

Australian Standard<sup>®</sup>

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**Straight sided splines**

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Australian and New Zealand Railway Conferences

Bureau of Steel Manufacturers

Department of Defence

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Federal Chambers of Automotive Industries

Metal Trades Employers Association

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This standard, prepared by Committee ME/11, Gears and Splines, was approved on behalf of the Council of the Standards Association of Australia on 7 May 1968.

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*This standard was issued in draft form for public review as Docs 864 and 1172.*

Australian Standard<sup>®</sup>

Straight sided splines

First published . . . . . 1968  
Appending:  
Corrig. — 1974

PUBLISHED BY STANDARDS AUSTRALIA  
(STANDARDS ASSOCIATION OF AUSTRALIA)  
1 THE CRESCENT, HOMEBUSH, NSW 2140

## PREFACE

Several years ago SAA Committee ME/11 — Gears and Splines, undertook the task of the preparation and issue of a series of standards on splines and serrations. Current British and USA standards noted were —

BS 2059:1953 Straight Sided Splines and Serrations — Parts 1 and 2

BS 3550:1963 Involute Splines

USAS B5.15—1960 Involute Splines, Serrations and Inspection.

BS 3550 was endorsed as AS B213 in 1966. A somewhat similar standard on involute serrations, based on information contained in USAS B5.15 and following the layout, nomenclature and gauging details of BS 3550, is being published as AS B265.

Although the use of involute serrations rather than straight sided splines is rapidly increasing, the committee decided that a standard on straight sided splines should be issued. However, it was also decided that a standard was not warranted for straight sided serrations as no strong arguments were advanced in its favour.

BS 2059 was first submitted for public review some years ago on the basis of a proposal that it be endorsed as the Australian standard. As a result of comment received a new draft was prepared to include, in particular, the following features:

- (a) use of top fitting splines, and
- (b) use of 4, 10 and 16 splines.

Both features were in old standards of British and USA origin. This new draft was then issued for public review and the present standard incorporates some further refinements resulting from comment received on that draft.

This standard requires reference to AS B129, Recommended Designs for Geometric Limit Gauges.

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## STANDARDS ASSOCIATION OF AUSTRALIA

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**Australian Standard**  
**for**  
**STRAIGHT SIDED SPLINES**

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**FOREWORD**

This standard has been prepared on the hole basis; that is to say the hole is the constant member and different fits are obtained by varying the size of the splined shaft. In all the tables actual maximum and minimum figures have been given while the maximum metal condition has been shown first in all instances. In compiling the tables, calculations have been made for the following classes of fit:

- Fit 1— represents the condition of closest fit. It is designed for use where minimum backlash is necessary.
- Fit 2— has a positive allowance, being designed for conditions where ease of assembly is required.
- Fit 3— has a larger positive allowance than Fit 2 and is intended for use where such clearances can be accepted in the assembly.

All three fits allow for clearance on the sides of splines but in Fit 1 the minor diameters of the hole and shaft may be identical in size.

Spline width is identical for 4 splines and 6 splines; 10 and 16 splines have respective widths of approximately 0.625 and 0.392 of the width of 4 and 6 splines of equivalent diameter.

When considering the assembly of a splined shaft and hole the designed profile of each must be borne in mind. Consideration should be concentrated on the maximum diameter of the shaft and the widths of external splines in association with the minimum diameter of the hole and the widths of internal splineways, or in other words both the external and internal splines in the maximum metal condition. Furthermore, it should be appreciated that the accuracy of spacing of the splines will have a proportionate bearing on the resultant fit. For instance, if angular position is inaccurate or the splines are not parallel with the axis (alignment error), then interference between the hole and the shaft could result.

The method of presentation of the tolerances has been to show maximum and minimum limits of size for the various features and it should be understood that there can be no errors of form, i.e. spacing, alignment, roundness, etc., with maximum metal conditions.

Note should be made of one variable which might cause needless concern. If two shafts are splined to different fits by the same cutter which has been adjusted radially in accordance with the principles previously noted, the radius of the arc at the root being constant will vary slightly from the designed arc. The actual amount of this variation, however, is infinitesimal and in any case will lie within the limits of size. Similarly, any error of form arising from the use of a single hob for producing the three fits of shaft will be negligible.

For splines which are to be longer than the appropriate gauges, alignment errors can assume serious proportions and maximum permissible errors under these conditions are specified.

The general principle of the system of gauging in this standard for both internal and external splines is the use of Full Form GO gauges in conjunction with NOT GO gauges for individual features. It is recognized that it is possible to produce both internal and external splines without the use of gauges, but that generally such production would be uneconomic where splines are produced on a mass production basis.

The gauges, details of which are given in this standard, are those necessary for the production of the grades of splines covered in the standard.

The gauge tolerance zone has two constituents, the first being that comprised by the limits and tolerances at the disposition of the gauge manufacturer, the second being the allowance for the wear of the gauge (necessary only on the Full Form GO gauges) resulting from its use.

GO gauges for individual features would tend to indicate as acceptable, elements which might later be unacceptable to the Full Form GO gauge. Users are warned, however, that when, for any reason, it is not intended to use Full Form GO gauges then direct measurement is necessary as GO feature gauges will not suffice and may, in fact, be dangerous for the reason mentioned above.

It is possible, when both the splined component and the full Form GO gauge are in the maximum metal condition, that the gauge will not accept the component although the latter may be within the limits of size. Direct measurement should be used in such instances.

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## SECTION 1. SCOPE AND DEFINITIONS

**1.1 SCOPE.** This standard relates to straight parallel sided splines produced in holes or on shafts of nominal size from  $\frac{1}{2}$ -in to 6-in inclusive. Provision is made for 4, 6, 10 and 16 splines of shallow depth, and 6 and 10 splines of deep depth.

Tables of dimensions and tolerances of bottom fitting (top clearance) and top fitting (bottom clearance) splines have been included. The dimensions allow for three grades of fit and apply whether the components are in the heat-treated condition or not. Maximum errors of twist permissible when a spline is considerably longer than the gauges are specified, thus making direct measurement necessary.

Details of gauges necessary for the production of the grades of splines covered are included in this standard. Notes on relationship of spline width to shaft minor diameter are given in Appendix A.

**1.2 DEFINITIONS.** For the purpose of this standard the following definitions apply:

**1.2.1 Straight Sided Spline** — a spline with straight sided (as compared with involute or other curved form) flanks which are parallel with an axial plane through the centre line of diametrically opposite splines.

**1.2.2 Tolerance Zone** — the cross-sectional area bounded by maximum and minimum metal conditions.

**1.2.3 Bottom Fitting (Top Clearance)** — that condition of spline assembly in which the minor diameter of the hub splineway is in bearing contact with the minor diameter of the shaft and there is a positive clearance between the major diameter of the shaft spline and the major diameter of the hub splineway.

**1.2.4 Top Fitting (Bottom Clearance)** — that condition of spline assembly in which the major diameter of the hub splineway is in bearing contact with the major diameter of the shaft and there is a positive clearance between the minor diameter of the shaft and minor diameter of the hub splineway.

**1.2.5 Spacing (Positional) Error** — an angular displacement of a spline or splineway relative to its design position.

**1.2.6 Alignment Error (Twist)** — deviation of the splines from parallelism with the axis of the splined shaft or splined hole.

## SECTION 2. DIMENSIONS AND TOLERANCES

**2.1 BOTTOM FITTING SHALLOW SPLINES.** Dimensions and tolerances of bottom fitting shallow splines shall conform to the dimensions given in the following tables and with Fig. 1:

Table 1 — Hole dimensions (inches)

Table 2 — Shaft dimensions (inches)

**2.2 TOP FITTING SHALLOW SPLINES.** Dimensions and tolerances of top fitting shallow splines shall conform to the dimensions given in the following tables and with Fig. 2:

Table 3 — Hole dimensions (inches)

Table 4 — Shaft dimensions (inches)

**2.3 BOTTOM FITTING DEEP SPLINES.** Dimensions and tolerances of bottom fitting deep splines shall conform to the dimensions given in the following tables and with Fig. 1:

Table 5 — Hole dimensions (inches)

Table 6 — Shaft dimensions (inches)

**2.4 TOP FITTING DEEP SPLINES.** Dimensions and tolerances of top fitting deep splines shall conform to the dimensions given in the following tables and with Fig. 2:

Table 7 — Hole dimensions (inches)

Table 8 — Shaft dimensions (inches)

## SECTION 3. PERMISSIBLE ERRORS

**3.1 ERRORS OF FORM.** The method of presentation of the tolerances in Section 2 shows maximum and minimum limits of size for the various features. There shall be no errors of form, i.e. spacing, roundness, etc., with minimum metal conditions.

**3.2 ALIGNMENT ERRORS IN LONG SPLINES.** Clause 3.1 shall apply generally to alignment errors except that when the length of engagement exceeds the length of the Full Form GO gauges (see Section 4) the alignment error shall be obtained by direct measurement and shall not exceed the appropriate value below:

| <i>Nominal Diameter</i><br>inch units                   |       | <i>Alignment Error</i><br>in/lin. ft |
|---------------------------------------------------------|-------|--------------------------------------|
| From $\frac{1}{2}$ up to and including $1\frac{3}{8}$   | ..... | .004                                 |
| Above $1\frac{3}{8}$ up to and including $2\frac{1}{2}$ | ..... | .006                                 |
| Above $2\frac{1}{2}$ up to and including $4\frac{1}{4}$ | ..... | .008                                 |
| Above $4\frac{1}{4}$ up to and including 6              | ..... | .010                                 |

## SECTION 4. GAUGES

**4.1 GAUGE BLANKS.** Plug, ring and calliper gauges shall conform to AS B129, Recommended Designs for Geometric Limit Gauges, and to the dimensions specified herein.

**4.2 HOLE GAUGES.** Gauge for female splines shall conform to the following tables and figures:

Full Form GO plug gauges —

Bottom fitting splines — Table 9, Figs 3 and 4.

Top fitting splines — Table 10, Figs 3 and 4.

NOT GO plug gauges for major diameter — Table 11, Fig. 5.

NOT GO plug gauges for minor diameter — Table 12, Fig. 6.

NOT GO plug gauges for splineway width — Table 13, Fig. 7.

**4.3 SHAFT GAUGES.** Gauges for male splines shall conform to the following tables and figures:

Full Form GO ring gauge —

Bottom fitting splines — Tables 14 and 16, Figs 8 and 9.

Top fitting splines — Tables 15 and 16, Figs 8 and 9.

NOT GO gap gauges for major and minor diameters —

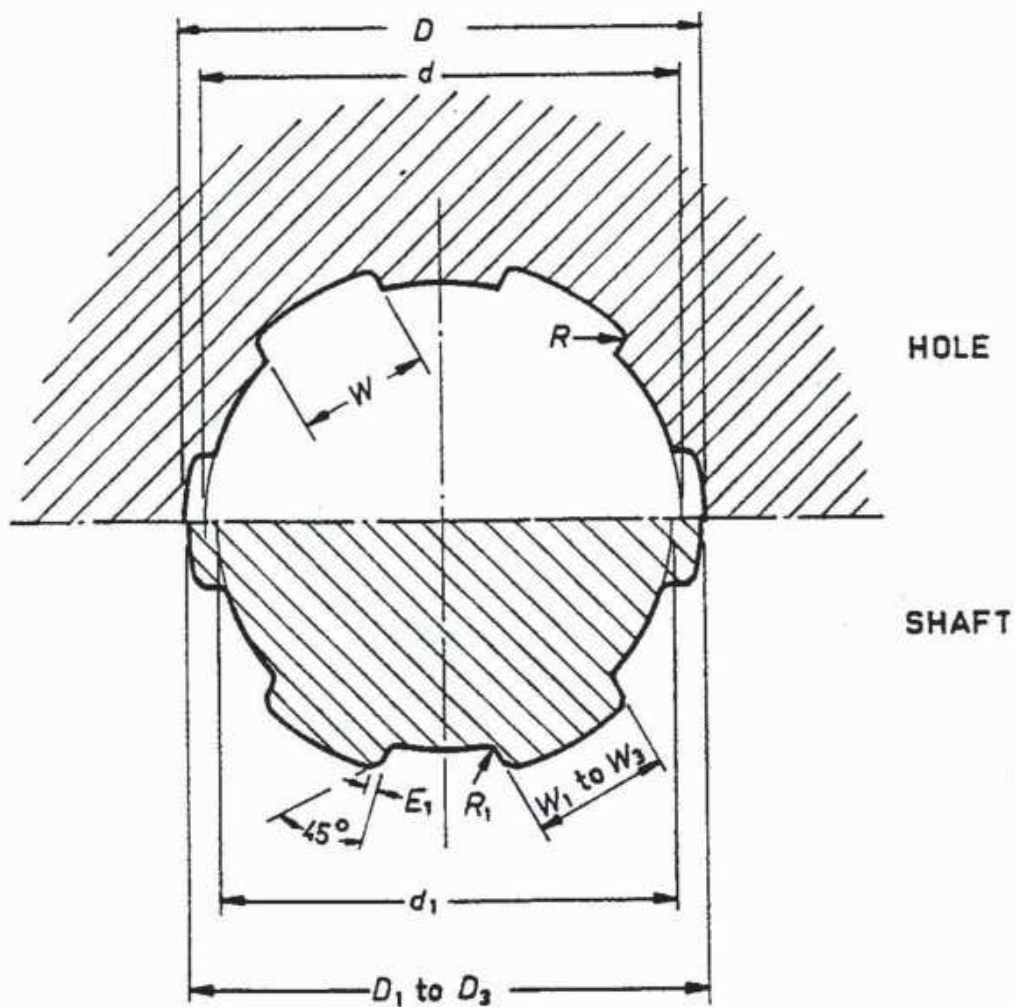
Bottom fitting splines — Table 17, Fig. 10.

Top fitting splines — Table 18, Fig. 10.

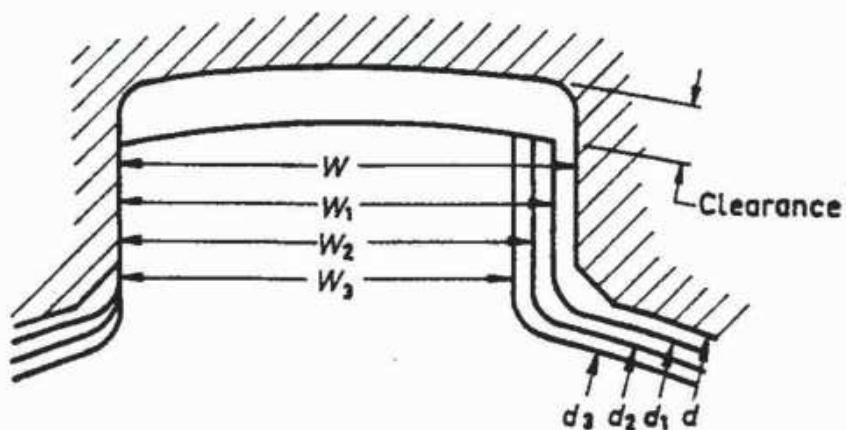
NOT GO gap gauges for spline width — Table 19, Fig. 11.

**4.4 WEAR ALLOWANCES.** An allowance for wear of 50 per cent of the relevant gauge tolerance but not less than 0.0002 in shall be added to the tolerances specified in the tables, disposed as shown in Fig. 12.

NOTE: For the gauges specified herein the GO gauge limit of size lies within the work limit of size. As the spline GO gauges are compound gauges it has been considered necessary to permit the wear allowance to lie outside the limit of size of the work.

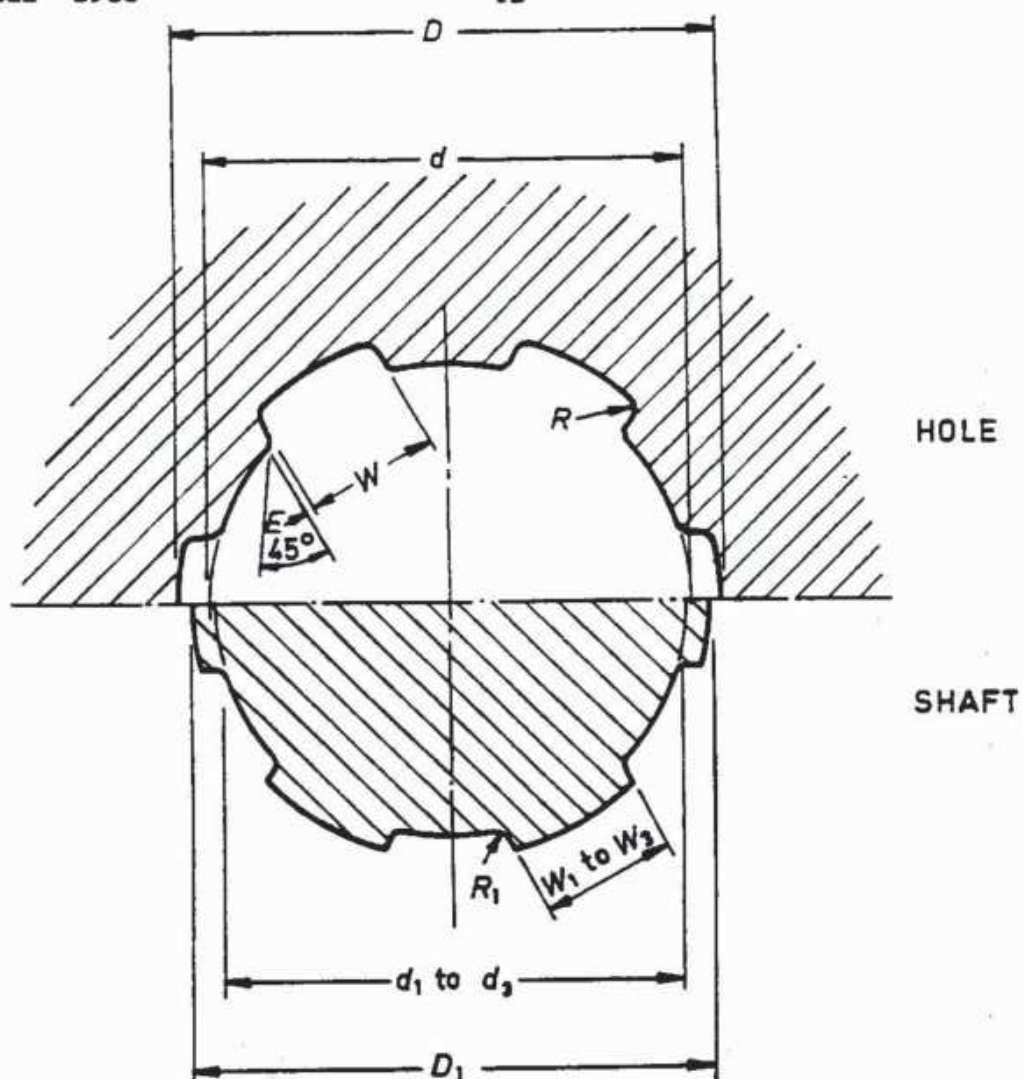


A. Dimensions

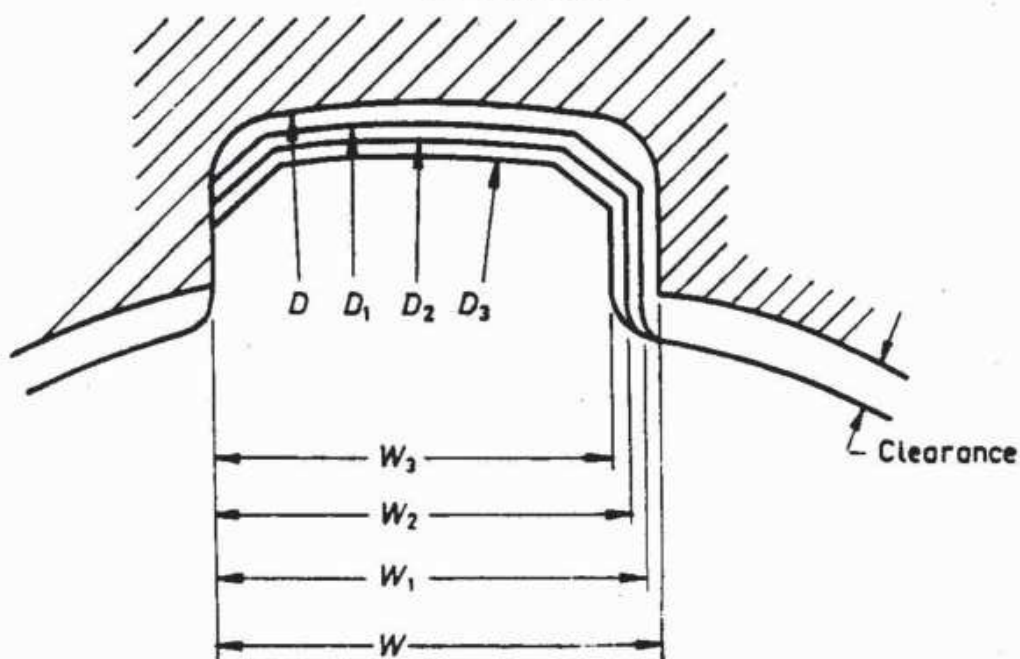


B. Fits

Fig. 1. BOTTOM FITTING SPLINES  
(See Tables 1, 2, 5 and 6)



A. Dimensions



B. Fits

Fig. 2. TOP FITTING SPLINES  
(See Tables 3, 4, 7 and 8)

**TABLE 1**  
**HOLE DIMENSIONS**  
**BOTTOM FITTING SHALLOW SPLINES**

inches

| 1                    | 2     | 3      | 4                 | 5      | 6      | 7      | 8     | 9     |
|----------------------|-------|--------|-------------------|--------|--------|--------|-------|-------|
| Nom-<br>inal<br>Size | D     | d      | W                 |        |        |        | R     | E     |
|                      |       |        | Number of Splines |        |        |        |       |       |
|                      |       |        | 4                 | 6      | 10     | 16     |       |       |
| $\frac{1}{2}$        | 0.520 | 0.4500 | 0.1250            | 0.1250 | -      | -      | 0.010 | 0.007 |
|                      | 0.530 | 0.4510 | 0.1265            | 0.1265 | -      | -      | 0.005 | 0.010 |
| $\frac{3}{8}$        | 0.645 | 0.5630 | 0.1560            | 0.1560 | -      | -      | 0.010 | 0.007 |
|                      | 0.655 | 0.5640 | 0.1575            | 0.1575 | -      | -      | 0.005 | 0.010 |
| $\frac{3}{4}$        | 0.770 | 0.6750 | 0.1870            | 0.1870 | 0.1170 | -      | 0.010 | 0.008 |
|                      | 0.780 | 0.6760 | 0.1885            | 0.1885 | 0.1185 | -      | 0.005 | 0.011 |
| $\frac{7}{8}$        | 0.905 | 0.7880 | 0.2180            | 0.2180 | 0.1360 | -      | 0.015 | 0.009 |
|                      | 0.915 | 0.7890 | 0.2195            | 0.2195 | 0.1375 | -      | 0.010 | 0.012 |
| 1                    | 1.030 | 0.9000 | 0.2490            | 0.2490 | 0.1560 | -      | 0.015 | 0.010 |
|                      | 1.040 | 0.9010 | 0.2510            | 0.2510 | 0.1575 | -      | 0.010 | 0.013 |
| $1\frac{1}{8}$       | 1.155 | 1.0130 | 0.2800            | 0.2800 | 0.1750 | -      | 0.015 | 0.012 |
|                      | 1.165 | 1.0140 | 0.2820            | 0.2820 | 0.1765 | -      | 0.010 | 0.015 |
| $1\frac{1}{4}$       | 1.280 | 1.1250 | 0.3120            | 0.3120 | 0.1950 | -      | 0.015 | 0.013 |
|                      | 1.290 | 1.1260 | 0.3140            | 0.3140 | 0.1965 | -      | 0.010 | 0.017 |
| $1\frac{3}{8}$       | 1.405 | 1.2380 | 0.3430            | 0.3430 | 0.2180 | -      | 0.015 | 0.014 |
|                      | 1.415 | 1.2390 | 0.3450            | 0.3450 | 0.2195 | -      | 0.010 | 0.018 |
| $1\frac{1}{2}$       | 1.560 | 1.3500 | 0.3740            | 0.3740 | 0.2340 | 0.1470 | 0.030 | 0.015 |
|                      | 1.570 | 1.3510 | 0.3765            | 0.3765 | 0.2360 | 0.1485 | 0.015 | 0.019 |
| $1\frac{5}{8}$       | 1.685 | 1.4630 | 0.4050            | 0.4050 | 0.2490 | 0.1560 | 0.030 | 0.017 |
|                      | 1.695 | 1.4645 | 0.4075            | 0.4075 | 0.2510 | 0.1575 | 0.015 | 0.021 |
| $1\frac{3}{4}$       | 1.810 | 1.5750 | 0.4370            | 0.4370 | 0.2730 | 0.1750 | 0.030 | 0.018 |
|                      | 1.820 | 1.5765 | 0.4395            | 0.4395 | 0.2750 | 0.1765 | 0.015 | 0.022 |
| $1\frac{7}{8}$       | 1.935 | 1.6880 | 0.4680            | 0.4680 | 0.2930 | 0.1870 | 0.030 | 0.019 |
|                      | 1.945 | 1.6895 | 0.4705            | 0.4705 | 0.2950 | 0.1885 | 0.015 | 0.023 |
| 2                    | 2.060 | 1.8000 | 0.4980            | 0.4980 | 0.3120 | 0.1950 | 0.030 | 0.021 |
|                      | 2.070 | 1.8015 | 0.5010            | 0.5010 | 0.3140 | 0.1965 | 0.015 | 0.026 |
| $2\frac{1}{4}$       | 2.330 | 2.0250 | 0.5610            | 0.5610 | 0.3510 | 0.2180 | 0.040 | 0.023 |
|                      | 2.340 | 2.0265 | 0.5640            | 0.5640 | 0.3530 | 0.2195 | 0.020 | 0.028 |
| $2\frac{1}{2}$       | 2.580 | 2.2500 | 0.6230            | 0.6230 | 0.3890 | 0.2490 | 0.040 | 0.025 |
|                      | 2.590 | 2.2515 | 0.6260            | 0.6260 | 0.3915 | 0.2510 | 0.020 | 0.030 |
| $2\frac{3}{4}$       | 2.830 | 2.4750 | 0.6860            | 0.6860 | 0.4290 | 0.2730 | 0.040 | 0.028 |
|                      | 2.840 | 2.4765 | 0.6895            | 0.6895 | 0.4315 | 0.2750 | 0.020 | 0.033 |
| 3                    | 3.080 | 2.7000 | 0.7480            | 0.7480 | 0.4680 | 0.2930 | 0.040 | 0.031 |
|                      | 3.090 | 2.7015 | 0.7515            | 0.7515 | 0.4705 | 0.2950 | 0.020 | 0.036 |
| $3\frac{1}{4}$       | 3.330 | 2.9250 | -                 | 0.8110 | 0.5070 | 0.3180 | 0.040 | 0.033 |
|                      | 3.340 | 2.9265 | -                 | 0.8145 | 0.5100 | 0.3200 | 0.020 | 0.038 |
| $3\frac{1}{2}$       | 3.580 | 3.1500 | -                 | 0.8730 | 0.5460 | 0.3430 | 0.040 | 0.036 |
|                      | 3.590 | 3.1515 | -                 | 0.8765 | 0.5490 | 0.3450 | 0.020 | 0.042 |
| $3\frac{3}{4}$       | 3.830 | 3.3750 | -                 | 0.9360 | 0.5850 | 0.3670 | 0.040 | 0.039 |
|                      | 3.840 | 3.3765 | -                 | 0.9400 | 0.5880 | 0.3695 | 0.020 | 0.045 |
| 4                    | 4.080 | 3.6000 | -                 | 0.9980 | 0.6230 | 0.3890 | 0.040 | 0.041 |
|                      | 4.090 | 3.6015 | -                 | 1.0020 | 0.6260 | 0.3915 | 0.020 | 0.047 |
| $4\frac{1}{4}$       | 4.330 | 3.8250 | -                 | 1.0600 | 0.6620 | 0.4160 | 0.040 | 0.043 |
|                      | 4.340 | 3.8270 | -                 | 1.0640 | 0.6655 | 0.4185 | 0.020 | 0.049 |
| $4\frac{1}{2}$       | 4.580 | 4.0500 | -                 | 1.1220 | 0.7010 | 0.4370 | 0.040 | 0.045 |
|                      | 4.590 | 4.0520 | -                 | 1.1260 | 0.7045 | 0.4395 | 0.020 | 0.051 |
| $4\frac{3}{4}$       | 4.830 | 4.2750 | -                 | 1.1850 | 0.7480 | 0.4680 | 0.040 | 0.048 |
|                      | 4.840 | 4.2770 | -                 | 1.1895 | 0.7515 | 0.4705 | 0.020 | 0.054 |
| 5                    | 5.080 | 4.5000 | -                 | 1.2470 | 0.7790 | 0.4890 | 0.040 | 0.051 |
|                      | 5.090 | 4.5020 | -                 | 1.2515 | 0.7825 | 0.4915 | 0.020 | 0.057 |
| $5\frac{1}{4}$       | 5.330 | 4.7250 | -                 | 1.3100 | 0.8110 | 0.5140 | 0.040 | 0.053 |
|                      | 5.340 | 4.7270 | -                 | 1.3145 | 0.8145 | 0.5170 | 0.020 | 0.060 |
| $5\frac{1}{2}$       | 5.580 | 4.9500 | -                 | 1.3720 | 0.8570 | 0.5380 | 0.040 | 0.055 |
|                      | 5.590 | 4.9520 | -                 | 1.3765 | 0.8605 | 0.5410 | 0.020 | 0.062 |
| $5\frac{3}{4}$       | 5.830 | 5.1750 | -                 | 1.4350 | 0.8970 | 0.5610 | 0.040 | 0.059 |
|                      | 5.840 | 5.1770 | -                 | 1.4395 | 0.9010 | 0.5640 | 0.020 | 0.066 |
| 6                    | 6.080 | 5.4000 | -                 | 1.4970 | 0.9360 | 0.5850 | 0.040 | 0.061 |
|                      | 6.090 | 5.4020 | -                 | 1.5015 | 0.9400 | 0.5880 | 0.020 | 0.068 |

**TABLE 2**  
**SHAFT DIMENSIONS**  
**BOTTOM FITTING SHALLOW SPLINES**

|                      | 1      | 2      | 3                 | 4      | 5      | 6      | 7      | 8      | 9      | 10                | 11     | 12    | 13     | 14     | 15     | 16     | 17     | 18    |
|----------------------|--------|--------|-------------------|--------|--------|--------|--------|--------|--------|-------------------|--------|-------|--------|--------|--------|--------|--------|-------|
| Nom-<br>inal<br>Size | $D_1$  | $d_1$  | Fit 1             |        |        |        | $d_2$  | Fit 2  |        |                   |        | $d_3$ | Fit 3  |        |        |        | $R_1$  |       |
|                      |        |        | $W_1$             |        |        |        |        | $W_2$  | $W_3$  | Number of Splines | $k_3$  |       |        |        |        |        |        |       |
|                      |        |        | Number of Splines |        |        |        |        |        |        |                   |        |       |        |        |        |        |        |       |
|                      |        |        | 4                 | 6      | 10     | 16     |        |        |        |                   |        |       |        |        |        |        |        |       |
| $1\frac{1}{2}$       | 0.4990 | 0.4500 | 0.1240            | 0.1240 | -      | -      | 0.4485 | 0.1232 | 0.1232 | -                 | -      | -     | 0.4470 | 0.1224 | 0.1224 | -      | -      | 0.006 |
| $1\frac{3}{4}$       | 0.4970 | 0.4485 | 0.1225            | 0.1225 | -      | -      | 0.4465 | 0.1215 | 0.1215 | -                 | -      | -     | 0.4445 | 0.1205 | 0.1205 | -      | -      | 0.003 |
| $2\frac{1}{8}$       | 0.6240 | 0.5630 | 0.1550            | 0.1550 | -      | -      | 0.5615 | 0.1542 | 0.1542 | -                 | -      | -     | 0.5600 | 0.1534 | 0.1534 | -      | -      | 0.006 |
| $2\frac{3}{8}$       | 0.6210 | 0.5615 | 0.1535            | 0.1535 | -      | -      | 0.5595 | 0.1525 | 0.1525 | -                 | -      | -     | 0.5575 | 0.1515 | 0.1515 | -      | -      | 0.003 |
| $2\frac{5}{8}$       | 0.7490 | 0.6750 | 0.1860            | 0.1860 | 0.1160 | -      | 0.6735 | 0.1852 | 0.1852 | 0.1152            | -      | -     | 0.6720 | 0.1844 | 0.1844 | 0.1144 | -      | 0.007 |
| $2\frac{7}{8}$       | 0.7460 | 0.6735 | 0.1845            | 0.1845 | 0.1145 | -      | 0.6715 | 0.1835 | 0.1835 | 0.1135            | -      | -     | 0.6695 | 0.1825 | 0.1825 | 0.1125 | -      | 0.004 |
| $3\frac{1}{8}$       | 0.8740 | 0.7880 | 0.2170            | 0.2170 | 0.1350 | -      | 0.7865 | 0.2162 | 0.2162 | 0.1342            | -      | -     | 0.7850 | 0.2154 | 0.2154 | 0.1334 | -      | 0.008 |
| $3\frac{3}{8}$       | 0.8710 | 0.7865 | 0.2155            | 0.2155 | 0.1335 | -      | 0.7845 | 0.2145 | 0.2145 | 0.1325            | -      | -     | 0.7825 | 0.2135 | 0.2135 | 0.1315 | -      | 0.005 |
| $3\frac{5}{8}$       | 0.9990 | 0.9000 | 0.2480            | 0.2480 | 0.1550 | -      | 0.8985 | 0.2472 | 0.2472 | 0.1542            | -      | -     | 0.8970 | 0.2464 | 0.2464 | 0.1534 | -      | 0.009 |
| $3\frac{7}{8}$       | 0.9950 | 0.8985 | 0.2460            | 0.2460 | 0.1535 | -      | 0.8965 | 0.2450 | 0.2450 | 0.1525            | -      | -     | 0.8945 | 0.2440 | 0.2440 | 0.1515 | -      | 0.005 |
| $4\frac{1}{8}$       | 1.1240 | 1.0130 | 0.2790            | 0.2790 | 0.1740 | -      | 1.0115 | 0.2782 | 0.2782 | 0.1732            | -      | -     | 1.0100 | 0.2774 | 0.2774 | 0.1724 | -      | 0.011 |
| $4\frac{3}{8}$       | 1.1200 | 1.0115 | 0.2770            | 0.2770 | 0.1725 | -      | 1.0090 | 0.2757 | 0.2757 | 0.1715            | -      | -     | 1.0065 | 0.2744 | 0.2744 | 0.1705 | -      | 0.005 |
| $4\frac{5}{8}$       | 1.2490 | 1.1250 | 0.3110            | 0.3110 | 0.1940 | -      | 1.1235 | 0.3102 | 0.3102 | 0.1932            | -      | -     | 1.1220 | 0.3094 | 0.3094 | 0.1924 | -      | 0.012 |
| $4\frac{7}{8}$       | 1.2450 | 1.1235 | 0.3090            | 0.3090 | 0.1925 | -      | 1.1210 | 0.3077 | 0.3077 | 0.1915            | -      | -     | 1.1185 | 0.3064 | 0.3064 | 0.1905 | -      | 0.005 |
| $5\frac{1}{8}$       | 1.3740 | 1.2380 | 0.3420            | 0.3420 | 0.2170 | -      | 1.2365 | 0.3412 | 0.3412 | 0.2162            | -      | -     | 1.2350 | 0.3404 | 0.3404 | 0.2154 | -      | 0.013 |
| $5\frac{3}{8}$       | 1.3700 | 1.2365 | 0.3400            | 0.3400 | 0.2155 | -      | 1.2340 | 0.3387 | 0.3387 | 0.2145            | -      | -     | 1.2315 | 0.3374 | 0.3374 | 0.2135 | -      | 0.005 |
| $5\frac{5}{8}$       | 1.4990 | 1.3500 | 0.3730            | 0.3730 | 0.2330 | 0.1460 | 1.3485 | 0.3722 | 0.3722 | 0.2322            | 0.1452 | -     | 1.3470 | 0.3714 | 0.3714 | 0.2314 | 0.1444 | 0.014 |
| $5\frac{7}{8}$       | 1.4940 | 1.3485 | 0.3705            | 0.3705 | 0.2310 | 0.1445 | 1.3460 | 0.3692 | 0.3692 | 0.2300            | 0.1435 | -     | 1.3435 | 0.3679 | 0.3679 | 0.2290 | 0.1425 | 0.005 |
| $6\frac{1}{8}$       | 1.6240 | 1.4630 | 0.4035            | 0.4035 | 0.2480 | 0.1550 | 1.4615 | 0.4027 | 0.4027 | 0.2472            | 0.1542 | -     | 1.4600 | 0.4019 | 0.4019 | 0.2464 | 0.1534 | 0.015 |
| $6\frac{3}{8}$       | 1.6190 | 1.4615 | 0.4010            | 0.4010 | 0.2460 | 0.1535 | 1.4585 | 0.3995 | 0.3995 | 0.2450            | 0.1525 | -     | 1.4555 | 0.3980 | 0.3980 | 0.2440 | 0.1515 | 0.005 |
| $6\frac{5}{8}$       | 1.7490 | 1.5750 | 0.4355            | 0.4355 | 0.2720 | 0.1740 | 1.5735 | 0.4347 | 0.4347 | 0.2712            | 0.1732 | -     | 1.5720 | 0.4339 | 0.4339 | 0.2704 | 0.1724 | 0.016 |
| $6\frac{7}{8}$       | 1.7440 | 1.5735 | 0.4330            | 0.4330 | 0.2700 | 0.1725 | 1.5705 | 0.4315 | 0.4315 | 0.2687            | 0.1715 | -     | 1.5675 | 0.4300 | 0.4300 | 0.2674 | 0.1705 | 0.005 |
| $7\frac{1}{8}$       | 1.8740 | 1.6880 | 0.4665            | 0.4665 | 0.2920 | 0.1860 | 1.6865 | 0.4657 | 0.4657 | 0.2912            | 0.1852 | -     | 1.6850 | 0.4649 | 0.4649 | 0.2904 | 0.1844 | 0.017 |
| $7\frac{3}{8}$       | 1.8690 | 1.6865 | 0.4640            | 0.4640 | 0.2900 | 0.1845 | 1.6835 | 0.4625 | 0.4625 | 0.2887            | 0.1835 | -     | 1.6805 | 0.4610 | 0.4610 | 0.2874 | 0.1825 | 0.005 |
| $7\frac{5}{8}$       | 1.9990 | 1.8000 | 0.4965            | 0.4965 | 0.3110 | 0.1940 | 1.7985 | 0.4957 | 0.4957 | 0.3102            | 0.1932 | -     | 1.7970 | 0.4949 | 0.4949 | 0.3094 | 0.1924 | 0.019 |
| $7\frac{7}{8}$       | 1.9940 | 1.7985 | 0.4935            | 0.4935 | 0.3090 | 0.1925 | 1.7955 | 0.4920 | 0.4920 | 0.3077            | 0.1915 | -     | 1.7925 | 0.4905 | 0.4905 | 0.3064 | 0.1905 | 0.005 |
| $8\frac{1}{8}$       | 2.2490 | 2.0250 | 0.5595            | 0.5595 | 0.3500 | 0.2170 | 2.0235 | 0.5587 | 0.5587 | 0.3467            | 0.2162 | -     | 2.0220 | 0.5579 | 0.5579 | 0.3454 | 0.2154 | 0.021 |
| $8\frac{3}{8}$       | 2.2440 | 2.0235 | 0.5565            | 0.5565 | 0.3480 | 0.2155 | 2.0200 | 0.5547 | 0.5547 | 0.3467            | 0.2145 | -     | 2.0165 | 0.5529 | 0.5529 | 0.3454 | 0.2135 | 0.005 |

| 1                           | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     | 17     | 18    |
|-----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 2 <sup>1</sup> <sub>2</sub> | 2.4990 | 2.2500 | 0.6215 | 0.6215 | 0.3880 | 0.2480 | 2.2485 | 0.6207 | 0.6207 | 0.3872 | 0.2472 | 2.2470 | 0.6199 | 0.6199 | 0.3864 | 0.2464 | 0.023 |
| 2 <sup>2</sup> <sub>4</sub> | 2.4940 | 2.2485 | 0.6185 | 0.6185 | 0.3855 | 0.2460 | 2.2450 | 0.6167 | 0.6167 | 0.3842 | 0.2450 | 2.2415 | 0.6149 | 0.6149 | 0.3829 | 0.2440 | 0.005 |
| 2 <sup>3</sup> <sub>4</sub> | 2.7490 | 2.4750 | 0.6845 | 0.6845 | 0.4275 | 0.2720 | 2.4735 | 0.6837 | 0.6837 | 0.4267 | 0.2712 | 2.4720 | 0.6829 | 0.6829 | 0.4259 | 0.2704 | 0.026 |
| 3                           | 2.7440 | 2.4735 | 0.6810 | 0.6810 | 0.4250 | 0.2700 | 2.4700 | 0.6792 | 0.6792 | 0.4235 | 0.2687 | 2.4665 | 0.6774 | 0.6774 | 0.4220 | 0.2674 | 0.005 |
| 3 <sup>1</sup> <sub>4</sub> | 2.9990 | 2.7000 | 0.7465 | 0.7465 | 0.4665 | 0.2920 | 2.6985 | 0.7457 | 0.7457 | 0.4657 | 0.2912 | 2.6970 | 0.7449 | 0.7449 | 0.4649 | 0.2904 | 0.029 |
| 3 <sup>2</sup> <sub>4</sub> | 2.9930 | 2.6985 | 0.7430 | 0.7430 | 0.4640 | 0.2900 | 2.6950 | 0.7412 | 0.7412 | 0.4625 | 0.2887 | 2.6915 | 0.7394 | 0.7394 | 0.4610 | 0.2874 | 0.010 |
| 3 <sup>3</sup> <sub>4</sub> | 3.2490 | 2.9250 | -      | 0.8090 | 0.5055 | 0.3170 | 2.9230 | -      | 0.8080 | 0.5047 | 0.3162 | 2.9210 | -      | 0.8070 | 0.5039 | 0.3154 | 0.031 |
| 3 <sup>4</sup> <sub>4</sub> | 3.2430 | 2.9230 | -      | 0.8055 | 0.5025 | 0.3150 | 2.9190 | -      | 0.8035 | 0.5010 | 0.3137 | 2.9150 | -      | 0.8015 | 0.4995 | 0.3124 | 0.010 |
| 3 <sup>5</sup> <sub>4</sub> | 3.4990 | 3.1500 | -      | 0.8710 | 0.5445 | 0.3420 | 3.1480 | -      | 0.8700 | 0.5437 | 0.3412 | 3.1460 | -      | 0.8690 | 0.5429 | 0.3404 | 0.033 |
| 3 <sup>6</sup> <sub>4</sub> | 3.4930 | 3.1480 | -      | 0.8675 | 0.5415 | 0.3400 | 3.1440 | -      | 0.8655 | 0.5397 | 0.3387 | 3.1400 | -      | 0.8635 | 0.5379 | 0.3374 | 0.010 |
| 3 <sup>7</sup> <sub>4</sub> | 3.7490 | 3.3750 | -      | 0.9340 | 0.5835 | 0.3665 | 3.3730 | -      | 0.9330 | 0.5827 | 0.3652 | 3.3710 | -      | 0.9320 | 0.5819 | 0.3644 | 0.036 |
| 4                           | 3.7420 | 3.3730 | -      | 0.9300 | 0.5805 | 0.3635 | 3.3685 | -      | 0.9277 | 0.5787 | 0.3622 | 3.3640 | -      | 0.9254 | 0.5769 | 0.3609 | 0.010 |
| 4 <sup>1</sup> <sub>4</sub> | 3.9990 | 3.6000 | -      | 0.9960 | 0.6215 | 0.3880 | 3.5980 | -      | 0.9950 | 0.6207 | 0.3872 | 3.5960 | -      | 0.9940 | 0.6199 | 0.3864 | 0.038 |
| 4 <sup>2</sup> <sub>4</sub> | 3.9920 | 3.5980 | -      | 0.9920 | 0.6185 | 0.3855 | 3.5935 | -      | 0.9897 | 0.6167 | 0.3842 | 3.5890 | -      | 0.9874 | 0.6149 | 0.3829 | 0.010 |
| 4 <sup>3</sup> <sub>4</sub> | 4.2490 | 3.8250 | -      | 1.0580 | 0.6605 | 0.4145 | 3.8230 | -      | 1.0570 | 0.6597 | 0.4137 | 3.8210 | -      | 1.0560 | 0.6589 | 0.4129 | 0.040 |
| 4 <sup>4</sup> <sub>4</sub> | 4.2420 | 3.8230 | -      | 1.0540 | 0.6570 | 0.4120 | 3.8185 | -      | 1.0517 | 0.6552 | 0.4105 | 3.8140 | -      | 1.0494 | 0.6534 | 0.4090 | 0.010 |
| 4 <sup>5</sup> <sub>4</sub> | 4.4990 | 4.0500 | -      | 1.1200 | 0.6995 | 0.4355 | 4.0480 | -      | 1.1190 | 0.6987 | 0.4347 | 4.0460 | -      | 1.1180 | 0.6979 | 0.4339 | 0.042 |
| 4 <sup>6</sup> <sub>4</sub> | 4.4910 | 4.0480 | -      | 1.1160 | 0.6960 | 0.4330 | 4.0435 | -      | 1.1137 | 0.6942 | 0.4315 | 4.0390 | -      | 1.1114 | 0.6924 | 0.4300 | 0.010 |
| 4 <sup>7</sup> <sub>4</sub> | 4.7490 | 4.2750 | -      | 1.1825 | 0.7465 | 0.4665 | 4.2730 | -      | 1.1815 | 0.7457 | 0.4657 | 4.2710 | -      | 1.1805 | 0.7449 | 0.4649 | 0.044 |
| 5                           | 4.7410 | 4.2730 | -      | 1.1780 | 0.7430 | 0.4640 | 4.2680 | -      | 1.1755 | 0.7412 | 0.4625 | 4.2630 | -      | 1.1730 | 0.7394 | 0.4610 | 0.010 |
| 5 <sup>1</sup> <sub>4</sub> | 4.9990 | 4.5000 | -      | 1.2445 | 0.7770 | 0.4875 | 4.4980 | -      | 1.2435 | 0.7760 | 0.4867 | 4.4960 | -      | 1.2425 | 0.7750 | 0.4859 | 0.047 |
| 5 <sup>2</sup> <sub>4</sub> | 4.9910 | 4.4980 | -      | 1.2400 | 0.7735 | 0.4850 | 4.4930 | -      | 1.2375 | 0.7715 | 0.4835 | 4.4880 | -      | 1.2350 | 0.7695 | 0.4820 | 0.010 |
| 5 <sup>3</sup> <sub>4</sub> | 5.2490 | 4.7250 | -      | 1.3075 | 0.8090 | 0.5125 | 4.7230 | -      | 1.3065 | 0.8080 | 0.5117 | 4.7210 | -      | 1.3055 | 0.8070 | 0.5109 | 0.049 |
| 5 <sup>4</sup> <sub>4</sub> | 5.2410 | 4.7230 | -      | 1.3030 | 0.8055 | 0.5095 | 4.7180 | -      | 1.3005 | 0.8035 | 0.5077 | 4.7130 | -      | 1.2980 | 0.8015 | 0.5065 | 0.010 |
| 5 <sup>5</sup> <sub>4</sub> | 5.4990 | 4.9500 | -      | 1.3695 | 0.8550 | 0.5365 | 4.9480 | -      | 1.3685 | 0.8540 | 0.5357 | 4.9460 | -      | 1.3675 | 0.8530 | 0.5349 | 0.051 |
| 5 <sup>6</sup> <sub>4</sub> | 5.4900 | 4.9480 | -      | 1.3650 | 0.8515 | 0.5335 | 4.9430 | -      | 1.3625 | 0.8495 | 0.5317 | 4.9380 | -      | 1.3600 | 0.8475 | 0.5299 | 0.010 |
| 5 <sup>7</sup> <sub>4</sub> | 5.7490 | 5.1750 | -      | 1.4325 | 0.8950 | 0.5595 | 5.1730 | -      | 1.4315 | 0.8940 | 0.5587 | 5.1710 | -      | 1.4305 | 0.8930 | 0.5579 | 0.055 |
| 6                           | 5.7400 | 5.1730 | -      | 1.4280 | 0.8910 | 0.5565 | 5.1680 | -      | 1.4255 | 0.8887 | 0.5547 | 5.1630 | -      | 1.4230 | 0.8864 | 0.5529 | 0.015 |
| 6 <sup>1</sup> <sub>4</sub> | 5.9990 | 5.4000 | -      | 1.4945 | 0.9340 | 0.5835 | 5.3980 | -      | 1.4935 | 0.9330 | 0.5827 | 5.3960 | -      | 1.4925 | 0.9320 | 0.5819 | 0.057 |
| 6 <sup>2</sup> <sub>4</sub> | 5.9900 | 5.3980 | -      | 1.4900 | 0.9300 | 0.5805 | 5.3930 | -      | 1.4875 | 0.9277 | 0.5787 | 5.3880 | -      | 1.4850 | 0.9254 | 0.5769 | 0.015 |

**TABLE 3**  
**HOLE DIMENSIONS**  
**TOP FITTING SHALLOW SPLINES**

inches

| 1                    | 2      | 3     | 4                 | 5      | 6      | 7      | 8     |
|----------------------|--------|-------|-------------------|--------|--------|--------|-------|
| Nom-<br>inal<br>Size | D      | d     | W                 |        |        |        | R     |
|                      |        |       | Number of Splines |        |        |        |       |
|                      |        |       | 4                 | 6      | 10     | 16     |       |
| $\frac{1}{2}$        | 0.5000 | 0.450 | 0.1250            | 0.1250 | -      | -      | 0.006 |
|                      | 0.5010 | 0.460 | 0.1265            | 0.1265 | -      | -      | 0.003 |
| $\frac{3}{8}$        | 0.6250 | 0.563 | 0.1560            | 0.1560 | -      | -      | 0.006 |
|                      | 0.6260 | 0.573 | 0.1575            | 0.1575 | -      | -      | 0.003 |
| $\frac{3}{4}$        | 0.7500 | 0.675 | 0.1870            | 0.1870 | 0.1170 | -      | 0.007 |
|                      | 0.7510 | 0.685 | 0.1885            | 0.1885 | 0.1185 | -      | 0.004 |
| $\frac{7}{8}$        | 0.8750 | 0.788 | 0.2180            | 0.2180 | 0.1360 | -      | 0.008 |
|                      | 0.8760 | 0.798 | 0.2195            | 0.2195 | 0.1375 | -      | 0.005 |
| 1                    | 1.0000 | 0.900 | 0.2490            | 0.2490 | 0.1560 | -      | 0.009 |
|                      | 1.0010 | 0.910 | 0.2510            | 0.2510 | 0.1575 | -      | 0.005 |
| $1\frac{1}{8}$       | 1.1250 | 1.013 | 0.2800            | 0.2800 | 0.1750 | -      | 0.011 |
|                      | 1.1260 | 1.023 | 0.2820            | 0.2820 | 0.1765 | -      | 0.005 |
| $1\frac{1}{4}$       | 1.2500 | 1.125 | 0.3120            | 0.3120 | 0.1950 | -      | 0.012 |
|                      | 1.2510 | 1.135 | 0.3140            | 0.3140 | 0.1965 | -      | 0.005 |
| $1\frac{3}{8}$       | 1.3750 | 1.238 | 0.3430            | 0.3430 | 0.2180 | -      | 0.013 |
|                      | 1.3760 | 1.248 | 0.3450            | 0.3450 | 0.2195 | -      | 0.005 |
| $1\frac{1}{2}$       | 1.5000 | 1.350 | 0.3740            | 0.3740 | 0.2340 | 0.1470 | 0.014 |
|                      | 1.5015 | 1.360 | 0.3765            | 0.3765 | 0.2360 | 0.1485 | 0.005 |
| $1\frac{5}{8}$       | 1.6250 | 1.463 | 0.4050            | 0.4050 | 0.2490 | 0.1560 | 0.015 |
|                      | 1.6265 | 1.473 | 0.4075            | 0.4075 | 0.2510 | 0.1575 | 0.005 |
| $1\frac{3}{4}$       | 1.7500 | 1.575 | 0.4370            | 0.4370 | 0.2730 | 0.1750 | 0.016 |
|                      | 1.7515 | 1.585 | 0.4395            | 0.4395 | 0.2750 | 0.1765 | 0.005 |
| $1\frac{7}{8}$       | 1.8750 | 1.688 | 0.4680            | 0.4680 | 0.2930 | 0.1870 | 0.017 |
|                      | 1.8765 | 1.698 | 0.4705            | 0.4705 | 0.2950 | 0.1885 | 0.005 |
| 2                    | 2.0000 | 1.800 | 0.4980            | 0.4980 | 0.3120 | 0.1950 | 0.019 |
|                      | 2.0015 | 1.810 | 0.5010            | 0.5010 | 0.3140 | 0.1965 | 0.005 |
| $2\frac{1}{4}$       | 2.2500 | 2.025 | 0.5610            | 0.5610 | 0.3510 | 0.2180 | 0.021 |
|                      | 2.2515 | 2.035 | 0.5640            | 0.5640 | 0.3530 | 0.2195 | 0.005 |
| $2\frac{1}{2}$       | 2.5000 | 2.250 | 0.6230            | 0.6230 | 0.3890 | 0.2490 | 0.023 |
|                      | 2.5015 | 2.260 | 0.6260            | 0.6260 | 0.3915 | 0.2510 | 0.005 |
| $2\frac{3}{4}$       | 2.7500 | 2.475 | 0.6860            | 0.6860 | 0.4290 | 0.2730 | 0.026 |
|                      | 2.7515 | 2.485 | 0.6895            | 0.6895 | 0.4315 | 0.2750 | 0.005 |
| 3                    | 3.0000 | 2.700 | 0.7480            | 0.7480 | 0.4680 | 0.2930 | 0.029 |
|                      | 3.0015 | 2.710 | 0.7515            | 0.7515 | 0.4705 | 0.2950 | 0.010 |
| $3\frac{1}{4}$       | 3.2500 | 2.925 | -                 | 0.8110 | 0.5070 | 0.3180 | 0.031 |
|                      | 3.2515 | 2.935 | -                 | 0.8145 | 0.5100 | 0.3200 | 0.010 |
| $3\frac{1}{2}$       | 3.5000 | 3.150 | -                 | 0.8730 | 0.5460 | 0.3430 | 0.033 |
|                      | 3.5015 | 3.160 | -                 | 0.8765 | 0.5490 | 0.3450 | 0.010 |
| $3\frac{3}{4}$       | 3.7500 | 3.375 | -                 | 0.9360 | 0.5850 | 0.3670 | 0.036 |
|                      | 3.7520 | 3.385 | -                 | 0.9400 | 0.5880 | 0.3695 | 0.010 |
| 4                    | 4.0000 | 3.600 | -                 | 0.9980 | 0.6230 | 0.3890 | 0.038 |
|                      | 4.0020 | 3.610 | -                 | 1.0020 | 0.6260 | 0.3915 | 0.010 |
| $4\frac{1}{4}$       | 4.2500 | 3.825 | -                 | 1.0600 | 0.6620 | 0.4160 | 0.040 |
|                      | 4.2520 | 3.835 | -                 | 1.0640 | 0.6655 | 0.4185 | 0.010 |
| $4\frac{1}{2}$       | 4.5000 | 4.050 | -                 | 1.1220 | 0.7010 | 0.4370 | 0.042 |
|                      | 4.5020 | 4.060 | -                 | 1.1260 | 0.7045 | 0.4395 | 0.010 |
| $4\frac{3}{4}$       | 4.7500 | 4.275 | -                 | 1.1850 | 0.7480 | 0.4680 | 0.044 |
|                      | 4.7520 | 4.285 | -                 | 1.1895 | 0.7515 | 0.4705 | 0.010 |
| 5                    | 5.0000 | 4.500 | -                 | 1.2470 | 0.7790 | 0.4890 | 0.047 |
|                      | 5.0020 | 4.510 | -                 | 1.2515 | 0.7825 | 0.4915 | 0.010 |
| $5\frac{1}{4}$       | 5.2500 | 4.725 | -                 | 1.3100 | 0.8110 | 0.5140 | 0.049 |
|                      | 5.2520 | 4.735 | -                 | 1.3145 | 0.8145 | 0.5170 | 0.010 |
| $5\frac{1}{2}$       | 5.5000 | 4.950 | -                 | 1.3720 | 0.8570 | 0.5380 | 0.051 |
|                      | 5.5020 | 4.960 | -                 | 1.3765 | 0.8605 | 0.5410 | 0.010 |
| $5\frac{3}{4}$       | 5.7500 | 5.175 | -                 | 1.4350 | 0.8970 | 0.5610 | 0.055 |
|                      | 5.7520 | 5.185 | -                 | 1.4395 | 0.9010 | 0.5640 | 0.015 |
| 6                    | 6.0000 | 5.400 | -                 | 1.4970 | 0.9360 | 0.5850 | 0.057 |
|                      | 6.0020 | 5.410 | -                 | 1.5015 | 0.9400 | 0.5880 | 0.015 |

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