

17 Splines

INVOLUTE SPLINES AND INSPECTIONS—SAE J498c

SAE Standard

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PARALLEL SIDE SPLINES FOR SOFT BROACHED HOLES IN FITTINGS—SAE J499a

SAE Standard

Report of Broaches Division approved January 1914, revised by Shaft Fittings Division March 1920, and reviewed January 1936. Last revised by ANSI B92 Committee—Involute Splines and Inspection—October 1975.

This Information Report along with SAE J500 and J501 is generally understood to be technically obsolete for the design of new applications. However, it is listed for those existing applications where it may be required. For the design of new applications, consult ANSI B92.1-1970—Involute Splines and Inspections Standard.

The dimensions, given in inches, apply only to soft broached holes. The shaft dimensions depend upon the shape and material of the parts, their heat treatment, and methods of machining to give the required fit. The method and amount of "breaking" sharp corners and edges also depend upon the conditions and requirements of each application.

The formula for theoretical torque capacity (pressure on sides of spline) in foot-pounds per inch of bearing length (L) and at 1000 psi pressure is:

$$T = \text{Torque} = 1000 \times \text{No. of splines} \times \text{mean radius} \times h \times L$$

The tolerances allowed are for good construction and may be readily maintained by usual broaching methods. The tolerances selected for the large and small diameters will depend upon whether the fit between the mating parts, as finally made, is on the large or the small diameter. The other diameter, being designed for clearance may have a wider manufacturing tolerance. If the final fit between the parts is on only the sides of the spline,

wider tolerances may be permitted on both the large and small diameters.]

Radii on corners of splines are not to exceed 0.015 in.

Splines shall not be more than 0.006 in per ft out of parallel with respect to the axis of the shaft.

No allowance is made for radii on corners or for clearance. Dimensions are intended to apply to only the soft broached hole. Allowance must be made for machining.

For values of D, W, d, h, and T for four-, six-, ten-, and sixteen-spline fittings, see Tables 2, 3, 4, and 5, respectively.

TABLE 1—W, h, AND d, IN TERMS OF LARGE DIAMETER, D

No. of Splines	W For All Fits	A Permanent Fit		B To Slide when Not under Load		C To Slide under Load	
		h	d	h	d	h	d
4	0.241*	0.075	0.850	*0.125	0.750	—	—
6	0.250	0.050	0.900	0.075	0.850	0.100	0.800
10	0.156	0.045	0.910	0.070	0.860	0.095	0.810
16	0.098	0.045	0.910	0.070	0.860	0.095	0.810

* Four splines, for fits A and B only.

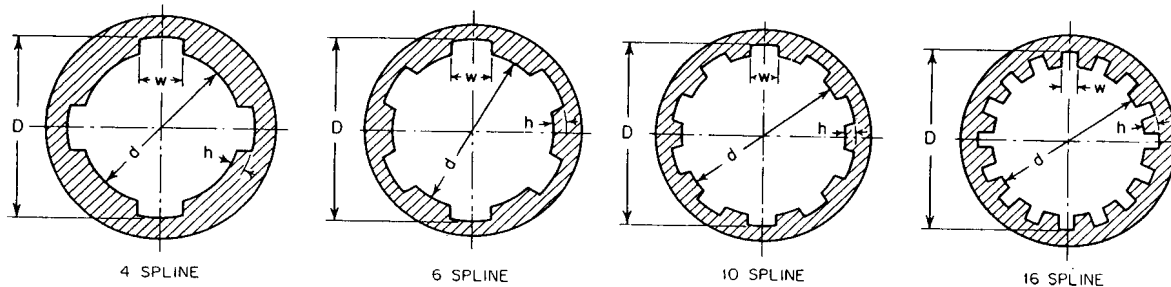


FIG. 1—DIMENSIONS FOR 4, 6, 10, AND 16 SPLINE FITTINGS (SEE TABLE 1)

TABLE 2—FOUR SPLINE FITTINGS

Nominal Dia	For All Fits				4A, Permanent Fit				4B, To Slide when Not under Load					
	D		W		d		T	c		h		T		
	Min	Max	Min	Max	Min	Max		Min	Max	Min	Max			
3/4	0.749	0.750	0.179	0.181	0.636	0.637	0.055	0.056	78	0.561	0.562	0.093	0.094	123
7/8	0.874	0.875	0.209	0.211	0.743	0.744	0.065	0.066	107	0.655	0.656	0.108	0.109	167
1	0.999	1.000	0.239	0.241	0.849	0.850	0.074	0.075	139	0.749	0.750	0.124	0.125	219
1-1/8	1.124	1.125	0.269	0.271	0.955	0.956	0.083	0.084	175	0.843	0.844	0.140	0.141	277
1-1/4	1.249	1.250	0.299	0.301	1.061	1.062	0.093	0.094	217	0.936	0.937	0.155	0.156	341
1-3/8	1.374	1.375	0.329	0.331	1.168	1.169	0.102	0.103	262	1.030	1.031	0.171	0.172	414
1-1/2	1.499	1.500	0.359	0.361	1.274	1.275	0.111	0.112	311	1.124	1.125	0.186	0.187	491
1-5/8	1.624	1.625	0.389	0.391	1.380	1.381	0.121	0.122	367	1.218	1.219	0.202	0.203	577
1-3/4	1.749	1.750	0.420	0.422	1.486	1.487	0.130	0.131	424	1.311	1.312	0.218	0.219	670
2	1.998	2.000	0.479	0.482	1.698	1.700	0.148	0.150	555	1.498	1.500	0.248	0.250	875
2-1/4	2.248	2.250	0.539	0.542	1.910	1.912	0.167	0.169	703	1.685	1.687	0.279	0.281	1106
2-1/2	2.498	2.500	0.599	0.602	2.123	2.125	0.185	0.187	865	1.873	1.875	0.310	0.312	1365
3	2.998	3.000	0.720	0.723	2.548	2.550	0.223	0.225	1249	2.248	2.250	0.373	0.375	1969

TABLE 3—SIX SPLINE FITTINGS

Nominal Dia	For All Fits				6A, Permanent Fit			6B, To Slide when Not under Load			6C, To Slide when under Load		
	D		W		d		T	d		T	c		T
	Min	Max	Min	Max	Min	Max		Min	Max		Min	Max	
3/4	0.749	0.750	0.186	0.188	0.674	0.675	80	0.637	0.638	117	0.599	0.600	152
7/8	0.874	0.875	0.217	0.219	0.787	0.788	109	0.743	0.744	159	0.699	0.700	207
1	0.999	1.000	0.248	0.250	0.899	0.900	143	0.849	0.850	208	0.799	0.800	270
1-1/8	1.124	1.125	0.279	0.281	1.012	1.013	180	0.955	0.956	263	0.899	0.900	342
1-1/4	1.249	1.250	0.311	0.313	1.124	1.125	223	1.062	1.063	325	0.999	1.000	421
1-3/8	1.374	1.375	0.342	0.344	1.237	1.238	269	1.168	1.169	393	1.099	1.100	510
1-1/2	1.499	1.500	0.373	0.375	1.349	1.350	321	1.274	1.275	468	1.199	1.200	608
1-5/8	1.624	1.625	0.404	0.406	1.462	1.463	376	1.380	1.381	550	1.299	1.300	713
1-3/4	1.749	1.750	0.436	0.438	1.574	1.575	436	1.487	1.488	637	1.399	1.400	827
2	1.998	2.000	0.497	0.500	1.798	1.800	570	1.698	1.700	833	1.598	1.600	1080
2-1/4	2.248	2.250	0.560	0.563	2.023	2.025	721	1.911	1.913	1052	1.798	1.800	1367
2-1/2	2.498	2.500	0.622	0.625	2.248	2.250	891	2.123	2.125	1300	1.998	2.000	1688
3	2.998	3.000	0.747	0.750	2.698	2.700	1283	2.548	2.550	1873	2.398	2.400	2430

TABLE 4—TEN SPLINE FITTINGS

Nominal Dia	For All Fits				10A, Permanent Fit			10B, To Slide when Not under Load			10C, To Slide when under Load		
	D		W		d		T	d		T	d		T
	Min	Max	Min	Max	Min	Max		Min	Max		Min	Max	
3/4	0.749	0.750	0.115	0.117	0.682	0.683	120	0.644	0.645	183	0.607	0.608	241
7/8	0.874	0.875	0.135	0.137	0.795	0.796	165	0.752	0.753	248	0.708	0.709	329
1	0.999	1.000	0.154	0.156	0.909	0.910	215	0.859	0.860	326	0.809	0.810	430
1-1/8	1.124	1.125	0.174	0.176	1.023	1.024	271	0.967	0.968	412	0.910	0.911	545
1-1/4	1.249	1.250	0.193	0.195	1.137	1.138	336	1.074	1.075	508	1.012	1.013	672
1-3/8	1.374	1.375	0.213	0.215	1.250	1.251	406	1.182	1.183	614	1.113	1.114	813
1-1/2	1.499	1.500	0.232	0.234	1.364	1.365	483	1.289	1.290	732	1.214	1.215	967
1-5/8	1.624	1.625	0.252	0.254	1.478	1.479	566	1.397	1.398	860	1.315	1.316	1135
1-3/4	1.749	1.750	0.271	0.273	1.592	1.593	658	1.504	1.505	997	1.417	1.418	1316
2	1.998	2.000	0.309	0.312	1.818	1.820	860	1.718	1.720	1302	1.618	1.620	1720
2-1/4	2.248	2.250	0.348	0.351	2.046	2.048	1088	1.933	1.935	1647	1.821	1.823	2176
2-1/2	2.498	2.500	0.387	0.390	2.273	2.275	1343	2.148	2.150	2034	2.023	2.025	2688
3	2.998	3.000	0.465	0.468	2.728	2.730	1934	2.578	2.580	2929	2.428	2.430	3869
3-1/2	3.497	3.500	0.543	0.546	3.182	3.185	2632	3.007	3.010	3987	2.832	2.835	5266
4	3.997	4.000	0.621	0.624	3.637	3.640	3438	3.437	3.440	5208	3.237	3.240	6878
4-1/2	4.497	4.500	0.699	0.702	4.092	4.095	4351	3.867	3.870	6591	3.642	3.645	8705
5	4.997	5.000	0.777	0.780	4.547	4.550	5371	4.297	4.300	8137	4.047	4.050	10746
5-1/2	5.497	5.500	0.855	0.858	5.002	5.005	6500	4.727	4.730	9846	4.452	4.455	13003
6	5.997	6.000	0.933	0.936	5.457	5.460	7735	5.157	5.160	11718	4.857	4.860	15475

TABLE 5—SIXTEEN SPLINE FITTINGS

Nominal Dia	For All Fits				16A, Permanent Fit			16B, To Slide when Not under Load			16C, To Slide when under Load		
	D		W		d		T	d		T	d		T
	Min	Max	Min	Max	Min	Max		Min	Max		Min	Max	
2	1.997	2.000	0.193	0.196	1.817	1.820	1375	1.717	1.720	2083	1.617	1.620	2751
2-1/2	2.497	2.500	0.242	0.245	2.273	2.275	2149	2.147	2.150	3255	2.022	2.025	4299
3	2.997	3.000	0.291	0.294	2.727	2.730	3094	2.577	2.580	4687	2.427	2.430	6190
3-1/2	3.497	3.500	0.340	0.343	3.182	3.185	4212	3.007	3.010	6378	2.832	2.835	8426
4	3.997	4.000	0.389	0.392	3.637	3.640	5501	3.437	3.440	8333	3.237	3.240	11005
4-1/2	4.497	4.500	0.438	0.441	4.092	4.095	6962	3.867	3.870	10546	3.642	3.645	13928
5	4.997	5.000	0.487	0.490	4.547	4.550	8595	4.297	4.300	13020	4.047	4.050	17195
5-1/2	5.497	5.500	0.536	0.539	5.002	5.005	10395	4.727	4.730	15754	4.452	4.455	20806
6	5.997	6.000	0.585	0.588	5.457	5.460	12377	5.157	5.160	18749	4.857	4.860	24740

S.A.E. Standard Splined Fittings

4-Spline Fittings									
Nom. Diam	For All Fits				4A—Permanent Fit				T^L
	D		w		d		h		
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3/4	0.749	0.750	0.179	0.181	0.636	0.637	0.055	0.056	78
7/8	0.874	0.875	0.209	0.211	0.743	0.744	0.065	0.066	107
1	0.999	1.000	0.239	0.241	0.849	0.850	0.074	0.075	139
1 1/8	1.124	1.125	0.269	0.271	0.955	0.956	0.083	0.084	175
1 1/4	1.249	1.250	0.299	0.301	1.061	1.062	0.093	0.094	217
1 3/8	1.374	1.375	0.329	0.331	1.168	1.169	0.102	0.103	262
1 1/2	1.499	1.500	0.359	0.361	1.274	1.275	0.111	0.112	311
1 5/8	1.624	1.625	0.389	0.391	1.380	1.381	0.121	0.122	367
1 3/4	1.749	1.750	0.420	0.422	1.486	1.487	0.130	0.131	424
2	1.998	2.000	0.479	0.482	1.698	1.700	0.148	0.150	555
2 1/4	2.248	2.250	0.539	0.542	1.910	1.912	0.167	0.169	703
2 1/2	2.498	2.500	0.599	0.602	2.123	2.125	0.185	0.187	865
3	2.998	3.000	0.720	0.723	2.548	2.550	0.223	0.225	1249
4-Spline Fittings									
4B—To Slide—No Load					6-Spline Fittings				
Nom. Diam.	d		h		T^L	For All Fits			
	D		w			Min.	Max.	Min.	Max.
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
3/4	0.561	0.562	0.093	0.094	123	0.749	0.750	0.186	0.188
7/8	0.655	0.656	0.108	0.109	167	0.874	0.875	0.217	0.219
1	0.749	0.750	0.124	0.125	219	0.999	1.000	0.248	0.250
1 1/8	0.843	0.844	0.140	0.141	277	1.124	1.125	0.279	0.281
1 1/4	0.936	0.937	0.155	0.156	341	1.249	1.250	0.311	0.313
1 3/8	1.030	1.031	0.171	0.172	414	1.374	1.375	0.342	0.344
1 1/2	1.124	1.125	0.186	0.187	491	1.499	1.500	0.373	0.375
1 5/8	1.218	1.219	0.202	0.203	577	1.624	1.625	0.404	0.406
1 3/4	1.311	1.312	0.218	0.219	670	1.749	1.750	0.436	0.438
2	1.498	1.500	0.248	0.250	875	1.998	2.000	0.497	0.500
2 1/4	1.685	1.687	0.279	0.281	1106	2.248	2.250	0.560	0.563

2 ¹ / ₂	1.873	1.875	0.310	0.312	1365	2.498	2.500	0.622	0.625
3	2.248	2.250	0.373	0.375	1969	2.998	3.000	0.747	0.750