20	7
0.062[b]	0.051	0.020	0.187	0.052	0.023	0.010	40	7
0.094	0.073	0.015	0.187	0.074	0.018	0.020	45	20
0.094	0.069	0.015	0.230	0.074	0.018	0.020	45	20
0.110	0.076	0.015	0.375	0.079	0.018	0.030	55	40
0.125	0.094	0.015	0.230	0.095	0.018	0.030	65	45
0.140	0.100	0.015	0.203	0.102	0.018	0.038	70	60
0.140[c]	0.108	0.015	0.250	0.110	0.018	0.030	70	45
0.140[d]	0.102	0.025	0.270	0.105	0.029	0.034	150	55
0.156	0.114	0.025	0.282	0.116	0.029	0.040	165	70
0.172	0.125	0.025	0.312	0.127	0.029	0.044	180	90
0.188	0.145	0.025	0.335	0.147	0.029	0.040	195	90
0.188	0.122	0.025	0.375	0.125	0.029	0.062	195	135
0.218	0.185	0.025	0.437	0.188	0.029	0.030	225	75
0.250	0.207	0.025	0.527	0.210	0.029	0.040	260	115
0.312	0.243	0.025	0.500	0.250	0.029	0.062	325	225
0.375	0.300	0.035	0.660	0.303	0.039	0.072	685	315
0.437	0.337	0.035	0.687	0.343	0.039	0.094	800	485
0.437	0.375	0.035	0.600	0.380	0.039	0.058	800	290
0.500	0.392	0.042	0.800	0.396	0.046	0.104	1100	600
0.625	0.480	0.042	0.940	0.485	0.046	0.140	1370	1040
0.744	0.616	0.050	1.000	0.625	0.056	0.118	1940	1050
0.750	0.616	0.050	1.000	0.625	0.056	0.124	1960	1100
0.750	0.574	0.050	1.120	0.580	0.056	0.170	1960	1500
0.875	0.668	0.050	1.300	0.675	0.056	0.200	2200	2050
0.985	0.822	0.050	1.500	0.835	0.056	0.148	2570	1710
1.000	0.822	0.050	1.500	0.835	0.056	0.164	2620	1900
1.188	1.066	0.062	1.626	1.079	0.068	0.108	3400	1500
1.375	1.213	0.062	1.875	1.230	0.068	0.144	4100	2300

[a] *Thrust Load Safety Factors:* Ring 3; groove, 2.

Source: Industrial Retaining Rings, 1000 Series. All dimensions are in inches. Depth of groove $d = (D - G)/2$. Standard material: carbon spring steel (SAE 1060 –1090). Thickness indicated is for unplated rings; for most plated rings with shaft sizes less than 0.625, the maximum ring thickness will not exceed the minimum groove width (W) minus 0.0002 inch; for larger rings, the thickness may increase by 0.002 inch.

Groove Maximum Bottom Radii: For shaft sizes 0.040 and 0.062, 0.003 inch; for sizes 0.094 through 0.250, 0.005 inch; for sizes 0.312 through 0.437, 0.010 inch; for sizes 0.500 through 1.375, 0.015 inch.

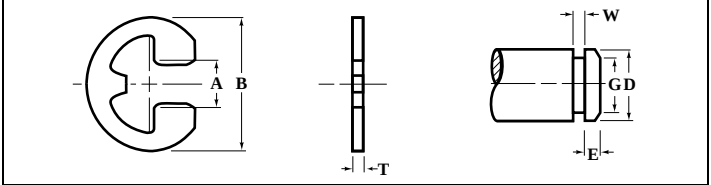
Ring Free Diameter Tolerances: For shaft sizes 0.040 through 0.250, +0.001, –0.003; for sizes 0.312 through 0.500, +0.002, –0.004; for sizes 0.625 through 1.000, +0.003, –0.005; for sizes 1.188 and 1.375, +0.006, –0.010.

Ring Thickness Tolerances: For shaft sizes 0.040 and 0.062[a], ±0.001; for sizes 0.062[b] through 1.000, ±0.002; for sizes 1.188 and 1.375, ±0.003.

Groove Diameter Tolerances: For shaft sizes 0.040 through 0.218, +0.002, –0.000; for sizes 0.250 through 1.000, +0.003, –0.000; for sizes 1.188 and 1.375, +0.005, –0.000.

Grove Width Tolerances: For shaft sizes 0.040 through 0.140[c], +0.002, –0.000; for sizes 0.140[d] through 1.000, +0.003, –0.000; for sizes 1.188 and 1.375, +0.004, –0.000.

Table 15. Dimensions of Inch Series External Retaining Rings *MS3215*



Shaft Diameter D	Ring			Groove			[a]Static Thrust Load (lb)	
	Free Dia. A	Thickness T	Diameter B	Diameter G	Width W	Margin E	Ring	Groove
0.094	0.072	0.015	0.206	0.074	0.018	0.020	55	13
0.125	0.093	0.015	0.270	0.095	0.018	0.030	75	25
0.156	0.113	0.025	0.335	0.116	0.029	0.040	150	40
0.188	0.143	0.025	0.375	0.147	0.029	0.040	180	50
0.219	0.182	0.025	0.446	0.188	0.029	0.031	215	50
0.250	0.204	0.025	0.516	0.210	0.029	0.040	250	75
0.312	0.242	0.025	0.588	0.250	0.029	0.062	300	135
0.312	0.242	0.035	0.588	0.250	0.039	0.062	420	135
0.375	0.292	0.035	0.660	0.303	0.039	0.072	520	190
0.438	0.332	0.035	0.746	0.343	0.039	0.096	600	285
0.500	0.385	0.042	0.810	0.396	0.046	0.104	820	360
0.562	0.430	0.042	0.870	0.437	0.046	0.124	930	480

[a] *Thrust Load Safety Factors:* Ring, 3; groove, 2.

Source: Industrial Retaining Rings, 1200 Series. All dimensions are in inches. Depth of groove $d = (D - G)/2$. Standard material: carbon spring steel (SAE 1060-1090). Thickness indicated is for unplated rings; for most plated rings the maximum thickness will not exceed the minimum groove width (W) minus 0.0002 inch.

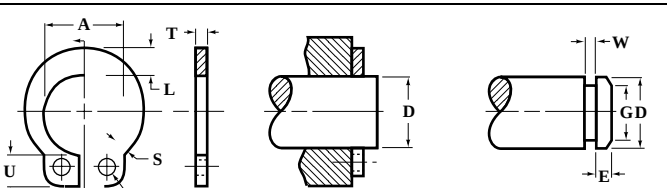
Groove Maximum Bottom Radii: For shaft sizes 0.250 and smaller, 0.005 inch; for sizes 0.312 through 0.438, 0.010 inch; for sizes 0.500 and 0.562, 0.015 inch. *Ring Free Diameter Tolerances:* For shaft sizes 0.094 through 0.156, +0.001, –0.003; for sizes 0.188 through 0.312, ±0.003; for sizes 0.375 through 0.562, ±0.004. *Ring Thickness Tolerances:* For all shaft sizes, ±0.002. *Groove Diameter Tolerances:* For shaft sizes 0.094 through 0.188, +0.002, –0.000; for sizes 0.219 and 0.250, ±0.002; for sizes 0.312 through 0.562, ±0.003. *Groove Width Tolerances:* For shaft sizes 0.094 and 0.125, +0.002, – 0.000; for sizes 0.156 through 0.562, +0.003, –0.000.

The thrust load capacities shown in the tables of this section include safety factors. Usually, a safety factor of 2 is used for groove thrust load calculations when the load is applied through a retained part and groove with both having sharp corners and where the minimum side clearance exists between the retained part and the shaft or bore. Groove thrust load values in the tables of this section are based on these conditions. A safety factor of 3 is usual for calculations of thrust load capacity based on ring shear.

Ideally, the corner of a retained part in contact with a retaining ring should have square corners and contact the ring as closely as possible to the shaft or housing. The tabulated thrust capacities assume that minimum clearances exist between the retained part and shaft or housing, that the groove and retained part have square corners, and that contact between the retained part and the ring occurs close to the shaft or housing. If these conditions apply, the tabulated thrust loads apply. If the application does not meet the previous conditions but the side clearances, radii, and chamfers are less than the maximum total radius or chamfer of Fig. 1, then the thrust load capacity must be reduced by dividing the tabulated value by 2. The maximum total radius is given by $0.5(b - d)$ and the maximum total chamfer by $0.375(b - d)$, where b is the radial wall thickness, and d is the groove depth. The recommended maximum total radius or chamfer specifications are intended to be used as guidelines by the designer, and to ensure the ring application will withstand published and calculated values of static thrust loads.

In analyzing the retaining ring loading conditions, a static, uniformly applied load is usually assumed. Dynamic and eccentric loads, however, are frequently encountered. Eccentric loading occurs when the load is concentrated on a small portion of the ring, such as may be caused by incorrectly machined surfaces, cocking of the retained part, and axial misalignment of parts. Conditions leading to eccentric loading on the ring should be avoided. In addition to the factors that affect the static thrust capacity, applications in which shock or impact loading occurs must be evaluated very carefully and tested in service to assess the effect of the mass and velocity of the retained part striking the ring. Vibration caused by impact loading can also cause the ring to fail if the resonant frequency of the system (retaining ring application) coincides with the resonant frequency of the retaining ring.

Table 16. Dimensions of Inch Series Self-Locking External Retaining Rings



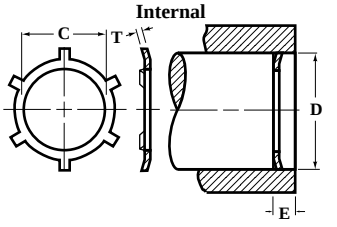
Shaft Diameter		Ring		Optical Groove			[a]Static Thrust Load (lb)	
Min. D	Max. D	Free Dia. A	Thickness T	Diameter G	Width W	Margin E	Ring	Groove
0.078	0.080	0.074	0.025	The use of grooves with these shaft sizes is not suggested.			10	0
0.092	0.096	0.089	0.025				10	0
0.123	0.127	0.120	0.025				20	0
0.134	0.138	0.130	0.025				20	0
0.154	0.158	0.150	0.025				22	0
0.185	0.189	0.181	0.035				25	0
0.248	0.252	0.238	0.035	0.240	0.041	0.030	35	90
0.310	0.316	0.298	0.042	0.303	0.048	0.030	50	110
0.373	0.379	0.354	0.042	0.361	0.048	0.030	55	185
0.434	0.440	0.412	0.050	0.419	0.056	0.030	60	280
0.497	0.503	0.470	0.050	0.478	0.056	0.040	65	390
0.622	0.628	0.593	0.062	0.599	0.069	0.045	85	570
0.745	0.755	0.706	0.062	0.718	0.069	0.050	90	845

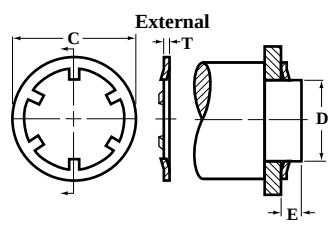
[a] *Thrust Load Safety Factors:* Ring, 1; groove, 2.

Source: Industrial Retaining Rings, 7100 Series. All dimensions are in inches. Depth of groove $d = (D - G)/2$. Standard material: carbon spring steel (SAE 1060-1090). Thickness indicated is for unplated rings; for plated, phosphate coated, and stainless steel rings, the maximum ring thickness may be exceeded by 0.002 inch.

Ring Free Diameter Tolerances: For shaft sizes 0.078 through 0.138, +0.002, –0.003; for sizes 0.154 through 0.252, +0.002, –0.004; for sizes 0.310 through 0.440, +0.003, –0.005; for sizes 0.497 through 0.755, +0.004, –0.006. *Ring Thickness Tolerances:* For shaft sizes 0.078 through 0.158, ±0.002; for sizes 0.185 through 0.503, ±0.003; for sizes 0.622 through 0.755, ±0.004. *Groove Diameter Tolerances:* For shaft sizes less than 0.248, grooves are not recommended; for other sizes, grooves are optional. For shaft sizes 0.248 through 0.316, +0.005, –0.0015; for sizes 0.373 through 0.628, +0.001, –0.002; for sizes 0.745 and 0.755, +0.002, –0.003. *Groove Width Tolerances:* For shaft sizes 0.248 through 0.379, +0.003, –0.000; for sizes 0.434 through 0.755, +0.004, –0.000.

Table 17. Inch Series Internal and External Self-Locking Retaining Rings





Housing		Ring Dimensions			Static	Shaft		Ring Dimensions			Static
Min. D	Max. D	Thick. T	Dia. D	Margin E	Thrust Load	Min. D	Max. D	Thick. T	Dia. D	Margin E	Thrust Load
0.311	0.313	0.010	0.136	0.040	80	0.093	0.095	0.010	0.250	0.040	15
0.374	0.376	0.010	0.175	0.040	75	0.124	0.126	0.010	0.325	0.040	20
0.437	0.439	0.010	0.237	0.040	70	0.155	0.157	0.010	0.356	0.040	25
0.498	0.502	0.010	0.258	0.040	60	0.187	0.189	0.010	0.387	0.040	35
0.560	0.564	0.010	0.312	0.040	50	0.218	0.220	0.010	0.418	0.040	35
0.623	0.627	0.010	0.390	0.040	45	0.239	0.241	0.015	0.460	0.060	35
0.748	0.752	0.015	0.500	0.060	75	0.249	0.251	0.010	0.450	0.040	40
0.873	0.877	0.015	0.625	0.060	70	0.311	0.313	0.010	0.512	0.040	40
0.936	0.940	0.015	0.687	0.060	70	0.374	0.376	0.010	0.575	0.040	40
0.998	1.002	0.015	0.750	0.060	70	0.437	0.440	0.015	0.638	0.060	50
1.248	1.252	0.015	0.938	0.060	60	0.498	0.502	0.015	0.750	0.060	50
1.436	1.440	0.015	1.117	0.060	60	0.560	0.564	0.015	0.812	0.060	50
1.498	1.502	0.015	1.188	0.060	60	0.623	0.627	0.015	0.875	0.060	50
						0.748	0.752	0.015	1.000	0.060	50
						0.873	0.877	0.015	1.125	0.060	55
						0.998	1.002	0.015	1.250	0.060	60

Source: Industrial Retaining Rings, 6000 Series (internal) and 6100 Series (external). All dimensions are in inches, thrust loads are in pounds. Thickness indicated is for unplated rings. Standard material: carbon spring steel (SAE 1060-1090).

Internal Rings: Thrust loads are for rings made of standard material inserted into cold-rolled, low-carbon housing. *Ring Thickness Tolerances:* For housing sizes 0.311 through 0.627, ±0.001; for sizes 0.748 through 1.502, ±0.002. *Ring Diameter Tolerances:* For housing sizes 0.311 through 0.439, ±0.005; for sizes 0.498 through 1.502, ±0.010.

External Rings: Thrust loads are for rings made of standard material installed onto cold-rolled, low-carbon shafts. *Ring Thickness Tolerances:* For shaft sizes 0.093 through 0.220, ±0.001; for size 0.239, ±0.002; for sizes 0.249 through 0.376, ±0.001; for sizes 0.437 through 1.002, ±0.002. *Ring Diameter Tolerances:* For shaft sizes 0.093 through 0.502, ±0.005; for sizes 0.560 through 1.002, ±0.010.

Centrifugal Capacity: Proper functioning of a retaining ring depends on the ring remaining seated on the groove bottom. External rings “cling” to the groove bottom because the ring ID is slightly smaller than the diameter at the bottom of the groove. Ring speed should be kept below the allowable steady-state speed of the ring, or self-locking rings specially designed for high-speed applications should be used, otherwise an external ring can lose its grip on the groove. Applications of large retaining rings that tend to spin in their grooves when subjected to sudden acceleration or deceleration of the retained part can benefit from a ring with more “cling” (i.e., a smaller interior diameter) as long as the stress of installation is within permissible limits. Special rings are also available that lock into a hole in the bottom of the groove, thereby preventing rotation. The following equation can be used to determine the allowable steady-state speed *N* of an external spiral retaining ring:

$$N = \sqrt{\frac{0.466 C_1 E^3 \times 10^{12}}{R_n^3 (1 + C_1)(R_o^3 - R_i^3)}} \quad (1)$$

where the speed N is in revolutions per minute, C_1 is the minimum ring cling to groove bottom, E is the ring radial wall, R_n is the free neutral ring radius, R_o is the free outside ring radius, and R_i is the free inside ring radius, all in inches. For external spiral rings, the minimum ring cling is given by: $C_1 = (C - G)/G$, where C is the mean groove diameter in inches, and G is the maximum ring free ID in inches.

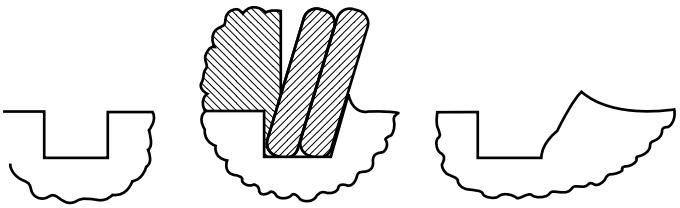


Fig. 2. Localized Groove Yielding under Load. (a) Groove Profile before Loading; (b) Localized Yielding of Retained Part and Groove under Load; (c) Groove Profile after Loading beyond Thrust Capacity (*Courtesy Spirolox Retaining Rings*)

Rotation between Parts: The use of spiral-wound rings to retain a rotating part should be limited to applications with rotation in only one direction. The ring should be matched so that the rotation tends to wind the spring into the groove. External rings should be wound in the direction of rotation of the retained part but internal rings should be wound against the direction of rotation of the rotating part. Failure to observe these precautions will cause the ring to wind out of the groove. Spiral-wound rings can be obtained with either right-hand (normal rotation) or left-hand (reverse rotation) wound configurations. Stamped retaining rings do not have these limitations, and may be used for applications that require rotation of the retained part, regardless of the direction of rotation.

Retaining Ring Failure.—Failure of a retaining ring application can result from failure of the ring itself, failure of the groove, or both. If a ring fails, the cause is likely to be from shearing of the ring. Shear failure occurs when a ring is installed in a groove and loaded by a retained part with both the groove and the retained part having a compressive yield strength greater than 45,000 psi; or when the load is applied through a retained part and groove, both having sharp corners and line-to-line contact; or when the ring is too thin in section compared with its diameter. To examine the possibility of ring shear, the allowable thrust P_s, based on the shear strength of the ring material, is given by

$$P_s = \frac{\pi D t S_s}{K} \quad (2)$$

where P_s is in lb_f, D is the shaft or housing diameter in inches, t is the ring thickness in inches, S_s is the shear strength of the ring material in lb/in.^{2}, and K is the factor of safety.

Groove Failure: The most common type of groove failure is yielding of the groove material that occurs when the thrust load, applied through the retaining ring against the corner of the groove, exceeds the compressive yield strength of the groove. This yielding of the groove results from a low compressive yield strength of the groove material, and allows the ring to tilt and come out of the groove, as illustrated in Fig. 2(b).

When dishing of a ring occurs as a result of yielding in the groove material, a bending moment across the cross-section of the ring generates a tensile stress that is highest at the

interior diameter of the ring. If the maximum stress is greater than the yield strength of the ring material, the ring ID will grow and the ring will become permanently dished in shape. To determine the thrust load capacity of a ring based on groove deformation, the allowable angle of ring deflection must be calculated, then the thrust load based on groove yield can be determined. However, for spiral-wound rings, the thrust load P_G that initiates the onset of groove deformation can be estimated from the following:

$$P_G = \frac{\pi D d S_y}{K} \tag{3}$$

where P_G is given in lb_f, D is the shaft or housing diameter in inches, d is the groove depth in inches, S_y is the yield strength of the groove material, and K is the safety factor. For stamped rings, estimate P_G by multiplying Equation (3) by the fraction of the groove circumference that contacts the ring.

The thrust load capacity of a particular retaining ring application can be increased by changing the workpiece material that houses the groove. Increasing the yield strength of the groove material increases the thrust load capacity of the retaining ring application. However, increasing the strength of the groove material may cause the failure mechanism to shift from groove deformation to ring shear. Therefore, use the lower of the values obtained from Equations (2) and (3) for the allowable thrust load.

Groove Design and Machining: In most applications, grooves are located near the end of a shaft or housing bore to facilitate installation and removal of the rings. The groove is normally located a distance at least two to three times the groove depth from the end of the shaft or bore. If the groove is too close to the end of the shaft or bore, the groove may shear or yield. The following equation can be used to determine the minimum safe distance Y of a groove from the end of a shaft or housing:

$$Y = \frac{KP_t}{\pi D S_c} \tag{4}$$

where K is the factor of safety, P_t is the thrust load on the groove in pounds, S_c is the shear strength of the groove material in psi, and D is the shaft or housing diameter in inches.

A properly designed and machined groove is just as important in a retaining ring application as the ring itself. The walls of grooves should be perpendicular to the shaft or bore diameter; the grooves should have square corners on the top edges, and radii at the bottom, within the tolerances specified by the manufacturers, as shown in Fig. 1 (page 1665). Test data indicate that the ultimate thrust capacity for both static and dynamic loading conditions is greatly affected if these groove requirements are not met. For spiral-wound rings, the maximum bottom groove radius is 0.005 inch for rings up to 1.000 inch free diameter and 0.010 inch for larger rings, internal or external. For stamped rings, the maximum bottom groove radius varies with ring size and style.

Table 18. Retaining Ring Standards

Military	
MIL-R-21248B	MS-16633 Open-type external uniform cross-section
	MS-16634 Open-type external uniform cross-section cylindrically
	MS-3215 Open-type external tapered cross-section
	MS-16632 Crescent-type external
	MS-16625 Internal
	MS-16629 Internal cylindrically bowed
	MS-16624 Closed-type external tapered cross-section

Table 18. Retaining Ring Standards *(Continued)*

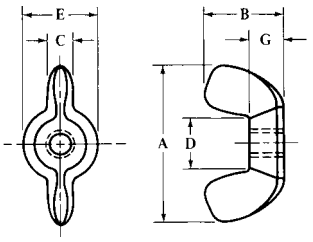
Military	
MIL-R-21248B	MS-16628 Closed-type external tapered cross-section cylindrically bowed
	MS-16627 Internal inverted
	MS-16626 Closed-type external tapered cross-section
	MS-90707 Self-locking external tapered cross-section
	MS-3217 External heavy-duty tapered cross-section
MIL-R-27426	Uniform cross-section spiral retaining rings, Type 1-External, Type 2-Internal
Acrospace Standard	
AS 3215	Ring, Retaining—Spiral, Internal, Heavy Duty, Stainless Steel
AS 3216	Ring, Retaining—Spiral, External, Heavy Duty, Stainless Steel
AS 3217	Ring, Retaining—Spiral, Internal, Light Duty, Stainless Steel
AS 3218	Ring, Retaining—Spiral, External, Light Duty, Stainless Steel
AS 3219	Ring, Wound, Dimensional and Acceptance Standard for Spiral Wound Retaining Rings
ANSI	
B27.6-1972, R1983	General Purpose Uniform Cross-Section Spiral Retaining Rings
B27.7M-1977, R1983	General Purpose Tapered and Reduced Cross-Section Retaining Rings (Metric)
B27.2M-1977, R1983	General Purpose Metric Tapered and Reduced Cross-Section Retaining Rings
	Type 3DM1—Heavy Duty External Rings
	Type 3EM1—Reinforced “E” Rings
	Type 3FM1—“C” Type Rings
ANSI/SAE	
MA4016	Ring, Retaining—External Spiral Wound, Heavy and Medium Duty, Crescent, Metric
MA4017	Ring, Retaining—External Spiral Wound, Heavy and Medium Duty, Crescent, Metric
MA4020	Ring, Retaining—External Tapered, Type 1, Class 2, AMS 5520, Metric
MA4021	Ring, Retaining—Internal Tapered, Type 1, Class 1, AMS 5520, Metric
MA4029	Ring, Retaining—Internal, Beveled, Tapered, Type 2, Class 1, AMS 5520, Metric
MA4030	Ring, Retaining—External, Reinforced E-Ring, Type 1, Class 3, AMS 5520, Metric
MA4035	Rings, Retaining—Spiral Wound, Uniform Section, Corrosion Resistant, Procurement Specification for, Metric
MA4036	Ring, Retaining—Tapered Width, Uniform Thickness, Corrosion Resistant, Procurement Specification for, Metric
DIN	
DIN 471, 472, 6799, 984, 5417, 7993	Standards for normal and heavy type, internal and external retaining rings and retaining washers
LN 471, 472, 6799	Aerospace standards for internal and external retaining rings

WING NUTS, WING SCREWS AND THUMB SCREWS

Wing Nuts.—A wing nut is a nut having wings designed for manual turning without driver or wrench. As covered by ANSI B18.17-1968 (R1983) wing nuts are classified first, by type on the basis of the method of manufacture; and second, by style on the basis of design characteristics. They consist of:

Type A: Type A wing nuts are cold forged or cold formed solid nuts having wings of moderate height. In some sizes they are produced in regular, light, and heavy series to best suit the requirements of specific applications. Dimensions are given in Table 1.

Table 1. American National Standard Type A Wing Nuts
ANSI B18.17-1968, R1983



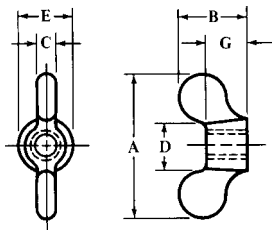
Nominal Size or Basic Major Diameter of Thread[a]		Thds. per Inch	Series[b]	Nut Blank Size (Ref)	*A* Wing Spread		*B* Wing Height		*C* Wing Thick.		*D* Between Wings		*E* Boss Diam.		*G* Boss Height	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	(0.0990)	48, 56	Hvy.	AA	0.72	0.59	0.41	0.28	0.11	0.07	0.21	0.17	0.33	0.29	0.14	0.10
4	(0.1120)	40, 38	Hvy.	AA	0.72	0.59	0.41	0.28	0.11	0.07	0.21	0.17	0.33	0.29	0.14	0.10
5	(0.1250)	40, 44	**Lgt.**	**AA**	**0.72**	**0.59**	**0.41**	**0.28**	**0.11**	**0.07**	**0.21**	**0.17**	**0.33**	**0.29**	**0.14**	**0.10**
			Hvy.	A	0.91	0.78	0.47	0.34	0.14	0.10	0.27	0.22	0.43	0.39	0.18	0.14
6	(0.1380)	32, 40	Lgt.	AA	0.72	0.59	0.41	0.28	0.11	0.07	0.21	0.17	0.33	0.29	0.14	0.10
			Hvy.	**A**	**0.91**	**0.78**	**0.47**	**0.34**	**0.14**	**0.10**	**0.27**	**0.22**	**0.43**	**0.39**	**0.18**	**0.14**
8	(0.1640)	32, 36	**Lgt.**	**A**	**0.91**	**0.78**	**0.47**	**0.34**	**0.14**	**0.10**	**0.27**	**0.22**	**0.43**	**0.39**	**0.18**	**0.14**
			Hvy.	B	1.10	0.97	0.57	0.43	0.18	0.14	0.33	0.26	0.50	0.45	0.22	0.17
10	(0.1900)	24, 32	**Lgt.**	**A**	**0.91**	**0.78**	**0.47**	**0.34**	**0.14**	**0.10**	**0.27**	**0.22**	**0.43**	**0.39**	**0.18**	**0.14**
			Hvy.	B	1.10	0.97	0.57	0.43	0.18	0.14	0.33	0.26	0.50	0.45	0.22	0.17
12	(0.2160)	24, 28	**Lgt.**	**B**	**1.10**	**0.97**	**0.57**	**0.43**	**0.18**	**0.14**	**0.33**	**0.26**	**0.50**	**0.45**	**0.22**	**0.17**
			Hvy.	C	1.25	1.12	0.66	0.53	0.21	0.17	0.39	0.32	0.58	0.51	0.25	0.20
¼	(0.2500)	20, 28	**Lgt.**	**B**	**1.10**	**0.97**	**0.57**	**0.43**	**0.18**	**0.14**	**0.39**	**0.26**	**0.50**	**0.45**	**0.22**	**0.17**
			Reg.	C	1.25	1.12	0.66	0.53	0.21	0.17	0.39	0.32	0.58	0.51	0.25	0.20
			Hvy.	D	1.44	1.31	0.79	0.65	0.24	0.20	0.48	0.42	0.70	0.64	0.30	0.26
5/16	(0.3125)	18, 24	**Lgt.**	**C**	**1.25**	**1.12**	**0.66**	**0.53**	**0.21**	**0.17**	**0.39**	**0.32**	**0.58**	**0.51**	**0.25**	**0.20**
			Reg.	D	1.44	1.31	0.79	0.65	0.24	0.20	0.48	0.42	0.70	0.64	0.30	0.26
			Hvy.	E	1.94	1.81	1.00	0.87	0.33	0.26	0.65	0.54	0.93	0.86	0.39	0.35
⅜	(0.3750)	16, 24	**Lgt.**	**D**	**1.44**	**1.31**	**0.79**	**0.65**	**0.24**	**0.20**	**0.48**	**0.42**	**0.70**	**0.64**	**0.30**	**0.26**
			Reg.	E	1.94	1.81	1.00	0.87	0.33	0.26	0.65	0.54	0.93	0.86	0.39	0.35
7/16	(0.4375)	14, 20	**Lgt.**	**E**	**1.94**	**1.81**	**1.00**	**0.87**	**0.33**	**0.26**	**0.65**	**0.54**	**0.93**	**0.86**	**0.39**	**0.35**
			Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	0.90	0.80	1.19	1.13	0.55	0.51
½	(0.5000)	13, 20	**Lgt.**	**E**	**1.94**	**1.81**	**1.00**	**0.87**	**0.33**	**0.26**	**0.65**	**0.54**	**0.93**	**0.86**	**0.39**	**0.35**
			Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	0.90	0.80	1.19	1.13	0.55	0.51
9/16	(0.5625)	12, 18	Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	0.90	0.80	1.19	1.13	0.55	0.51
⅝	(0.6250)	11, 18	Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	0.90	0.80	1.19	1.13	0.55	0.51
¾	(0.7500)	10, 16	Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	0.90	0.80	1.19	1.13	0.55	0.51

[a] Where specifying nominal size in decimals, zeros in the fourth decimal place are omitted.
[b] Lgt. = Light; Hvy. = Heavy; Reg. = Regular. Sizes shown in **bold face** are preferred.

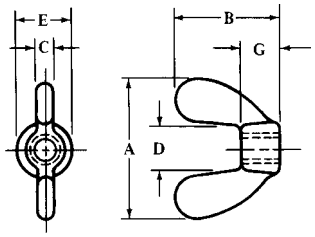
All dimensions in inches.

Type B: Type B wing nuts are hot forged solid nuts available in two wing styles: Style 1, having wings of moderate height; and Style 2, having high wings. Dimensions are given in Table 2.

Table 2. American National Standard Type B Wing Nuts
ANSI B18.17-1968, R1983



STYLE 1



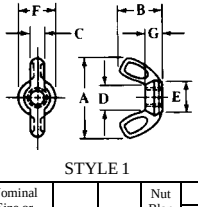
STYLE 2

Nominal Size or Basic Major Diameter of Thread[a]	Thds. per Inch	A Wing Spread		B Wing Height		C Wing Thick.		D Between Wings		E Boss Diam.		G Boss Height	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Type B, Style 1													
5 (0.1250)	40	0.78	0.72	0.36	0.30	0.13	0.10	0.28	0.22	0.31	0.28	0.22	0.16
10 (0.1900)	24	0.97	0.91	0.45	0.39	0.15	0.12	0.34	0.28	0.39	0.36	0.28	0.22
1/4 (0.2500)	20	1.16	1.09	0.56	0.50	0.17	0.14	0.41	0.34	0.47	0.44	0.34	0.28
5/16 (0.3125)	18	1.44	1.38	0.67	0.61	0.18	0.15	0.50	0.44	0.55	0.52	0.41	0.34
3/8 (0.3750)	16	1.72	1.66	0.80	0.73	0.20	0.17	0.59	0.53	0.63	0.60	0.47	0.41
7/16 (0.4375)	14	2.00	1.94	0.91	0.84	0.21	0.18	0.69	0.62	0.71	0.68	0.53	0.47
1/2 (0.5000)	13	2.31	2.22	1.06	0.94	0.23	0.20	0.78	0.69	0.79	0.76	0.62	0.50
9/16 (0.5625)	12	2.59	2.47	1.17	1.05	0.25	0.21	0.88	0.78	0.88	0.84	0.69	0.56
5/8 (0.6250)	11	2.84	2.72	1.31	1.19	0.27	0.23	0.94	0.84	0.96	0.92	0.75	0.62
3/4 (0.7500)	10	3.31	3.19	1.52	1.39	0.29	0.25	1.10	1.00	1.12	1.08	0.88	0.75
Type B, Style 2													
5 (0.1250)	40	0.81	0.75	0.62	0.56	0.12	0.09	0.28	0.22	0.31	0.28	0.22	0.16
10 (0.1900)	24	1.01	0.95	0.78	0.72	0.14	0.11	0.35	0.29	0.39	0.36	0.28	0.22
1/4 (0.2500)	20	1.22	1.16	0.94	0.88	0.16	0.13	0.41	0.35	0.47	0.44	0.34	0.28
5/16 (0.3125)	18	1.43	1.37	1.09	1.03	0.17	0.14	0.48	0.42	0.55	0.52	0.41	0.34
3/8 (0.3750)	16	1.63	1.57	1.25	1.19	0.18	0.15	0.55	0.49	0.63	0.60	0.47	0.41
7/16 (0.4375)	14	1.90	1.84	1.42.	1.36	0.19	0.16	0.62	0.56	0.71	0.68	0.53	0.47
1/2 (0.5000)	13	2.13	2.04	1.58	1.45	0.20	0.17	0.69	0.60	0.79	0.76	0.62	0.50
9/16 (0.5625)	12	2.40	2.28	1.75	1.62	0.22	0.18	0.76	0.67	0.88	0.84	0.69	0.56
5/8 (0.6250)	11	2.60	2.48	1.91	1.78	0.23	0.19	0.83	0.74	0.96	0.92	0.75	0.62
3/4 (0.7500)	10	3.02	2.90	2.22	2.09	0.24	0.20	0.97	0.88	1.12	1.08	0.88	0.75

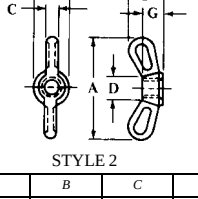
[a] Where specifying nominal size in decimals, zeros in the fourth decimal place are omitted.

All dimensions in inches.

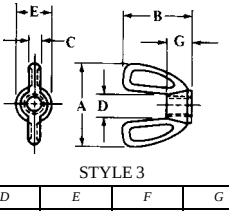
Table 3. American National Standard Type C Wing Nuts *ANSI B18.17-1968, R1983*



STYLE 1



STYLE 2



STYLE 3

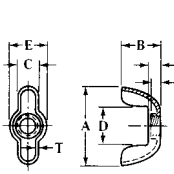
Nominal Size or Basic Major Diameter of Thread[a]	Thds. per Inch	Series	Nut Blank Size (Ref)	*A* Wing Spread		*B* Wing Height		*C* Wing Thick.		*D* Between Wings		*E* Boss Diam.		*F* Boss Diam.		*G* Boss Height	
				Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Type C, Style 1																	
4 (0.1120)	40	Reg.	AA	0.66	0.64	0.36	0.35	0.11	0.09	0.18	0.16	0.27	0.25	0.32	0.30	0.16	0.14
5 (0.1250)	40	Reg.	AA	0.66	0.64	0.36	0.35	0.11	0.09	0.18	0.16	0.27	0.25	0.32	0.30	0.16	0.14
6 (0.1380)	32	**Reg.**	**AA**	**0.66**	**0.64**	**0.36**	**0.35**	**0.11**	**0.09**	**0.18**	**0.16**	**0.27**	**0.25**	**0.32**	**0.30**	**0.16**	**0.14**
		Hvy.	A	0.85	0.83	0.43	0.42	0.14	0.12	0.29	0.27	0.38	0.36	0.41	0.40	0.20	0.18
8 (0.1640)	32	Reg.	A	0.85	0.83	0.43	0.42	0.14	0.12	0.29	0.27	0.38	0.36	0.41	0.40	0.20	0.18
10 (0.1900)	24, 32	Reg.	A	0.85	0.83	0.43	0.42	0.14	0.12	0.29	0.27	0.38	0.36	0.41	0.40	0.20	0.18
12 (0.2160)	24	**Reg.**	A	**0.85**	**0.83**	**0.43**	**0.42**	**0.14**	**0.12**	**0.29**	**0.27**	**0.38**	**0.36**	**0.41**	**0.40**	**0.20**	**0.18**
		Hvy.	B	1.08	1.05	0.57	0.53	0.16	0.14	0.32	0.30	0.44	0.42	0.48	0.46	0.23	0.21
1/4 (0.2500)	20, 28	Reg.	B	1.08	1.05	0.57	0.53	0.16	0.14	0.32	0.30	0.44	0.42	0.48	0.46	0.23	0.21
5/16 (0.3125)	18, 24	Reg.	C	1.23	1.20	0.64	0.62	0.20	0.18	0.39	0.35	0.50	0.49	0.57	0.55	0.26	0.24
3/8 (0.3750)	16, 24	Reg.	D	1.45	1.42	0.74	0.72	0.23	0.21	0.46	0.42	0.62	0.60	0.69	0.67	0.29	0.27
7/16 (0.4375)	14, 20	**Reg.**	**E**	**1.89**	**1.86**	**0.91**	**0.90**	**0.29**	**0.28**	**0.67**	**0.65**	**0.75**	**0.73**	**0.83**	**0.82**	**0.38**	**0.37**
		Hvy.	EH	1.89	1.86	0.93	0.91	0.34	0.33	0.63	0.62	0.81	0.79	0.89	0.87	0.42	0.40
1/2 (0.5000)	13, 20	**Reg.**	**E**	**1.89**	**1.86**	**0.91**	**0.90**	**0.29**	**0.28**	**0.67**	**0.65**	**0.75**	**0.73**	**0.83**	**0.82**	**0.38**	**0.37**
		Hvy.	EH	1.89	1.86	0.93	0.91	0.34	0.33	0.63	0.62	0.81	0.79	0.89	0.87	0.42	0.40
Type C, Style 2																	
5 (0.1250)	40	…	…	0.82	0.80	0.25	0.23	0.09	0.08	0.21	0.19	0.26	0.24	…	…	0.17	0.15
6 (0.1380)	32	…	…	0.82	0.80	0.25	0.23	0.09	0.08	0.21	0.19	0.26	0.24	…	…	0.17	0.15
8 (0.1640)	32	…	…	1.01	0.99	0.28	0.27	0.11	0.09	0.29	0.28	0.36	0.34	…	…	0.19	0.18
10 (0.1900)	24, 32	…	…	1.01	0.99	0.28	0.27	0.11	0.09	0.29	0.28	0.36	0.34	…	…	0.19	0.18
12 (0.2160)	24	…	…	1.20	1.18	0.32	0.31	0.12	0.11	0.38	0.37	0.44	0.43	…	…	0.22	0.20
1/4 (0.2500)	20	…	…	1.20	1.18	0.32	0.31	0.12	0.11	0.38	0.37	0.44	0.43	…	…	0.22	0.20
5/16 (0.3125)	18	…	…	1.51	1.49	0.36	0.35	0.14	0.12	0.44	0.43	0.51	0.49	…	…	0.24	0.23
3/8 (0.3750)	16	…	…	1.89	1.86	0.58	0.55	0.20	0.17	0.44	0.43	0.63	0.62	…	…	0.37	0.35
Type C, Style 3																	
5 (0.1250)	40	…	…	0.92	0.89	0.70	0.67	0.16	0.15	0.26	0.24	0.38	0.36	…	…	0.25	0.24
6 (0.1380)	32	…	…	0.92	0.89	0.70	0.67	0.16	0.15	0.26	0.24	0.38	0.36	…	…	0.25	0.24
8 (0.1640)	32	…	…	0.92	0.89	0.70	0.67	0.16	0.15	0.26	0.24	0.38	0.36	…	…	0.25	0.24
10 (0.1900)	24, 32	…	…	1.14	1.12	0.85	0.83	0.19	0.17	0.32	0.30	0.44	0.42	…	…	0.29	0.27
12 (0.2160)	24	…	…	1.14	1.12	0.85	0.83	0.19	0.17	0.32	0.30	0.44	0.42	…	…	0.29	0.27
1/4 (0.2500)	20	…	…	1.14	1.12	0.85	0.83	0.19	0.17	0.32	0.30	0.44	0.42	…	…	0.29	0.27
5/16 (0.3125)	18	…	…	1.29	1.27	1.04	1.02	0.23	0.22	0.39	0.36	0.50	0.49	…	…	0.35	0.34
3/8 (0.3750)	16	…	…	1.51	1.49	1.20	1.18	0.27	0.25	0.45	0.42	0.62	0.60	…	…	0.43	0.42

[a] Where specifying nominal size in decimals, zeros in the fourth decimal place are omitted.

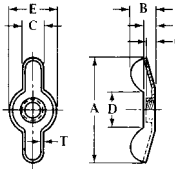
All dimensions in inches. Sizes shown in **bold face** are preferred.

Type C: Type C wing nuts are die cast solid nuts and are available in three wing styles: Style 1, having wings of moderate height; Style 2, having low wings; and Style 3, having high wings. In some sizes, the Style 1 nuts are produced in regular, light, and heavy series to best suit the requirements of specific applications. Dimensions are given in Table 3.

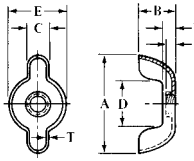
Table 4. American National Standard Type D Wing Nuts *ANSI B18.17-1968, R1983*



STYLE 1



STYLE 2 (LOW WING)



STYLE 3 (LARGE BASE)

Nominal Size or Basic Major Diameter of Thread[a]	Thds. per Inch	Series[b]	A Wing Spread		B Wing Height		C Wing Thick.		D Between Wings	E Boss Diam.		G Boss Hgt.	H Wall Hgt.	T Stock Thick.	
			Max	Min	Max	Min	Max	Min	Min	Max	Min	Min	Min	Max	Min
Type D, Style 1															
8 (0.1640)	32, 36	…	0.78	0.72	0.40	0.34	0.18	0.14	0.25	0.41	0.35	0.08	0.12	0.04	0.03
10 (0.1900)	24, 32	…	0.91	0.85	0.47	0.41	0.21	0.17	0.34	0.53	0.47	0.10	0.12	0.04	0.03
12 (0.2160)	24, 28	…	1.09	1.03	0.47	0.41	0.21	0.17	0.34	0.53	0.47	0.10	0.12	0.05	0.04
1/4 (0.2500)	20, 28	…	1.11	1.05	0.50	0.44	0.25	0.21	0.34	0.62	0.56	0.11	0.12	0.05	0.04
5/16 (0.3125)	18, 24	…	1.30	1.24	0.59	0.53	0.30	0.26	0.46	0.73	0.67	0.14	0.18	0.06	0.05
3/8 (0.3750)	16, 24	…	1.41	1.34	0.67	0.61	0.34	0.30	0.69	0.83	0.77	0.16	0.18	0.06	0.05
Type D, Style 2															
5 (0.1250)	40	Reg.	1.03	0.97	0.25	0.19	0.19	0.13	0.30	0.40	0.34	0.07	0.09	0.04	0.03
6 (0.1380)	32	Reg.	1.03	0.97	0.25	0.19	0.19	0.13	0.30	0.40	0.34	0.08	0.09	0.04	0.03
8 (0.1640)	32	Reg.	1.03	0.97	0.25	0.19	0.19	0.13	0.30	0.40	0.34	0.08	0.09	0.04	0.03
10 (0.1900)	24, 32	Reg.	1.40	1.34	0.34	0.28	0.25	0.18	0.32	0.53	0.47	0.09	0.16	0.05	0.04
		Hvy.	1.21	1.16	0.28	0.26	0.31	0.25	0.60	0.61	0.55	0.09	0.13	0.05	0.04
12 (0.2160)	24	Reg.	1.21	1.16	0.28	0.26	0.31	0.25	0.60	0.61	0.55	0.11	0.13	0.05	0.04
1/4 (0.2500)	20	Reg.	1.21	1.16	0.28	0.26	0.31	0.25	0.60	0.61	0.55	0.11	0.13	0.05	0.04
Type D, Style 3															
10 (0.1900)	24, 32	Lgt.	1.31	1.25	0.48	0.42	0.29	0.23	0.47	0.65	0.59	0.08	0.12	0.04	0.03
		Reg.	1.40	1.34	0.53	0.47	0.25	0.19	0.50	0.75	0.69	0.08	0.14	0.04	0.03
12 (0.2160)	24	Reg.	1.28	1.22	0.40	0.34	0.23	0.17	0.59	0.73	0.67	0.11	0.12	0.04	0.03
1/4 (0.2500)	20	Lgt.	1.28	1.22	0.40	0.34	0.23	0.17	0.59	0.73	0.67	0.11	0.12	0.04	0.03
		Reg.	1.78	1.72	0.66	0.60	0.31	0.25	0.70	1.03	0.97	0.14	0.17	0.06	0.04
		Hvy.	1.47	1.40	0.50	0.44	0.37	0.31	0.66	1.03	0.97	0.14	0.14	0.08	0.06
5/16 (0.3125)	18	Reg.	1.78	1.72	0.66	0.60	0.31	0.25	0.70	1.03	0.97	0.14	0.17	0.06	0.04
		Hvy.	1.47	1.40	0.50	0.44	0.37	0.31	0.66	1.03	0.97	0.14	0.14	0.08	0.06

[a] Where specifying nominal size in decimals, zeros in the fourth decimal place are omitted.

[b] Lgt. = Light; Hvy. = Heavy; Reg. = Regular.

All dimensions in inches.

Type D: Type D wing nuts are stamped sheet metal nuts and are available in three styles: Style 1, having wings of moderate height; Style 2, having low wings; and Style 3, having wings of moderate height and a larger bearing surface. In some sizes, Styles 2 and 3 are produced in regular, light, and heavy series to best suit the requirements of specific applications. Dimensions are given in Table 4.

Specification of Wing Nuts.—When specifying wing nuts, the following data should be included in the designation and should appear in the following sequence: nominal size (number, fraction or decimal equivalent), threads per inch, type, style and/or series, material, and finish.

Examples: 10—32 Type A Wing Nut, Regular Series, Steel, Zinc Plated.
0.250—20 Type C Wing Nut, Style 1, Zinc Alloy, Plain.

Threads for Wing Nuts.—Threads are in conformance with the ANSI Standard Unified Thread, Class 2B for all types of wing nuts except type D which have a modified Class 2B thread. Because of the method of manufacture, the minor diameter of the thread in type D

nuts may be somewhat larger than the Unified Thread Class 2B maximum but shall in no case exceed the minimum pitch diameter.

Materials and Finish for Wing Nuts.—Types A, B, and D wing nuts are normally supplied as specified by the user in carbon steel, brass or corrosion resistant steel of good quality and adaptable to the manufacturing process. Type C wing nuts are made from die cast zinc alloy. Unless otherwise specified, wing nuts are supplied with a plain (unplated or uncoated) finish.

Wing Screws.—A wing screw is a screw having a wing-shaped head designed for manual turning without a driver or wrench. As covered by ANSI B18.17-1968 (R1983) wing screws are classified first, by type on the basis of the method of manufacture, and second, by style on the basis of design characteristics. They consist of the following:

Type A: Type A wing screws are of two-piece construction having cold formed or cold forged wing portions of moderate height. In some sizes they are produced in regular, light, and heavy series to best suit the requirements of specific applications. Dimensions are given in Table .

Type B: Type B wing screws are of hot forged one-piece construction available in two wing styles: Style 1, having wings of moderate height; and Style 2, having high wings. Dimensions are given in Table .

Type C: Type C wing screws are available in two styles: Style 1, of a one-piece die cast construction having wings of moderate height; and Style 2, of a two-piece construction having a die cast wing portion of moderate height. Dimensions are given in Table 6.

Type D: Type D wing screws are of two-piece welded construction having stamped sheet metal wing portions of moderate height. Dimensions are given in Table 6.

Materials for Wing Screws and Thumb Screws: Type A wing screws are normally supplied in carbon steel with the shank portion case hardened. When so specified, they also may be made from corrosion resistant steel, brass or other materials as agreed upon by the manufacturer and user.

Type B wing screws are normally made from carbon steel but also may be made from corrosion resistant steel, brass or other materials.

Type C, Style 1, wing screws are supplied only in die cast zinc alloy. Type C, Style 2, wing screws have the wing portion made from die cast zinc alloy with the shank portion normally made from carbon steel. Where so specified, the shank portion may be made from corrosion resistant steel, brass or other materials as agreed upon by the manufacturer and user.

Type D wing screws are normally supplied in carbon steel but also may be made from corrosion resistant steel, brass or other materials.

Thumb screws of all types are normally made from a good commercial quality of carbon steel having a maximum ultimate tensile strength of 48,000 psi. Where so specified, carbon steel thumb screws are case hardened. They are also made from corrosion resistant steel, brass, and other materials as agreed upon by the manufacturer and user.

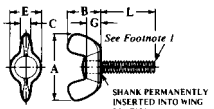
Unless otherwise specified, wing screws and thumb screws are supplied with a plain (unplated or uncoated) finish.

Thumb Screws: A thumb screw is a screw having a flattened head designed for manual turning without a driver or wrench. As covered by ANSI B18.17-1968 (R1983) thumb screws are classified by type on the basis of design characteristics. They consist of the following:

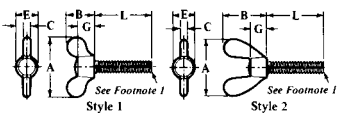
Type A: Type A thumb screws are forged one-piece screws having a shoulder under the head and are available in two series: regular and heavy. Dimensions are given in Table .

Type B: Type B thumb screws are forged one-piece screws without a shoulder and are available in two series: regular and heavy. Dimensions are given in Table .

Table 5. American National Standard Types A and B Wing Screws
ANSI B18.17-1968, R1983



TYPE A

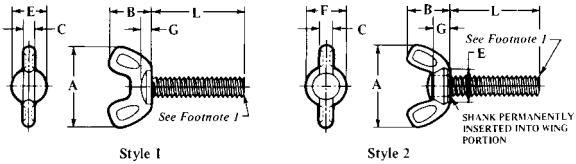


TYPE B

Nominal Size or Basic Major Diameter[a]	Thds. per Inch	Series[b]	Head Blank size (Ref)	*A* Wing Spread		*B* Wing Height		*C* Wing Thick.		*E* Boss Diam.		*G* Boss Height.		*L* Practical Screw Lengths	
				Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Type A															
4 (0.1120)	40	Hvy.	AA	0.72	0.59	0.41	0.28	0.11	0.07	0.33	0.29	0.14	0.10	0.75	0.25
6 (0.1380)	32	Lgt.	AA	0.72	0.59	0.41	0.28	0.11	0.07	0.33	0.29	0.14	0.10	} 0.75	0.25
		Hvy.	**A**	**0.91**	**0.78**	**0.47**	**0.34**	**0.14**	**0.10**	**0.43**	**0.39**	**0.18**	**0.14**		
8 (0.1640)	32	**Lgt.**	**A**	**0.91**	**0.78**	**0.47**	**0.34**	**0.14**	**0.10**	**0.43**	**0.39**	**0.18**	**0.14**	} 0.75	0.38
		Hvy.	B	1.10	0.97	0.57	0.43	0.18	0.14	0.50	0.45	0.22	0.17		
10 (0.1900)	24, 32	**Lgt.**	**A**	**0.91**	**0.78**	**0.47**	**0.34**	**0.14**	**0.10**	**0.43**	**0.39**	**0.18**	**0.14**	} 1.00	0.38
		Hvy.	B	1.10	0.97	0.57	0.43	0.18	0.14	0.50	0.45	0.22	0.17		
12 (0.2160)	24	**Lgt.**	**B**	**1.10**	**0.97**	**0.57**	**0.43**	**0.18**	**0.14**	**0.50**	**0.45**	**0.22**	**0.17**	} 1.00	0.38
		Hvy.	C	1.25	1.12	0.66	0.53	0.21	0.17	0.58	0.51	0.25	0.20		
¼ (0.2500)	20	**Lgt.**	**B**	**1.10**	**0.97**	**0.57**	**0.43**	**0.18**	**0.14**	**0.50**	**0.45**	**0.22**	**0.17**	} 1.50	0.50
		Reg.	C	1.25	1.12	0.66	0.53	0.21	0.17	0.58	0.51	0.25	0.20		
		Hvy.	D	1.44	1.31	0.79	0.65	0.24	0.20	0.70	0.64	0.30	0.26		
5/16 (0.3125)	18	**Lgt.**	**C**	**1.25**	**1.12**	**0.66**	**0.53**	**0.21**	**0.17**	**0.58**	**0.51**	**0.25**	**0.20**	} 1.50	0.50
		Reg.	D	1.44	1.31	0.79	0.65	0.24	0.20	0.70	0.64	0.30	0.26		
		Hvy.	E	1.94	1.81	1.00	0.87	0.33	0.26	0.93	0.86	0.39	0.35		
3/8 (0.3750)	16	**Lgt.**	**D**	**1.44**	**1.31**	**0.79**	**0.65**	**0.24**	**0.20**	**0.70**	**0.64**	**0.30**	**0.26**	} 2.00	0.75
		Reg.	E	1.94	1.81	1.00	0.87	0.33	0.26	0.93	0.86	0.39	0.35		
		Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	1.19	1.13	0.55	0.51		
7/16 (0.4375)	14	**Lgt.**	**E**	**1.94**	**1.81**	**1.00**	0.87	**0.33**	**0.26**	**0.93**	**0.86**	**0.39**	**0.35**	} 4.00	1.00
		Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	1.19	1.13	0.55	0.51		
½ (0.5000)	13	**Lgt.**	**E**	**1.94**	**1.81**	**1.00**	**0.87**	**0.33**	**0.26**	**0.93**	**0.86**	**0.39**	**0.35**	} 4.00	1.00
		Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	1.19	1.13	0.55	0.51		
5/8 (0.6250)	11	Hvy.	F	2.76	2.62	1.44	1.31	0.40	0.34	1.19	1.13	0.55	0.51	4.00	1.25
Type B, Style 1															
10 (0.1900)	24	…	…	0.97	0.91	0.45	0.39	0.15	0.12	0.39	0.36	0.28	0.22	2.00	0.50
¼ (0.2500)	20	…	…	1.16	1.09	0.56	0.50	0.17	0.14	0.47	0.44	0.34	0.28	3.00	0.50
5/16 (0.3125)	18	…	…	1.44	1.38	0.67	0.61	0.18	0.15	0.55	0.52	0.41	0.34	3.00	0.50
3/8 (0.3750)	16	…	…	1.72	1.66	0.80	0.73	0.20	0.17	0.63	0.60	0.47	0.41	4.00	0.50
7/16 (0.4375)	14	…	…	2.00	1.94	0.91	0.84	0.21	0.18	0.71	0.68	0.53	0.47	3.00	1.00
½ (0.5000)	13	…	…	2.31	2.22	1.06	0.94	0.23	0.20	0.79	0.76	0.62	0.50	3.00	1.00
5/8 (0.6250)	11	…	…	2.84	2.72	1.31	1.19	0.27	0.23	0.96	0.92	0.75	0.62	2.50	1.00
Type B, Style 2															
10 (0.1900)	24	…	…	1.01	0.95	0.78	0.72	0.14	0.11	0.39	0.36	0.28	0.22	1.25	0.50
¼ (0.2500)	20	…	…	1.22	1.16	0.94	0.88	0.16	0.13	0.47	0.44	0.34	0.28	2.00	0.50
5/16 (0.3125)	18	…	…	1.43	1.37	1.09	1.03	0.17	0.14	0.55	0.52	0.41	0.34	2.00	0.50
3/8 (0.3750)	16	…	…	1.63	1.57	1.25	1.19	0.18	0.15	0.63	0.60	0.47	0.41	2.00	0.50

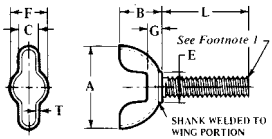
[a] Where specifyin nominal size in decimals, zeros in the fourth decimal place are omitted.
[b] Hvy. = Heavy; Lgt. = Light; Reg. = Regular.
All dimensions in inches. Sizes shown in **bold face** are preferred.
[1] Plain point, unless alternate point from styles shown in Table 8 is specified by user.

Table 6. American National Standard Types C and D Wing Screws
ANSI B18.17-1968, R1983



Style 1 Style 2

TYPE C



TYPE D

Nominal Size or Basic Screw Diameter[a]	Thds. per Inch	A Wing Spread		B Wing Height		C Wing Thick.		E Boss Diam.		F Boss Diam.		G Height		L Practical Screw Lengths	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Type C, Style 1															
6 (0.1380)	32	0.85	0.83	0.45	0.43	0.15	0.12	…	…	0.41	0.39	0.12	0.07	0.75	0.25
8 (0.1640)	32	0.85	0.83	0.45	0.43	0.15	0.12	…	…	0.41	0.39	0.12	0.07	1.00	0.38
10 (0.1900)	24, 32	0.85	0.83	0.45	0.43	0.15	0.12	…	…	0.41	0.39	0.12	0.07	1.25	0.38
1/4 (0.2500)	20	1.08	1.05	0.56	0.53	0.17	0.14	…	…	0.46	0.44	0.12	0.07	1.50	0.50
5/16 (0.3125)	18	1.23	1.20	0.64	0.62	0.22	0.19	…	…	0.51	0.49	0.14	0.10	1.50	0.50
3/8 (0.3750)	16	1.45	1.42	0.74	0.72	0.24	0.21	…	…	0.63	0.62	0.15	0.12	1.50	0.50
Type C, Style 2															
6 (0.1380)	32	0.85	0.83	0.43	0.42	0.14	0.12	0.38	0.36	0.41	0.40	0.20	0.18	1.00	0.25
8 (0.1640)	32	0.85	0.83	0.43	0.42	0.14	0.12	0.38	0.36	0.41	0.40	0.20	0.18	1.00	0.38
10 (0.1900)	24, 32	0.85	0.83	0.43	0.42	0.14	0.12	0.38	0.36	0.41	0.40	0.20	0.18	2.00	0.38
1/4 (0.2500)	20	1.08	1.05	0.57	0.53	0.16	0.14	0.44	0.42	0.48	0.46	0.23	0.21	2.50	0.50
5/16 (0.3125)	18	1.23	1.20	0.64	0.62	0.20	0.18	0.50	0.49	0.57	0.55	0.26	0.24	3.00	0.50
3/8 (0.3750)	16	1.45	1.42	0.74	0.72	0.23	0.21	0.62	0.60	0.69	0.67	0.29	0.27	3.00	0.75
7/16 (0.4375)	14	1.89	1.86	0.91	0.90	0.29	0.28	0.75	0.73	0.83	0.82	0.38	0.37	4.00	1.00
1/2 (0.5000)	13	1.89	1.86	0.91	0.90	0.29	0.28	0.75	0.73	0.83	0.82	0.38	0.37	4.00	1.00
Type D															
6 (0.1380)	32	0.78	0.72	0.40	0.34	0.18	0.12	0.35	0.31	0.40	0.34	0.21	0.14	0.75	0.25
8 (0.1640)	32	0.78	0.72	0.40	0.34	0.18	0.12	0.35	0.31	0.40	0.34	0.21	0.14	0.75	0.38
10 (0.1900)	24	0.90	0.84	0.46	0.40	0.21	0.15	0.35	0.31	0.53	0.47	0.22	0.16	1.00	0.38
12 (0.2160)	24	1.09	1.03	0.46	0.40	0.26	0.20	0.44	0.39	0.61	0.55	0.24	0.18	1.00	0.38
1/4 (0.2500)	20	1.09	1.03	0.46	0.40	0.26	0.20	0.47	0.43	0.61	0.55	0.24	0.18	1.50	0.50
5/16 (0.3125)	18	1.31	1.25	0.62	0.56	0.29	0.23	0.57	0.53	0.68	0.62	0.29	0.23	1.50	0.50
3/8 (0.3750)	16	1.31	1.25	0.62	0.56	0.29	0.23	0.63	0.59	0.68	0.62	0.29	0.23	2.00	0.75

[a] Where specifying nominal size in decimals, zeros in the fourth decimal place are omitted.

All dimensions in inches.

[1] Plain point, unless alternate point from styles shown in Table 8 is specified by user.

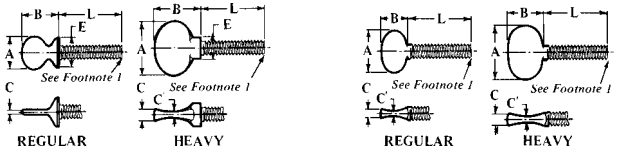
Wing Screw and Thumb Screw Designation.—When specifying wing and thumb screws, the following data should be included in the designation and should appear in the following sequence: nominal size (number, fraction or decimal equivalent), threads per inch, length (fractions or decimal equivalents), type, style and/or series, point (if other than plain point), materials, and finish.

Examples: 10—32 × 1¼, Thumb Screw, Type A, Regular, Steel, Zinc Plated.

0.375—16 × 2.00, Wing Screw, Type B, Style 2, Steel, Cadmium Plated.

0.250—20 × 1.50, Wing Screw, Type C, Style 2, Zinc Alloy Wings, Steel Shank, Brass Plated.

Table 7. American National Standard Types A and B Thumb Screws
ANSI B18.17-1968, R1983



TYPE A TYPE B

Nominal Size or Basic Screw Diameter[a]	Thds. per Inch	A Head Width		B Head Height		C Head Thick.		C' Head Thick.		E Shoulder Diameter		L Practical Screw Lengths	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Type A, Regular													
6 (0.1380)	32	0.31	0.29	0.33	0.31	0.05	0.04	…	…	0.25	0.23	0.75	0.25
8 (0.1640)	32	0.36	0.34	0.38	0.36	0.06	0.05	…	…	0.31	0.29	0.75	0.38
10 (0.1900)	24, 32	0.42	0.40	0.48	0.46	0.06	0.05	…	…	0.35	0.32	1.00	0.38
12 (0.2160)	24	0.48	0.46	0.54	0.52	0.06	0.05	…	…	0.40	0.38	1.00	0.38
¼ (0.2500)	20	0.55	0.52	0.64	0.61	0.07	0.05	…	…	0.47	0.44	1.50	0.50
5/16 (0.3125)	18	0.70	0.67	0.78	0.75	0.09	0.07	…	…	0.59	0.56	1.50	0.50
⅜ (0.3750)	16	0.83	0.80	0.95	0.92	0.11	0.09	…	…	0.76	0.71	2.00	0.75
Type A, Heavy													
10 (0.1900)	24	0.89	0.83	0.84	0.72	0.18	0.16	0.10	0.08	0.33	0.31	2.00	0.50
¼ (0.2500)	20	1.05	0.99	0.94	0.81	0.24	0.22	0.10	0.08	0.40	0.38	3.00	0.50
5/16 (0.3125)	18	1.21	1.15	1.00	0.88	0.27	0.25	0.11	0.09	0.46	0.44	4.00	0.50
⅜ (0.3750)	16	1.41	1.34	1.16	1.03	0.30	0.28	0.11	0.09	0.55	0.53	4.00	0.50
7/16 (0.4375)	14	1.59	1.53	1.22	1.09	0.36	0.34	0.13	0.11	0.71	0.69	2.50	1.00
½ (0.5000)	13	1.81	1.72	1.28	1.16	0.40	0.38	0.14	0.12	0.83	0.81	3.00	1.00
Type B, Regular													
6 (0.1380)	32	0.45	0.43	0.28	0.26	0.08	0.06	0.03	0.02	…	…	1.00	0.25
8 (0.1640)	32	0.51	0.49	0.32	0.30	0.09	0.07	0.04	0.02	…	…	1.00	0.38
10 (0.1900)	24, 32	0.58	0.54	0.39	0.36	0.10	0.08	0.05	0.03	…	…	2.00	0.38
12 (0.2160)	24	0.71	0.67	0.45	0.43	0.11	0.09	0.05	0.03	…	…	2.00	0.38
¼ (0.2500)	20	0.83	0.80	0.52	0.48	0.16	0.14	0.06	0.03	…	…	2.50	0.50
5/16 (0.3125)	18	0.96	0.91	0.64	0.60	0.17	0.14	0.09	0.06	…	…	3.00	0.50
⅜ (0.3750)	16	1.09	1.03	0.71	0.67	0.22	0.18	0.11	0.08	…	…	3.00	0.75
7/16 (0.4375)	14	1.40	1.35	0.96	0.91	0.27	0.24	0.14	0.11	…	…	4.00	1.00
½ (0.5000)	13	1.54	1.46	1.09	1.03	0.33	0.29	0.15	0.11	…	…	4.00	1.00
Type B, Heavy													
10 (0.1900)	24	0.89	0.83	0.78	0.66	0.18	0.16	0.08	0.06	…	…	2.00	0.50
¼ (0.2500)	20	1.05	0.99	0.81	0.72	0.24	0.22	0.11	0.09	…	…	3.00	0.50
5/16 (0.3125)	18	1.21	1.15	0.88	0.78	0.27	0.25	0.11	0.09	…	…	4.00	0.50
⅜ (0.3750)	16	1.41	1.34	0.94	0.84	0.30	0.28	0.14	0.12	…	…	4.00	0.50
7/16 (0.4375)	14	1.59	1.53	1.00	0.91	0.36	0.34	0.14	0.12	…	…	3.00	1.00
½ (0.5000)	13	1.81	1.72	1.09	0.97	0.40	0.38	0.18	0.16	…	…	3.00	1.00

[a] Where specifying nominal size in decimals, zeroes in fourth decimal place are omitted.

All dimensions in inches.

[1] Plain point, unless alternate point from styles shown in Table 8 is specified by user.

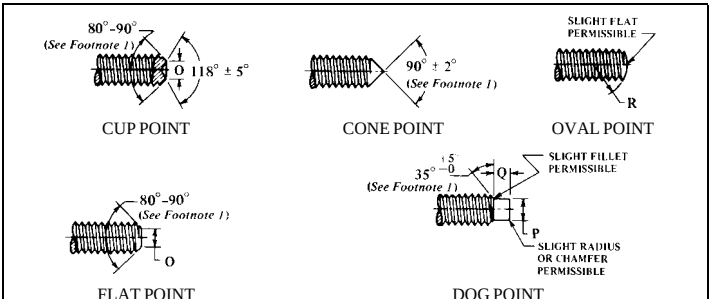
Lengths of Wing and Thumb Screws.—The length of wing or thumb screws is measured parallel to the axis of the screw from the intersection of the head or shoulder with the shank to the extreme point of the screw. Standard length increments are as follows: For

sizes No. 4 through ¼ inch and for nominal lengths of 0.25 to 0.75 inch, 0.12-inch increments; from 0.75- to 1.50-inch lengths, 0.25-inch increments; and for 1.50- to 3.00-inch lengths, 0.50-inch increments. For sizes 5/16 through ½ inch and for 0.50- to 1.50-inch lengths, 0.25-inch increments; for 1.50- to 3.00-inch lengths, 0.50-inch increments; and for 3.00- to 4.00-inch lengths, 1.00-inch increments.

Threads for Wing Screws and Thumb Screws.—Threads for all types of wing screws and thumb screws are in conformance with ANSI Standard Unified Thread, Class 2A. For threads with an additive finish the Class 2A maximum diameters apply to an unplated screw or to a screw before plating, whereas the basic diameters (Class 2A maximum diameters plus the allowance) apply to a screw after plating. All types of wing and thumb screws should have complete (full form) threads extending as close to the head or shoulder as practicable.

Points for Wing and Thumb Screws.—Wing and thumb screws are normally supplied with plain points (sheared ends). Where so specified, these screws may be obtained with cone, cup, dog, flat or oval points as shown in Table 8.

Table 8. American National Standard Alternate Points for Wing and Thumb Screws
ANSI B18.17-1968, R1983



Nominal Size or Basic Screw Diamter[a]	*O* Cup and Flat Point Diameter		*P* Dog Point[b] Diameter		*Q* Dog Point[b] Length		*R* Oval Point Radius	
	Max	Min	Max	Min	Max	Min	Max	Min
4 (0.1120)	0.061	0.051	0.075	0.070	0.061	0.051	0.099	0.084
6 (0.1380)	0.074	0.064	0.092	0.087	0.075	0.065	0.140	0.109
8 (0.1640)	0.087	0.076	0.109	0.103	0.085	0.075	0.156	0.125
10 (0.1900)	0.102	0.088	0.127	0.120	0.095	0.085	0.172	0.141
12 (0.2160)	0.115	0.101	0.144	0.137	0.115	0.105	0.188	0.156
¼ (0.2500)	0.132	0.118	0.156	0.149	0.130	0.120	0.219	0.188
5/16 (0.3125)	0.172	0.156	0.203	0.195	0.161	0.151	0.256	0.234
3/8 (0.3750)	0.212	0.194	0.250	0.241	0.193	0.183	0.312	0.281
7/16 (0.4375)	0.252	0.232	0.297	0.287	0.224	0.214	0.359	0.328
½ (0.5000)	0.291	0.270	0.344	0.334	0.255	0.245	0.406	0.375
5/8 (0.6250)	0.371	0.347	0.469	0.456	0.321	0.305	0.500	0.469

[a] Where specifying nominal size in decimals, zeros in the fourth decimal place are omitted.

[b] The axis of dog points shall not be eccentric with the axis of the screw by more than 3 per cent of the basic screw diameter or 0.005 in., whichever is the smaller.

All dimensions in inches.

[1] The external point angles specified shall apply to those portions of the angles which lie below the thread root diameter, it being recognized the angle within the thread profile may be varied due to the manufacturing processes.