

ANSI/ASME
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TAPER PINS

PINS

See IFI Notes, Page L-33.

1. Introductory Notes.

1.1 Scope.

1.1.1 This standard is intended to cover the complete dimensional and general data for taper pins, recognized as "American National Standard," which are widely used in general industrial applications. Also included is an appendix providing supplementary information for the drilling of holes for taper pins.

1.1.2 The inclusion of dimensional data in this standard is not intended to imply that all

of the products described are stock production sizes. Consumers are requested to consult with manufacturers concerning availability of product.

1.2 Types of Pins.

1.2.1 *Taper Pins.* Taper pins shall have a uniform taper over the pin length with both ends crowned. Most sizes are supplied in both commercial and precision classes, the latter having generally tighter tolerances and being more closely controlled in manufacture. Dimensions for both classes are given in Table 1.

1.3 Dimensions.

All dimensions in this standard are given in inches, unless otherwise stated.

1.4 Options.

Options, where specified, shall be at the discretion of the manufacturer, unless otherwise agreed upon by the manufacturer and purchaser.

1.5 Terminology.

For definition of terms relating to fasteners or component features thereof used in this standard, refer to Glossary of Terms for Mechanical Fasteners, ANSI/ASME B18.12, page M-1.

2. General Data for Taper Pins.

2.1 Diameters.

2.1.1 *Major Diameter.* The major diameter, A, of both commercial and precision classes of pins, specified in Table 1, is the diameter at the large end and is the basis for the pin size.

2.1.2 *Diameter at Small End.* The diameter at the small end of pins, B, is a function of the length and should be specified as a reference dimension for determining drilled hole size, see Appendix I. It shall be computed by mul-

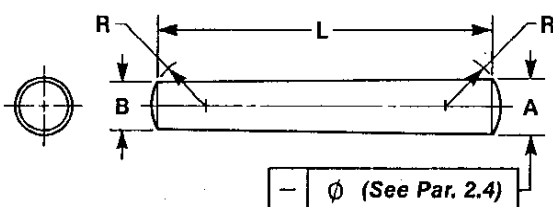


Table 1 Dimensions of Taper Pins

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

NOTES:

- Where specifying nominal pin size in decimals, zeros preceding decimal and in the fourth decimal place shall be omitted.
- Precision Class pins are not produced in sizes 11 thru 14.
- For additional requirements refer to General Data for Taper Pins.



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Table 2 Standard Sizes and Lengths of Taper Pins

Nominal Length	Pin Size Number													
	7/0	6/0	5/0	4/0	3/0	2/0	0	1	2	3	4	5	6	7
1/4	X	X	X	X	X									
3/8	X	X	X	X	X									
1/2	X	X	X	X	X	X	X							
5/8	X	X	X	X	X	X	X							
3/4	X	X	X	X	X	X	X	X	X	X	X			
7/8	X	X	X	X	X	X	X	X	X	X	X			
1	X	X	X	X	X	X	X	X	X	X	X	X		
1-1/4		X	X	X	X	X	X	X	X	X	X	X	X	X
1-1/2		X	X	X	X	X	X	X	X	X	X	X	X	X
1-3/4				X	X	X	X	X	X	X	X	X	X	X
2				X	X	X	X	X	X	X	X	X	X	X
2-1/4					X	X	X	X	X	X	X	X	X	X
2-1/2					X	X	X	X	X	X	X	X	X	X
2-3/4						X	X	X	X	X	X	X	X	X
3						X	X	X	X	X	X	X	X	X
3-1/4									X	X	X	X	X	X
3-1/2									X	X	X	X	X	X
3-3/4									X	X	X	X	X	X
4									X	X	X	X	X	X
4-1/4										X	X	X	X	X
4-1/2										X	X	X	X	X
4-3/4										X	X	X	X	X
5										X	X	X	X	X
5-1/4										X	X	X	X	X
5-1/2										X	X	X	X	X
5-3/4										X	X	X	X	X
6										X	X	X	X	X
6-1/4											X	X	X	X
6-1/2											X	X	X	X
6-3/4											X	X	X	X
7											X	X	X	X
7-1/4											X	X	X	X
7-1/2											X	X	X	X
7-3/4											X	X	X	X
8											X	X	X	X
8-1/4												X	X	X
8-1/2												X	X	X
8-3/4												X	X	X
9													X	X
9-1/4														X
9-1/2														X
9-3/4														X
10														X
10-1/4														X
10-1/2														X
10-3/4														X
11														X
11-1/4														X
11-1/2														X
11-3/4														X
12														X
12-1/4														X
12-1/2														X
12-3/4														X
13														X

¹ Precision class pins are not produced in size numbers 11 through 14.
Standard reamers are available for pins shown above heavy lines.



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tipling the nominal length of pin by the factor 0.02083 and subtracting the result from the basic pin diameter.

2.2 Ends.

Both ends of commercial and precision class pins shall be crowned with a spherical radius as specified in Table 1.

2.3 Taper.

2.3.1 Commercial Class. The taper on diameter of commercial class taper pins shall be 0.250 ± 0.006 in. per ft. (12.00 in.) of length.

2.3.2 Precision Class. The taper on diameter of precision class taper pins shall be 0.250 ± 0.004 in. per ft. (12.00 in.) of length.

2.4 Concavity and Convexity.

Pins shall be straight within the following limits. Refer to illustration above Table 1.

Pin Class	Commercial	Precision
Nominal Pin Length	Concavity and Convexity Limits	
Up to 2 in., Incl.	0.001	0.0005
Over 2 to 4 in., Incl.	0.002	0.001
Over 4 in.	0.004	0.002

2.5 Length.

2.5.1 Measurement. The length of taper pins shall be measured, parallel to the axis of pin, between the points of intersection of the crown with the diameter at ends of pin.

2.5.2 Tolerance on Length. The tolerance on length of taper pins shall be ± 0.010 in. for both commercial and precision classes.

2.5.3 Standard Lengths. The standard sizes and lengths in which taper pins are normally available are depicted in Table 2. Precision class pins are not produced in Size Numbers 11 through 14. Where other size-length combinations may be required, manufacturers should be consulted.

2.6 Surface Roughness.

The surface roughness over the length of pins shall not exceed 63μ in. (arithmetical average) on commercial class pins nor 32μ in. (arithmetical average) on precision class pins. Refer to American National Standard, Surface Texture, ANSI/ASME B46.1. For pins having additive finishes, these limits shall apply prior to plating or coating.

2.7 Materials.

Unless otherwise specified, taper pins shall be made from AISI 1211 steel, or cold drawn AISI 1212 or 1213 steel, or equivalents, and no mechanical property requirements shall apply.

2.8 Finishes.

Unless otherwise specified, taper pins shall be furnished with a natural (as processed) finish, unplated or uncoated. Other finishes, where required, shall be subject to agreement between the manufacturer and purchaser.

2.9 Workmanship.

Taper pins shall be free from burrs, seams, scratches or nicks and any other defects affecting their serviceability.

2.10 Hole Sizes.

Under most circumstances, holes for taper pins require taper reaming. Recommended practices covering the preparation of holes for installation of taper pins are contained in Appendix I.

2.11 Designation.

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

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

Pin, Taper (Precision Class) .219 x 1.750, Steel, Zinc Plated



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APPENDIX I

RECOMMENDED HOLE SPECIFICATIONS FOR TAPER PINS

The following data and procedures are intended to provide the users of taper pins guidance in the preparation of tapered holes for proper pin installation.

The holes for taper pins are commonly produced by drilling or step drilling, depending on the hole depth (pin length), with suitable diameter drills and reaming with straight fluted taper reamers. The drill steps applicable to the longest standard pin lengths shown in Table 2 are depicted graphically on the Step Drill Selection Graph by the dots dividing the slanting lines (respective pin sizes) into equal parts to the nearest 0.25 in. The number of drills and their respective diameters and depths for a given taper pin shall be obtained in accordance with the procedure below:

1. Determine the depth of hole. (Normally, this shall be equal to the pin length.)

2. Determine the point where slanting line for respective pin size intersects the hole depth.
3. The drill diameter of the through hole shall be the next smaller diameter indicated by the horizontal line immediately above this point.
4. The number of drill steps applicable is indicated by the number of dots appearing within the hole depth. Divide the hole depth on slanting line into corresponding number of equal spaces (to nearest 0.25 in.) to establish step drill depths. Step drill diameters shall be as designated by the horizontal line located immediately above the respective division marks.

For ready reference, the drill diameters and depths applicable to the drill steps shown on the graph are summarized in the Drill Chart below:

Drill Chart

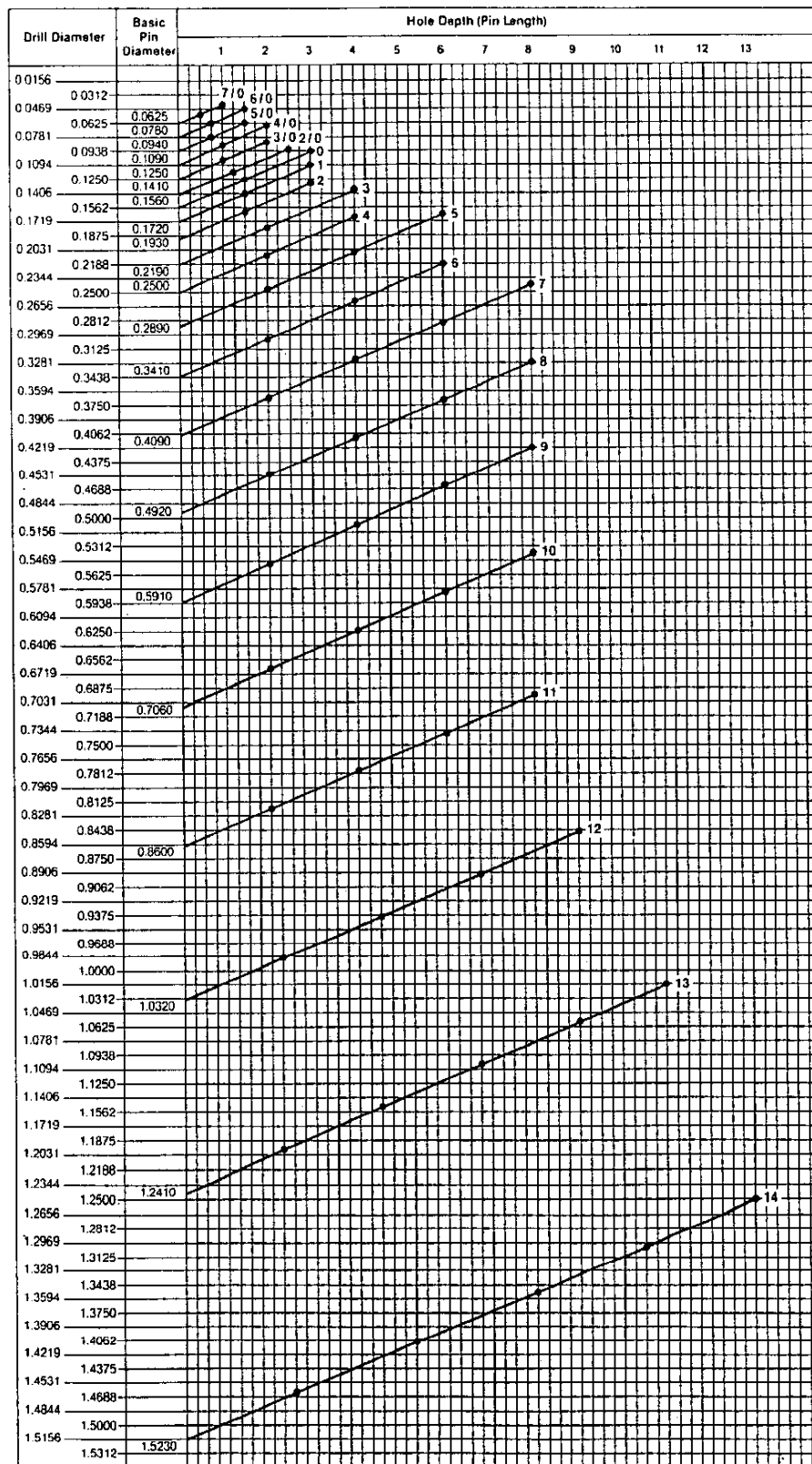
Pin Size Number	First Drill Through	Second Drill		Third Drill		Fourth Drill		Fifth Drill	
	Diameter	Diameter	Depth	Diameter	Depth	Diameter	Depth	Diameter	Depth
7/0	0.0312	0.0469	0.50						
6/0	0.0312	0.0469	0.75						
5/0	0.0625	0.0781	0.75						
4/0	0.0625	0.0781	1.00						
3/0	0.0781	0.0938	1.00						
2/0	0.0938	0.1094	1.25						
0	0.0938	0.1250	1.50						
1	0.1094	0.1406	1.50						
2	0.1250	0.1562	1.50						
3	0.1250	0.1719	2.00						
4	0.1562	0.2031	2.00						
5	0.1562	0.2031	4.00	0.2344	2.00				
6	0.2188	0.2500	4.00	0.2969	2.00				
7	0.2344	0.2812	6.00	0.3125	4.00	0.3594	2.00		
8	0.3125	0.3594	6.00	0.4062	4.00	0.4375	2.00		
9	0.4219	0.4531	6.00	0.5000	4.00	0.5469	2.00		
10	0.5312	0.5781	6.00	0.6094	4.00	0.6562	2.00		
11	0.6875	0.7344	6.00	0.7812	4.00	0.8125	2.00		
12	0.8438	0.8906	6.25	0.9375	4.50	0.9844	2.25		
13	1.0000	1.0469	9.00	1.0938	6.75	1.1406	4.50	1.1875	2.25
14	1.2500	1.2969	10.50	1.3438	8.00	1.4062	5.25	1.4531	2.50

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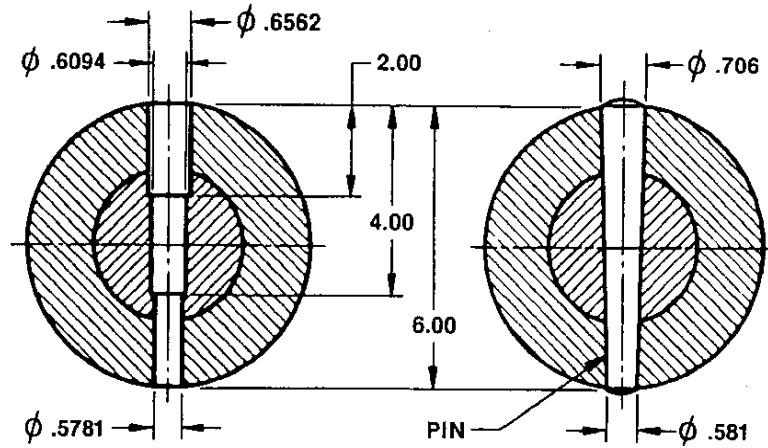
Step Drill Selection Graph



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Example A: For a No. 10 x 6.000 Taper Pin
Use 3 drills (See illustration)
0.5781 diameter drill through
0.6094 diameter drill 4.00 deep
0.6562 diameter drill 2.00 deep

Example B: For a No. 10 x 3.500 Taper Pin
Use 2 drills
0.6250 diameter drill through
0.6719 diameter drill 1.75 deep

It is recommended that detail drawings covering taper pins carry the information, as set forth in the examples above, in the form of a note.

Where helically fluted taper reamers are used in lieu of step drilling and straight fluted taper reamers, the diameter at the small end of taper pin shall be the diameter for the through drill. It shall be obtained by multiplying the nominal length by the factor 0.02083 and subtracting the result from the basic pin diameter.

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See IFI Notes, page L-33.

1. Introductory Notes.

1.1 Scope.

1.1.1 This standard is intended to cover the complete dimensional and general data for dowel pins, recognized as "American National Standard," which are widely used in general industrial applications. Also included is an appendix providing information on the testing of pins in double shear, page L-75.

1.1.2 The inclusion of dimensional data in this standard is not intended to imply that all of the products described are stock production sizes. Consumers are requested to consult with manufacturers concerning availability of product.

1.2 Types of Pins.

1.2.1 Dowel Pins. Three varieties of dowel pins are contained herein to serve specific needs as delineated in the following:

1.2.1.1 Hardened Ground Machine Dowel Pins. This variety of hardened dowel pin shall have ground cylindrical sides with one end pointed slightly to enter mating drive-fit holes and the other end rounded or crowned for driving purposes. They are available in standard and oversize diameter series to satisfy initial and replacement requirements, respectively. These dowel pins are intended for applications where precise locating of mating parts is essential, such as, for doweling hardened tool and machine components or to serve as stops, guides and load bearing pins, etc., where strength, shock or wear factors necessitate a hardened pin. Dimensions for both series are given in Table 1.

1.2.1.2 Hardened Ground Production Dowel Pins. This variety of hardened dowel pin shall have ground cylindrical sides with both ends rounded sufficiently to enable pin to be pressed into drive-fit holes. These dowel pins are used extensively for applications such as those cited for hardened ground machine dowel pins, in volume production situations, entailing automated installation equipment. Dimensions are given in Table 2.

1.2.1.3 Unhardened Ground Dowel Pins. This variety of dowel pin shall have ground cylindrical sides with both ends chamfered. These pins are intended for applications similar to those cited for the other varieties of dowel pins where strength, shock and wear factors do not warrant use of hardened pins, such as, prealigning component parts to be assembled with threaded fasteners, stops, guides or pivots subject to little wear, and as low shear load bearing pins. Dimensions are given in Table 3.

1.3 Dimensions.

All dimensions in this standard are given in inches, unless otherwise stated.

1.4 Options.

Options, where specified, shall be at the discretion of the manufacturer, unless otherwise agreed upon by the manufacturer and purchaser.

1.5 Terminology.

For definition of terms relating to fasteners or component features thereof used in this standard, refer to Glossary of Terms for Mechanical Fasteners, ANSI/ASME B18.12, page M-1.

2. General Data for Hardened Ground Machine Dowel Pins.

2.1 Diameters.

2.1.1 Size. Hardened ground machine dowel pins are furnished in two diameter series: Standard Series having basic diameters 0.0002 in. over the nominal diameter, intended for initial installations; and Oversize Series having basic diameters 0.001 in. over the nominal diameter, intended for replacement use. For both series the diameter shall be ground, or ground and lapped, to within ± 0.0001 in. of the respective basic diameters, as specified in Table 1.

2.1.2 Roundness. The outer periphery of hardened ground machine dowel pins shall con-

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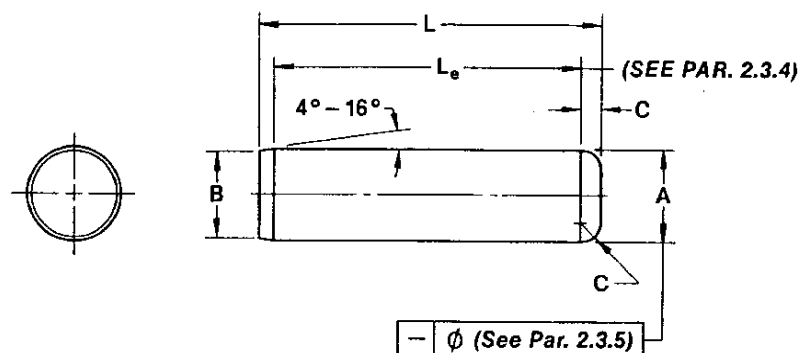
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Table 1 Dimensions of Hardened Ground Machine Dowel Pins

Nominal Size ¹ or Nominal Pin Diameter		A							B		C		Double Shear Load Min, lb
		Pin Diameter							Point Diameter		Crown Height or Radius		Material
		Standard Series Pins			Oversize Series Pins								Carbon or Alloy Steel
		Basic	Max	Min	Basic	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	800	
*5/64	0.0781	0.0783	0.0784	0.0782	0.0791	0.0792	0.0790	0.074	0.064	0.026	0.010	1,240	
3/32	0.0938	0.0940	0.0941	0.0939	0.0948	0.0949	0.0947	0.089	0.079	0.031	0.012	1,800	
1/8	0.1250	0.1252	0.1253	0.1251	0.1260	0.1261	0.1259	0.120	0.110	0.041	0.016	3,200	
*5/32	0.1562	0.1564	0.1565	0.1563	0.1572	0.1573	0.1571	0.150	0.140	0.052	0.020	5,000	
3/16	0.1875	0.1877	0.1878	0.1876	0.1885	0.1886	0.1884	0.180	0.170	0.062	0.023	7,200	
1/4	0.2500	0.2502	0.2503	0.2501	0.2510	0.2511	0.2509	0.240	0.230	0.083	0.031	12,800	
5/16	0.3125	0.3127	0.3128	0.3126	0.3135	0.3136	0.3134	0.302	0.290	0.104	0.039	20,000	
3/8	0.3750	0.3752	0.3753	0.3751	0.3760	0.3761	0.3759	0.365	0.350	0.125	0.047	28,700	
7/16	0.4375	0.4377	0.4378	0.4376	0.4385	0.4386	0.4384	0.424	0.409	0.146	0.055	39,100	
1/2	0.5000	0.5002	0.5003	0.5001	0.5010	0.5011	0.5009	0.486	0.471	0.167	0.063	51,000	
5/8	0.6250	0.6252	0.6253	0.6251	0.6260	0.6261	0.6259	0.611	0.595	0.208	0.078	79,800	
3/4	0.7500	0.7502	0.7503	0.7501	0.7510	0.7511	0.7509	0.735	0.715	0.250	0.094	114,000	
7/8	0.8750	0.8752	0.8753	0.8751	0.8760	0.8761	0.8759	0.860	0.840	0.293	0.109	156,000	
1	1.0000	1.0002	1.0003	1.0001	1.0010	1.0011	1.0009	0.980	0.960	0.333	0.125	204,000	

¹Where specifying nominal size as basic diameter, zeros preceding decimal and in the fourth decimal place shall be omitted.

*Nonpreferred sizes, not recommended for use in new designs.

For additional requirements refer to Introductory Notes and General Data for Hardened Ground Machine Dowel Pins, page L-47.

form to true round about the longitudinal axis of pin within 0.0001 in., when measured with equipment that will detect a lobed surface.

2.2 Ends.

2.2.1 End Contours. The ends of hardened ground machine dowel pins shall be reasonably flat and perpendicular to the axis of pin.

One end of pin shall be pointed and the other end crowned to the dimensions specified in Table 1. On the pointed end, the edge formed by the surface of point and the end of pin may be slightly rounded or broken.

2.2.1.1 Point Concentricity. For pins having nominal lengths equal to four times the basic pin diameter, and longer, the concentricity be-

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Table 1A Preferred Sizes and Lengths of Hardened Ground Machine Dowel Pins

Nominal Length	Nominal Size												
	1/16	3/32	1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
3/16	X												
1/4	X												
5/16	X	X											
3/8	X	X	X										
1/2	X	X	X	X	X	X	X						
5/8	X	X	X	X	X	X	X						
3/4	X	X	X	X	X	X	X		X				
7/8		X	X	X	X	X	X	X					
1		X	X	X	X	X	X	X	X				
1-1/4			X	X	X	X	X	X	X	X			
1-1/2			X	X	X	X	X	X	X	X	X		
1-3/4			X	X	X	X	X	X	X	X	X		
2			X	X	X	X	X	X	X	X	X	X	X
2-1/4					X	X	X	X	X	X	X		
2-1/2					X	X	X	X	X	X	X	X	X
3							X	X	X	X	X	X	X
3-1/2									X	X	X	X	X
4									X	X	X	X	X
4-1/2										X	X	X	X
5										X	X	X	X
5-1/2											X	X	
6											X	X	X

tween the diameter of point and the pin diameter shall be such that the minimum length of point on the pin is not less than 0.010 in. See Fig. 1.

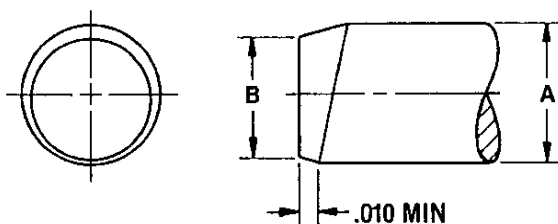


FIG. 1 POINT CONCENTRICITY

2.3 Length.

2.3.1 Measurement. The length of hardened ground machine dowel pins shall be measured

overall from end to end, parallel to the axis of pin.

2.3.2 Tolerance on Length. The tolerance on the length of hardened ground machine dowel pins shall be ± 0.010 in.

2.3.3 Preferred Lengths. The preferred sizes and lengths in which hardened ground machine dowel pins are normally available are depicted in Table 1A. Other sizes and lengths are produced as required by the purchaser.

2.3.4 Effective Length. The effective length, L_e , (that portion of the pin length bounded by the length of point on one end and the radius of crown on the other) on short dowel pins shall not be less than 75 percent of the overall length of pin. For the pin lengths affected, it may be necessary to deviate from the specified

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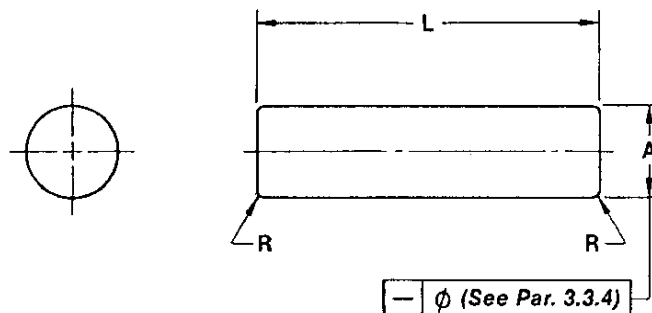
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Table 2 Dimensions of Hardened Ground Production Dowel Pins

Nominal Size' or Nominal Pin Diameter	A			R		Double Shear Load
	Pin Diameter			Corner Radius		Min, Lb
	Basic	Max	Min	Max	Min	Material
						Carbon Steel
1/16 0.0625	0.0627	0.0628	0.0626	0.020	0.010	790
3/32 0.0938	0.0939	0.0940	0.0938	0.020	0.010	1,400
7/64 0.1094	0.1095	0.1096	0.1094	0.020	0.010	1,900
1/8 0.1250	0.1252	0.1253	0.1251	0.020	0.010	2,600
5/32 0.1562	0.1564	0.1565	0.1563	0.020	0.010	4,100
3/16 0.1875	0.1877	0.1878	0.1876	0.020	0.010	5,900
7/32 0.2188	0.2189	0.2190	0.2188	0.020	0.010	7,600
1/4 0.2500	0.2502	0.2503	0.2501	0.020	0.010	10,000
5/16 0.3125	0.3127	0.3128	0.3126	0.020	0.010	16,000
3/8 0.3750	0.3752	0.3753	0.3751	0.020	0.010	23,000

¹Where specifying nominal pin size in decimals, zeros preceding decimal and in the fourth decimal place shall be omitted.

For additional requirements refer to Introductory Notes, page L-47, and to General Data for Hardened Ground Production Dowel Pins, page L-54.

dimensions by reducing the crown radius and height, or increasing the point angle, or both.

2.3.5 Straightness. Machine dowel pins shall be straight over the effective length within an accumulative total of 0.0005 in. per inch of length for nominal lengths up to and including 4 in., and within 0.002 in. total for all nominal lengths over 4 in.

2.4 Surface Roughness.

The surface roughness on hardened ground machine dowel pins shall not exceed 8 μ in. (arithmetical average) on the effective length nor 125 μ in. (arithmetical average) on

all other surfaces. Refer to American National Standard, Surface Texture, ANSI/ASME B46.1. For pins having additive finishes, these limits shall apply prior to coating or plating.

2.5 Material and Heat Treatment.

2.5.1 Steel. Hardened ground machine dowel pins shall be made from any carbon or alloy steel capable of being heat treated to a core hardness of Rockwell C50 minimum and having sulphur and phosphorus content not in excess of 0.05 and 0.04 percent, respectively.

2.5.2 Heat Treatment. Pins shall be hardened by quenching in oil from the austenitizing tem-

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Table 2A Preferred Sizes and Lengths of Hardened Ground Production Dowel Pins

Nominal Length	Nominal Size									
	1/16	3/32	7/64	1/8	5/32	3/16	7/32	1/4	5/16	3/8
3/16	X	X	X	X	X	X				
1/4	X	X	X	X	X	X	X	X		
5/16	X	X	X	X	X	X	X	X	X	
3/8	X	X	X	X	X	X	X	X	X	X
7/16	X	X	X	X	X	X	X	X	X	X
1/2	X	X	X	X	X	X	X	X	X	X
9/16	X	X	X	X	X	X	X	X	X	X
5/8	X	X	X	X	X	X	X	X	X	X
11/16	X	X	X	X	X	X	X	X	X	X
3/4	X	X	X	X	X	X	X	X	X	X
13/16	X	X	X	X	X	X	X	X	X	X
7/8	X	X	X	X	X	X	X	X	X	X
15/16	X	X	X	X	X	X	X	X	X	X
1	X	X	X	X	X	X	X	X	X	X
1-1/8		X	X	X	X	X	X	X	X	X
1-1/4		X	X	X	X	X	X	X	X	X
1-3/8		X	X	X	X	X	X	X	X	X
1-1/2		X	X	X	X	X	X	X	X	X
1-5/8		X	X	X	X	X	X			
1-3/4		X	X	X	X	X	X	X	X	X
1-7/8		X	X	X	X	X	X			
2		X	X	X	X	X	X	X	X	X
2-1/4								X	X	X
2-1/2								X	X	X
3										X

perature and tempering to meet the following conditions:

2.5.2.1 Case Hardened Pins. Pins shall be case hardened to a minimum case depth of 0.010 in. for nominal pin sizes 5/32 in. or smaller, and 0.015 in. for nominal pin sizes 3/16 in. and larger. The case shall have a minimum surface hardness of Rockwell C60, or equivalent, and the core hardness shall be Rockwell C47 to 58.

2.5.2.2 Through Hardened Pins. At manufacturer's option, pins smaller than 1/8 in. nominal size may be through hardened to a hardness of Rockwell C50 to 58. However, in no

instance shall the hardness of the pin surface be softer than that of the core.

2.5.3 Shear Strength. Hardened ground machine dowel pins shall have a single shear strength of 130,000 psi minimum. They shall be capable of withstanding the minimum double shear loads specified in Table 1 when tested in accordance with Double Shear Testing of Pins specified in Appendix I, page L-75. The holes in test fixtures shall conform with the basic pin diameter within a tolerance of ± 0.0002 in.

2.5.4 Ductility. Hardened ground machine dowel pins shall have sufficient ductility to



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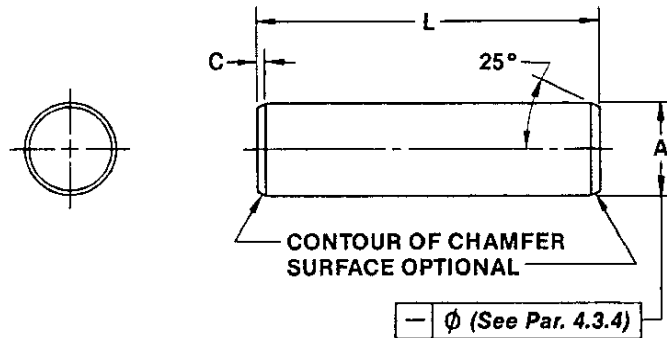
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Table 3 Dimensions of Unhardened Ground Dowel Pins

Nominal Size ¹ or Nominal Pin Diameter		A		C		Double Shear Load Min, lb	
		Pin Diameter		Chamfer Length		Material	
		Max	Min	Max	Min	Carbon Steel	Brass
1/16	0.0625	0.0600	0.0595	0.025	0.005	350	220
3/32	0.0938	0.0912	0.0907	0.025	0.005	820	510
*7/64	0.1094	0.1068	0.1063	0.025	0.005	1,130	710
1/8	0.1250	0.1223	0.1218	0.025	0.005	1,490	930
5/32	0.1562	0.1535	0.1530	0.025	0.005	2,350	1,470
3/16	0.1875	0.1847	0.1842	0.025	0.005	3,410	2,130
7/32	0.2188	0.2159	0.2154	0.025	0.005	4,660	2,910
1/4	0.2500	0.2470	0.2465	0.025	0.005	6,120	3,810
5/16	0.3125	0.3094	0.3089	0.040	0.020	9,590	5,990
3/8	0.3750	0.3717	0.3712	0.040	0.020	13,850	8,650
7/16	0.4375	0.4341	0.4336	0.040	0.020	18,900	11,810
1/2	0.5000	0.4964	0.4959	0.040	0.020	24,720	15,450
5/8	0.6250	0.6211	0.6206	0.055	0.035	38,710	24,190
3/4	0.7500	0.7548	0.7453	0.055	0.035	55,840	34,900
7/8	0.8750	0.8705	0.8700	0.070	0.050	76,090	47,550
1	1.0000	0.9952	0.9947	0.070	0.050	99,460	62,160

¹Where specifying nominal pin size in decimals, zeros preceding decimal and in the fourth decimal place shall be omitted.

*Nonpreferred size not recommended for use in new designs.

For additional requirements refer to Introductory Notes, page L-47, and to General Data for Unhardened Ground Dowel Pins, page L-56.

withstand being pressed into holes 0.0005 in. smaller than the nominal diameter in hardened steel without cracking or shattering.

2.6 Finishes.

Unless otherwise specified, machine dowel pins shall be furnished with a ground

(as processed) finish or with black oxide coating at the option of the manufacturer. Other protective or decorative finishes, where required, shall be subject to agreement between the manufacturer and purchaser. However, where a finish applied to carbon or alloy steel pins is such that it might produce hydrogen embrittlement, the pins shall be baked for a

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Table 3A Preferred Sizes and Lengths of Unhardened Ground Dowel Pins

Nominal Length	Nominal Size														
	1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
1/4	X	X	X	X	X	X	X								
5/16	X	X	X	X	X	X	X	X							
3/8	X	X	X	X	X	X	X	X	X						
7/16	X	X	X	X	X	X	X	X	X	X					
1/2	X	X	X	X	X	X	X	X	X	X	X				
9/16	X	X	X	X	X	X	X	X	X	X	X				
5/8	X	X	X	X	X	X	X	X	X	X	X	X			
11/16	X	X	X	X	X	X	X	X	X						
3/4	X	X	X	X	X	X	X	X	X	X	X	X	X		
13/16	X	X	X	X	X	X	X	X	X						
7/8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
15/16	X	X	X	X	X	X	X	X	X	X					
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
1-1/8		X	X	X	X	X	X	X	X	X	X	X			
1-1/4		X	X	X	X	X	X	X	X	X	X	X	X	X	X
1-3/8		X	X	X	X	X	X	X	X	X	X	X			
1-1/2		X	X	X	X	X	X	X	X	X	X	X	X	X	X
1-5/8			X	X	X	X									
1-3/4			X	X	X	X	X	X	X	X	X	X	X	X	X
1-7/8			X	X	X	X									
2			X	X	X	X	X	X	X	X	X	X	X	X	X
2-1/4							X	X	X	X	X				
2-1/2							X	X	X	X	X	X	X	X	X
3											X	X	X	X	X
3-1/2												X	X	X	X
4												X	X	X	X

suitable time at a temperature that will obviate such embrittlement. Baking shall be accomplished as soon as possible following the plating or coating operation inasmuch as delay is detrimental to achievement of the desired results. Where additive type finishes are used, the tabulated dimensions and tolerances shall apply to the pins prior to application of the plating or coating, unless otherwise specified by the purchaser.

2.7 Workmanship.

Dowel pins shall be free from detrimental burrs, cracks, seams, or nicks and other defects affecting their serviceability or properties.

2.8 Designation.

Hardened ground machine dowel pins shall be 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. See examples below:

Pin, Hardened Ground Machine Dowel — Standard Series, 3/8 x 1-1/2, Steel Phosphate Coated

Pin, Hardened Ground Machine Dowel — Oversize Series, .625 x 2.500, Steel

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2.9.1 Hole Sizes. Because of the wide variety of materials in which dowel pins are used and of the many design requirements which must be considered, it is not possible to provide hole size recommendations that will be suitable for all applications. However, the suggested hole sizes tabulated below 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 in. to increase the press fit.

Nominal Pin Size	Suggested Hole Diameter for Standard Series Pins	
	Max	Min
1/16	0.0625	0.0620
5/64	0.0781	0.0776
3/32	0.0937	0.0932
1/8	0.1250	0.1245
5/32	0.1562	0.1557
3/16	0.1875	0.1870
1/4	0.2500	0.2495
5/16	0.3125	0.3120
3/8	0.3750	0.3745
7/16	0.4375	0.4370
1/2	0.5000	0.4995
5/8	0.6250	0.6245
3/4	0.7500	0.7495
7/8	0.8750	0.8745
1	1.0000	0.9995

Holes for oversize series machine dowel pins may best be determined by the user to suit the particular application.

2.9.2 Responsibility for Modification. The manufacturer shall not be held responsible for malfunctions of product determined to be due to plating or other modifications when such plating or modification is not accomplished under his control or direction.

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

3. General Data for Hardened Ground Production Dowel Pins.

3.1 Diameter.

3.1.1 Size. Hardened ground production dowel pins have basic diameters which are 0.0002 in. over the nominal pin diameter. The diameter shall be ground, or ground and lapped, to within ± 0.0001 in. of the basic diameter as specified in Table 2.

3.1.2 Roundness. The outer periphery of hardened ground production dowel pins shall conform to true round about the longitudinal axis of pin within 0.0001 in., when measured with equipment that will detect a lobed surface.

3.2 Ends.

The ends of hardened ground production dowel pins shall be reasonably flat and perpendicular to the axis of pin. The corners at both ends of pins shall be rounded as defined in Table 2 and the accompanying illustration.

3.3 Length.

3.3.1 Measurement. The length of hardened ground production dowel pins shall be measured overall from end to end, parallel to the axis of pin.

3.3.2 Tolerance on Length. The tolerance on the length of hardened ground production dowel pins shall be ± 0.010 in.

3.3.3 Preferred Lengths. The preferred sizes and lengths in which hardened ground production dowel pins are normally available are depicted in Table 2A. Other sizes and lengths are produced as required by the purchaser.

3.3.4 Straightness. Production dowel pins shall be straight over that portion of the pin length not affected by the rounded ends within an accumulative total of 0.0005 in. per in. of length for nominal lengths up to and including 4 in., and within 0.002 in. total for all nominal lengths over 4 in.

3.4 Surface Roughness.

The surface roughness on hardened ground production dowel pins shall not exceed 8μ in. (arithmetical average) over the cylindrical portion of the pin length nor 125μ in.

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(arithmetical average) on all other surfaces. Refer to American National Standard, Surface Texture, ANSI/ASME B46.1. For pins having additive finishes, these limits shall apply prior to coating or plating.

3.5 Material and Heat Treatment.

3.5.1 Steel. Hardened ground production dowel pins shall be made from carbon steel having a sulphur and phosphorus content not in excess of 0.05 and 0.04 percent, respectively.

3.5.2 Heat Treatment. Pins shall be case hardened to a minimum case depth of 0.010 in. for nominal pin sizes 5/32 in. or smaller, and 0.02 in. for nominal pin sizes 3/16 in. and larger. Pins shall be quenched in oil from the austenizing temperature and tempered to provide a minimum case hardness of Rockwell C58, or equivalent, and a core hardness of Rockwell C50 to 55.

3.5.3 Shear Strength. Hardened ground production dowel pins shall have a single shear strength of 102,000 psi minimum. They shall be capable of withstanding the minimum double shear loads specified in Table 2 when tested in accordance with the Double Shear Testing of Pins specified in Appendix I, page L-75. The holes in the test fixtures shall conform with the basic pin diameter within a tolerance of ± 0.0002 in.

3.5.4 Ductility. Hardened ground production dowel pins shall have sufficient ductility to withstand being pressed into holes 0.0005 in. smaller than the nominal pin diameter in hardened steel without cracking or shattering.

3.6 Finishes.

Unless otherwise specified, production dowel pins shall be furnished with a ground (as processed) finish, unplated or uncoated. Protective or decorative finishes, where required, shall be subject to agreement between the manufacturer and purchaser. However, where a finish applied to pins is such that it might produce hydrogen embrittlement, the pins shall be baked for a suitable time at a temperature that will obviate such embrittlement. Baking shall be accomplished as soon

as possible following the plating or coating operation inasmuch as delay is detrimental to achievement of the desired results. Where additive type finishes are used, the tabulated dimensions and tolerances shall apply to the pins prior to application of the plating or coating, unless otherwise specified by the purchaser.

3.7 Workmanship.

Dowel pins shall be free from burrs, cracks, seams, scratches and nicks and any other defects affecting their serviceability.

3.8 Hole Sizes.

Because of the wide variety of materials in which dowel pins are used and the many design requirements which must be considered, it is not possible to provide hole size recommendations that will be suitable for all applications. However, the suggested hole sizes tabulated below 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 in. to increase the press fit.

Nominal Pin Size	Suggested Hole Diameter	
	Max	Min
1/16	0.0625	0.0620
3/32	0.0937	0.0932
7/64	0.1094	0.1089
1/8	0.1250	0.1245
5/32	0.1562	0.1557
3/16	0.1875	0.1870
7/32	0.2188	0.2183
1/4	0.2500	0.2495
5/16	0.3125	0.3120
3/8	0.3750	0.3745

3.9 Designation.

Hardened ground production dowel pins shall be designated by the following data in the sequence shown: Product name (noun first); nominal pin diameter (fraction or decimal equivalent); length (fraction or decimal



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equivalent); material; and protective finish, if required. See examples below:

Pin, Hardened Ground Production Dowel,
1/8 x 3/4, Steel, Phosphate Coated

Pin, Hardened Ground Production Dowel,
.375 x 1.500, Steel

4. General Data for Unhardened Ground Dowel Pins.

4.1 Diameter.

4.1.1 Size. 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 in. on the 1/16 in. nominal pin size to 0.0028 in. on the 1 in. nominal pin size.

4.1.2 Roundness. The outer periphery of unhardened ground dowel pins shall conform to true round about the longitudinal axis of pin within 0.00025 in., when measured with equipment that will detect a lobed surface.

4.2 Ends.

The ends of unhardened ground dowel pins shall be reasonably flat and perpendicular to the axis of pin. The corners at both ends of pins shall be chamfered to the dimensions given in Table 3 and the accompanying illustration. The contour of the chamfer surface shall be optional providing the juncture of chamfer with the pin outside diameter is such as to permit pins to be pressed into a hole of the respective minimum suggested hole size (see Paragraph 4.8) in AA 2011-T3 aluminum material without shaving the hole sides.

4.3 Length.

4.3.1 Measurement. The length of unhardened ground dowel pins shall be measured overall from end to end, parallel to the axis of pin.

4.3.2 Tolerance on Length. The tolerance on length of unhardened ground dowel pins shall be ± 0.010 in.

4.3.3 Preferred Lengths. The preferred sizes and lengths in which unhardened and ground dowel pins are normally available are depicted in Table 3A. Other sizes and lengths are produced as required by the purchaser.

4.3.4 Straightness. Unhardened ground dowel pins shall be straight over that portion of the pin length bounded by the end chamfers within an accumulative total of 0.0005 in. per in. of pin length.

4.4 Surface Roughness.

The surface roughness on unhardened ground dowel pins shall not exceed 32μ in. (arithmetical average) over the cylindrical portion of the pin length nor 250μ in. (arithmetical average) on all other surfaces. Refer to American National Standard, Surface Texture, ANSI/ASME B46.1. For pins having additive finishes, these limits shall apply prior to coating or plating.

4.5 Materials.

4.5.1 Steel. Unhardened ground dowel pins shall be made from carbon steel optional with the manufacturer but having a maximum hardness of Rockwell C32 for nominal pin sizes up to and including 1/8 in.; Rockwell C23 for nominal sizes over 1/8 to 1/2 in. inclusive; and Rockwell B95 for all larger nominal pin sizes.

4.5.2 Brass. Brass pins, when specified, shall be made from ASTM B16 (half hard) or SAE CA 360 (half hard), or equivalent, copper alloys.

4.5.3 Shear Strength. Unhardened ground dowel pins shall have a single shear strength of 64,000 psi minimum for pins made from steel and 40,000 psi minimum when made from brass. They shall be capable of withstanding the minimum double shear loads specified in Table 3 for the respective materials when tested in accordance with the Double Shear Testing of Pins set forth in Appendix I, page L-75. The holes in test fixtures shall conform with the maximum pin diameter within a tolerance of plus 0.0001 in. and minus 0.0003 in.

4.6 Finishes.

Unless otherwise specified, unhardened ground dowel pins shall be furnished with a

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natural (as processed) finish, unplated or uncoated. Other protective or decorative finishes, where required, shall be subject to agreement between the manufacturer and purchaser. Where additive type finishes are used, the tabulated dimensions and tolerances shall apply to the pins prior to application of the plating or coating, unless otherwise specified by the purchaser.

4.7 Workmanship.

Dowel pins shall be free from burrs, seams, sharp edges and any other defects affecting their serviceability.

4.8 Hole Sizes.

Because of the wide variety of materials in which dowel pins are used and of the many design requirements which must be considered, it is not possible to provide hole size recommendations that will be suitable for all applications. However, experience has indicated the suggested hole sizes tabulated below to be satisfactory for press fitting pins into mild steels 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 in. to increase the press fit.

Nominal Pin Size	Suggested Hole Diameter	
	Max	Min
1/16	0.0595	0.0580
3/32	0.0907	0.0892
7/64	0.1062	0.1047
1/8	0.1217	0.1202
5/32	0.1528	0.1513
3/16	0.1840	0.1825
7/32	0.2151	0.2136
1/4	0.2462	0.2447
5/16	0.3085	0.3070
3/8	0.3708	0.3693
7/16	0.4331	0.4316
1/2	0.4954	0.4939
5/8	0.6200	0.6185
3/4	0.7446	0.7431
7/8	0.8692	0.8677
1	0.9938	0.9923

4.9 Designation.

Unhardened ground dowel pins shall be 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. See examples below:

Pin, Unhardened Ground Dowel, 1/8 x 3/4 Steel

Pin, Unhardened Ground Dowel, .250 x 2.500, Steel, Zinc Plated

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STRAIGHT PINS

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See IFI Notes, page L-33.

1. Introductory Notes.

1.1 Scope.

1.1.1 This standard is intended to cover the complete dimensional and general data for straight pins, recognized as "American National Standard," which are widely used in general industrial applications.

1.1.2 The inclusion of dimensional data in this standard is not intended to imply that all of the products described are stock production sizes. Consumers are requested to consult with manufacturers concerning availability of product.

1.2 Types of Pins.

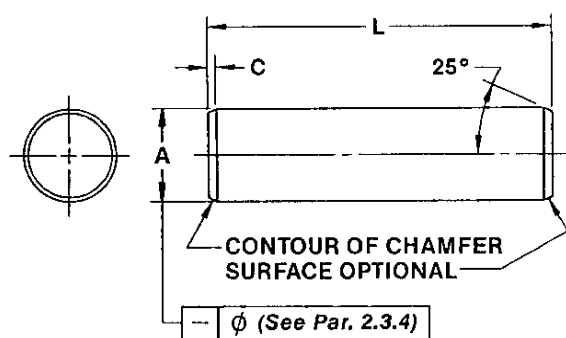
1.2.1 *Straight Pins.* Straight pins shall have unground, straight cylindrical sides with both ends definitely chamfered on Chamfered Straight Pins and with both ends having broken corners or being slightly chamfered on Square End Straight Pins. Dimensions are given in Table 1.

1.3 Dimensions.

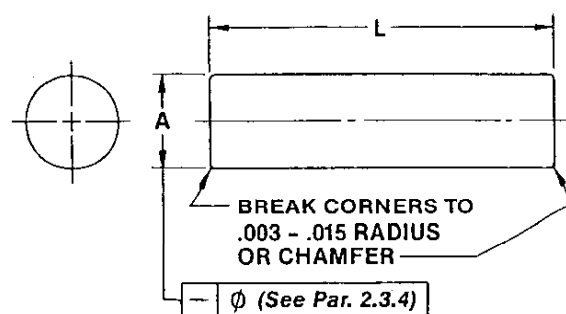
All dimensions in this standard are given in inches, unless otherwise stated.

1.4 Options.

Options, where specified, shall be at the discretion of the manufacturer, unless otherwise agreed upon by the manufacturer and purchaser.



CHAMFERED STRAIGHT PIN



SQUARE END STRAIGHT PIN

Table 1 Dimensions of Chamfered and Square End Straight Pins

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

¹ Where specifying nominal size in decimals, zeros preceding decimal shall be omitted.

For additional requirements refer to General Data for Straight Pins.

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1.5 Terminology.

For definition of terms relating to fasteners or component features thereof used in this standard, refer to Glossary of Terms for Mechanical Fasteners, ANSI/ASME B18.12, page M-1.

2. General Data for Straight Pins.

2.1 Diameter.

2.1.1 Size. The diameter of both chamfered and square end straight pins shall conform to that of the commercial wire or rod from which the pins are made. The tolerances specified in Table 1 are applicable to carbon steel and some deviations in the diameter limits may be necessary for pins made from other materials.

2.2 Ends.

2.2.1 General. The ends of straight pins shall be flat and reasonably perpendicular to the axis of pin. Cut-off nibs not protruding more than 0.010 in. beyond pin ends shall be permissible.

2.2.2 Chamfered Straight Pins. The corners of both ends of chamfered straight pins shall be chamfered to the dimensions specified in Table 1. The contour of the chamfer surface shall be optional.

2.2.3 Square End Straight Pins. The corners of both ends of square end straight pins shall be broken with a radius or chamfer conforming to the specified limits.

2.3 Length.

2.3.1 Measurement. The length of straight pins shall be measured overall from end to end, parallel to the axis of pin, excluding cut-off nibs where they exist.

2.3.2 Tolerance on Length. The tolerance on length shall be ± 0.010 in.

2.3.3 Length Increments. Lengths shall be as specified by purchaser. However, it is recommended that nominal pin lengths be limited to increments of not less than 0.062 in.

2.3.4 Straightness. Pins shall be straight over the entire length within a total runout equivalent to 0.001 in. per in. of length.

2.4 Materials.

2.4.1 Steel. Straight pins are normally made from cold drawn steel wire or rod having a maximum carbon content of 0.28 percent. Unless otherwise agreed upon between the manufacturer and purchaser, no mechanical property requirements shall apply.

2.4.2 Other Materials. Where required, pins may also be made from corrosion resistant steel, brass, or other metals, having chemical and mechanical properties as agreed upon between the manufacturer and purchaser.

2.5 Finishes.

Unless otherwise specified, straight pins shall be furnished with a natural (as processed) finish, unplated or uncoated. Other finishes, where required, shall be subject to agreement between the manufacturer and purchaser. Where additive type finishes are used, the tabulated dimensions and tolerances shall apply to the pins prior to application of the plating or coating, unless otherwise specified by the purchaser.

2.6 Workmanship.

Straight pins shall be free from peripheral burrs, excessive cut-off nibs, seams, scale, sharp edges and any other defects affecting their serviceability.

2.7 Designation.

Straight pins shall be designated by the following data, in the sequence shown: Product name (noun first); nominal size (fraction or decimal equivalent); length (fraction or decimal equivalent); material; and protective finish, if required. See examples below:

Pin, Chamfered Straight, $1/8 \times 1.500$,
Steel

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



PINS

GROOVED PINS

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1978*See IFI Notes, page L-33.***1. Introductory Notes.****1.1 Scope.**

1.1.1 This standard is intended to cover the complete dimensional and general data for grooved pins, recognized as "American National Standard," which are widely used in general industrial applications. Also included is an appendix, page L-75, providing supplementary information on the testing of pins in double shear.

1.1.2 The inclusion of dimensional data in this standard is not intended to imply that all of the products described are stock production sizes. Consumers are requested to consult with manufacturers concerning availability of product.

1.2 Types of Pins.

1.2.1 Grooved Pins. Grooved pins shall have unground, straight cylindrical sides with three or more swaged or extruded grooves equally spaced around the periphery to displace material beyond the basic pin diameter. Both ends of pins are normally crowned or chamfered. Grooved pins are available in several types to satisfy various design considerations and also in headed versions, grooved drive studs and grooved T-head cotter pins. Upon installation, the material displaced by the grooves is forced back into the grooves and reacts against the sides of the hole to promote retention of the pin or stud. Dimensions of the various types of groove pins are given in Tables 1 through 1B; grooved drive studs are shown in Table 2; and grooved T-head Cotter Pins are covered in Tables 3 and 3A.

1.3 Dimensions.

All dimensions in this standard are given in inches, unless otherwise stated.

1.4 Options.

Options, where specified, shall be at the discretion of the manufacturer, unless otherwise agreed upon by the manufacturer and purchaser.

1.5 Terminology.

For definition of terms relating to fasteners or component features thereof used in this standard, refer to Glossary of Terms for Mechanical Fasteners, ANSI/ASME B18.12, page M-1.

2. General Data for Grooved Pins, Grooved Drive Studs and Grooved T-Head Cotter Pins.**2.1 Heads of Grooved Drive Studs and T-Head Cotter Pins.**

2.1.1 Bearing Surface. The bearing surface of head on round head grooved drive studs and grooved T-head cotter pins, shall be flat and perpendicular with the axis of pin (determined over a distance from under the head equivalent to 1.5 times the basic diameter) within 2 deg.

2.1.2 Head Position. The axis of head on round head grooved drive studs and grooved T-head cotter pins shall be located at true position with respect to the axis of the shank within a tolerance zone having a diameter equivalent to 12 percent of the maximum head diameter or 0.02 in., whichever is greater.

2.1.2.1 Eccentricity shall be equal to one-half of the full or total indicator reading.

2.2 Diameters.

2.2.1 Size. The pin diameter and shank diameter, A, specified in Table 1 and Tables 2 and 3, respectively, conform with that of the commercial wire or rod from which the pins and studs are fabricated and is the basis for the product size.

2.2.2 Expanded Diameter. The expanded diameter, B, specified in Tables 1A, 1B, 2 and 3 represents the diameter over the crests of raised ridges formed by the material displaced when grooves are produced. It is dependent upon the depth, shape, and length of the grooves and the pin material. Conformance of expanded diameters to minimum and maximum dimensions shall be determined by the use of GO and NOT GO plain ring gages, respectively.

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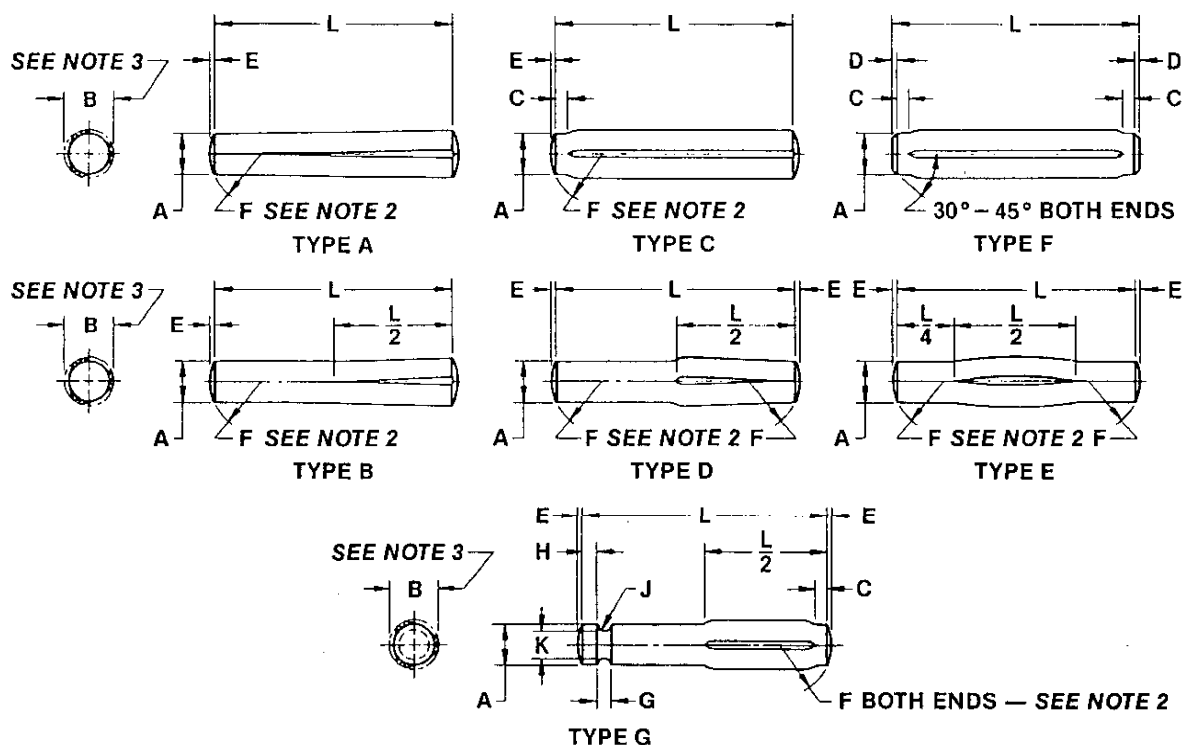


Table 1 Dimensions of Grooved Pins

Nominal Size or Basic Pin Diameter	A		C	D	E		F		G		H		J	K	
	Pin Diameter		Pilot Length	Chamfer Length	Crown Height		Crown Radius		Neck Width		Shoulder Length		Neck Radius	Neck Diameter	
	Max	Min	Ref	Min	Max	Min	Max	Min	Max	Min	Max	Min	Ref	Max	Min
1/32	0.0312	0.0312	0.0302	0.015	—	—	—	—	—	—	—	—	—	—	—
3/64	0.0469	0.0469	0.0459	0.031	—	—	—	—	—	—	—	—	—	—	—
1/16	0.0625	0.0625	0.0615	0.031	0.016	0.0115	0.0015	0.088	0.068	—	—	—	—	—	—
5/64	0.0781	0.0781	0.0771	0.031	0.016	0.0137	0.0037	0.104	0.084	—	—	—	—	—	—
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
7/64	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	0.072
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
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
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
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
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
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
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
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
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
See Note 1, 4				2	2	2	2	2	2	2	2	2	2	2	2

NOTES:

- Where specifying nominal size in decimals, zeros preceding decimal and in the fourth decimal place shall be omitted.
- Pins in 1/32 and 3/64 in. sizes of any length and all sizes 1/4 in. nominal length, or shorter, are not crowned or chamfered. See Paragraph 2.4 of General Data. Alloy steel pins of all types shall have chamfered ends conforming with Type F pins, included within the pin length.
- For expanded diameters applicable to pins made from corrosion resistant steel or monel, see Table 1B; and for pins made from other materials, see Table 1A.
- For additional requirements and recommended hole sizes see Introductory Notes and General Data for Grooved Pins, page L-60.



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Table 1A Expanded Diameters for Grooved Pins Made from Materials Other Than Corrosion Resistant Steel and Monel

Groove Length ¹	Nominal 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
	B Expanded Pin Diameter														
	± 0.001					± 0.002									
0.125	0.035	0.051	0.068	0.084	0.101	0.117	0.134								
0.188	0.035	0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198						
0.250	0.035	0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198	0.230	0.263				
0.312	0.035	0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198	0.230	0.263	0.329			
0.375	0.035	0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198	0.230	0.263	0.329	0.394		
0.438	0.035	0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198	0.230	0.263	0.329	0.394	0.459	
0.500	0.035	0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198	0.230	0.263	0.329	0.394	0.459	0.525
0.562		0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198	0.230	0.263	0.329	0.394	0.459	0.525
0.625		0.051	0.068	0.084	0.101	0.117	0.134	0.166	0.198	0.230	0.263	0.329	0.394	0.459	0.525
0.750			0.067	0.083	0.100	0.116	0.134	0.166	0.198	0.230	0.263	0.329	0.394	0.459	0.525
0.875			0.067	0.083	0.100	0.116	0.133	0.165	0.198	0.230	0.263	0.329	0.394	0.459	0.525
1.000					0.100	0.115	0.133	0.165	0.198	0.230	0.263	0.329	0.394	0.459	0.525
1.125					0.100	0.115	0.132	0.164	0.197	0.230	0.263	0.329	0.394	0.459	0.525
1.250					0.100	0.115	0.132	0.164	0.197	0.230	0.263	0.329	0.394	0.459	0.525
1.375							0.132	0.164	0.197	0.229	0.262	0.329	0.394	0.459	0.525
1.500							0.132	0.164	0.197	0.229	0.262	0.329	0.394	0.459	0.525
1.625								0.163	0.197	0.229	0.262	0.328	0.393	0.458	0.524
1.750								0.163	0.197	0.229	0.262	0.328	0.393	0.458	0.524
1.875								0.163	0.196	0.229	0.262	0.328	0.393	0.458	0.524
2.000								0.163	0.196	0.229	0.262	0.328	0.393	0.458	0.524
2.125									0.196	0.229	0.262	0.328	0.393	0.458	0.524
2.250									0.196	0.229	0.262	0.328	0.393	0.458	0.524
2.500										0.228	0.261	0.327	0.393	0.458	0.524
2.750										0.228	0.261	0.327	0.393	0.458	0.524
3.000										0.227	0.260	0.327	0.392	0.457	0.523
3.250											0.260	0.326	0.392	0.457	0.523
3.500												0.326	0.391	0.456	0.522
3.750													0.391	0.456	0.522
4.000													0.390	0.455	0.521
4.250													0.390	0.455	0.521
4.500														0.454	0.520

1. Groove length shall be considered as being substantially equal to the pin length for Types A, C and F grooved pins, and equal to one-half of the pin length for Types B, D, E and G grooved pins. For groove lengths not shown, use expanded diameters given for the next longer tabulated groove length.

For expanded diameters applicable to pins made from corrosion resistant steel or monel, see Table 1B.

2.3 Grooves.

Grooved pins and drive studs shall have three grooves equally spaced on the diameter. All grooves in any pin or stud shall be of uniform depth, shape and length and the crests shall be free from tears, burrs, or other irregularities, over the entire length of groove.

Grooves shall be aligned with axis of pin or stud and, unless otherwise specified, shall be parallel or tapered and of length as designated for the respective pin types. For Types B, D and E grooved pins having groove lengths equal to 0.125 in. or shorter, the grooves shall be parallel instead of tapered or oval as depicted in the illustrations.

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Table 1B Expanded Diameters for Grooved Pins Made from Corrosion Resistant Steel and Monel

Groove Length ¹	Nominal 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
	B Expanded Pin Diameter														
	± 0.001						± 0.002								
0.125	0.034	0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195						
0.188	0.034	0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195						
0.250	0.034	0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195	0.227	0.260				
0.312	0.034	0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195	0.227	0.260	0.325			
0.375	0.034	0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195	0.227	0.260	0.325	0.389		
0.438	0.034	0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195	0.227	0.260	0.325	0.389	0.453	
0.500	0.034	0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195	0.227	0.260	0.325	0.389	0.453	0.519
0.562		0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195	0.227	0.260	0.325	0.389	0.453	0.519
0.625		0.050	0.066	0.082	0.099	0.115	0.132	0.164	0.195	0.227	0.260	0.325	0.389	0.453	0.519
0.750			0.065	0.081	0.098	0.114	0.132	0.164	0.195	0.227	0.260	0.325	0.389	0.453	0.519
0.875			0.065	0.081	0.098	0.114	0.131	0.163	0.195	0.227	0.260	0.325	0.389	0.453	0.519
1.000			0.065	0.081	0.098	0.113	0.131	0.163	0.195	0.227	0.260	0.325	0.389	0.453	0.519
1.125					0.098	0.113	0.130	0.162	0.194	0.227	0.260	0.325	0.389	0.453	0.519
1.250							0.130	0.162	0.194	0.227	0.260	0.325	0.389	0.453	0.519
1.375							0.130	0.162	0.194	0.226	0.259	0.325	0.389	0.453	0.519
1.500							0.130	0.162	0.194	0.226	0.259	0.325	0.389	0.453	0.519
1.625								0.161	0.194	0.226	0.259	0.324	0.388	0.453	0.519
1.750								0.161	0.194	0.226	0.259	0.324	0.388	0.453	0.519
1.875								0.161	0.193	0.226	0.259	0.324	0.388	0.452	0.519
2.000								0.161	0.193	0.226	0.259	0.324	0.388	0.452	0.519
2.125									0.193	0.226	0.259	0.324	0.388	0.452	0.518
2.250									0.193	0.226	0.259	0.324	0.388	0.452	0.518
2.500										0.225	0.258	0.323	0.388	0.452	0.518
2.750										0.225	0.258	0.323	0.388	0.452	0.518
3.000										0.224	0.257	0.323	0.387	0.451	0.517
3.250											0.257	0.322	0.387	0.451	0.517
3.500												0.322	0.387	0.450	0.516
3.750													0.387	0.450	0.516
4.000													0.386	0.449	0.515
4.250													0.386	0.449	0.515
4.500														0.448	0.514

1. Groove length shall be considered as being substantially equal to the pin length for Types A, C and F grooved pins, and equal to one-half of the pin length for Types B, D, E and G grooved pins. For groove lengths not shown, use expanded diameters given for the next longer tabulated groove length.

For expanded diameters applicable to pins made from materials other than corrosion resistant steel or monel, see Table 1A.

2.3.1 Grooved T-Head Cotter Pins shall have three grooves equally spaced on the diameter. Deformation of the shank diameter between the grooves is permitted, however, this may cause high insertion pressures. Where high insertion pressures cannot be tolerated, a solution should be negotiated between user and the supplier.

2.4 Ends.

2.4.1 Grooved Pins. Except for nominal lengths of 1/4 in. or shorter on which ends are neither crowned nor chamfered, both ends of grooved pins shall be crowned or chamfered as specified for the respective types. Pins made from alloy steel shall have a cham-



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Nominal Length	Nominal 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
1/8	Y	Y	Y												
1/4	Y	Y	Y	Y	Y	Y	Y								
3/8	Y	Y	Y	Y	X	X	X	X	X						
1/2	Y	Y	Y	Y	X	X	X	X	X	X	X				
5/8		Y	Y	Y	X	X	X	X	X	X	X	X			
3/4			Y	Y	X	X	X	X	X	X	X	X	X		
7/8			Y	Y	X	X	X	X	X	X	X	X	X	X	
1			Y	Y	X	X	X	X	X	X	X	X	X	X	X
1-1/4					X	X	X	X	X	X	X	X	X	X	X
1-1/2							X	X	X	X	X	X	X	X	X
1-3/4								X	X	X	X	X	X	X	X
2								X	X	X	X	X	X	X	X
2-1/4									X	X	X	X	X	X	X
2-1/2										X	X	X	X	X	X
2-3/4										X	X	X	X	X	X
3										X	X	X	X	X	X
3-1/4											X	X	X	X	X
3-1/2												X	X	X	X
3-3/4													X	X	X
4													X	X	X
4-1/4													X	X	X
4-1/2														X	X

1. Pins made from carbon steel are normally available as indicated above, where: X designates all types of pins and Y designates all types except Type G. For other size-length combinations and materials, manufacturers should be consulted.

fer on both ends conforming with that specified for Type F pins in lieu of crowned ends. At manufacturer's option, the ends of pins in nominal sizes up to and including 1/4 in. may be tumbled to provide rounded corners equivalent to a 0.015 in. $\pm$ 0.005 in. radius.

2.4.2 Grooved Drive Studs. The ends of groove drive studs shall have a definite chamfer.

2.4.3 Grooved T-Head Cotter Pins. The ends of grooved T-head cotter pins may have square, rounded or chamfered corners conforming to manufacturer's practices.

2.5 Length.

2.5.1 Measurement. The length of grooved pins, drive studs and T-head cotter pins shall be measured, parallel to the axis of product as defined in the following.

2.5.1.1 Grooved Pins. The length of grooved pins shall be measured between the points of intersection of the crown with the pin diameter on pins having crowned ends and overall from end to end on pins having chamfered ends.

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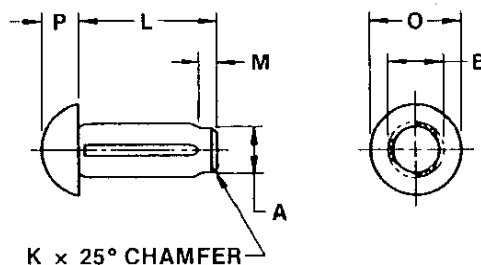


Table 2 Dimensions of Round Head Grooved Drive Studs

Stud Size Number and Basic Shank Diameter	A		O		P		B								K + 0.010 - 0.000
	Shank Diameter		Head Diameter		Head Height		Expanded Diameter								
							±0.002								
							Nominal Stud Length								
	Max	Min	Max	Min	Max	Min	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	
0 0.067	0.067	0.065	0.130	0.120	0.050	0.040	0.074	0.074	0.074						0.016
2 0.086	0.086	0.084	0.162	0.146	0.070	0.059	0.096	0.096	0.095						0.016
4 0.104	0.104	0.102	0.211	0.193	0.086	0.075		0.115	0.113	0.113					0.016
6 0.120	0.120	0.118	0.260	0.240	0.103	0.091			0.132	0.130	0.130				0.031
7 0.136	0.136	0.134	0.309	0.287	0.119	0.107				0.147	0.147	0.144			0.031
8 0.144	0.144	0.142	0.309	0.287	0.119	0.107					0.155	0.153	0.153		0.031
10 0.161	0.161	0.159	0.359	0.334	0.136	0.124					0.173	0.171	0.171		0.047
12 0.196	0.196	0.194	0.408	0.382	0.152	0.140						0.206	0.204	0.204	0.047
14 0.221	0.221	0.219	0.457	0.429	0.169	0.156						0.234	0.232	0.232	0.047
16 0.250	0.250	0.248	0.472	0.443	0.174	0.161						0.263			0.047
See Note 1, 3							2								

NOTES:

- Where specifying stud size in decimals, zeros preceding decimal and in the fourth decimal place shall be omitted.
- Sizes and lengths for which B values are tabulated are normally readily available in carbon steel. For other size-length combinations or materials, manufacturers should be consulted.
- For additional requirements and recommended hole sizes refer to Introductory Notes, and to General Data for Grooved Drive Studs, page L-60.

Table 2A Pilot Length Dimensions for Round Head Grooved Drive Studs

Nominal Length	Nominal Size																			
	0		2		4		6		7		8		10		12		14		16	
	M Pilot Length																			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1/8	0.051	0.031	0.051	0.031	0.067	0.047	0.082	0.062	0.082	0.062	0.082	0.062	0.082	0.062	0.082	0.062	0.082	0.062	0.082	0.062
3/16	0.067	0.047	0.067	0.047																
1/4	0.082	0.062	0.082	0.062																
5/16																				
3/8					0.114	0.094	0.114	0.094	0.114	0.094	0.114	0.094	0.114	0.094	0.14	0.12	0.14	0.12	0.14	0.12
1/2									0.14	0.12	0.14	0.12	0.14	0.12	0.14	0.12	0.14	0.12	0.14	0.12
5/8											0.18	0.16	0.18	0.16	0.18	0.16	0.18	0.16	0.18	0.16
3/4															0.20	0.18	0.20	0.18		

To find total pilot length of lengths (L) not shown above, use the next shorter length.

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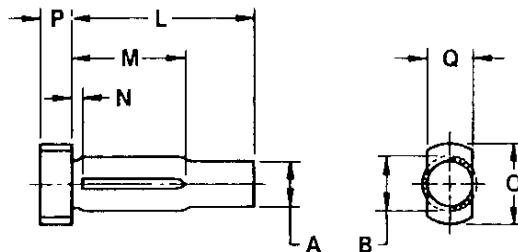
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Table 3 Dimensions of Grooved T-Head Cotter Pins

Nominal Size or Basic Shank Diameter	A		B		N	O		P		Q		Recommended Hole Size	
	Shank Diameter		Expanded Shank Diameter		Length	Head Diameter		Head Height		Head Width			
	Max	Min	Max	Min	Max	Max	Min	Max	Min	Max	Min	Max	Min
5/32 0.156	0.154	0.150	0.168	0.163	0.08	0.26	0.24	0.11	0.09	0.18	0.15	0.161	0.156
3/16 0.187	0.186	0.182	0.201	0.195	0.09	0.30	0.28	0.13	0.11	0.22	0.18	0.193	0.187
1/4 0.250	0.248	0.244	0.265	0.259	0.12	0.40	0.38	0.17	0.15	0.28	0.24	0.257	0.250
5/16 0.312	0.310	0.305	0.326	0.320	0.16	0.51	0.48	0.21	0.19	0.34	0.30	0.319	0.312
23/64 0.359	0.358	0.353	0.375	0.369	0.18	0.57	0.54	0.24	0.22	0.38	0.35	0.366	0.359
1/2 0.500	0.498	0.493	0.520	0.514	0.25	0.79	0.76	0.32	0.30	0.54	0.49	0.508	0.500
See Notes 1, 3					2								

NOTES:

- Where specifying nominal size in decimals, zeros preceding decimal and in the fourth decimal place shall be omitted.
- For groove lengths, M, which vary with pin length, see Table 3A.
- For additional requirements refer to Introductory Notes, and to General Data for Grooved Pins, page L-60.

Table 3A Groove Length Dimensions for Grooved T-Head Cotter Pins

Nominal Length	Nominal Size											
	5/32		3/16		1/4		5/16		23/64		1/2	
	M, Groove Length¹											
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3/4	0.50	0.48	0.50	0.48								
7/8	0.50	0.48	0.50	0.48								
1	0.62	0.60	0.62	0.60	0.62	0.60						
1-1/8	0.68	0.66	0.68	0.66	0.68	0.66	0.68	0.66				
1-1/4			0.75	0.73	0.75	0.73	0.75	0.73	0.75	0.73		
1-1/2					0.88	0.86	0.88	0.86	0.88	0.86		
1-3/4							1.00	0.98	1.00	0.98		
2							1.25	1.23	1.25	1.23	1.25	1.23
2-1/4											1.31	1.29
2-1/2											1.50	1.48
2-3/4											1.62	1.60
3											1.85	1.83

- Sizes and lengths for which M values are tabulated are normally readily available. For other size-length combinations, manufacturers should be consulted.



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2.5.1.2 Groove Drive Studs and T-Head Cotter Pins. The length of round head grooved drive studs and grooved T-head cotter pins shall be measured from the extreme end of the shank to the bearing surface of the head.

2.5.2 Tolerance on Length. The tolerance on length of grooved pins and grooved drive studs shall be ± 0.010 in. The tolerance on length of grooved T-head cotter pins shall be ± 0.031 in.

2.5.3 Standard Lengths. The standard sizes and lengths in which grooved pins of all types, grooved drive studs and T-head cotter pins are normally available are depicted in Tables 1C, 2 and 3A, respectively. Where other size-length combinations and materials are required, manufacturers should be consulted.

2.6 Materials.

2.6.1 Grooved Pins. 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.

Where required for specific applications, 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 the manufacturer and purchaser.

2.6.2 Grooved Drive Studs and T-Head Cotter Pins. Unless otherwise specified, grooved drive studs and T-head cotter pins shall be made from low carbon steel. Where so indicated by purchaser, they may be made from corrosion resistant steel, brass and other non-ferrous metals as agreed upon between the manufacturer and the purchaser.

2.7 Performance Requirements.

Grooved pins shall be capable of withstanding the minimum double shear loads tabulated below for the respective materials, when tested in accordance with the Double Shear Testing of Pins set forth in Appendix 1,

page L-75. The holes in the fixtures for testing grooved pins shall conform with the specified recommended hole size limits.

Grooved pins which have been sheared at loads exceeding the minimums specified shall exhibit a ductile fracture at the shear point with no longitudinal cracks.

Nom- inal Pin Size	Double Shear Load, Min, lb			
	Material			
	Low Carbon Steel	Alloy Steel (Rockwell C45 to 50)	Corrosion Resistant Steel	Brass
1/32	104	202	143	64
3/64	220	430	300	136
1/16	402	785	540	250
5/64	624	1,215	860	386
3/32	896	1,750	1,240	555
7/64	1,222	2,380	1,685	757
1/8	1,600	3,115	2,200	990
5/32	2,494	4,860	3,440	1,540
3/16	3,588	6,990	4,960	2,220
7/32	4,884	9,520	6,760	3,020
1/4	6,380	12,430	8,840	3,950
5/16	9,970	19,420	13,750	6,170
3/8	11,620	27,950	19,800	9,050
7/16	15,820	38,060	27,000	12,100
1/2	20,600	49,700	35,200	15,800

2.8 Hole Sizes.

To obtain optimum product retention under average conditions, it is recommended that holes for installation of grooved pins and grooved drive studs shown below, and those for grooved T-head cotter pins given in Table 3 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 pin or 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 the 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.



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Recommended Hole Sizes For Grooved Pins			
Nominal Pin Size	Drill Size	Hole Diameter	
		Max	Min
1/32	1/32	0.0324	0.0312
3/64	3/64	0.0482	0.0469
1/16	1/16	0.0640	0.0625
5/64	5/64	0.0798	0.0781
3/32	3/32	0.0956	0.0938
7/64	7/64	0.1113	0.1094
1/8	1/8	0.1271	0.1250
5/32	5/32	0.1587	0.1563
3/16	3/16	0.1903	0.1875
7/32	7/32	0.2219	0.2188
1/4	1/4	0.2534	0.2500
5/16	5/16	0.3166	0.3125
3/8	3/8	0.3797	0.3750
7/16	7/16	0.4428	0.4375
1/2	1/2	0.5060	0.5000

Recommended Hole Sizes For Grooved Drive Studs			
Stud Size Number	Drill Size	Hole Diameter	
		Max	Min
0	51	0.0686	0.0670
2	44	0.0877	0.0860
4	37	0.1059	0.1040
6	31	0.1220	0.1200
7	29	0.1382	0.1360
8	27	0.1463	0.1440
10	20	0.1636	0.1610
12	9	0.1990	0.1960
14	2	0.2240	0.2210
16	1/4	0.2534	0.2500

In applications where the grooved products are to be installed into materials which are appreciably harder than the product material, it is recommended the edges of the holes be chamfered or otherwise relieved to avoid shearing of the expanded pin or shank section during insertion.

2.9 Finishes.

Unless otherwise specified, carbon steel grooved pins and studs shall have a flash

plating of cadmium or zinc to provide interim corrosion protection and products of other materials shall be furnished with a natural (as processed) finish, unplated or uncoated. Other finishes, where required, shall be subject to agreement between the manufacturer and the purchaser. However, where a corrosion preventative finish applied to hardened carbon or alloy steel pins is such that it might produce hydrogen embrittlement, the pins shall be baked for a suitable time at a temperature that will obviate such embrittlement. Baking shall be accomplished as soon as possible following the plating or coating operation inasmuch as delay is detrimental to achievement of the desired result.

2.10 Workmanship.

Grooved pins, drive studs and T-head cotter pins shall be free from burrs, seams, loose scale, sharp edges and any other defects affecting their serviceability.

2.11 Designation.

Grooved pins, drive studs and T-head cotter pins shall be designated by the following data, in the sequence shown: Product name (noun first), including type designation for pins; nominal size (number, fraction or decimal equivalent); length (fraction or decimal equivalent); material, including specification or heat treatment where necessary; protective finish, if required. See examples below:

Pin, Type A Grooved, 3/32 × 3/4, Steel, Zinc Plated

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

Drive Stud, Round Head Grooved, No. 10 × 1/2, Steel, Zinc Plated

Pin, Grooved T-Head Cotter, 1/4 × 1-1/4, Steel, Zinc Plated

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See IFI Notes, page L-33.

1. Introductory Notes.

1.1 Scope.

1.1.1 This standard is intended to cover the complete dimensional and general data for spring pins recognized as "American National Standard," which are widely used in general industrial applications. Also included is an appendix, page L-75, providing supplementary information on the testing of pins in double shear.

1.1.2 The inclusion of dimensional data in this standard is not intended to imply that all of the products described are stock production sizes. Consumers are requested to consult with manufacturers concerning availability of product.

1.2 Types of Pins.

1.2.1 *Spring Pins.* Spring pins shall have straight cylindrical sides with both ends chamfered. They are available in two basic types, reflecting slotted construction and coiled construction, and the latter in Standard Duty, Heavy Duty, and Light Duty series to suit various design requirements. Slotted type spring pins having a single wall and coiled type spring pins having multiple walls are formed or wrapped from strip stock to a diameter larger than basic and heat treated. Upon installation the pin diameters contract and the spring reaction against the sides of the hole tends to retain the pin. Dimensions of slotted type spring pins and coiled type spring pins are given in Tables 1 and 2, respectively.

1.3 Dimensions.

All dimensions in this standard are given in inches, unless otherwise stated.

1.4 Options.

Options, where specified, shall be at the discretion of the manufacturer, unless otherwise agreed upon by the manufacturer and purchaser.

1.5 Terminology.

For definition of terms relating to fasteners or component features thereof used in this standard, refer to Glossary of Terms for Mechanical Fasteners, ANSI/ASME B18.12, page M-1.

2. General Data for Spring Pins.

2.1 Diameter.

2.1.1 *Slotted Type.* Due to the manufacturing process, the outer periphery of slotted type spring pins in the free state deviates somewhat from true round. Therefore, conformance with the specified maximum diameter limits shall be checked with GO plain ring gages and the minimum diameter shall be determined by averaging three measurements taken at successive 45 deg intervals away from the center of slot. These measurements shall be made at approximately the center of pins 1 in. or shorter nominal length, and at a distance of 0.25 in. from the end of pins having longer nominal lengths.

2.1.2 *Coiled Type.* Due to the nature of the manufacturing process and the overlapping coil, the outer periphery of coiled type spring pins deviates from true round. Consequently, conformance with specified minimum and maximum diameter limits shall be determined by the use of GO and NOT GO plain ring gages, respectively.

2.2 Slots.

The dimensions and end configurations of the slot in the circumference of slotted type spring pins shall be such that pins in the free state will not interlock and that sides of slot will not contact when pin is inserted into a hole of a diameter equal to the recommended minimum hole size within a tolerance of ± 0.0003 in. The edges of slot intersecting the pin diameter shall be broken or rounded.

2.3 Ends.

Both ends of all spring pins shall be chamfered as depicted in the illustrations



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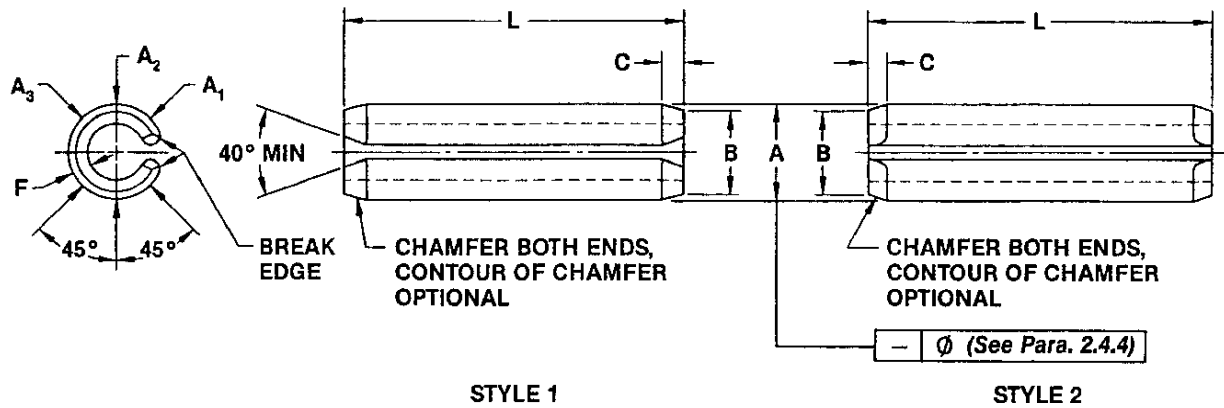
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Table 1 Dimensions of Slotted Type Spring Pins

Nominal Size or Basic Pin Diameter		A		B	C		F	Recommended Hole Size		Double Shear Load, Min, lb		
		Pin Diameter		Chamfer Diameter	Chamfer Length		Stock Thick- ness			Material		
										AISI 1070- 1095 and AISI 420	AISI 302	Beryllium Copper
Max	Min	Max	Max	Min	Basic	Max	Min					
1/16	0.062	0.069	0.066	0.059	0.028	0.007	0.012	0.065	0.062	425	350	270
5/64	0.078	0.086	0.083	0.075	0.032	0.008	0.018	0.081	0.078	650	550	400
3/32	0.094	0.103	0.099	0.091	0.038	0.008	0.022	0.097	0.094	1,000	800	660
1/8	0.125	0.135	0.131	0.122	0.044	0.008	0.028	0.129	0.125	2,100	1,500	1,200
9/64	0.141	0.149	0.145	0.137	0.044	0.008	0.028	0.144	0.140	2,200	1,600	1,400
5/32	0.156	0.167	0.162	0.151	0.048	0.010	0.032	0.160	0.156	3,000	2,000	1,800
3/16	0.188	0.199	0.194	0.182	0.055	0.011	0.040	0.192	0.187	4,400	2,800	2,600
7/32	0.219	0.232	0.226	0.214	0.065	0.011	0.048	0.224	0.219	5,700	3,550	3,700
1/4	0.250	0.264	0.258	0.245	0.065	0.012	0.048	0.256	0.250	7,700	4,600	4,500
5/16	0.312	0.328	0.321	0.306	0.080	0.014	0.062	0.318	0.312	11,500	7,095	6,800
3/8	0.375	0.392	0.385	0.368	0.095	0.016	0.077	0.382	0.375	17,600	10,000	10,100
7/16	0.438	0.456	0.448	0.430	0.095	0.017	0.077	0.445	0.437	20,000	12,000	12,200
1/2	0.500	0.521	0.513	0.485	0.110	0.025	0.094	0.510	0.500	25,800	15,500	16,800
5/8	0.625	0.650	0.640	0.608	0.125	0.030	0.125	0.636	0.625	46,000 ⁴	18,800	...
3/4	0.750	0.780	0.769	0.730	0.150	0.030	0.150	0.764	0.750	66,000 ⁴	23,200	...
See Note 1, 5		2, 3								4		

NOTES:

- Where specifying nominal size in decimals, zeros preceding the decimal shall be omitted.
- Maximum diameter shall be checked by GO ring gage.
- Minimum diameter shall be average of three diameters measured at points illustrated. $A_{min} = \frac{A_1 + A_2 + A_3}{3}$
- Sizes 5/8 in. (0.625) and larger are produced from AISI 6150H alloy steel, not AISI 1070-1095.
- For additional requirements refer to Introductory Notes and General Data for Spring Pins, page L-69.

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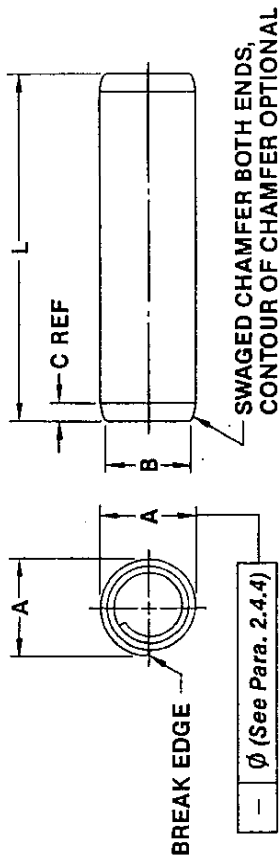


Table 2 Dimensions of Coiled Type Spring Pins

Nominal Size or Basic Pin Diameter	A						B	C	Recom- mended Hole Size				Double Shear Load, Min, lb					
	Pin Diameter								Chamfer	Standard Duty			Heavy Duty			Light Duty		
	Standard Duty		Heavy Duty		Light Duty					Dia	Length	Material						
												AISI 1070- 1095 and AISI 420	AISI 302	AISI 1070- 1095 and AISI 420	AISI 302	AISI 1070- 1095 and AISI 420		
1/32	0.031	0.035	0.033	...	...	...	0.029	0.024	0.032	0.031	60	...	...	...	...	...		
0.039	0.044	0.041	...	...	...	...	0.037	0.024	0.040	0.039	100	...	...	...	...	...		
3/64	0.047	0.052	0.049	...	...	...	0.045	0.024	0.048	0.046	140	...	...	...	...	...		
0.052	0.057	0.054	...	...	...	...	0.050	0.024	0.053	0.051	190	...	...	...	...	...		
1/16	0.062	0.072	0.067	0.070	0.073	0.067	0.059	0.028	0.065	0.061	250	...	...	...	...	135		
5/64	0.078	0.088	0.083	0.086	0.089	0.083	0.075	0.032	0.081	0.077	400	...	...	...	...	225		
3/32	0.094	0.105	0.099	0.103	0.106	0.099	0.091	0.038	0.097	0.093	550	...	...	...	...	300		
7/64	0.109	0.120	0.114	0.118	0.121	0.114	0.106	0.038	0.112	0.108	750	...	...	...	...	425		
1/8	0.125	0.138	0.131	0.136	0.139	0.131	0.121	0.044	0.129	0.124	1,000	...	...	...	...	550		
5/32	0.156	0.171	0.163	0.168	0.172	0.163	0.152	0.048	0.160	0.155	1,550	...	...	...	...	875		
3/16	0.188	0.205	0.196	0.202	0.207	0.196	0.182	0.055	0.192	0.185	2,250	...	...	...	...	1,200		
7/32	0.219	0.238	0.228	0.235	0.240	0.228	0.214	0.065	0.224	0.217	3,800	...	...	...	...	1,700		
1/4	0.250	0.271	0.260	0.268	0.273	0.260	0.243	0.065	0.256	0.247	5,000	...	...	...	...	2,200		
5/16	0.312	0.337	0.324	0.334	0.339	0.324	0.304	0.080	0.319	0.308	7,700	...	...	...	...	3,500		
3/8	0.375	0.403	0.388	0.400	0.386	0.405	0.366	0.095	0.383	0.370	11,200	...	...	...	...	5,000		
7/16	0.438	0.469	0.452	0.466	0.471	0.452	0.427	0.095	0.446	0.431	15,200	...	...	...	...	6,700		
1/2	0.500	0.535	0.516	0.532	0.514	0.537	0.488	0.110	0.510	0.493	20,000	...	...	...	...	8,800		
5/8	0.625	0.661	0.642	0.658	0.640	...	0.613	0.125	0.635	0.618	31,000	...	...	...	...	...		
3/4	0.750	0.787	0.768	0.784	0.765	...	0.738	0.150	0.760	0.743	45,000	...	...	...	...	...		
See Note 1, 6	2, 3												4, 5					

NOTES:

- Where specifying nominal size in decimals, zeros preceding the decimal shall be omitted.
- Maximum diameter shall be checked by GO ring gage.
- Minimum diameter shall be checked by NOT GO ring gage.
- Sizes 1/32 in. (0.031) through 0.052 in. are not available in AISI 1070-1095 carbon steel.
- Sizes 5/8 in. (0.625) and larger are produced from AISI 6150 alloy steel, not AISI 1070-1095 carbon steel.
- For additional requirements refer to Introductory Notes and General Data for Spring Pins, page L-69.



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and specified in the dimensional tables. The contour of the chamfer shall be optional.

2.4 Length.

2.4.1 Measurement. The length of spring pins shall be measured overall from end to end, parallel to the axis of pin.

2.4.2 Tolerance on Length. The tolerance on the length of spring pins shall be as tabulated below for the respective types:

Pin Type	Slotted	Coiled
Nominal Pin Size	1/16 thru 3/4	1/32 thru 7/16 thru 3/4
Nominal Pin Length	Tolerance on Length	
Up to 1 in., Incl.	± 0.015	± 0.010 ± 0.025
Over 1 to 2 in., Incl.	± 0.020	± 0.010 ± 0.025
Over 2 to 3 in., Incl.	± 0.025	± 0.015 ± 0.025
Over 3 to 4 in., Inc.	± 0.030	± 0.025 ± 0.025
Over 4 in.	± 0.035	± 0.025 ± 0.025

2.4.3 Practical Lengths. The diameter-length combinations in which spring pins are normally readily available are depicted in Table 3. Manufacturers should be consulted concerning the availability of other size-length combinations in the various types, series, and materials.

2.4.4 Straightness. The straightness over the length of spring pins shall be such that pins will pass freely through a ring gage of length as tabulated below for the respective pin lengths. The maximum diameter of the gaging hole shall be equivalent to the maximum pin free diameter for the respective pin types and series, given in Tables 1 and 2, plus the straightness diameter allowance tabulated below:

Nominal Pin Length	Gage Length	Straightness Diameter Allowance
	± 0.005	
Up to 1 in., Incl.	1.000	0.007
Over 1 to 2 in., Incl.	2.000	0.010
Over 2 in.	3.000	0.013

2.5 Materials.

Spring pins are normally made from AISI 1070-1095 carbon steel, AISI 6150 H alloy

steel, AISI Types 410 through 420 and 302 corrosion resistant steels, and beryllium copper alloy as designated in the respective dimensional tables; heat treated or cold worked to attain the hardness and performance requirements set forth in this standard. Where required for specific applications, pins may also be made from other materials having chemicals and mechanical properties as agreed upon between the manufacturer and purchaser.

2.6 Hardness.

The hardness of the various spring pin types and materials shall conform to the requirements tabulated below:

For Slotted Type Spring Pins				
Nominal Pin Size Range	From	1/32	1/8	5/16
	Thru	7/64	1/4	3/4
Hardness Test		Rockwell 15N	Rockwell A	Rockwell C
Material	Hardness Reading			
AISI 1070 to 1095 Steel		83.5 to 86.9	73.6 to 77.4	46 to 53
AISI 6150H Alloy Steel		...	...	43 to 51
AISI 420 Cor Resistant Steel		82 to 86.6	72 to 76.8	43 to 52
AISI 302 Cor Resistant Steel		*	*	*
Beryllium Copper		78.3 to 86.6	68.4 to 76.8	36 to 52

For Coiled Type Spring Pins					
Stock Thickness Range	Over	0.001	0.010	0.025	0.050
	Thru	0.010	0.025	0.050	0.094
Hardness Test		Tukon DPH ¹	Rockwell 15N	Rockwell A	Rockwell C
Material	Hardness Reading				
AISI 1070 to 1095 Steel		458 to 562	83.5 to 86.9	73.6 to 77.4	46 to 53
AISI 6150H Alloy Steel		...	...	...	43 to 51
AISI 420 Cor Resistant Steel		458 to 598	83.5 to 87.9	73.6 to 78.5	46 to 55
AISI 302 Cor Resistant Steel		*	*	*	*

¹Diamond pyramid hardness

*Work hardened only.

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Table 3 Practical Sizes and Lengths of Coiled and Slotted Types of Spring Pins

Nominal Length	Nominal Size																		
	1/32	0.039	3/64	0.052	1/16	5/64	3/32	7/64	1/8	9/64	5/32	3/16	7/32	1/4	5/16	3/8	7/16	1/2	5/8
1/8	X	X	X	X															
3/16	X	X	X	X	X	X	X												
1/4	X	X	X	X	X	X	X	X											
5/16	X	X	X	X	X	X	X	X	X										
3/8	X	X	X	X	X	X	X	X	X	X									
7/16	X	X	X	X	X	X	X	X	X	X	X								
1/2	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
9/16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
5/8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
11/16					X	X	X	X	X	X	X	X	X	X	X				
3/4					X	X	X	X	X	X	X	X	X	X	X	X			
13/16					X	X	X	X	X	X	X	X	X	X	X	X	X		
7/8					X	X	X	X	X	X	X	X	X	X	X	X	X	X	
15/16					X	X	X	X	X	X	X	X	X	X	X	X	X	X	
1					X	X	X	X	X	X	X	X	X	X	X	X	X	X	
1-1/8						X	X	X	X	X	X	X	X	X	X	X	X	X	
1-1/4						X	X	X	X	X	X	X	X	X	X	X	X	X	X
1-3/8						X	X	X	X	X	X	X	X	X	X	X	X	X	
1-1/2						X	X	X	X	X	X	X	X	X	X	X	X	X	X
1-5/8								X	X	X	X	X	X	X	X	X	X	X	
1-3/4								X	X	X	X	X	X	X	X	X	X	X	
1-7/8									X	X	X	X	X	X	X	X	X	X	
2									X	X	X	X	X	X	X	X	X	X	X
2-1/4											X	X	X	X	X	X	X	X	X
2-1/2											X	X	X	X	X	X	X	X	X
2-3/4													X	X	X	X	X	X	X
3													X	X	X	X	X	X	X
3-1/4														X	X	X	X	X	X
3-1/2														X	X	X	X	X	X
3-3/4															X	X	X	X	X
4															X	X	X	X	X
4-1/4																			X
4-1/2																			X
4-3/4																			X
5																			X
5-1/4																			X
5-1/2																			X
5-3/4																			X
6																			X

Pins indicated above are normally available in sizes and materials for which double shear strengths are specified in Tables 1 and 2. Manufacturers should be consulted relative to availability of other sizes, lengths or materials.



PINS

SPRING PINS

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It is recommended that the hardness tests designated for the respective pin sizes be used in conducting hardness checks. For slotted type spring pins the hardness readings shall be taken near the midpoint of a longitudinal flat ground on the pin at 90 deg to the slot. For coiled type spring pins, the pin shall be ground or cut in half along the longitudinal axis and the hardness readings taken on the inside surface of the outer half coil.

2.7 Performance Requirements.

Spring pins shall be capable of withstanding the minimum double shear loads specified in the dimensional tables for the respective pin types, series, sizes and materials, when tested in accordance with the Double Shear Testing of Pins specified in Appendix I, page L-75. The holes in the fixtures for testing spring pins shall be in conformance with the specified recommended hole size limits. Slotted type spring pins shall be positioned such that the slot is approximately perpendicular to the plane of application of the shear load.

Spring pins which have been sheared at loads exceeding the minimums specified shall exhibit a ductile fracture at the shear point with no longitudinal cracks.

2.8 Finishes.

Unless otherwise specified, spring pins shall be furnished with a natural (as processed) finish, unplated or uncoated. Where corrosion preventative treatment is required,

steel pins may be cadmium or zinc plated or phosphate coated as agreed upon between the manufacturer and the purchaser. However, where a corrosion preventative finish applied to carbon steel or alloy steel spring pins is such that it might produce hydrogen embrittlement, the pins shall be baked for a suitable time at a temperature that will obviate such embrittlement. Baking shall be accomplished as soon as possible following the plating or coating operation inasmuch as delay is detrimental to achievement of the desired results.

2.9 Workmanship.

Spring pins shall be free from burrs, loose scale, seams, notches, sharp edges and corners and any other defects affecting their serviceability.

2.10 Designation.

Spring pins shall be designated by the following data, in the sequence shown: Product name (noun first); nominal size (fraction or decimal equivalent); nominal length (fraction or decimal equivalent); series, for coiled type spring pins; material, including specification where necessary; protective finish, if required. See examples below:

Pin, Coiled Spring, $\frac{1}{4}$ x $1\frac{1}{4}$, Standard Duty, Steel, Zinc Plated

Pin, Slotted Spring, 0.375 x 1.875, AISI 420 Corrosion Resistant Steel

Pin, Slotted Spring, $\frac{1}{2}$ x 3, Steel, Phosphate Coated

SHEAR TESTING OF PINS

APPENDIX I

DOUBLE SHEAR TESTING OF PINS

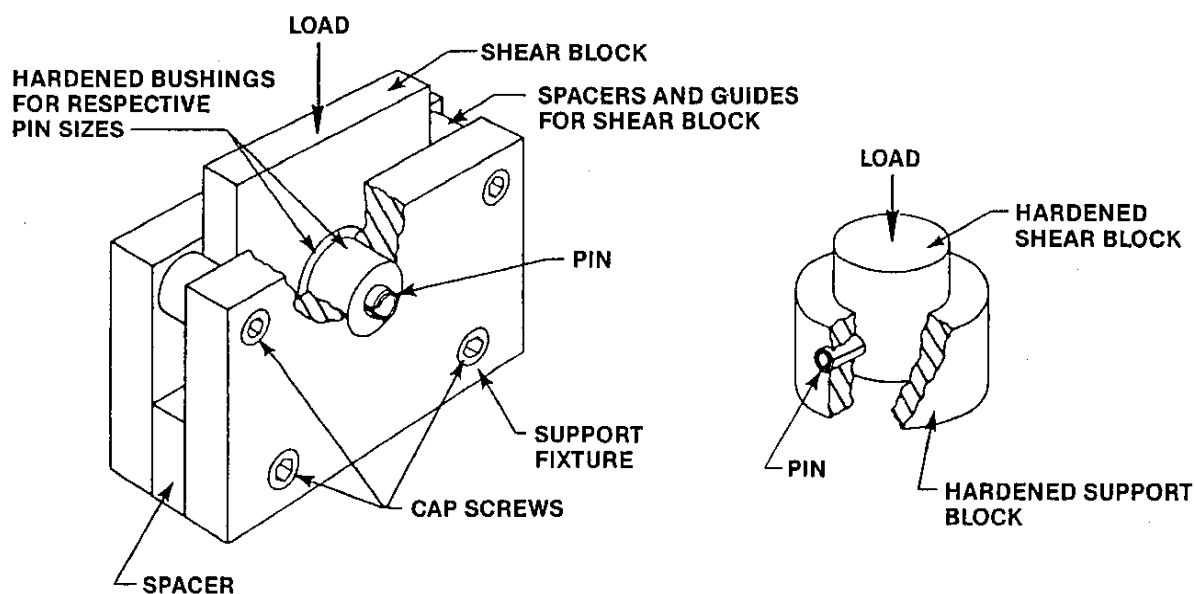
The following specifications and procedures are set forth to establish uniformity in the testing of pins in double shear.

The shear test shall be performed in a suitable fixture in which the pin support members and the member for applying the shear load have holes for the pin of a diameter conforming to that designated in the General Data for the respective pin type being tested. These members shall have a minimum hardness of Rockwell C58, or equivalent. The clearance between the supporting member and loading member shall not exceed 0.005 in.

and means for keeping the loading member aligned perpendicular to the axis of pin shall be provided. The rate of load application shall not exceed 0.50 in. per minute.

The shear planes shall be located at a minimum distance equivalent to one pin diameter from each end of pin. Pins of lengths that are too short to be tested in double shear shall be evaluated by testing two pins simultaneously in single shear.

Two typical pin shear test fixtures are illustrated below:



TYPICAL PIN SHEAR TEST FIXTURES