P-6 PROPELLER SHAFTING SYSTEMS

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Based on ABYC's assessment of the existing technology, and the problems associated with achieving the goals of this standard, ABYC recommends compliance with this standard for all boats, associated equipment, and systems manufactured after July 31, 2003.

6.1 PURPOSE

This standard is a guide for the design, construction and materials for propeller shafts and struts, and the installation of shaft bearings, stern bearings, struts, shaft seals, shaft logs, shaft couplings, and propellers.

6.2 *SCOPE*

This standard applies to all boats driven by propeller shafting systems that penetrate the hull.

NOTE: This standard incorporates those dimensional standards of the Society of Automotive Engineers (SAE) that apply to propeller shaft couplings and ends used on propeller shafts that penetrate the hull.

6.3 *REFERENCED ORGANIZATIONS*

ABYC - American Boat & Yacht Council, Inc., 3069 Solomons Island Road, Edgewater, MD 21037-1416. Phone: (410) 956-1050. Fax: (410) 956-2737. Web site: www.abycinc.org.

ASTM International – American Society for Testing and Materials International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Phone: (610) 832-9585. Fax: (610) 832-9585. Web site: www.astm.org.

SAE - Society of Automotive Engineers - 400 Commonwealth Drive, Warrendale, PA 15096-0001. Phone: (724) 776-4841. Fax: (724) 776-5760. Website: www.sae.org.

6.4 DEFINITIONS

For the purposes of this standard, the following definitions apply.

Shaft bearing spacing - The relative distance between the bearings supporting the propeller shaft as measured center to center.

Shaft seal - A device placed around a shaft at the point of entry into the hull to exclude the flow of water into the hull while permitting the shaft to rotate about its own axis. The stuffing box and packing gland constitute one common type of shaft seal.

Yield strength in torsion - For copper base alloys, shall be computed as one-half the minimum tensile yield strength determined at 0.5% offset under load by American Society for Testing Materials International (ASTM International) Designation E8, *Tentative Methods of Tension Testing of Metallic Materials*.

Yield strength in torsion - For nickel and steel alloys, shall be computed as two-thirds the minimum tensile yield strength determined at 0.2% offset by ASTM International Designation E8, *Tentative Methods of Tension Testing of Metallic Materials*.

6.5 *PROPELLER SHAFTS*

6.5.1 Shaft diameter shall be selected with consideration of the type of use for which the boat is intended.

NOTE: The accompanying graphs (i.e., Figures 1, 2, 3 and 4), are computed using a design coefficient of two (2.0), based on minimum torsional yield stress for each material. This design coefficient is recommended for shafts protected by skegs and for boats intended for light pleasure service. For more severe service, such as racing crafts, work boats, and diesel boats, higher design coefficients should be chosen based on experience. For example, commercial boats should consider design coefficients approaching ten, and diesel pleasure boats should consider design coefficients approaching five.

6.5.2 Materials - TABLE I lists some shaft materials with federal specifications and physical properties where available.

6.5.3 Design - The basic formula for shaft diameter is as follows:

$$D = \sqrt[3]{\frac{321{,}000 \times P \times Cd}{St \times N}}$$

where: P = shaft horsepower
Cd = design coefficient (see P-6.5.1)
St = yield strength, torsional shear lb./in.^{2} (see definition and material)
N = shaft speed, RPM
D = shaft diameter, inches

For quick reference, the accompanying graphs (i.e., Figures 1, 2, 3 and 4), help select shaft sizes for the more common shafting materials).

6.5.4 Dimensional Standards and Specifications

6.5.4.1 The dimensions and tolerances for propeller shaft ends, propeller hubs, and shaft couplings shall be in accordance with the latest versions of SAE standard J755, *Marine Propeller Shaft Ends and Hubs*, and J756*, Marine Propeller Shaft Couplings*, except that keyway fillet radii are mandatory for all sizes of shafting, couplings and hubs.

6.5.4.1.1 The top corners of the keyways shall be rounded to a radius half of that used at the bottom of the keyway.

An additional exception to the above SAE standards is the specification on the surface finish which is covered in P-6.5.4 .

6.5.4.2 The permissible variations in straightness of precision straightened cold finish round rod and shafting as determined by the departure from straightness (i.e., throw in one revolution), shall not exceed the indicated values in TABLE II when supported on rollers at 42 in. (1.07 m) intervals, or TABLE III or IV, as appropriate.

6.5.4.3 Straightness tolerance methods consist of placing roller supports at the ends of a bar and measuring the variation from straightness at the quarter points and center point. The permissible variation from straightness, depending on the diameter and length of the bar, can be extracted from TABLE III and IV.

6.5.4.4 Propeller shaft diameter shall not vary, at any point, from the specified dimensions by more than the amounts specified in Table IV.

6.5.4.5 Machined surfaces of the taper and keyways shall have a surface finish of 32 RMS (29 RA) maximum.

6.5.5 Installation

6.5.5.1 Transmission Coupling End - The coupling end of the propeller shaft and/or the coupling shall be sized to a diameter that permits a maximum clearance of .001 in. (.025 mm). See Table IV and SAE Standard J756, *Marine Propeller Shaft Couplings,* Tables 4 and 5.

6.5.5.2 If a non-conductive flexible coupling is used, an alternative means of grounding the shaft must be provided.

6.5.5.3 Bearings, shaft, and couplings shall be aligned to a tolerance of no more than .004 in. (.102 mm) measured between the parallel flange of the coupling with the coupling bolts loose.

6.5.5.3.1 Alignment shall be accomplished with the boat floating.

NOTE: Wood and fiberglass vessels may require some time after launching to reach a point of equilibrium whereby distortion induced by storage stresses have been relieved.

6.5.5.4 The distance between the forward end of the propeller hub and the aft end of the last strut bearing shall be limited to one shaft diameter.

EXCEPTION: When the last bearing is installed aft of the propeller.

6.5.5.5 A propeller installation shall be provided with a positive locking system to prevent accidental loss of the propeller.

NOTE: One acceptable method is illustrated in APPENDIX 1.

6.5.5.6 All components of shafting assembly, including the propeller, shall be galvanically compatible or shall have cathodic protection as specified in ABYC E-2, Cathodic Protection.

6.6 *SHAFT BEARING SPACING*

6.6.1 General - The shaft-bearing spacing formula is based on the formula for critical speed for a shaft having fully flexible bearings at both ends. The most common shaft installation for boats up to about 40 ft. (12.192 m) in length, consisting of a rigid shaft coupling on a rigid mounting engine at the forward end and a strut bearing at the after end, may be considered to have two rigid bearings. This permits increasing shaft-bearing spacing by 50% over the values shown in the accompanying graphs (Figures 5, 6, 7 and 8). If the shaft seal is of the rigid type and is located approximately at the midpoint of the shaft, bearing spacing may be twice the values shown in the graphs.

6.6.2 Design - The formula for computing maximum shaft-bearing space is

$$L = \sqrt{\frac{3.21D}{N}} \times \sqrt[4]{\frac{E}{W1}}$$

for shafts with fully flexible bearings.

where: L = maximum unsupported length, feet
D = shaft diameter, inches
N = shaft speed, RPM
E = modulus of elasticity of shaft material, in tension, lbs./in.^{2}.
W1 = weight of one cubic inch of shaft material, pounds

NOTE: The minimum required spacing for rigid bearings should exceed 20 shaft diameters when possible to facilitate alignment.

6.7 *SHAFT SEALS AND SHAFT LOGS*

6.7.1 Shaft seals shall be readily accessible.

6.7.2 Shaft seals shall be constructed so that, if a failure occurs, no more than two gallons of water per minute can enter the hull with the shaft continuing to operate at low speed.

6.7.3 If a shaft seal utilizing replaceable packing material is installed in the boat, it shall have clearance along the shaft line to permit replacement of the packing without uncoupling the shaft or moving the engine.

NOTE: Face seal and lip seal types are not considered replaceable within the context of this requirement.

6.7.4 Graphite impregnated packing material shall not be used because of the possibility of galvanic incompatibility with the shaft material.

6.8 ***BEARINGS***

6.8.1 Tubular bearings shall be installed in the bearing housing with a light press fit.

NOTE: In order to accommodate the requirement of a light press fit, TABLE V ***may be used as a guide.***

6.8.1.1 A minimum of two radial set screws shall be used.

6.8.1.1.1 The set screw material shall be harder, and galvanically more noble, than the bearing shell.

6.8.1.1.2 Spot drills having the same tip angle as the set screws shall be used to increase the grip of the set screws.

NOTE: Set screws should be located 60° each side of the bottom centerline of the strut or bearing housing (see FIGURE 9 ***). An acceptable alternate location for the set screws is opposite each other no higher than the propeller shaft centerline.***

6.8.2 A means shall be provided to insure the flow of water through the strut bearings.

6.9 ***STRUTS***

NOTE: Struts may be of the "V" or "I" type.

6.9.1 The length of the strut barrel or boss, which is also the length of the bearing, shall be, at minimum, four times the diameter of the propeller shaft.

6.9.2 The thickness of the strut barrel or boss that holds the bearing shall be, at minimum, one-fourth the diameter of the propeller shaft.

6.9.3 The section modulus (Z) required at the hull shall be determined from the following formula:

For "I" struts $Z = \frac{126{,}000(SHP)\ (L)\ (S.F.)}{(RPM)\ (D)\ (SIAllow)}$

For "V" struts $Z = \frac{63{,}000(SHP)\ (L)\ (S.F.)}{(RPM)\ (D)\ (SIAllow)}$

Where: SHP = Shaft horsepower of the installed engine
L = Strut length (see FIGURE 10)
RPM = RPM of the propeller
D = Propeller diameter
SIAllow = Tensile yield strength from TABLE VI , divided by 2.
S.F. = Safety factor chosen to be 1.25 for gas engines and 1.5 for diesel engines.

6.9.4 Dimension "A" in FIGURE 10 shall be selected to produce the required section modulus and dimension "B" to suit the barrel length.

NOTE: A strut cord/thickness ratio of 5:1 is a good starting point in the design process; however, this ratio should not be less than 4.5:1 to avoid excessive drag or greater than 6.7:1 to ensure strength without excessive cord length.

6.9.5 Installation

6.9.5.1 Where bolts are used to secure struts to the hull, the bolt material shall be galvanically compatible with the strut material.

6.9.5.1.1 A means to insure positive locking of the nuts on the strut bolts must be provided to prevent their loosening in service.

NOTE: Lock washers, lock nuts, and double nuts are examples of means for accomplishing this purpose.

6.9.5.2 To distribute the stress into the hull structure, local reinforcement of the hull or doubler plates shall be used.

APPENDIX

TABLE I - EXAMPLES OF SHAFT MATERIALS

Material	Specifications		Yield strength torsion, PSI	Modulus of elasticity, tension, PSI	Weight per cubic in., LB
	ASTM	Federal			
naval brass	B21	QQ-B-637	22,500	15,000,000	.304
nickel-copper	B164	QQ-N-281	40,000	26,000,000	.319
ni-cu-al	-------	QQ-N-286	3/4"-1", 73,333 1-1/8"-3", 66,666	26,000,000	.306
type 304 steel	A276	QQ-S-763	20,000	28,000,000	.29
type 316 steel	A276	QQ-S-763	20,000	28,000,000	.29
type 630 steel*	A276		70,000	28,000,000	.28

*Similar types of martensitic age hardening stainless steel may be used if they meet the above mechanical properties.

NOTES: 1. Propeller Diameter vs. Shaft Diameter - The ratio of propeller diameter to shaft diameter should not exceed 15:1. Higher ratios may create excessive stresses and may shorten shaft life. High performance boats, such as racing boats, should consider a ratio of 12:1.

2. Table I provides yield strength and modulus of elasticity values for the specific materials and specifications listed. Yield strength and modulus of elasticity may vary due to shaft diameter and material make-up. Contact shaft manufacturer for these values.

TABLE II - STRAIGHTNESS TOLERANCES FOR SHAFT SUPPORTED AT 42 INCH INTERVALS

Specified diameter inches (millimeters)	Commercial mill bar shafting and propeller shaft boat shaft standard permissible variation inches (millimeters)
1/2 (12.7) to 15/16 (23.9) incl.	.005 (.127)
Over 15/16 (23.9) to 1-15/16 (49.3) incl.	.006 (.152)
Over 1-15/16 (49.3) to 2-1/2 (63.5) incl.	.007 (.178)
Over 2-1/2 (63.5) to 4 (101.6) incl.	.008 (.203)

NOTE: Taken from Table XI of specification QQ-N-281.

TABLE III - STRAIGHTNESS TOLERANCES

Specified diameter of shafting - over 15/16 inch (23.8 mm) to eight inch (203.2 mm) incl.
Specified lengths of 20 ft. (6.0960 m) and less.
Supports placed at ends of bar.

Specified length of bar - feet (meter)	Commercial Mill Bar Shafting Permissible Variations [throw in one revolution from Straightness - inches (millimeters)]	Propeller Shaft Boat Shaft Permissible Variations [throw in one revolution from Straightness - inches (millimeters)]
up to 3' (.9144) incl.	0.005 (.127)	.0025 (.063)
over 3' (.9144) to 4' (1.2192) incl.	0.0065 (.1651)	.0025 (.063)
over 4' (1.2192) to 5' (1.524) incl.	0.0080 (.2032)	.003 (.075)
over 5' (1.524 to 6' (1.8288) incl.	0.0095 (.2413)	.003 (.075)
over 6' (1.8288) to 7' (2.1136) incl.	0.0110 (.2794)	.003 (.075)
over 7' (2.1136) to 8' (2.4384) incl.	0.0125 (.3175)	.003 (.075)
over 8' (2.4384) to 9' (2.7432) incl.	0.0140 (.3556)	.004 (.101)
over 9' (2.7432) to 10' (3.0480) incl.	0.0155 (.3937)	.005 (.127)
over 10' (3.0480) to 11' (3.3528) incl.	0.0170 (.4318)	.006 (.152)
over 11' (3.3528) to 12' (3.6576) incl.	0.0185 (.4699)	.007 (.178)
over 12' (3.6576) to 13' (3.9624) incl.	0.0200 (.5080)	.008 (.203)
over 13' (3.9624) to 14' (4.2672) incl.	0.0215 (.5461)	.008 (.203)
over 14' (4.2672) to 15' (4.5720) incl.	0.0230 (.5842)	.008 (.203)
over 15' (4.5720) to 16' (4.8768) incl.	0.0245 (.6223)	.008 (.203)
over 16' (4.8768) to 17' (5.1816) incl.	0.0260 (.6604)	.010 (.25)
over 17' (5.1816) to 18' (5.4864) incl.	0.0275 (.6985)	.010 (.25)
over 18' (5.4864) to 19' (5.7912) incl.	0.0290 (.7366)	.010 (.25)
over 19' (5.7912) to 20' (6.0960) incl.	0.0305 (.7747)	.010 (.25)

TABLE IV - DIAMETER TOLERANCES

Diameter Limits Inches (millimeters)	Permissible Variation Inches (millimeters)		
	Plus	Minus	Total
1/2 (12.7) to 15/16 (23.9)	.001 (.025)	.001 (.025)	0.002 (.051)
1 (25.4) to 1-1/2 (38.1) excl.	.002 (.051)	.001 (.025)	0.003 (.076)
1-1/2 (38.1) to 2 (50.8) incl.	.003 (.076)	.001 (.025)	0.004 (.102)
Over 2 (50.8) to 4 (101.6) incl.	.005 (.127)	.001 (.025)	0.006 (.152)
Over 4 to 4 1/2	.009	.001	0.010
Over 4 1/2 to 5 1/2	.011	.005	0.016

TABLE V - STRUT BEARING TOLERANCES

Shaft Diameter	Bearing OD	Bearing Shell Tolerance OD		Bearing Housing and Strut Bore Interface		Bearing to Shaft Clearance	
Inches (millimeters)	Inches (millimeters)	Plus	Minus	Minimum	Maximum	Minimum	Maximum
3/4 (19.05)	1-1/4(31.75)	.001 (.025)	.001 (.025)	.0001 (.0025)	.0007 (.0178)	.003 (.076)	.007 (.178)
1(25.4)	1-1/4 (31.75) - 2 (50.8)	.001 (.025)	.001 (.025)	.0001 (.0025)	.0009 (.0229)	.003 (.076)	.007 (.178)
1-1/4 (31.75)	1-1/2 (38.10) - 2-1/8 (53.98)	.001 (.025)	.001 (.025)	.0001 (.0025)	.0009 (.0229)	.003 (.076	.007 (.178)
1-1/2 (38.10)	2 (50.8) - 2-3/8 (60.33)	.002 (.051)	.001 (.025)	.0001 (.0025)	.0011 (.0279)	.004 (.102)	.009 (.229)
2 (50.8)	2-5/8 (66.68) - 3 (76.2)	.002 (.051)	.001 (.025)	.0001 (.0025)	.0013 (.0330)	.005 (.127)	.010 (.254)
2-1/2 (63.50)	3-1/8 (79.38) - 3-3/8 (85.73)	.002 (.051)	.001 (.025)	.0001 (.0025)	.0014 (.0356)	.005 (.127)	.011 (.279)
3 (76.20)	3-3/4 (95.25) - 4 (101.6)	.002 (.051)	.001 (.025)	.0001 (.0025)	.0017 (.0432)	.007 (.178)	.014 (.356)
4 (101.6)	5 (127.) - 5-1/4 (133.35)	.002 (.051)	.001 (.025)	.0001 (.0025)	.0020 (.0508)	.008 (.203)	.015 (.381)

NOTES: 1. Replacement bearings may have to be selected in order to maintain a bearing housing or strut bore interference fit.

2. It is essential that bearing to shaft clearance be as indicated in Table V. The installer should achieve this clearance by selection of shaft bearings or machining of shaft bearings as necessary.

TABLE VI - TENSILE YIELD STRENGTHS

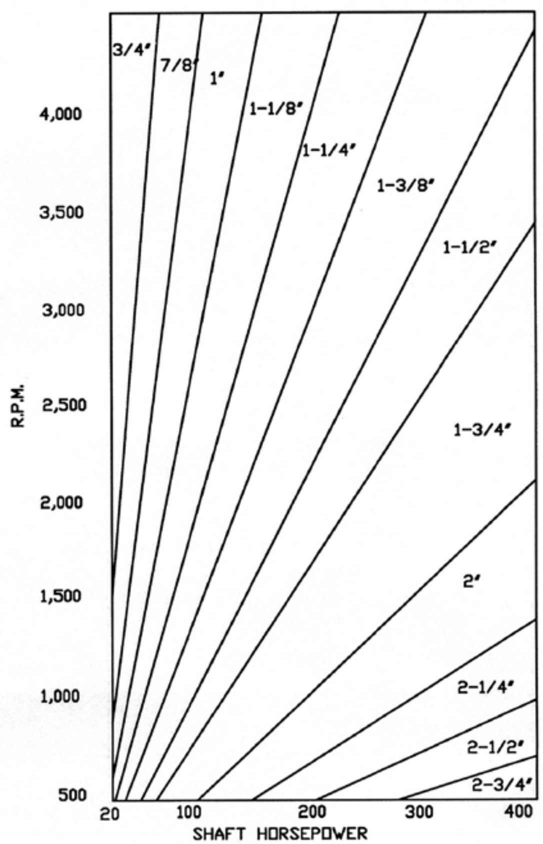
COMMERCIAL BRONZE	37,000 PSI
NAVAL BRASS	57,000 PSI
MANGANESE BRONZE: SAE NO. C86500 SAE NO. C86200 (GrA) SAE NO. C86300 (GrB)	 25,000 PSI 45,000 PSI 67,000 PSI
SILICON BRONZE	55,000 PSI
STAINLESS (304)	30,000 PSI
STAINLESS (CF8M)	42,000 PSI

FIGURE 1

HORESPOWER-SHAFT DIAMETERS NAVAL BRASS

DESIGN COEFFICIENT MAY BE INCREASED BY MULTIPLYING THE SIZES THIS TABLE BY THE FOLLOWING FACTORS AND CHOOSING THE NEXT LARGEST STOCK SIZE AVOVE THE ANSWER OBTAINED.

FOR DESIGN COEFFICIENT =3 MULTIPLY BY 1.14
FOR DESIGN COEFFICIENT =4 MULTIPLY BY 1.26
FOR DESIGN COEFFICIENT =5 MULTIPLY BY 1.36



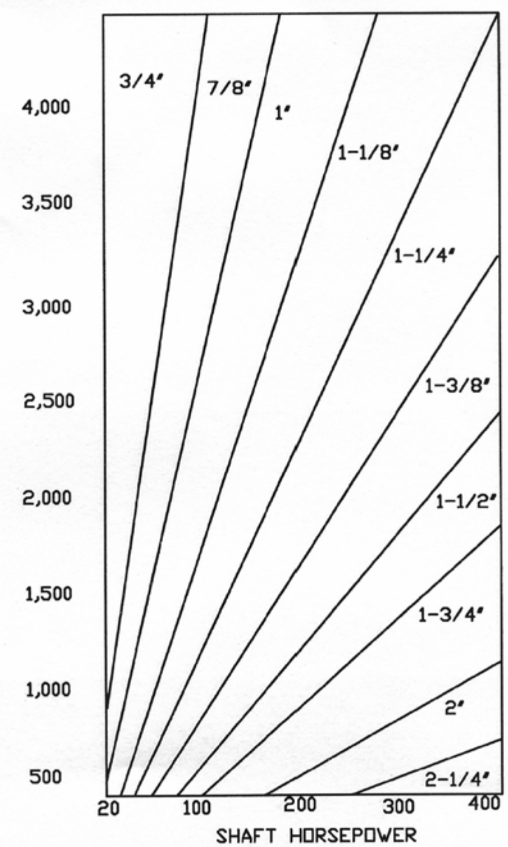
SPECIFICATION_______QQ-B-637
TORSIONAL STRESS____11,250 p.s.i.
DESIGN COEFFICIENT___2.0

FIGURE 2

HORSEPOWER-SHAFT DIAMETERS FOR NICKEL-COPPER

DESIGN COEFFICIENT MAY BE INCREASED BY MULTIPLYING THE SIZES IN THIS TABLE BY THE FOLLOWING FACTORS AND CHOOSING THE NEXT LARGEST STOCK SIZE ABOVE THE ANSWER OBTAINED.

FOR DESIGN COEFFICIENT= 3 MULTIPLY BY 1.14
FOR DESIGN COEFFICIENT= 4 MULTIPLY BY 1.26
FOR DESIGN COEFFICIENT= 5 MULTIPLY BY 1.36



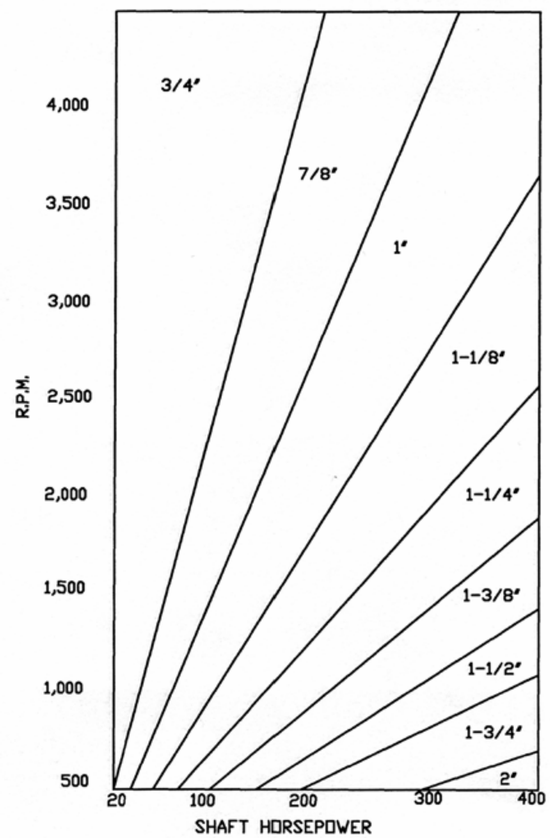
SPECIFICATION_________QQ-N-281
TORSIONAL STRESS_____20,000 p.s.i.
DESIGN COEFFICIENT____2.0

FIGURE 3

HORESPOWER-SHAFT DIAMETERS FOR TYPE 630 STEEL

DESIGN COEFFICIENT MAY BE INCREASED BY MULTIPLYING THE SIZE: THIS TABLE BY THE FOLLOWING FACTORS AND CHOOSING THE NEXT LARGEST STOCK SIZE AVOVE THE ANSWER OBTAINED.

FOR DESIGN COEFFICIENT =3 MULTIPLY BY 1.14
FOR DESIGN COEFFICIENT =4 MULTIPLY BY 1.26
FOR DESIGN COEFFICIENT =5 MULTIPLY BY 1.36



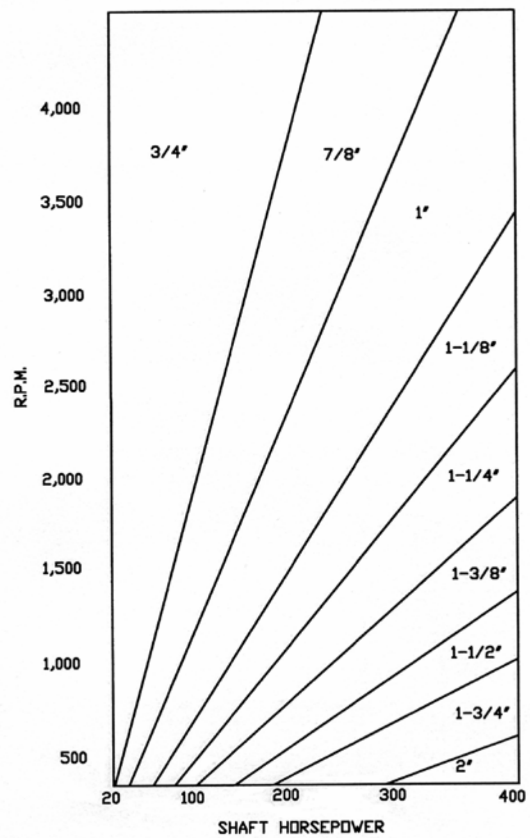
ASTM________________564-66
TORSIONAL STRESS____35,000 p.s.i.
DESIGN COEFFICIENT___2.0

FIGURE 4

HORESPOWER-SHAFT DIAMETERS NICKEL COPPER-ALUMINUM

DESIGN COEFFICIENT MAY BE INCREASED BY MULTIPLYING THE SIZES IN THIS TABLE BY THE FOLLOWING FACTORS AND CHOOSING THE NEXT LARGEST STOCK SIZE AVOVE THE ANSWER OBTAINED.

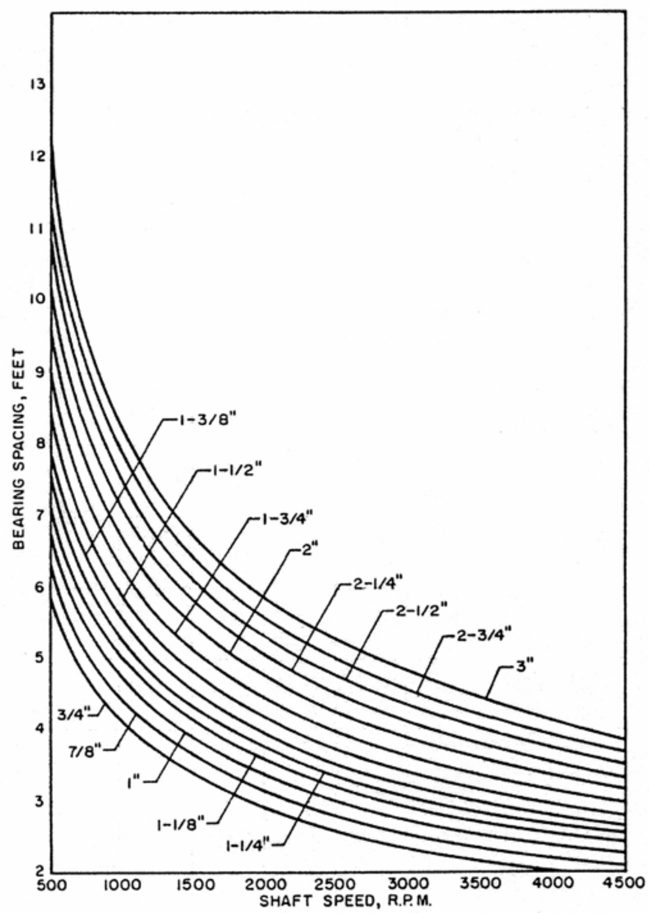
FOR DESIGN COEFFICIENT =3 MULTIPLY BY 1.14
FOR DESIGN COEFFICIENT =4 MULTIPLY BY 1.26
FOR DESIGN COEFFICIENT =5 MULTIPLY BY 1.36



SPECIFICATION________QQ-N-286
TORSIONAL STRESS____36,666 p.s.i.
(FOR 3/4"-1")
33,333 p.s.i.
(FOR 1-1/8"-3")
DESIGN COEFFICIENT___2.0

FIGURE 5

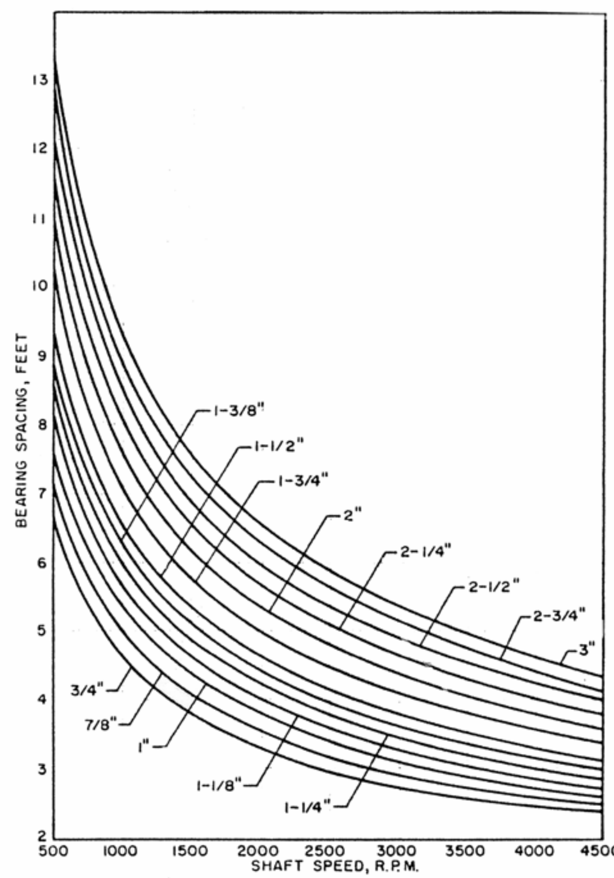
MAXIMUM BEARING SPACING FOR
NAVAL BRASS PROPELLER SHAFTS WITH
FLEXIBLE BEARING MOUNTINGS



SPECIFICATION QQ-B-637
THESE VALUES ARE CONSERVATIVE, BEING COMPUTED FOR FULLY FLEXIBLE BEARINGS. WHERE A RIGID BEARING IS INSTALLED AT EACH END, THESE VALUES MAY BE INCREASED BY 50 PER CENT.

FIGURE 6

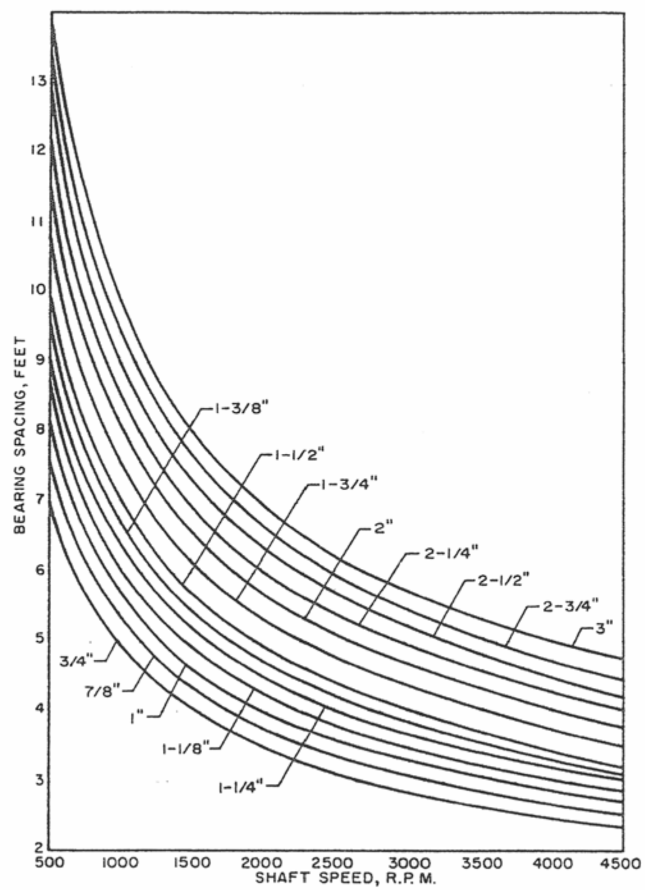
MAXIMUM BEARING SPACING FOR
NICKEL – COPPER PROPELLER SHAFTS WITH
FLEXIBLE BEARING MOUNTINGS



SPECIFICATION QQ-N-281
THESE VALUES ARE CONSERVATIVE, BEING COMPUTED FOR FULLY FLEXIBLE BEARINGS. WHERE A RIGID BEARING IS INSTALLED AT EACH END, THESE VALUES MAY BE INCREASED BY 50 PER CENT.

FIGURE 7

MAXIMUM BEARING SPACING FOR
TYPE 630 STEEL PROPELLER SHAFTS WITH
FLEXIBLE BEARING MOUNTINGS

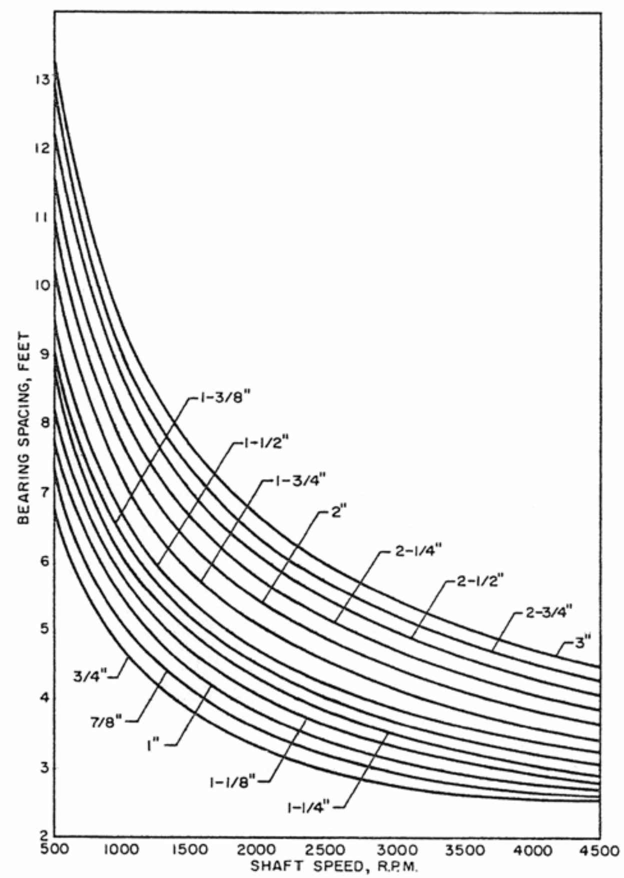


SPECIFICATION 564-66

THESE VALUES ARE CONSERVATIVE, BEING COMPUTED FOR FULLY FLEXIBLE BEARINGS. WHERE A RIGID BEARING IS INSTALLED AT EACH END, THESE VALUES MAY BE INCREASED BY 50 PER CENT.

FIGURE 8

MAXIMUM BEARING SPACING FOR
NICKEL – COPPER – ALUMINUM PROPELLER SHAFTS
FLEXIBLE BEARING MOUNTINGS



SPECIFICATION QQ-N-286

THESE VALUES ARE CONSERVATIVE, BEING COMPUTED FOR FULLY FLEXIBLE BEARINGS. WHERE A RIGID BEARING IS INSTALLED AT EACH END, THESE VALUES MAY BE INCREASED BY 50 PER CENT.

FIGURE 9

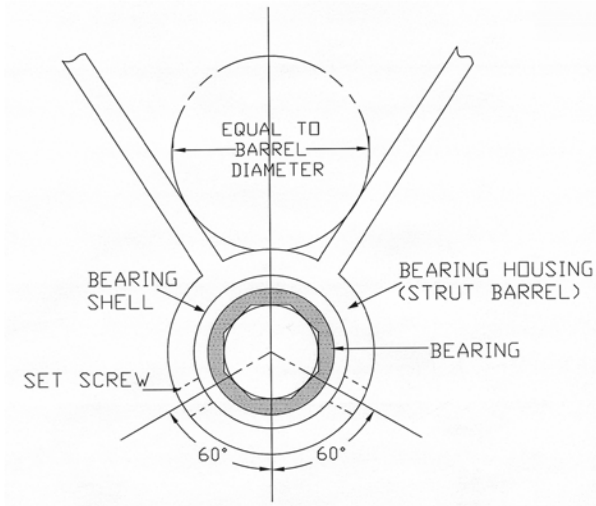
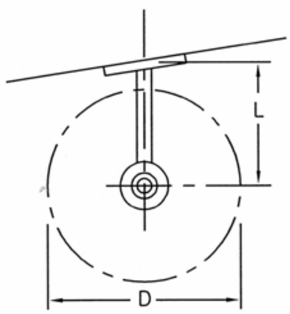


FIGURE 10



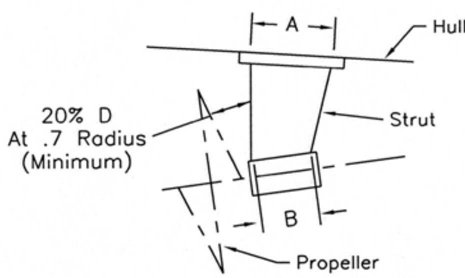
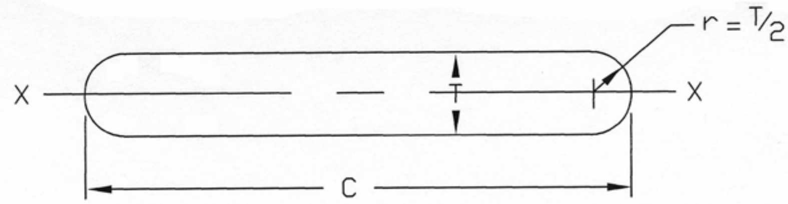


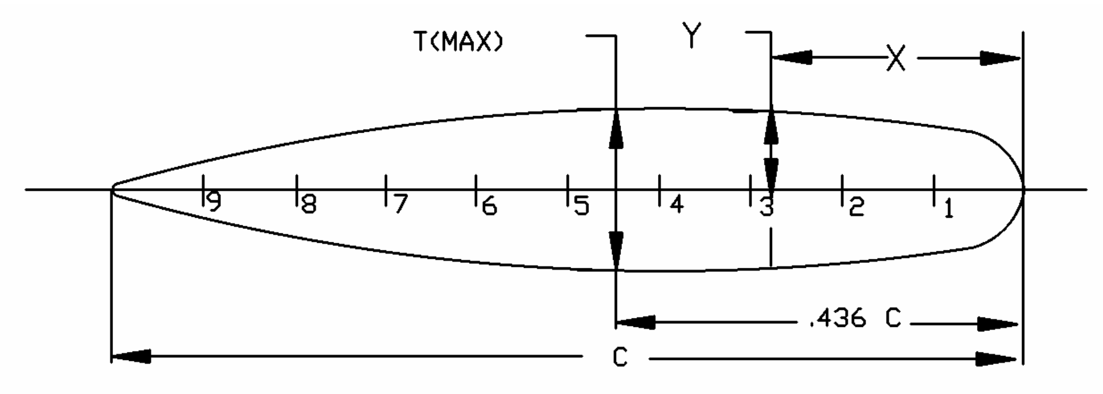
FIGURE 11 - RECTANGULAR STRUT SECTION



Recommended for speeds less than 20 knots

$C/T = 4.5$	$C/T = 6.7$
$A = 0.9526\ CT$	$A = 0.9680\ CT$
$I_x = 0.07697\ CT^3$	$I_x = 0.07821\ CT^3$
$Z_x = 0.1591\ CT^2$	$Z_x = 0.1616\ CT^2$

FIGURE 12 - EPH COMPOSITE STRUT SECTION



X/C	Y/TMAX	X/C	Y/TMAX	X/C	Y/TMAX
0.010	0.1064	0.350	0.4902	0.750	0.3705
0.025	0.1669	0.400	0.4983	0.800	0.3260
0.050	0.2325	0.450	0.4997	0.850	0.2749
0.100	0.3186	0.500	0.4946	0.900	0.2170
0.150	0.3774	0.550	0.4830	0.950	0.1480
0.200	0.4204	0.600	0.4647	0.975	0.1027
0.250	0.4522	0.650	0.4399	0.990	0.0642
0.300	0.4750	0.700	0.4085	1.000	0.0000

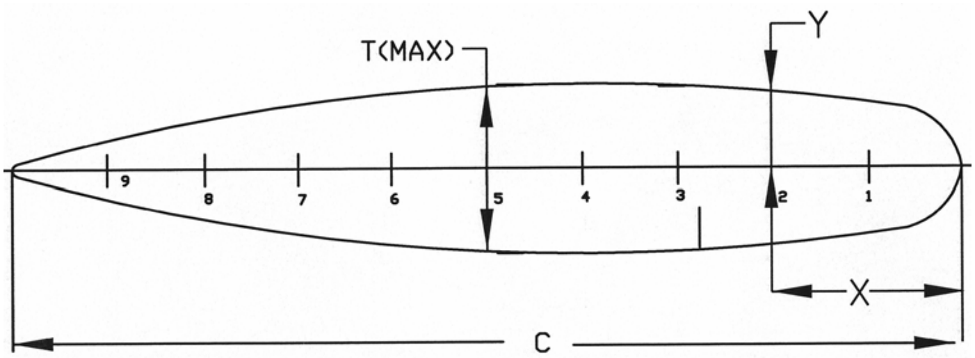
RECOMMENDED FOR SPEEDS LESS THAN 30 KNOTS

$A = 0.747CT$

$I_X = 0.0449CT^3$

$Z_X = 0.0898CT^2$

FIGURE 13 - NACA SERIES 16 STRUT SECTION



X/C	Y/TMAX	X/C	Y/TMAX	X/C	Y/TMAX
0.0125	0.10765	0.1500	0.3446`	0.6000	0.48625
0.0250	0.1500	0.2000	0.38865	0.7000	0.4391
0.0500	0.2091	0.3000	0.4514	0.8000	0.3499
0.0750	0.25265	0.4000	0.4879	0.9000	0.20975
0.1000	0.2881	0.5000	0.5000	0.9500	0.1179
		0.6000	0.48625	1.0000	0.0100

L.E. RADIUS - 0.011C

$A = 0.738CT$

$I_X = 0.0445CT^3$

$Z_X = 0.0891CT^2$

P-6 ***APPENDIX 1 - MATERIALS, SIZE AND INSTALLATION OF PROPELLER SHAFTING SYSTEMS***

P-6.Ap.6.1 If the propeller shaft does not have sufficient flexibility to prevent overstressing the bearings at the marine transmission, a flexible coupling or a floating section of shafting shall be installed with engines equipped with flexible mounting systems.

P-6.Ap.6.2 If a double nut and key system is used, it should consist of the following components;

a. a straight key,
b. jam nut (thin - identified as “W” in Figure 1 of SAE J755, *Marine Propeller - Shaft Ends and Hubs*),
c. plain nut (thick - identified as “T” in Figure 1 of SAE J755, *Marine Propeller - Shaft ends and Hubs*), and
d. cotter pin.

P-6.Ap.6.2.1 The length of the key should not exceed the dimension "x" minus one-quarter inch (6.35 mm) in SAE standard J755, *Marine Propeller - Shaft Ends and Hubs.*

P-6.Ap.6.2.2 Install the propeller on the shaft taper first without a key, and mark its position with a non-graphite marker.

P-6.Ap.6.2.3 Then remove the propeller. The key should be placed in the keyway and the propeller installed so its position is at the mark. Precaution should be taken to prevent the propeller from riding the key up the keyway end radius, forcing the propeller off-center.

P-6.Ap.6.2.4 Install the first nut, and torque to seat the propeller. Then install and torque the second nut.

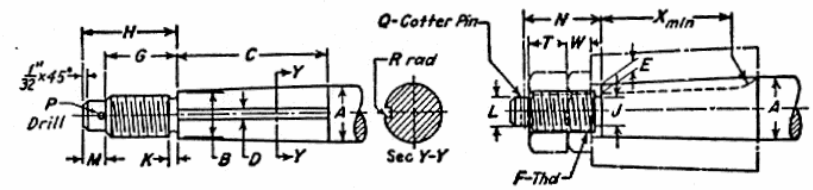
P-6.Ap.6.2.5 Install the cotter pin. This pin will prevent the loss of the nuts if they should come loose in service.

P-6.Ap.6.2.6 Other positive locking systems may be used if they protect against accidental loss of the propeller.

APPENDIX TO P–6 *(PROPELLER SHAFTING)*

Those portions of SAE J 755 and SAE J 756 that normally apply to recreational boat design and construction have been reproduced herein as a convenience. The complete standards may be obtained from SAE. The Society of Automotive Engineers, Inc. has granted permission for the inclusion of this material.

MARINE PROPELLER–SHAFT ENDS AND HUBS - SAE J755 SAE Standard



TAPER = 3/4 IN. ON DIAMETER PER FT = 1/16 IN. PER IN. = 3 DEG 34 MIN 47 SEC TOTAL INCLUDED ANGLE

FIG. 1—PROPELLER-SHAFT ENDS

***Tolerances for SAE Marine Tapers*—Surface Finish**—The machined surfaces of propeller hubs and shafting shall be equal to that defined by American Standard B46 as Roughness Symbol 60, which denotes that the root mean square average height of surface irregularities shall not exceed 60 Mu in. (microinches).

Basic Dimensions—Taper per foot measured on the diameter and diameter of small end of taper shall be basic dimensions.

Taper Tolerances for Hub Bores

Sizes 3/4 to 1 1/4 in. inclusive, 0.7500 (+0.0000, −0.0020) in. taper per ft.
Sizes 1 3/8 to 2 in. inclusive, 0.7500 (+0.0000, −0.0019) in. taper per ft.
Sizes 2 1/4 to 3 in. inclusive, 0.7500 (+0.0000, −0.0015) in. taper per ft.

Taper Tolerances for Shafts

Sizes 3/4 to 1 1/4 in. inclusive, 0.7500 (+0.0020, −0.0000) in. taper per ft.
Sizes 1 3/8 to 2 in. inclusive, 0.7500 (+0.0019, −0.0000) in. taper per ft.
Sizes 2 1/4 to 3 in. inclusive, 0.7500 (+0.0015, −0.0000) in. taper per ft.
Sizes 3 1/4 to 5 1/2 in. inclusive, 0.7500 (+0.0013, −0.0000) in. taper per ft.
Sizes 6 to 8 in. inclusive, 1.0000 (+0.0013, −0.0000) in. taper per ft.

***Basic Data* — Keyways** — The keyway shall be cut parallel to taper At the small end of the hub length and shaft taper length, the keyway shall have the specified side depth. The keyway side depth shall be measured normal to the axis of the taper, not normal to the surface of the taper.

Keys—Keys for use in filleted keyways must be chamfered so that the corners of the key do not touch the keyway fillets.

Small-End Diameter of Taper for Hubs—For nominal bore diameters 3 1/4 to 4 in. inclusive, the small end of the taper shall be 0.8125 times the nominal bore diameter.

Small-End Diameter of Taper for Shafts—For nominal shaft diameters 3/4 to 2 1/2 in. inclusive, the small end of the taper shall be 0.8125 times the nominal shaft diameter plus 0.01562 in.

For nominal shaft diameters 2 3/4 to 4 in. inclusive, the small end of the taper shall be 0.8125 times the nominal shaft diameter plus 0.02344 in.

Intermediate-Size Tapers—The required small-end taper diameter of hub bore and shaft end for intermediate diameters not covered by this Standard shall be calculated from data given above using the next smaller standard taper data.

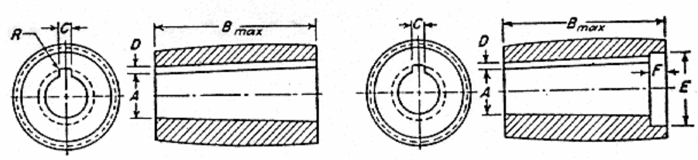
The keyway for intermediate-size hub bore and shaft end shall be that specified for the next smallest standard bore and shaft.

TABLE 1 – DIMENSIONS FOR SHAFTS 3/4 TO 3 INCHES (19.05 TO 76.20mm) IN DIAMETER

Nominal Shaft Diameter Inches (Millimeters) A	Diameter Small End Inches (Millimeters) B Minimum	Maximum	Taper Length Inches (Millimeters) C	Keyway Width Inches (Millimeters) D Nominal	Minimum	Maximum	Keyway Side Depth[a] Inches (Millimeters) E Nominal	Minimum	Maximum	Keyway Fillet Radius[b] Inches (Millimeters) R	Thread[c] Inches (Millimeters) F Diameter	Thread per in. (25.4mm)	End of Taper to End of Thread Inches (Millimeters) G	Extension Beyond Taper Inches (Millimeters) H
3/4 (19.05)	0.624 (15.85)	0.626 (15.90)	2 (50.80)	3/16 (4.76)	0.1865 (4.74)	0.1875 (4.76)	3/32 (2.38)	0.095 (2.41)	0.097 (2.46)	1/32 (0.80)	1/2 (12.70)	13	1 1/16 (26.99)	1 5/16 (33.34)
7/8 (22.23)	0.726 (18.44)	0.728 (18.49)	2 3/8 (60.33)	1/4 (6.35)	0.249 (6.32)	0.250 (6.35)	1/8 (3.18)	0.125 (3.18)	0.127 (3.23)	1/32 (0.80)	5/8 (15.88)	11	1 1/4 (31.75)	1 1/2 (38.10)
1 (25.40)	0.827 (21.01)	0.829 (21.06)	2 3/4 (69.85)	1/4 (6.35)	0.249 (6.32)	0.250 (6.35)	1/8 (3.18)	0.125 (3.18)	0.127 (3.23)	1/32 (0.80)	3/4 (19.05)	10	1 7/16 (36.51)	1 3/4 (44.45)
1 1/8 (28.58)	0.929 (23.60)	0.931 (23.65)	3 1/8 (79.38)	1/4 (6.35)	0.249 (6.32)	0.250 (6.35)	1/8 (3.18)	0.125 (3.18)	0.127 (3.23)	1/32 (0.80)	3/4 (19.05)	10	1 7/16 (36.51)	1 3/4 (44.45)
1 1/4 (31.75)	1.030 (26.16)	1.032 (26.21)	3 1/2 (88.90)	5/16 (7.94)	0.3115 (7.91)	0.3125 (7.94)	5/32 (3.97)	0.157 (3.99)	0.160 (4.06)	1/16 (1.59)	7/8 (22.23)	9	1 5/8 (41.28)	2 (50.80)
1 3/8 (34.93)	1.132 (28.75)	1.134 (28.80)	3 7/8 (98.43)	5/16 (7.94)	0.3115 (7.91)	0.3125 (7.94)	5/32 (3.97)	0.157 (3.99)	0.160 (4.06)	1/16 (1.59)	1 (25.40)	8	1 13/16 (46.04)	2 1/4 (57.15)
1 1/2 (38.10)	1.233 (31.32)	1.235 (31.37)	4 1/4 (107.95)	3/8 (9.53)	0.374 (9.50)	0.375 (9.53)	3/16 (4.76)	0.189 (4.80)	0.192 (4.88)	1/16 (1.59)	1 1/8 (28.58)	7	2 (50.80)	2 7/16 (61.91)
1 3/4 (44.45)	1.437 (36.50)	1.439 (36.55)	5 (127.0)	7/16 (11.11)	0.4365 (11.09)	0.4375 (11.11)	7/32 (5.56)	0.219 (5.56)	0.222 (5.64)	1/16 (1.59)	1 1/4 (31.75)	7	2 1/4 (57.15)	2 3/4 (69.85)
2 (50.80)	1.640 (41.66)	1.642 (41.71)	5 3/4 (146.05)	1/2 (12.70)	0.499 (12.67)	0.500 (12.70)	1/4 (6.35)	0.251 (6.38)	0.254 (6.45)	1/16 (1.59)	1 1/2 (38.10)	6	2 5/8 (66.68)	3 1/8 (79.38)
2 1/4 (57.15)	1.843 (46.81)	1.845 (46.86)	6 1/2 (165.1)	9/16 (14.29)	0.561 (14.25)	0.5625 (14.29)	9/32 (7.14)	0.281 (7.14)	0.284 (7.21)	3/32 (2.38)	1 3/4 (44.45)	5	3 (76.20)	3 1/2 (88.90)
2 1/2 (63.50)	2.046 (51.97)	2.048 (52.02)	7 1/4 (184.15)	5/8 (15.88)	0.6235 (15.84)	0.625 (15.88)	5/16 (7.94)	0.315 (8.00)	0.312 (7.92)	3/32 (2.38)	1 3/4 (44.45)	5	3 (76.20)	3 1/2 (38.90)
2 3/4 (69.85)	2.257 (57.33)	2.259 (57.38)	7 7/8 (200.03)	5/8 (15.88)	0.6235 (15.84)	0.625 (15.88)	5/16 (7.94)	0.313 (7.95)	0.316 (8.03)	3/32 (2.38)	2 (50.80)	4 1/2	3 1/2 (88.90)	4 (101.60)
3 (76.20)	2.460 (62.48)	2.462 (62.53)	8 5/8 (219.08)	3/4 (19.05)	0.7485 (19.01)	0.750 (19.05)	5/16 (7.94)	0.311 (7.90)	0.314 (7.98)	3/32 (2.38)	2 1/4 (57.15)	4 1/2	3 7/8 (98.43)	4 3/8 (111.13)

Nominal Shaft Dia. A	Undercut J	K	Diameter of Pin End L	Length of Pin End M	Cotter Pin Hole N	P (Drill)	Cotter Pin, Q Nominal Dia.	Length	Size	Nuts[d] Plain Thickness T	Jam Thickness W	Keyway Length X
3/4 (19.05)	25/64 (9.92)	1/8 (3.18)	3/8 (9.53)	1/4 (6.35)	1 9/64 (28.97)	9/64 (3.57)	1/8 (3.18)	3/4 (19.05)	1/2 – 13 (12.7 – 330.2)	1/2 (12.70)	5/16 (7.94)	1 1/2 (38.10)
7/8 (22.23)	31/64 (12.30)	1/8 (3.18)	7/16 (11.11)	1/4 (6.35)	1 21/64 (33.73)	9/64 (3.57)	1/8 (3.18)	3/4 (19.05)	5/8 – 11 (15.88 – 279.4)	5/8 (15.88)	3/8 (9.53)	1 25/32 (45.24)
1 (25.40)	19/32 (15.08)	1/8 (3.18)	1/2 (12.70)	5/16 (7.94)	1 33/64 (38.50)	9/64 (3.57)	1/8 (3.18)	1 (25.40)	3/4 – 10 (19.05 – 254.0)	3/4 (19.05)	7/16 (11.11)	2 1/8 (53.98)
1 1/8 (28.58)	19/32 (15.08)	1/8 (3.18)	1/2 (12.70)	5/16 (7.94)	1 33/64 (38.50)	9/64 (3.57)	1/8 (3.18)	1 (25.40)	3/4 – 10 (19.05 – 254.0)	3/4 (19.05)	7/16 (11.11)	2 1/8 (53.98)
1 1/4 (31.75)	23/32 (18.26)	1/8 (3.18)	5/8 (15.88)	3/8 (9.53)	1 23/32 (43.66)	11/64 (4.37)	5/32 (3.97)	1 1/4 (31.75)	7/8 – 9 (22.23 – 228.6)	7/8 (22.23)	1/2 (12.70)	2 13/16 (71.44)
1 3/8 (34.93)	13/16 (20.64)	1/8 (3.18)	3/4 (19.05)	7/16 (11.11)	1 29/32 (48.42)	11/64 (4.37)	5/32 (3.97)	1 1/2 (38.10)	1 – 8 (25.4 – 203.2)	1 (25.40)	9/16 (14.29)	3 3/16 (80.96)
1 1/2 (38.10)	29/32 (23.02)	3/16 (4.76)	7/8 (22.23)	7/16 (11.11)	2 3/32 (53.18)	11/64 (4.37)	5/32 (3.97)	1 1/2 (38.10)	1 1/8 – 7 (28.58 – 177.8)	1 1/8 (28.58)	5/8 (15.88)	3 1/2 (88.90)
1 3/4 (44.45)	1 1/32 (26.20)	3/16 (4.76)	1 (25.40)	1/2 (12.70)	2 23/64 (59.93)	13/64 (5.16)	3/16 (4.76)	1 3/4 (44.45)	1 1/4 – 7 (31.75 – 177.8)	1 1/4 (31.75)	3/4 (19.05)	4 7/32 (107.16)
2 (50.80)	1 1/4 (31.75)	3/16 (4.76)	1 1/4 (31.75)	1/2 (12.70)	2 47/64 (69.45)	13/64 (5.16)	3/16 (4.76)	2 (50.80)	1 1/2 – 6 (38.10 – 152.4)	1 1/2 (38.10)	7/8 (22.23)	4 15/16 (125.41)
2 1/4 (57.15)	1 3/8 (34.92)	3/16 (4.76)	1 3/8 (34.92)	1/2 (12.70)	3 9/64 (79.77)	17/64 (6.75)	1/4 (6.35)	2 1/4 (57.15)	1 3/4 – 5 (44.45 – 127.0)	1 3/4 (44.45)	1 (25.40)	5 5/8 (142.88)
2 1/2 (63.50)	1 7/16 (36.51)	3/16 (4.76)	1 7/16 (36.51)	1/2 (12.70)	3 9/64 (79.77)	17/64 (6.75)	1/4 (6.35)	2 1/4 (57.15)	1 3/4 – 5 (44.45 – 127.0)	1 3/4 (44.45)	1 (25.40)	6 3/32 (154.78)
2 3/4 (69.85)	1 11/16 (42.86)	1/4 (6.35)	1 11/16 (42.86)	1/2 (12.70)	3 41/64 (92.47)	17/64 (6.75)	1/4 (6.35)	2 1/2 (63.50)	2 – 4 1/2 (50.8 – 114.3)	2 (50.80)	1 1/8 (28.58)	6 21/32 (169.07)
3 (76.20)	1 15/16 (49.21)	1/4 (6.35)	1 15/16 (49.21)	1/2 (12.70)	4 1/64 (102.0)	17/64 (6.75)	1/4 (6.35)	3 (76.20)	2 1/4 – 4 1/2 (57.15 – 114.3)	2 1/4 (57.15)	1 1/4 (31.75)	7 11/32 (186.53)

a Keyway shall be cut parallel to taper.
b Fillets are recommended for keyways in shafts through 2" (50.8mm) in diameter. Fillets are mandatory for shafts above 2" (50.8mm) in diameter.
c Threads are Unified and American Standard, Class 3A.
d Nuts are to be semifinished stock, American Standard B18.2.



TAPER = 3/4 IN. ON DIAMETER PER FT = 1/16 IN. PER IN. = 3 DEG 34 MIN 47 SEC TOTAL INCLUDED ANGLE

FIG. 3—PROPELLER HUBS

TABLE 3 – HUBS FOR SHAFT FROM 3/4 TO 3 INCHES (19.05 TO 76.20mm) IN DIAMETER, INCLUSIVE, WITHOUT SLEEVE [a]

Nominal Bore Dia.	Diameter Small End, A		Length, B	Keyway Width, C			Keyway Side Depth [b], D			Keyway Fillet Radius [c], R
	Minimum	Maximum		Nominal	Minimum	Maximum	Nominal	Minimum	Maximum	
3/4	0.608	0.610	2 1/4	3/16	0.1865	0.1875	3/32	0.098	0.100	1/32
(19.05)	(15.44)	(15.49)	(57.15)	(4.76)	(4.74)	(4.76)	(2.38)	(2.49)	(2.54)	(.80)
7/8	0.710	0.712	2 5/8	1/4	0.249	0.250	1/8	0.129	0.131	1/32
(22.23)	(18.03)	(18.08)	(73.03)	(6.35)	(6.32)	(6.35)	(3.18)	(3.28)	(3.33)	(.80)
1	0.811	0.813	3	1/4	0.249	0.250	1/8	0.129	0.131	1/32
(25.4)	(20.60)	(20.65)	(76.20)	(6.35)	(6.32)	(6.35)	(3.18)	(3.28)	(3.33)	(.80)
1 1/8	0.913	0.915	3 3/8	1/4	0.249	0.250	1/8	0.129	0.131	1/32
(28.58)	(23.19)	(23.24)	(85.73)	(6.35)	(6.32)	(6.35)	(3.18)	(3.28)	(3.33)	(.80)
1 1/4	1.015	1.017	3 3/4	5/16	0.3115	0.3125	5/32	0.162	0.165	1/16
(31.75)	(25.78)	(25.83)	(95.25)	(7.94)	(7.91)	(7.94)	(3.97)	(4.11)	(4.19)	(1.59)
1 3/8	1.116	1.118	4 1/8	5/16	0.3115	0.3125	5/32	0.161	0.164	1/16
(34.93)	(28.35)	(28.40)	(104.78)	(7.94)	(7.91)	(7.94)	(3.97)	(4.10)	(4.17)	(1.59)
1 1/2	1.218	1.220	4 1/2	3/8	0.374	0.375	3/16	0.195	0.198	1/16
(38.10)	(30.94)	(30.99)	(114.3)	(9.53)	(9.50)	(9.53)	(4.76)	(4.95)	(5.03)	(1.59)
1 3/4	1.421	1.423	5 1/4	7/16	0.4365	0.4375	7/32	0.226	0.229	1/16
(44.45)	(36.09)	(36.14)	(133.35)	(11.11)	(11.09)	(11.11)	(5.56)	(5.74)	(5.82)	(1.59)
2	1.624	1.626	6	1/2	0.499	0.500	1/4	0.259	0.262	1/16
(50.80)	(41.25)	(41.30)	(152.4)	(12.7)	(12.67)	(12.7)	(6.35)	(6.58)	(6.65)	(1.59)
2 1/4	1.827	1.829	6 3/4	9/16	0.561	0.5625	9/32	0.291	0.294	3/32
(57.15)	(46.40)	(46.46)	(171.45)	(14.29)	(14.25)	(14.29)	(7.14)	(7.39)	(7.47)	(2.38)
2 1/2	2.030	2.032	7 1/2	5/8	0.6235	0.625	5/16	0.322	0.325	3/32
(63.50)	(51.56)	(51.61)	(190.5)	(15.88)	(15.84)	(15.88)	(7.94)	(8.18)	(8.26)	(2.38)
2 3/4	2.233	2.235	8 1/4	5/8	0.6235	0.625	5/16	0.322	0.325	3/32
(69.85)	(56.72)	(56.77)	(209.55)	(15.88)	(15.84)	(15.88)	(7.94)	(8.18)	(8.26)	(2.38)
3	2.437	2.439	9	3/4	0.7485	0.750	5/16	0.323	0.326	3/32
(76.20)	(61.90)	(61.95)	(228.6)	(19.05)	(19.01)	(19.05)	(7.94)	(8.20)	(8.28)	(2.38)

a For intermediate sizes and other design data, see Basic Data.

b Keyway shall be cut parallel to taper. Keyway side depth is measured normal to axis of taper.

c Fillets are recommended for keyways in hubs for shafts through 2" (50.8mm) in diameter. Fillets are mandatory in hubs for shafts above 2" (50.8mm) in diameter.

MARINE PROPELLER-SHAFT COUPLINGS -- SAE STANDARD J756

TABLE 3 – PROPELLER-SHAFT COUPLINGS, TYPE 1, INTERNAL PILOT – STRAIGHT BORE [a]

SAE Flange No.	Shaft Dia. Max.	D	E	F	K	L	M	N	S	P (Pilot)		T	W	X	Y	Z (Pilot)	
										Maximum	Minimum					Maximum	Minimum
1S	1 1/8	4	3 1/4	3/8	2 1/4	2 7/8	1 1/4	4	25/64	2.002	2.000	3/8 – 16	3/8	5/8	2 1/4	2.000	1.998
	(28.58)	(101.6)	(82.55)	(9.53)	(57.50)	(73.03)	(31.75)	(101.6)	(9.92)	(50.85)	(50.8)	(9.53 – 406.4)	(9.53)	(15.88)	(57.15)	(50.8)	(50.75)
2S	1 1/2	4 3/4	3 7/8	15/32	2 3/4	3 5/8	1 5/8	6	29/64	2.502	2.500	7/16 – 14	15/32	11/16	2 3/4	2.500	2.498
	(38.10)	(120.65)	(98.43)	(11.90)	(69.85)	(92.08)	(41.28)	(152.4)	(11.50)	(63.55)	(63.5)	(11.1 – 355.6)	(11.90)	(17.46)	(69.85)	(63.5)	(63.45)
3S	2	5 3/4	4 3/4	9/16	3 1/2	4 5/8	1 7/8	6	33/64	3.002	3.000	1/2 – 13	9/16	3/4	3 1/2	3.000	2.998
	(50.80)	(146.05)	(120.65)	(14.29)	(88.90)	(117.48)	(47.63)	(152.4)	(13.10)	(76.25)	(76.2)	(12.7 – 330.2)	(14.29)	(19.05)	(88.90)	(76.2)	(76.15)
4S	3	7 1/4	6	5/8	4 1/2	6 1/2	2 5/8	6	41/64	3.752	3.750	5/8 – 11	5/8	15/16	4 1/2	3.750	3.748
	(76.20)	(184.15)	(152.4)	(15.88)	(114.3)	(165.1)	(66.68)	(152.4)	(16.27)	(95.30)	(95.25)	(15.88 – 279.4)	(15.88)	(23.81)	(114.3)	(95.25)	(95.20)

a For intermediate size, see Basic Data in SAE Standard, Marine Propeller-Shaft Ends and Hubs – SAE J755.

TABLE 4 – STRAIGHT – BORE DIMENSIONS [a]

SAE Flange Number	Nominal Shaft Diameter	A		B[b]		C	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
1S	3/4 (19.05)	0.749 (19.02)	0.750 (19.05)	0.1885 (4.79)	0.1905 (4.84)	0.8378 (21.28)	0.8428 (21.40)
	7/8 (22.23)	0.874 (22.20)	0.875 (22.23)	0.2510 (6.38)	0.2530 (6.43)	0.9878 (25.09)	0.9928 (25.21)
	1 (25.40)	0.999 (25.37)	1.000 (25.4)	0.2510 (6.38)	0.2530 (6.43)	1.1151 (28.32)	1.1201 (28.45)
	1 1/8 (28.58)	1.124 (28.55)	1.125 (28.58)	0.2510 (6.38)	0.2530 (6.43)	1.2419 (31.54)	1.2469 (31.67)
2S	1 1/4 (31.75)	1.249 (31.72)	1.250 (31.75)	0.3135 (7.96)	0.3155 (8.01)	1.3924 (35.37)	1.3974 (35.49)
	1 3/8 (34.92)	1.374 (34.90)	1.375 (34.93)	0.3135 (7.96)	0.3155 (8.01)	1.5192 (38.59)	1.5242 (38.71)
	1 1/2 (38.10)	1.499 (38.07)	1.500 (38.10)	0.3760 (9.55)	0.3780 (9.60)	1.6697 (42.41)	1.6747 (42.54)
3S	1 3/4 (44.45)	1.749 (44.42)	1.750 (44.45)	0.4385 (11.14)	0.4405 (11.19)	1.9470 (49.45)	1.9520 (49.58)
	2 (50.80)	1.999 (50.77)	2.000 (50.8)	0.5010 (12.73)	0.5030 (12.78)	2.2243 (56.50)	2.2293 (56.62)
4S	2 1/4 (57.15)	2.249 (57.12)	2.250 (57.15)	0.5635 (14.31)	0.5655 (14.36)	2.5015 (63.54)	2.5065 (63.67)
	2 1/2 (63.50)	2.499 (63.47)	2.500 (63.50)	0.6260 (15.90)	0.6280 (15.95)	2.7789 (70.58)	2.7839 (70.71)
	2 3/4 (69.85)	2.749 (69.82)	2.750 (69.85)	0.6260 (15.90)	0.6280 (15.95)	3.0335 (77.05)	3.0385 (77.18)
	3 (76.20)	2.999 (76.17)	3.000 (76.20)	0.7510 (19.08)	0.7530 (19.13)	3.3334 (84.67)	3.3384 (84.80)

a For intermediate size, see Basic Data in SAE Standard, Marine Propeller Shaft Ends and Hubs – SAE J755.

b Based on Woodruff-key tolerances.

TABLE 5 – PROPELLER-SHAFT COUPLINGS, TYPE II, EXTERNAL PILOT – STRAIGHT BORE

SAE Flange No.	Shaft Dia. Max.	D	E	F	K	L	M	N	S	P (Pilot)		T	W	X	Y	Z (Pilot)	
										Maximum	Minimum					Maximum	Minimum
400	1 1/4	4	3 1/4	1/2	2	1 7/8	1 1/4	4	25/64	2.000	1.998	3/8 – 16	1/2	5/8	2	2.002	2.000
	(31.75)	(101.6)	(82.55)	(12.7)	(50.8)	(47.63)	(31.75)	(101.6)	(9.92)	(50.8)	(50.75)	(9.53 – 406.4)	(12.7)	(15.88)	(50.8)	(50.85)	(50.80)
500	1 3/4	5	4 1/8	9/16	2 3/4	2 5/8	1 5/8	4	29/64	2.500	2.498	7/16 – 14	9/16	11/16	2 3/4	2.502	2.500
	(44.45)	(127.)	(104.78)	(14.29)	(69.85)	(66.68)	(41.28)	(101.6)	(11.50)	(63.50)	(63.45)	(11.1 – 355.6)	(14.29)	(17.46)	(69.85)	(63.55)	(63.50)
600	2 1/4	6	5	5/8	3 1/2	3 3/8	1 7/8	6	33/64	3.250	3.248	1/2 – 13	5/8	3/4	3 1/2	3.252	3.250
	(57.15)	(152.4)	(127.)	(15.88)	(88.9)	(85.73)	(47.63)	(152.4)	(13.10)	(82.55)	(82.50)	(12.7 – 330.2)	(15.88)	(19.05)	(88.9)	(82.60)	(82.55)
725	3	7 1/4	6	3/4	4 1/2	4 1/2	2 5/8	6	41/64	4.250	4.248	5/8 – 11	3/4	15/16	4 1/2	4.252	4.250
	(76.2)	(161.29)	(152.4)	(19.05)	(114.3)	(114.3)	(66.68)	(152.4)	(16.27)	(107.95)	(107.90)	(15.88 – 279.4)	(19.05)	(23.81)	(114.3)	(108.00)	(107.95)

TABLE 6 – STRAIGHT – BORE DIMENSIONS

SAE Flange Number	Nominal Shaft Diameter	A		B[a]		C	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
400	3/4 (19.05)	0.749 (19.02)	0.750 (19.05)	0.1885 (4.79)	0.1905 (4.84)	0.8378 (21.28)	0.8428 (21.40)
	7/8 (22.23)	0.874 (22.20)	0.875 (22.23)	0.2510 (6.38)	0.2530 (6.43)	0.9878 (25.09)	0.9928 (25.21)
	1 (25.4)	0.999 (25.37)	1.000 (25.4)	0.2510 (6.38)	0.2530 (6.43)	1.1151 (28.32)	1.1201 (28.45)
	1 1/8 (28.58)	1.124 (28.55)	1.125 (28.58)	0.2510 (6.38)	0.2530 (6.43)	1.2419 (31.54)	1.2469 (31.67)
	1 1/4 (31.75)	1.249 (31.72)	1.250 (31.75)	0.3135 (7.96)	0.3155 (8.01)	1.3924 (35.37)	1.3974 (35.49)
500	1 3/8 (34.92)	1.374 (34.90)	1.375 (34.93)	0.3135 (7.96)	0.3155 (8.01)	1.5162 (38.51)	1.5242 (38.71)
	1 1/2 (38.10)	1.499 (38.07)	1.500 (38.10)	0.3760 (9.55)	0.3780 (9.60)	1.6697 (42.41)	1.6747 (42.54)
	1 5/8 (41.28)	1.624 (41.25)	1.625 (41.28)	0.4385 (11.14)	0.4405 (11.19)	1.8197 (46.22)	1.8247 (46.35)
	1 3/4 (44.45)	1.749 (44.42)	1.750 (44.45)	0.4385 (11.14)	0.4405 (11.19)	1.9470 (49.45)	1.9520 (49.58)
600	1 7/8 (47.63)	1.874 (47.60)	1.875 (47.63)	0.5010 (12.73)	0.5030 (12.78)	2.0970 (53.26)	2.1020 (53.39)
	2 (50.8)	1.999 (50.77)	2.000 (50.80)	0.5010 (12.73)	0.5030 (12.78)	2.2243 (56.50)	2.2293 (56.62)
	2 1/4 (57.15)	2.249 (57.12)	2.250 (57.15)	0.5635 (14.31)	0.5655 (14.38)	2.5015 (63.54)	2.5065 (63.67)
725	2 1/2 (63.50)	2.499 (63.47)	2.500 (63.50)	0.6260 (15.90)	0.6280 (15.95)	2.7789 (70.58)	2.7839 (70.71)
	2 3/4 (69.85)	2.749 (69.82)	2.750 (69.85)	0.6260 (15.90)	0.6280 (15.95)	3.0335 (77.05)	3.0385 (77.18)
	3 (76.20)	2.999 (76.17)	3.000 (76.20)	0.7510 (19.08)	0.7530 (19.13)	3.3334 (84.67)	3.3384 (84.80)

[a] Based on Woodruff-key tolerances.

NOTE: Inches with millimeters in parenthesis on all above Tables.

NOTE 1—**No. 1S** flange coupling bolt is to be ⅜–24 x 1¼ with plain nut and lockwasher.
No. 2S flange coupling bolt is to be 7/16–20 x 1½ with plain nut and lockwasher.
No. 3S flange coupling bolt is to be ½–20 x 1¾ with plain nut and lockwasher.
No. 4S flange coupling bolt is to be ⅝–18 x 2 with plain nut and lockwasher.
NOTE 2—Either cone or dog point setscrews with spotting of shaft is recommended.

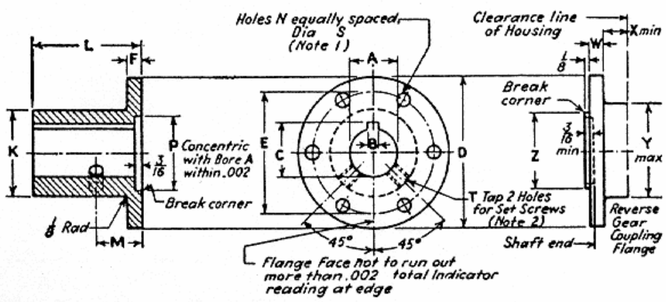
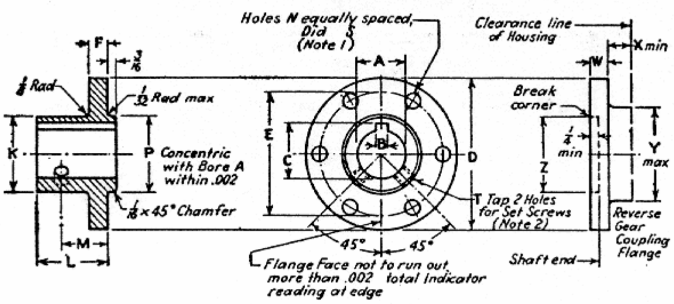


FIG. 2—TYPE I PROPELLER-SHAFT COUPLING, INTERNAL PILOT, STRAIGHT BORE



NOTE 1—**No. 400** flange coupling bolt is to be ⅜–24 x 1½ with plain nut and lockwasher.
No. 500 flange coupling bolt is to be 7/16–20 x 1⅝ with plain nut and lockwasher.
No. 600 flange coupling bolt is to be ½–20 x 1⅞ with plain nut and lockwasher.
No. 725 flange coupling bolt is to be ⅝–18 x 2¼ with plain nut and lockwasher.
NOTE 2—Either cone or dog point setscrews with spotting of shaft is recommended.

FIG. 3—TYPE II PROPELLER-SHAFT COUPLING, EXTERNAL PILOT, STRAIGHT BORE

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Origin and Development of ABYC P-6, Propeller Shafting Systems

ABYC P-6 first appeared in 1963 and was approved in 1964. This standard was revised in 1965, 1966, 1967, 1968, 1970, 1973, 1977 and 1992. The 2002 update is the work of the Engine and Powertrain Project Technical Committee.

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