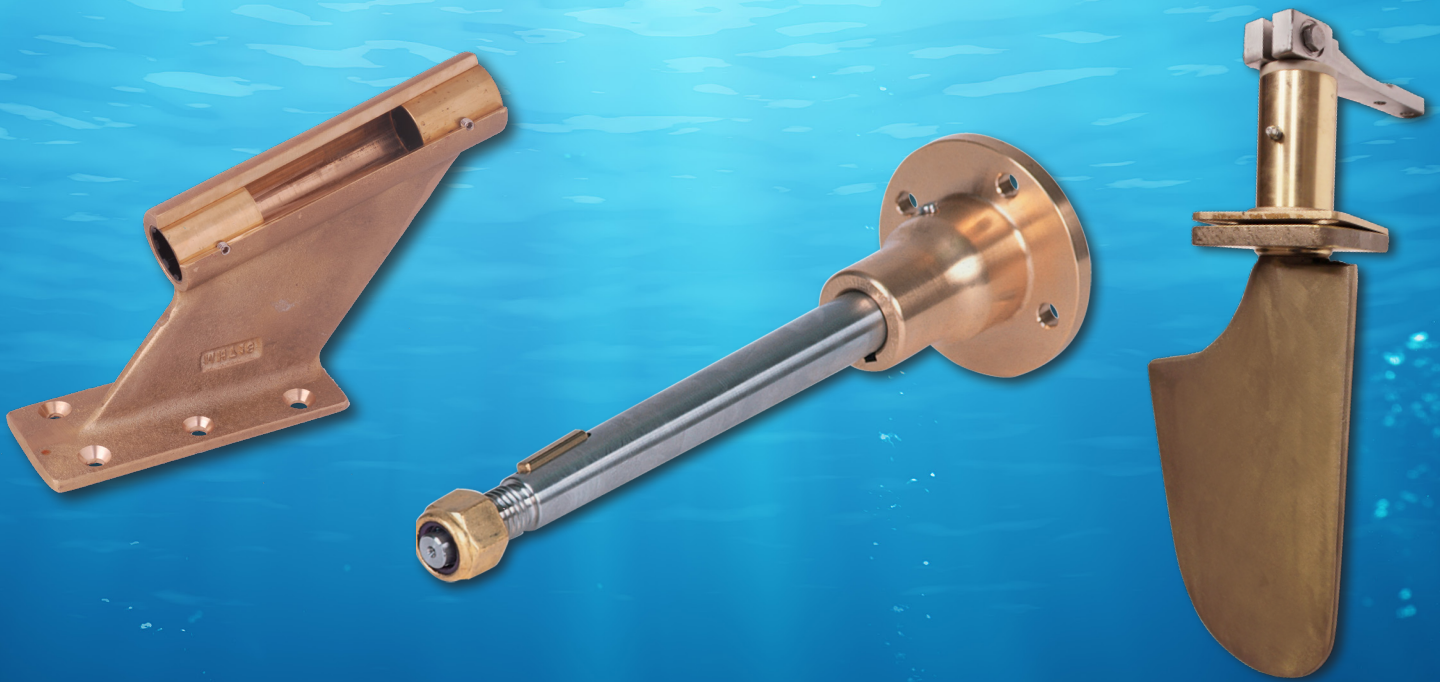


# MARINE HARDWARE™ INC

"Quality materials make it strong... *Our designs make it better.*"



## RUNNING GEAR

# COMPANY HISTORY & INTRODUCTION

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Thank you for taking the time to look at our company as a supplier of parts for your boating needs.

We started Marine Hardware Inc. in 1979. Growing up around boating as a kid and working for a few of our new local Seattle boat builders, John Pugh saw the need to manufacture shafts, struts and rudders specifically designed to fit the “new fiberglass” boats coming to the marketplace. Traditional suppliers for running gear had a long history of making parts for wood boats and were slow to re-design parts to fit these new fiberglass boats.

In 1979, Marine Hardware was given the opportunity to supply Bayliner, a small Seattle builder. At the time with no idea they would soon become the largest boat builder in the world with production numbers that would eclipse 1000 boats per week. Along with really hard work, long hours and a little luck we were also able to take advantage of another new emerging technology, CNC machines. We were able to program designs and get perfect parts machined over and over at high production rates, less labor which allowed us to keep up with Bayliners needs and have capacity to take on other new customers. In 1982, fate again having its way we were introduced to a startup builder in Merced, CA. known as Malibu Boats. Again, who would have imagined then that they would grow into what they are today.

This foundation set with these two great boat builders, allowed Marine Hardware to continue pursuing best practices in manufacturing. Automation became reliable and now better priced, we were meeting delivery schedules and now as a proven supplier, we started supplying other boat builders, allowing us to offer better pricing.

With manufacturing efficiencies, competitive pricing and continuous on-time delivery, the results are what make Marine Hardware an industry leader today. We are a unique multi-disciplined manufacturer with the ability to manage automating a thousand production parts or produce one-off service parts from our extensive library of over 2,500 strut patterns, 1,000 different rudders, and many more parts to choose from.

We are here to offer you the same great customer service and quality parts that support the motto we have stood behind for more than 40 years in the marine industry.

**“Quality materials make it strong... *Our designs make it better.*”**





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# MATERIAL SPECIFICATIONS

## BRASS AND BRONZE STANDARD CASTING ALLOYS

TYPE	SPECIFICATIONS						CHEMICAL COMPOSITIONS								MECHANICAL PROPERTIES						
	1978 CDA	1961 ASTM	1981 SAE	ALLOY ID	MILITARY	AMS	Cu %	Sn %	Pb %	Zn %	Ni %	Fe %	Al %	Others %	Tensile Strength		Yield Strength		Brinell Hardness	Weigh Lbs./In.	Machinability Free Cut YB-100
															min. ksi	typ. ksi	min. ksi	typ. ksi			
Red Brass	C83300	-	-	131	-	-	93	1.5	1.5	4	-	-	-	-	-	32	-	10	35	.318	35
	C83600	B584-836	C83600	115	C-22229Gr2	-	85	5	5	5	-	-	-	-	30	37	14	17	50-65	.318	84
	C83800	B584-838	C83800	120	-	-	83	4	6	7	-	-	-	-	29	35	12	16	50-60	.312	90
Yellow Brass	C85400	B584-854	C86400	403	-	-	67	1	3	29	-	-	-	-	30	34	11	12	40-60	.305	80
	C85700	B564-857	-	405-2	C-15345Gr3	-	63	1	1	34.7	-	-	.3	-	40	50	14	18	75	.304	80
Manganese Bronze *NiBral	C86200	B584-862	C86200	423	C-22229Gr9	-	64*	-	-	26	-	3	4	-	90	95	45	48	170†	.288	30
	*C86300	B584-863	C86300	424	C-22229Gr8	4862B	63*	-	-	25	-	3	6	-	110	119	60	83	225†	.283	8
	C86500	B584-865	C86500	421	C-22229Gr7	4860A	58	5	-	40	-	1	1	Mn .25	65	71	25	28	130†	.301	26

## ALUMINUM STANDARD SAND & PERM MOLD CASTING ALLOYS

AA#	SPECIFICATIONS						CHEMICAL COMP.				MECHANICAL PROPERTIES								
	Former Designation	S=Sand P=PermMold	Federal		Current Same as AA Old ASTM #'s		SAE	Cu %	Si %	Pb %	Zn %	Temper		Tensile Strength, psi		Yield Strength, psi		Brinell Hardness	
			QA601E (S)	QA596 (PM)	8-26 (S)	8-108 (PM)						S	PM	S	PM	S	PM	S	PM
319	319, Allcast	S,P	319	319	SC64D	SC64D	326	3.5	6.0	-	-	T62	-	41	34	32	19	85	85
	-	-	-	-	-	-	-	-	-	-	-	T7	T6	39	40	26	27	60	95
	-	-	-	-	-	-	-	-	-	-	-	F	T551	27	36	18	28	75	105
356.0	356	S,P	356	356	SG70A	SG70A	323	-	7.0	0.3	-	T51	T61	25	41	20	30	60	90
	-	-	-	-	-	-	-	-	-	-	-	T6	-	33	-	24	-	70	-
	-	-	-	-	-	-	-	-	-	-	-	T7	-	34	-	30	-	75	-
713.0	613, Tenzaloy	S,P	Tenza loy		ZG81A		315	0.7		0.4	7.5	ForT5	T5	34	40	23	27	75	80

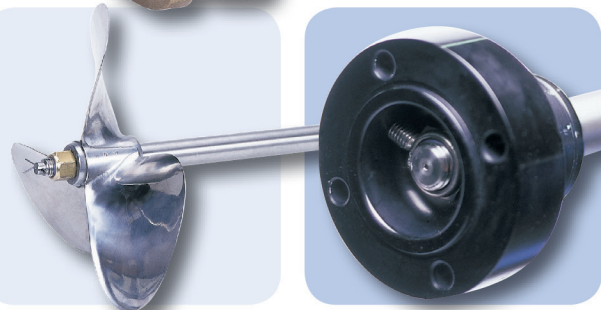
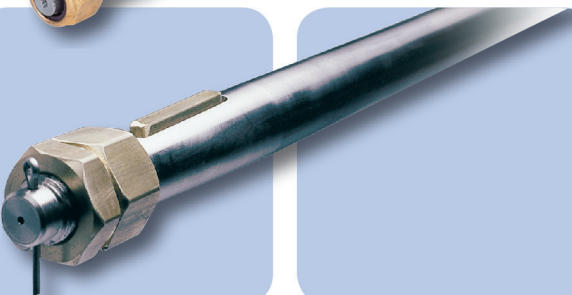
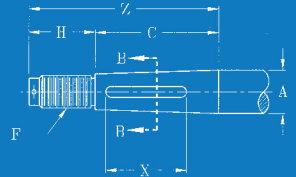
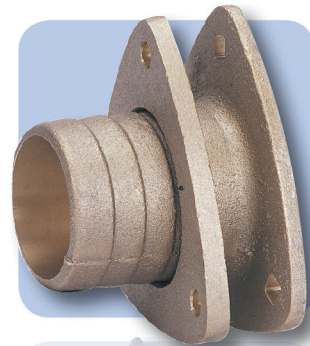
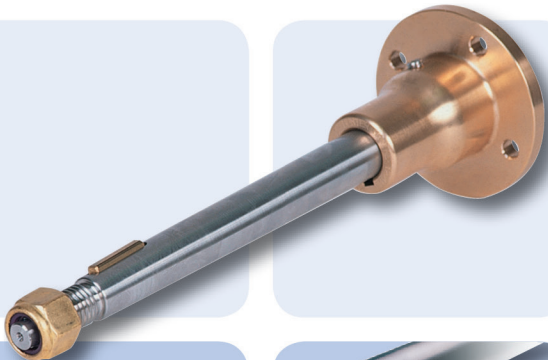
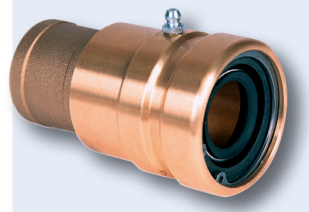
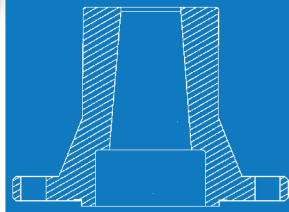
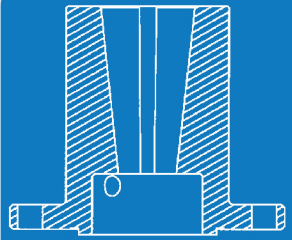
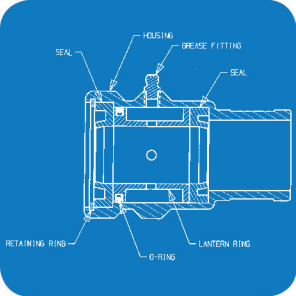
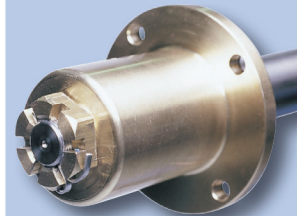
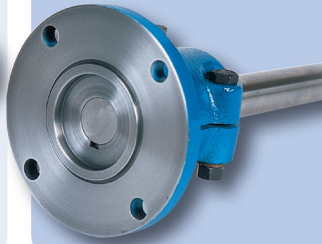
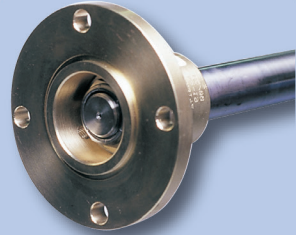
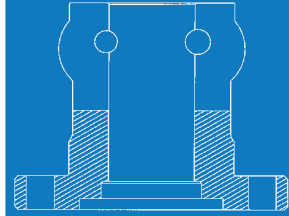
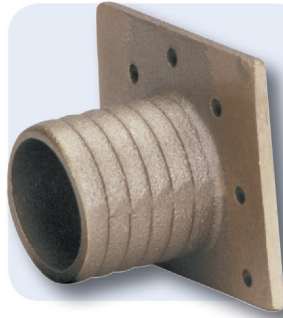
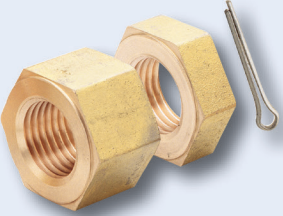
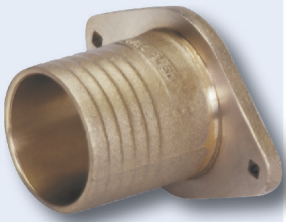
## STAINLESS STEEL

TYPE	CHEMICAL COMPOSITIONS								MECHANICAL PROPERTIES				
	C	Mn	Ph	s	Si	Cr	Ni	Fe	Tensile Strength, psi		Yield Strength, psi		Hardness
303	0.15	2.00	0.200	0.150	1.00	17.00-19.00	8.00-10.00	Balance	95,000		45,000		Brinell 160
304	0.08	2.00	0.045	0.030	1.00	18.00-20.00	8.00-12.00	Balance	90,000		40,000		Rockwell b85
316	0.08	2.00	0.045	0.030	1.00	16.00-18.00	10.00-14.00	Balance	115,000		75,000		-
17-4	0.04	0.28	-	-	0.60	16.00	4.25	Balance	150,000		110,000		Rockwell c34

## BOAT SHAFTING

TYPE	CHEMICAL COMPOSITIONS													MECHANICAL PROPERTIES				
	Cr	Ni	Cu	Mo	N	C	Mn	Ph	s	Si	Cb	V	Fe	Tensile Strength, psi	Yield	Torsional Yield	Elong., % in 2"	Red. of Area, %
AQ - 17 .750" - 8.000" dia	15.00-17.00	3.00-5.00	3.00-5.00	-	0.20-0.30	0.07	1.00	0.04	0.03	1.00	0.15-0.45	-	Balance	135,000	105,000	70,000	16	50
AQ - 19 .750" - 1.50" dia	18.00-20.00	8.00-10.50	-	-	0.20-0.40	0.08	2.00	0.04	0.03	1.00	-	-	Balance	130,000	105,000	70,000	20	55
AQ - 19 1.50" - 2.00" dia	18.00-20.00	8.00-10.50	-	-	0.20-0.40	0.08	2.00	0.04	0.03	1.00	-	-	Balance	115,000	85,000	57,000	25	55
AQ - 19 2.00" - 2.50" dia	18.00-20.00	8.00-10.50	-	-	0.20-0.40	0.08	2.00	0.04	0.03	1.00	-	-	Balance	105,000	60,000	40,000	30	55
AQ - 19 2.50" - 3.00" dia	18.00-20.00	8.00-10.50	-	-	0.20-0.40	0.08	2.00	0.04	0.03	1.00	-	-	Balance	100,000	55,000	36,600	35	55
AQ - 19 3.00" - 12.00" dia	18.00-20.00	11.50-13.50	-	-	0.20-0.40	0.08	2.00	0.04	0.03	1.00	-	-	Balance	95,000	50,000	33,000	35	55
AQ - 22 .75" - 1.25" dia	20.50-23.50	11.50-13.50	-	1.50-3.00	0.20-0.40	0.06	4.00-6.00	0.04	0.03	1.00	0.10-0.30	0.10-0.30	Balance	145,000	130,000	86,600	18	45
AQ - 22 1.25" - 2.50" dia	20.50-23.50	11.50-13.50	-	1.50-3.00	0.20-0.40	0.06	4.00-6.00	0.04	0.03	1.00	0.10-0.30	0.10-0.30	Balance	135,000	105,000	70,000	20	50
AQ - 22 2.00" - 2.50" dia	20.50-23.50	11.50-13.50	-	1.50-3.00	0.20-0.40	0.06	4.00-6.00	0.04	0.03	1.00	0.10-0.30	0.10-0.30	Balance	120,000	95,000	63,300	20	50
AQ - 22 2.50" - 3.00" dia	20.50-23.50	11.50-13.50	-	1.50-3.00	0.20-0.40	0.06	4.00-6.00	0.04	0.03	1.00	0.10-0.30	0.10-0.30	Balance	115,000	75,000	50,000	25	50
AQ - 22 3.00" - 12.00" dia	20.50-23.50	11.50-13.50	-	1.50-3.00	0.20-0.40	0.06	4.00-6.00	0.04	0.03	1.00	0.10-0.30	0.10-0.30	Balance	100,000	55,000	36,600	30	50
AQ - 22HS 2.250" - 6.00" dia	20.50-23.50	11.50-13.50	-	1.50-3.00	0.20-0.40	0.06	4.00-6.00	0.04	0.03	1.00	0.10-0.30	0.10-0.30	Balance	130,000	105,000	70,000	15	45

# Shafting & Components





# Shaft Alloys

Marine Hardware™, Inc. worked for years with most of the world's leading stainless steel bar mills to provide the ultimate in boat shafting quality. By combining our field experience with our metallurgical excellence, our goal is to bring to our customers a product that is superior in materials and exacting tolerances. Our aquanox™ shafting is used in yachts manufactured by Bayliner, Maxum, and Luhrs, to ski boats such as Malibu and Fineline as well as Unlimited Hydroplanes like the Miss Budweiser and Miss Bardahl. We supply bars in type 17, 19, 22 and 22HS with diameters ranging from 1 inch thru 4 inches. Our lengths are available to 32 feet.

Our computer-controlled Mazak turning centers make prime quality shafting, part after part. We start with aquanox™ precision polished and ground modified 304 or 316 nitrogen stainless steel, and turn the taper, thread, and journal simultaneously in a Hardinge collet, not in a chuck which must be readjusted for each part. Our tapers have less than .002" runout, and the threads are Class 2 fit. After turning, keyways are cut to exacting standards which have proved over time and in the field to prevent shaft breakage at this critical area. Then we proceed with balancing and straightening to a tolerance of .002" on 42" intervals. This is 300% better accuracy than specified in American Boat and Yacht Council (ABYC) standards.



The chart on pg. 7 outlines some of the standards we enforce when building a precision prop shaft; it reflects the toughest ABYC, SAE, and Navy specifications.

Marine Hardware™, Inc. also prides itself in manufacturing shafts with our unique Nautilloy™ material. A unique blend of 316 stainless steel with nitrogen for strength, providing great strength and maximum corrosion protection.



## SHAFT MATERIAL COMPARISON GUIDE

Type	Density	Marine Grade	Aquatech <sup>1</sup>	Aquamet <sup>2</sup>	Marinox <sup>3</sup>	Aqualloy	Temet	ASTM Family	Chrome	Nickel
AQ - 17	.284	17-4	17	17	17	17	17	17-4	18.00 - 20.00	18.00 - 10.50
AQ - 19	.286	304N	19	19	19	19	19	304	18.00 - 20.00	8.00 - 12.00
AQ - 22	.285	XM19	22	22	22	22	22	316	16.00 - 18.00	10.00 - 14.00
AQ - 22HS	.285	XM19	22HS	22HS	22HS	22HS	22HS	316	18.00 - 20.00	18.00 - 20.00
Ny - 22	.285	316N	N/A	N/A	N/A	N/A	N/A	316	18.00 - 20.00	18.00 - 20.00

# Shaft Strength & Alloy Analysis

## SHAFT ANALYSIS

Boat shaft requirements vary dramatically by both the alloy you select as well as the horsepower and gear ratio used to propel your boat. The alloy selection really is a choice of corrosion protection versus strength. Higher strength alloys are typically very strong and allow you to use a smaller diameter shaft and the more corrosion resistant alloys do not have the strength but are very resistant to corrosion.

We at MH have put together a very simple spreadsheet type analysis that will quickly tell you the mechanical safety factor of each shaft choice you may want to consider.

Once the math is completed for the calculations you get the "safety factor" for the projected installation. The safety factor you select for your application varies as either the strength grade of the shafting is changed or the diameter of the boat-shaft itself. Typically a safety factor of 3:1 is minimum for a recreation boats and a 5:1 for diesel and heavy recreation and up to 7:1 for heavy duty industrial applications.

All we need for information to do a calculation is the horsepower, max engine rpm and gear ratio. We can run an information sheet for you offering a variety of materials and diameters for your review.

### Please provide the following necessary information:

- Engine horsepower
- Engine RPM
- Gear reduction ratio
- Desired shaft diameter and material, if known

$$D = \sqrt[3]{\frac{321,000 \times P \times S.F.}{S^\dagger \times N}} \quad S.F. = \frac{D^3 \times S^\dagger \times N}{321,000 \times P}$$

D = Shaft Diameter, inches (mm)

P = Shaft Horsepower

S.F. = Safety Factor

S<sup>†</sup> = Yield Strength, torsional shear, lbs/in<sup>2</sup> (MPa)

N = Shaft Speed, RPM



CMM inspection on shaft tapers to verify precision accuracy.

## BEARING SPACING ANALYSIS - ABYC

When calculating overall assembled length, please refer to the following formula to minimize whip of the shaft.

$$L = \sqrt[2]{\frac{3.21 D}{N}} \times \sqrt[4]{\frac{E}{W_1}}$$

L = Max Unsupported length, feet (m)

D = Shaft diameter, inches (mm)

N = Shaft speed, RPM

E = Modulus of elasticity in tension, lbs/in<sup>2</sup> (MPa)

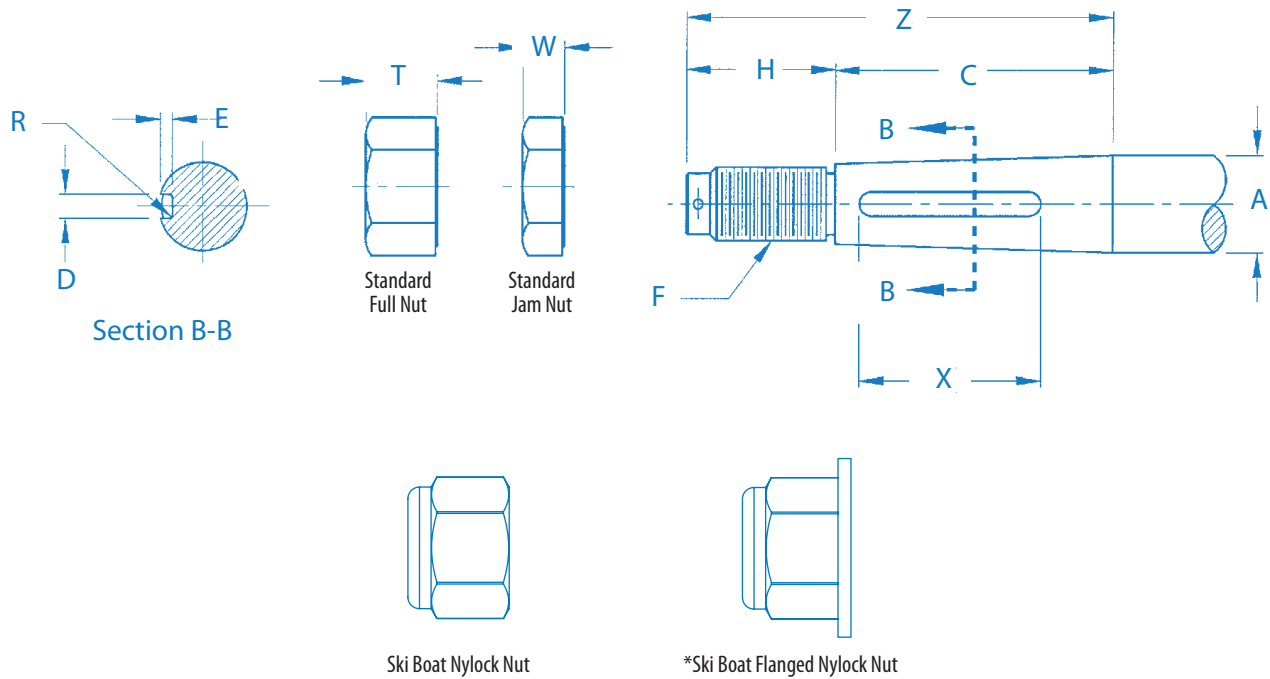
W<sub>1</sub> = Weight of one cubic inch (cm<sup>3</sup>) of material, pounds (gm)

Note: The ABYC minimum required spacing for rigid bearings should exceed 20 times the shaft diameter when possible to facilitate alignment. If the shaft seal is of the rigid type and is located approximately at the mid-point of the shaft, bearing spacing may be twice the values shown in the equation.

## COMPOSITION OF aquanox™ STAINLESS STEEL

Type	17	19	Nautilloy 22	22	22HS	K-500	Type 304	Type 316	Type 17-4
Carbon (max.)	0.08	0.03	0.03	0.08	0.08	.25	0.03	0.08	0.08
Manganese (max.)	2.00	2.00	2.00	2.00	2.00	1.50	2.00	2.00	2.00
Phosphorus	0.030	0.030	0.030	0.030	0.030	.010	0.030	0.030	0.030
Sulfur (max.)	1.00	1.00	1.00	1.00	1.00	.050	1.00	1.00	1.00
Silicon (max.)	18.00-20.00	18.00-20.00	18.00-20.00	16.00-18.00	18.00-20.00	-	18.00-20.00	16.00-18.00	18.00-20.00
Chromium	8.00-10.500	8.00-12.00	18.00-20.00	10.00-14.00	8.00-10.50	63-70	8.00-12.00	10.00-14.00	8.00-10.500
Nickel	-	-	-	-	-	Balance	-	-	-
Copper	-	-	-	-	-	2.30 min.	-	-	-
Aluminum	-	-	-	-	-	.35-.85	-	-	-
Titanium	N 0.16-0.30	N 0.10-0.16	-	Mo 2.00-3.00 N 0.10 max	N 0.20-0.30	-	-	Mo 2.00-3.00	N 0.16-0.30

# Shaft Dimensions



## MACHINING SPECIFICATIONS

Nom. Shaft Dia.	Taper Length	Keyway Width	Keyway Side Depth*	Keyway Fillet Radius	Thread Spec.	Extension Beyond Taper	Cotter Pin Dia.	Nut Thickness		Keyway Length (min.)	Taper to Tip
								Full Nut	Jam Nut		
(A)	(C)	(D)	(E)	(R)	(F)	(H)		(T)	(W)	(X)	(Z)
1"	2-3/4"	1/4"	1/8"	1/16"	3/4" — 10	1-3/4"	1/8"	3/4"	7/16"	1-1/2"	4-1/2"
*1-1/8"	3-1/8"	1/4"	1/8"	1/16"	3/4" — 10	1-3/4"	1/8"	3/4"	7/16"	1-3/4"	4-7/8"
1-1/4"	3-1/2"	5/16"	5/32"	1/16"	7/8" — 9	2"	5/32"	N/A	N/A	2-1/8"	5-1/2"
*1-1/4"	3-1/2"	5/16"	5/32"	1/16"	3/4" — 10	2"	5/32"	N/A	N/A	2-1/8"	5-1/2"
1-3/8"	3-7/8"	5/16"	5/32"	1/16"	1" — 8	2-1/4"	5/32"	1"	9/16"	2-1/2"	6-1/8"
1-1/2"	4-1/4"	3/8"	3/16"	1/16"	1-1/8" — 7	2-7/16"	5/32"	1-1/8"	5/8"	2-3/8"	6-11/16"
1-3/4"	5"	7/16"	7/32"	1/16"	1-1/4" — 7	2-3/4"	3/16"	1-1/4"	3/4"	3-1/8"	7-3/4"
2"	5-3/4"	1/2"	1/4"	1/16"	1-1/2" — 6	3-1/8"	3/16"	1-1/2"	7/8"	3-5/8"	8-7/8"
2-1/4"	6-1/2"	9/16"	9/32"	3/32"	1-3/4" — 5	3-1/2"	1/4"	1-3/4"	1"	4"	10"
2-1/2"	7-1/4"	5/8"	5/16"	3/32"	1-3/4" — 5	3-1/2"	1/4"	1-3/4"	1"	4-1/2"	10-3/4"
2-3/4"	7-7/8"	5/8"	5/16"	3/32"	2" — 4-1/2	4"	1/4"	2"	1-1/8"	5-1/8"	11-7/8"
3"	8-5/8"	3/4"	5/16"	3/32"	2-1/4" — 4-1/2	4-3/8"	1/4"	2-1/4"	1-1/4"	6-1/4"	13"
3-1/2"	10-1/8"	7/8"	5/16"	1/8"	2-1/2" — 4	5-1/8"	3/8"	2-1/2"	1-1/2"	7-3/4"	15-1/4"
4"	11-5/8"	1"	5/16"	1/8"	3" — 4	5-7/8"	3/8"	3"	1-3/4"	9-1/4"	17-1/2"

**Note:** For shafts of 3" diameter and larger, keystone material is machine-planned on one side so that it is no longer square. Keyway side depths on both shafts and couplers of these larger diameters are equal. All shafts 3/4" through 6" in diameter have 3/4" per foot taper.

\* Used on high-performance ski/surf boat shaft assemblies



## DIAMETER TOLERANCES

Allowable tolerance in overall diameter by size.

Diameter, inches	Permissible Variation, inches
3/4 to 15/16 incl	+.001 - .001
1 to 1-1/2 excl	+.002 - .001
1-1/2 to 2 incl	+.003 - .001
Over 2 to 4 incl	+.005 - .001
Over 4 to 4-1/2 incl	+.005 - .005
Over 4-1/2 to 5-1/2 incl	+.008 - .008
Over 5-1/2 to 7 incl	+.008 - .012
Over 7 to 8 incl	+.008 - .014
Over 8 to 12 incl	+.010 - .016
Over 12	+.015 - .020

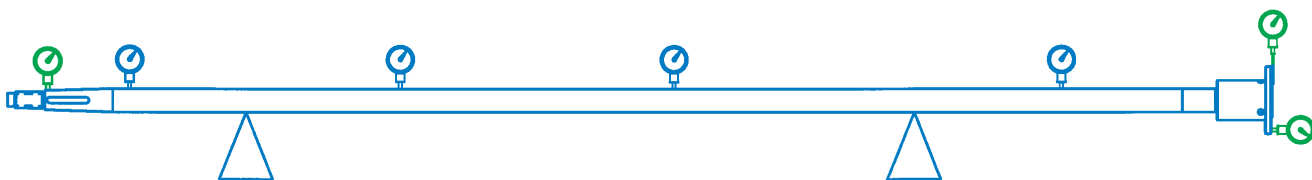
## PROPELLER SHAFTING WEIGHT PER LENGTH

Dia. of shaft	Weight, lbs/ft	Dia. of shaft	Weight, lbs/ft
1"	2.607	3"	24.030
1-1/8"	3.379	3-1/4"	28.202
1-1/4"	4.172	3-1/2"	32.708
1-3/8"	5.048	3-3/4"	37.547
1-1/2"	6.008	4"	42.720
1-3/4"	8.177	4-1/2"	54.068
2"	10.680	5"	66.750
2-1/4"	13.517	5-1/2"	80.768
2-1/2"	16.688	6"	96.120
2-3/4"	20.192	8"	170.880

## SHAFT ASSEMBLIES STRAIGHTNESS TOLERANCES

Specific diameter of shafting in inches	Standard distance between supports in inches	Permissible variation (per revolution) from straightness in inches	Marine Hardware™, Inc. specs in inches
1/2 to 15/16 incl	42	0.005	0.001
Over 15/16 to 1-15/16 incl	42	0.006	0.002
Over 1-15/16 to 2-1/2 Incl	42	0.007	0.002
Over 2-1/2 to 4 incl	42	0.008	0.0025
3/4 to 15/16 incl	Specified lengths of 3 to 12 feet (Supported within 2" of ends)*	0.004 plus 0.0025 for each foot or fraction thereof in excess of 3 feet.	0.002
Over 15/16 to 8 incl	Specified lengths up to 25 feet (Supported within 2" of ends)*	0.005 plus 0.0015 for each foot or fraction thereof in excess of 3 feet.	0.003 plus 0.000
Over 15/16 to 8 incl	Specified lengths over 25 feet to 31-1/2 feet (Supported within 2" of ends)*	0.010 plus 0.0015 for each foot.	0.005
Over 8 to 14-1/2 incl	Up to 31-1/2 feet (Supported within 2" of ends)*	0.010 plus 0.0015 for each foot.	0.005

\* If bars sag excessively by the end method, it is advisable to test using 42" method.



Marine Hardware™, Inc. inspects all Shaft Assemblies to American Boat and Yacht Council (ABYC) specifications. The green above indicates we inspect to .002 inches beyond the most stringent standards.

Engineering Note: Safety factor for both ABYC and SAE specify when calculating appropriate shaft diameters, a safety factor of 3 used with gas and 5 with diesel. With today's mechanical transmissions we recommend a safety factor of 5 for all applications.

Sport fishing applications are considered to be high performance continuous duty and a safety factor of seven should be used.

# Shaft Assemblies

When replacing a shaft, we recommend replacement with a factory-assembled shaft/coupler set. Our assemblies are precision bored, honed, faced, straightened, and balanced to ensure concentricity and reduce vibration and shaft whip. Materials are the highest quality available in the industry, and all machining meets or exceeds ABYC standards.

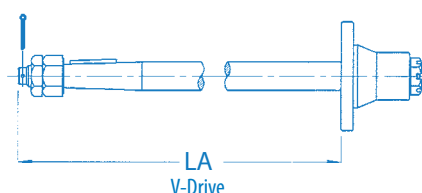
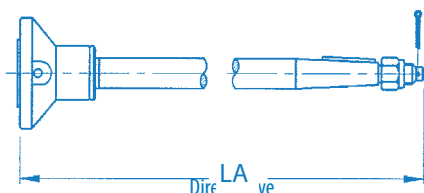
Our assemblies can be shipped complete with all keys, nuts, and cotter pin. Specify loose fit assembly for applications where shaft & coupler must be disassembled for installation, such as refits. Specify tight fit assembly for applications such as installation during boat builder's factory assembly of new boats.



## INFORMATION NEEDED WHEN ORDERING A SHAFT AND COUPLER ASSEMBLY

To order a prop shaft and coupler assembly, specify:

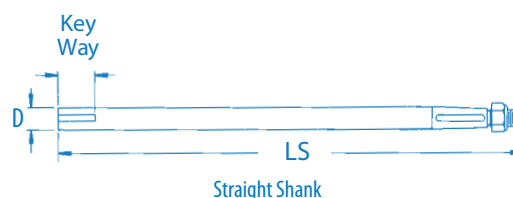
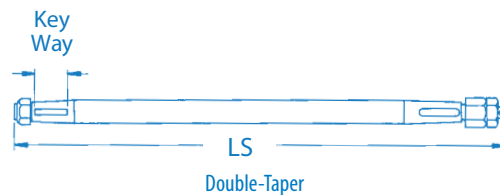
- Transmission Make & Model
- Straight Shank or Double Taper
- Material
- D = Shaft Diameter
- LA = Length of assembly  
(Length of assembly is measured from coupler mounting face to the tip of the shaft.)



## INFORMATION NEEDED WHEN ORDERING A PROP SHAFT ONLY

To order only a prop shaft, specify:

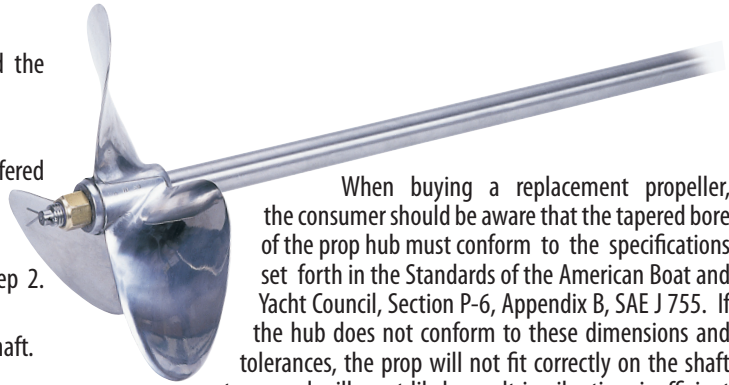
- LS = Length of Shaft
- Material
- Key Way Length
- Key Way Width
- Single or Double Taper
- D=Shaft Diameter



# Correct Fit of Propeller/Coupler on Shaft

## PROCEDURE FOR CORRECT FIT OF PROPELLER ON SHAFT

1. Put propeller snugly onto shaft taper without the key in place.
2. Make a line with a non-graphite marker on the shaft around the forward edge of the prop hub.
3. Remove prop from shaft.
4. Put key into keyway on shaft taper with radiused or chamfered corners in keyway.
5. Put propeller onto shaft taper.
6. Check to see that propeller moves forward to line made in Step 2. If it does, skip to Step 7. If not, perform Steps 6a through 6f.
  - a. If prop does not move forward to line, remove prop from shaft.
  - b. Remove key and secure in vise with radiused or chamfered corners down and square corners up.
  - c. File down top of key a small amount.
  - d. Replace filed key in shaft keyway with radiused or chamfered corners in shaft and filed edge on top.
  - e. Replace prop on shaft and again check to see if it moves forward to the line made in Step 2.
  - f. If it does not line up, repeat Steps 6a through 6e. Be sure to file only a small amount from key at a time, so that key will fit in keyway snugly, yet will not prevent prop from seating completely on the shaft taper.
7. When prop hub moves to correct position, install prop nut on shaft and torque to seat the propeller. (ABYC Standard, Sec. P-6, Appendix A, 6.2.5.) Install and torque jam nut also, if your shaft is so equipped.
8. Which nut comes first?... Full or Jam? See Prop Nuts on **pg. 16** for opinion and explanation of nut orientations.



When buying a replacement propeller, the consumer should be aware that the tapered bore of the prop hub must conform to the specifications set forth in the Standards of the American Boat and Yacht Council, Section P-6, Appendix B, SAE J 755. If the hub does not conform to these dimensions and tolerances, the prop will not fit correctly on the shaft taper and will most likely result in vibration, inefficient power transmission, stress and weakening of the shaft, and possible shaft breakage. Once the correct dimensions of the prop hub length, bore, and keyway are verified, it is extremely important to ensure correct fit of the propeller on the shaft. The tapers of the shaft and the prop hub must be in contact over at least 75% of their surface area to transmit power effectively and without undue stress. If the prop is not installed far enough forward on the shaft taper because of interference by the key, stresses will occur which may result in shaft breakage.

Satisfactory installation of a correctly bored and keyed propeller is not difficult. If you have any doubts about the fit of the prop on the shaft, contact a qualified marine technician or boatyard for installation.

*Note: The key should slide easily through the keyway in the hub of the propeller. This may require the keyway to be filed as well as the key to provide for a clean, smooth fit with no interference to keep the propeller from full engagement to the shaft taper.*

*For best power transmission the hub bore of the propeller should be a "Full Taper Bore" allowing the forward end of the hub to seat at the edge of the taper and full diameter of the shaft.*

## PROPER FIT OF TAPERED COUPLER TO SHAFT

1. Inspect both tapered surfaces, shaft and coupling, for smooth debris-free surfaces. Do not apply any oils, lubricants or anti-seize materials to the surfaces.
2. Slide coupling on the shaft without key to make certain the parts mate correctly. Mark the end location with a non-graphite marker.
3. Remove coupling leaving non-graphite mark visible on the shaft.
4. Install key in keyway making sure there is no binding.
5. Make sure both surfaces do **NOT** have oil, grease, or anti-seize.
6. Re-install coupling with the key installed, making sure the coupler slides to the same position indicated by your mark.
7. Once determined there is no key bind, install coupling nut and torque to recommended specifications.
8. If your coupling has external lock screws –install them with Loctite 262 and proper stainless safety wire.
9. Slide coupling and shaft assembly to engage the transmission flange and confirm final alignment.
10. Once final alignment is confirmed, bolt the assemblies together with proper fasteners, make sure diameter of fasteners match the bolt pattern on the coupling to prevent ratcheting.





# Couplers

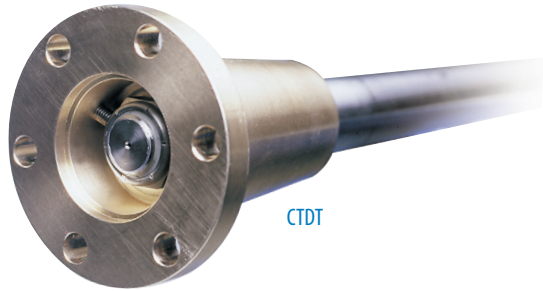
Marine Hardware™, Inc. manufactures a full range of shaft couplers, plus many special models depending on installation requirements, including V-drives. All are cast from pure bronze ingot or billet 6061-T6 aluminum and Computer Numerical Controlled (CNC) turned to insure absolute concentricity of the bore with the registration ring, part after part. All bolt patterns are jig-drilled and registered from the finished bore. We make all models and styles of couplers (except solid style) from 70 manganese bronze; also available in mild steel by special order. Certain styles for ski boats are available in heat-treated, anodized aluminum. Our couplers are shipped with a thick, protective peel-off plastic coating to prevent damage in transit.

When a coupler or shaft needs replacing due to damage or wear, we recommend that the complete shaft/coupler assembly be replaced.

Every solid-style coupler must be reamed to match the precise diameter of its mating shaft, since shafting stock has a diametrical tolerance range of  $+.002"$  and  $-.001"$ . A light interference fit (Class LN 3) is attained in every solid-style assembly. Best results are achieved when the two assembled parts can be faced and precision-straightened at the factory.

Marine Hardware™, Inc. utilizes 70 manganese bronze for all yacht couplings. This alloy is very similar to that of propellers. The corrosion-resistant characteristic of this metal allows easy removal of the coupling from the shaft.

Our ski boat couplings are of 6061 T6 aluminum, anodized for corrosion resistance. The desirable qualities of this material are its light weight and sound-dampening properties. The stainless steel super-short Ski-Vee coupling is the industry's first with a self removal feature plus a simple self lock.



CTDT

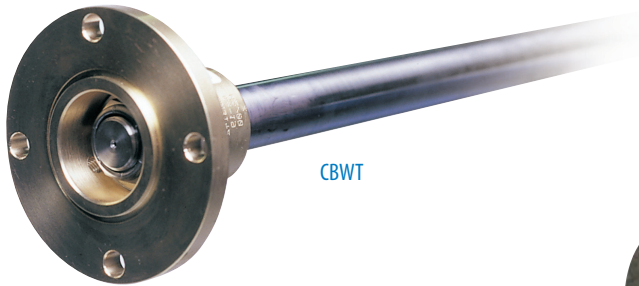


BW5 CBWR-STL

We offer Coupler Removal Tools. See Pg. 18



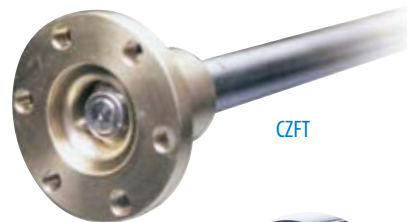
CWL-A



CBWT



CBW-S



CZFT



CBWR



CZFSVI



CBWT-A

Note: Steel couplings are available upon request. Specify either solid style or split. All steel couplings on shafts 2-1/2" and larger are heat treated.

## TYPES OF COUPLERS

Marine Hardware™, Inc. manufactures and assembles a variety of couplings to meet your needs. As always, if room allows, a double taper bronze coupling insures the tightest tolerances for better accuracies.

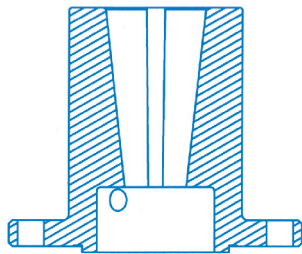
### TAPERED BORE STYLE

The many advantages of Marine Hardware™, Inc.'s tapered-bore coupler assembly have made it the style of choice for more than two decades. It has racked up an impressive durability and performance record in all types of craft from competition ski boats to large motor yachts.

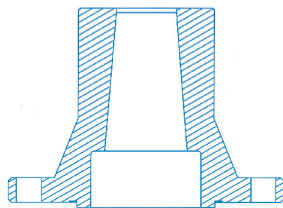
Tapered bore couplers offer many advantages over standard straight bore styles. Since the diameter of the shafting and exact bore diameter of a straight-bore coupler may vary from piece to piece, driving on a taper assures two major advantages:

- A snug and precise fit, yet very easy to disassemble
- A coupler which will run concentric with the shaft throughout an entire revolution (This makes alignment significantly easier, which in turn helps reduce vibration)

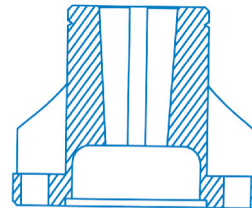
The Marine Hardware™, Inc., design team has engineered the most secure coupler-to-shaft locking system available for production boats. Heavy-duty set screws penetrate the coupler to seat against the nut on the shaft; these set screws are prevented from loosening by being tied together with high-strength wire. An absolute positive lock, yet still very accessible for service.



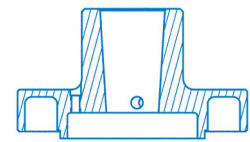
Tapered Bore Coupler Male Pilot



Tapered Bore Coupler Male Pilot



Tapered Bore Coupler Female Pilot



Ski Vee Coupler Male Pilot

### STRAIGHT BORE STYLE

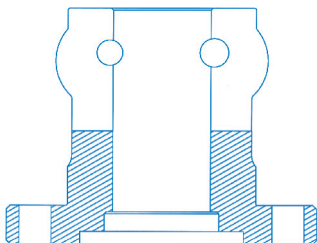
#### SPLIT STYLE

This straight bore style allows for easy removal and has bolts intersecting the shaft for reverse pull-out protection. Meets all ABYC specifications.

#### SOLID STYLE

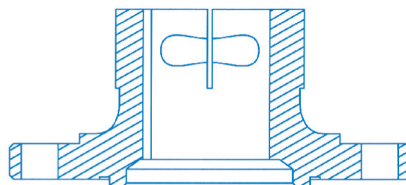
This straight bore style is secured by two set screws which seat in dimples on the shaft, to guard against slippage during reversing maneuvers.

Split Style



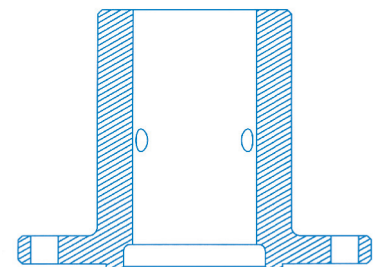
Straight Bore Split Style Female Pilot

Split Style



Straight Bore Split Style Male Pilot

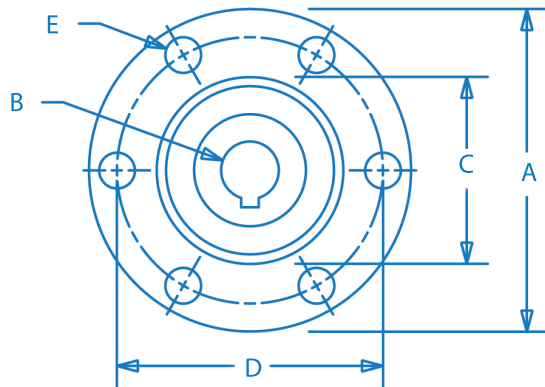
Solid Style



Straight Bore Solid Style Male Pilot

# Couplers

## HOW TO SPECIFY A COUPLER



The following dimensions are required to determine the correct application:  
Transmission Make and Model-if known

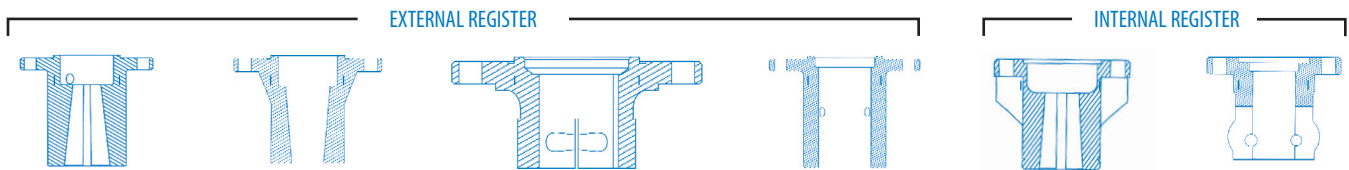
Bore Diameter (shaft diameter) Internal or External Register

A = Flange Diameter B = Bore/Shaft Dia.

D = Bolt Circle Diameter E = Diameter of Bolt

C = Register Diameter (a.k.a. registration ring or pilot)

\* please specify external (male) or internal (female)

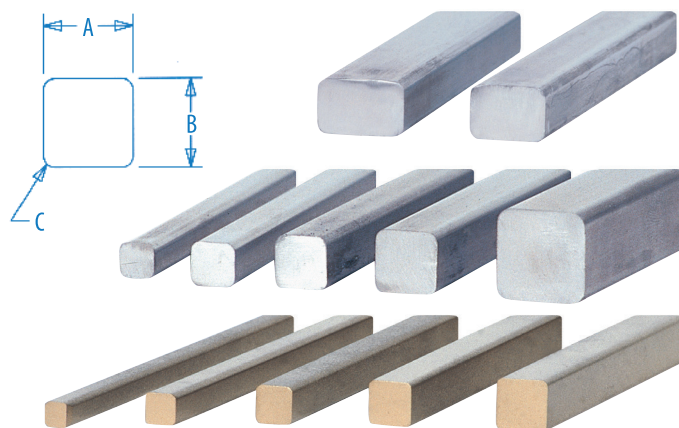


The following table is just a sample of the many sizes of couplers Marine Hardware™, Inc., manufactures. Please call with your specifications.

Name/Model	Flange Dia.	Pilot Dia. & Type	Bolt Circle	Bolt Size (dia.)	No. Holes	Bore Dia. Avail.	Length Overall	
							Tapered Bore	Straight Bore
Borg-Warner 71	4.00	2.50 External	3.25	3/8"	4	1" & 1-1/8"	3.00	2.25
B-W 72/Hurth 630	5.00	2.50 Ext.	4.25	7/16"	4	1-1/4" — 1-3/4"	3.00	2.25, 3.25
Velvet Drive 5000	5.00	2.50 Ext.	4.25	3/8"	4	1-1/4" — 1-3/4"	3.00	N/A
Borg-Warner 73	5.75	3.00 Internal	4.75	7/16"	8	1-1/2" — 2"	4.20	4.20
Caterpillar	5.75	3.00 Int.	4.75	5/8"	6	1-1/2" — 2"	4.20	Spc. Ord.
Twin Disc 502	4.75	2.50 Int.	3.88	7/16"	6	1-1/4" — 1-1/2"	4.25	3.70
Twin Disc 507	5.75	3.00 Int.	4.75	5/8"	6	1-1/2" — 2"	4.20	Spec. Ord.
Twin Disc 507A	7.25	3.75 Int.	6.00	3/4"	6	2" — 3"	7.38	N/A
Twin Disc 510A	9.00	6.00 Int.	7.50	7/8"	8	2" — 3-1/2"	7.38	N/A
Volvo Penta	100mm	60 mm Int.	80 mm	M10	4	1" — 1-1/2"	N/A	65 mm
Yanmar	3.95	1.97 Ext.	3.02	3/8" or M10	4	1" & 1-1/8"	3.50	N/A
Yanmar	4.72	2.55 Ext.	3.94	3/8" or M10	4	1" — 1-1/2"	N/A	2.75
Walters 26	3.50	2.00 Int.	2.88	3/8"	8	1" & 1-1/8"	2.95	N/A
Walters 36	4.00	2.00 Int.	3.25	3/8"	8	1" & 1-1/8"	2.95	N/A
ZF 25A	4.00	2.50 Int.	3.25	3/8"	4	1" & 1-1/8"	3.00	2.25
ZF 220A	4.75	2.50 Int.	3.88	7/16"	6	1-1/4" — 1-1/2"	4.25	3.70
ZF 63A and IV	5.25	2.50 Ext.	4.25	7/16"	4	1-1/4" — 1-3/4"	3.00	N/A
ZF 80A and IV	5.75	3.00 Int.	4.75	1/2"	6	1-1/2" — 2"	4.20	N/A
ZF 280A	5.75	3.00 Int.	4.75	5/8"	6	1-1/2" — 2"	4.20	N/A
ZF 302 IV and 311A	7.25	3.75 Int.	6.00	5/8"	8	2" — 3"	7.38	N/A
ZF 325-1 A	6.69	4.53 Int.	5.51	5/8"	12	1-3/4" — 2-1/2"	7.38	N/A
ZF45IV (Ski-Vee)	4.00	2.50 Ext.	3.25	7/16"	4	1" — 1-1/8"	2.12	N/A



This pre-radiused, extruded material is forged. Keystock comes in 12 foot lengths. Our custom-extruded stock fulfills the requirement for keys to be radiused on edges for proper fit in prop end of the shaft. Thus there is no contact in fillet areas of the keyway, where such contact would result in early shaft failure. These are the same high quality materials that are used for the keys in our Prop Nut Kits.



## RADIUSED - Square - 304 Stainless Steel

Part. No.	Size	Radius	Weight per 12'
	(A x B)	(C)	
KYSLSS-0.250-LB	1/4" x 1/4"	1/16"	2.32
KYSLSS-0.312-LB	5/16" x 5/16"	1/16"	3.74
KYSLSS-0.375-LB	3/8" x 3/8"	1/16"	5.52
KYSLSS-0.438-LB	7/16" x 7/16"	1/16"	7.56
KYSLSS-0.500-LB	1/2" x 1/2"	1/16"	9.96
KYSLSS-0.560-LB	9/16" x 9/16"	3/32"	12.50
KYSLSS-0.625-LB	5/8" x 5/8"	3/32"	15.80

## RADIUSED - Rectangle - 304 Stainless Steel

Part. No.	Size	Radius	Weight per 12'
	(A x B)	(C)	
KYSL-0.625R-LB	5/8" x 3/4"	3/32"	18.44
KYSL-0.875X0.625	7/8" x 5/8"	3/32"	20.00
KYSL-1.00X0.62	1" x 5/8"	3/32"	19.50

## PRE-CUT SINGLE PIECE KEYSTOCK-Rudder

Part. No.	Width	Length	Material
KEYS-RUDDER-1	1/4"	1"	Brass
KEYS-RUDDER-2	5/16"	1-1/4"	Brass
KEYS-RUDDER-3	5/16"	2"	Brass
KEYS-RUDDER-4	5/8"	5-3/8"	Brass
KEYS-RUDDER-5	1/2"	2"	Brass

## PRE-CUT SINGLE PIECE KEYSTOCK-Rudder

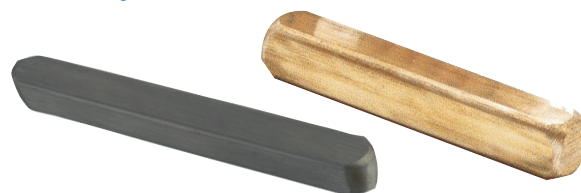
Part. No.	Width	Length	Material
KEYS-1.00SHAFT-PE	1/4"	1-1/4"	Brass
KEYS-1.12SHAFT-PE	1/4"	1-1/2"	Brass
KEYS-1.12SHAFT-PE-SS	1/4"	1-1/2"	SS
KEYS-1.25SHAFT-PE	5/16"	2"	Brass
KEYS-1.25SHAFT-PE-SS	5/16"	2"	SS
KEYS-1.50SHAFT-PE	3/8"	2"	Brass
KEYS-1.75SHAFT-PE	7/16"	2-5/8"	Brass
KEYS-2.00SHAFT-PE	1/2"	3-1/8"	Brass
KEYS-2.25SHAFT-PE	5/8"	4"	SS
KEYS-2.50SHAFT-PE	5/8"	4-1/2"	SS
KEYS-2.75SHAFT-PE	5/8"	5"	SS
KEYS-3.00SHAFT-PE	5/8"	6-1/4"	SS

## BRASS RADIUSED-360 Free Machining Brass

Compatible with all bronze propellers.

Part. No.	Size	Radius	Weight per 12'
	(A x B)	(C)	
KYBLBRS-0.250-LB	1/4" x 1/4"	1/32"	2.38
KYBLBRS-0.312-LB	5/16" x 5/16"	1/16"	3.74
KYBLBRS-0.375-LB	3/8" x 3/8"	1/16"	5.52
KYBLBRS-0.438-LB	7/16" x 7/16"	1/16"	7.56
KYBLBRS-0.500-LB	1/2" x 1/2"	1/16"	9.96
KYBLBRS-0.625-LB	5/8" x 5/8"	3/32"	15.80
KYBLBRS-0.625R-LB	5/8" x 3/4"	3/32"	18.44

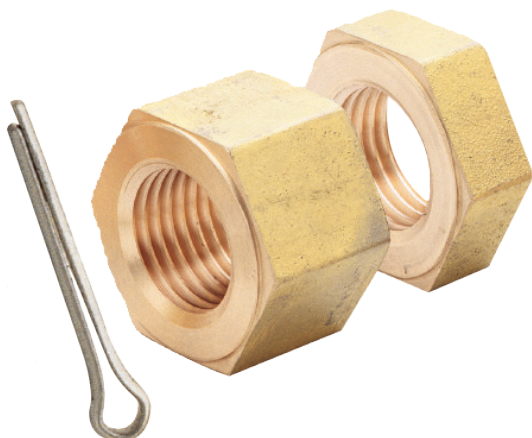
Sold in 12 ft. lengths.



## PRE-CUT SINGLE PIECE KEYSTOCK-Rudder

Part. No.	Size	Length	Material
KEYS-1.00SHAFT-CE	1/4"	1-1/2"	Brass
KEYS-1.00SHAFT-CE-SS	1/4"	1-1/2"	SS
KEYS-1.12SHAFT-CE	1/4"	1-1/2"	Brass
KEYS-1.12SHAFT-CE-SS	1/4"	1-1/2"	SS
KEYS-1.25SHAFT-CE	5/16"	1-5/8"	SS
KEYS-1.50SHAFT-CE	5/16"	2-3/8"	SS
KEYS-1.75SHAFT-CE	5/16"	2-3/8"	SS
KEYS-2.00SHAFT-CE	3/8"	3-1/8"	SS
KEYS-2.25SHAFT-CE	5/8"	3-5/8"	SS
KEYS-2.50SHAFT-CE	5/8"	4"	SS
KEYS-2.50SHAFT-CE-LG	5/8"	5"	SS
KEYS-2.75SHAFT-CE	5/8"	4-5/8"	SS
KEYS-3.00SHAFT-CE	5/8"	4-3/4"	SS

# Prop Nuts



All prop nuts are machined on a CNC turning center from extruded barstock. Material is compatible with XM21, Aquamet™ 19, Marinox or aquanox™ shafting and will not seize once installed. Prop nuts are made with extra wall thickness to mate compatibly with all propeller hubs, and a large washer face to allow easier tightening during installation. All features meet or exceed ABYC standards. Cotter pins are corrosion-resistant 304 18-8 stainless steel, sized as specified by ABYC. Keys are manufactured from pre-radiused extruded keystock for proper fit in prop end of shaft. Thus there is no contact in fillet areas where such contact would lead to early shaft failure.

Which nut comes first?

*Most experts suggest the jam nut should be against the propeller. The full nut should be installed last, furthest from the propeller. When the full nut installed against the jam nut and is torqued, the majority of that load or tension, is transferred to the full nut so it should engage more of the propeller shaft threads.*

## JAM PROP NUTS



Part No.	For Shaft Dia.	Thread
PNUTJAM-1.000-B	1" & 1-1/8"	3/4"—10
PNUTJAM-1.250-B	1-1/4"	7/8"—9
PNUTJAM-1.370-B	1-3/8"	1"—8
PNUTJAM-1.500-B	1-1/2"	1-1/8"—7
PNUTJAM-1.750-B	1-3/4"	1-1/4"—7
PNUTJAM-2.000-B	2"	1-1/2"—6
PNUTJAM-2.250-B	2-1/4"	1-3/4"—5
PNUTJAM-2.500-B	2-1/2"	1-3/4"—5
PNUTJAM-3.000-B	3"	2-1/4"—4-1/2
PNUTJAM-3.500-B	3-1/2"	2-1/2"—4
PNUTJAM-4.000-B	4"	3"—4

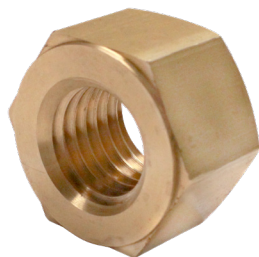


## COTTER PINS

304 stainless steel.

Part No.	Size
0270S125X1.25	1/8" x 1-1/4"
0270S125X1.50	1/8" x 1-1/2"
0270S156X1.50	5/32" x 1-1/4"
0270S156X1.50	5/32" x 1-1/2"
0270S156X2.00	5/32" x 2"
0270S188X1.75	3/16" x 1-3/4"
0270S188X2.00	3/16" x 2"
0270S188X3.00	3/16" x 3"
0270S250X2.25	1/4" x 2-1/4"
0270S250X3.0	1/4" x 3"

## FULL PROP NUTS



Part No.	For Shaft Dia.	Thread
PNUTFULL-1.000-B	1" & 1-1/8"	3/4"—10
PNUTFULL-1.250-B	1-1/4"	7/8"—9
PNUTFULL-1.375-B	1-3/8"	1"—8
PNUTFULL-1.500-B	1-1/2"	1-1/8"—7
PNUTFULL-1.750-B	1-3/4"	1-1/4"—7
PNUTFULL-2.000-B	2"	1-1/2"—6
PNUTFULL-2.250-B	2-1/4"	1-3/4"—5
PNUTFULL-2.500-B	2-1/2"	1-3/4"—5
PNUTFULL-3.000-B	3"	2-1/4"—4-1/2
PNUTFULL-3.500-B	3-1/2"	2-1/2"—4
PNUTFULL-4.000-B	4"	3"—4

## PROP NUT KITS

Complete kits include our nylock nut, pre-radiused key & stainless steel cotter pin.

Part No.	For Shaft Dia.	Thread
PNKT1.000-B	1" & 1-1/8"	3/4"—10
PNKT1.000-SL	1-1/4"	7/8"—9
PNKT1.125-B	1-3/8"	1"—8
PNKT1.125-SL	1-1/2"	1-1/8"—7
PNKT1.125-SS	1-1/8"	1-1/8"—7
PNKT1.250-B	2"	1-1/2"—6
PNKT1.250-SS	2-1/4"	3/4"—10
PNKT1.375-B	2-1/2"	1-3/4"—5



## FLANGED NYLOCK NUTS

Brass full nut with nylon insert and flange for optimal surface contact and positive lock.

Part No.	For Shaft Dia.	Thread
0251BF750-10NUT	1-1/4"	3/4"—10
0251BF1-8NUT	1-3/8"	1"—8



## SKI BOAT NYLOCK NUT

Brass full nut with nylon insert for positive lock. Class 3 thread.

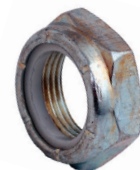
Part No.	For Shaft Dia.	Thread
0251B750-10	1 & 1-1/8"	3/4"—10



## CASTLE NUTS

Machine grooves to accept all cotter pin sizes. CNC Class 3 thread.

Part No.	For Shaft Dia.	Thread
PNUFULL-1.000-BCN	1"—1/8"	3/4"—10
PNUFULL-1.250-BCN	1-1/4"	7/8"—9
PNUFULL-1.375-BCN	1-3/8"	1"—8
PNUFULL-1.500-BCN	1-1/2"	1-1/8"—7
PNUFULL-1.750-BCN	1-3/4"	1-1/4"—7



## NYLOCK COUPLER NUTS

Zinc coated steel to prevent shaft gauling.

Part No.	Socket Size	Thread
0253ZINC0.750-10	1-1/16"	3/4"—10
0253ZINC1-4	1-7/16"	1"—14
0253ZINC1.25-7	1-13/16"	1-1/4"—7
0253ZINC1.25-12	1-13/16"	1-1/4"—12

# COUPLER REMOVAL TOOL

Marine Hardware™, Inc has developed two coupler removal tools for the ski/surf and wake boats shafts. We offer the Borg warner and Ski Vee coupler with threads on the inside of the register. We have also developed a Reverse Coupler Removal tool for those tight spaces. Using these tools will alleviate stress and save valuable time removing the coupler from hard to reach areas.



## BW-5 REVERSE STEEL COUPLER REMOVAL TOOL

With the reverse coupler next to the fuel tank, this tool makes removing the coupler very easy.

Part No.	For Shaft Dia.	Thread
CPLRTOOLKIT-ASSY-01	1-1/8"	3/4"—10
CPLRTOOLKIT-ASSY-02	1-1/4"	1"—14



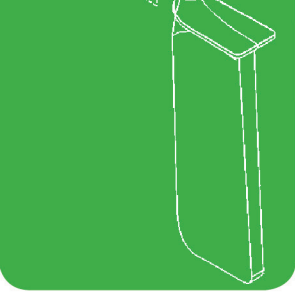
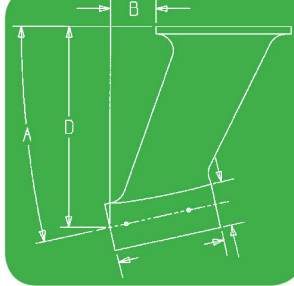
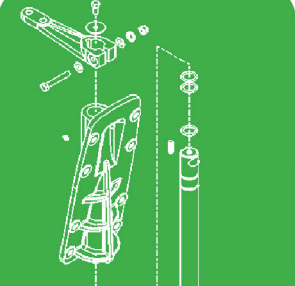
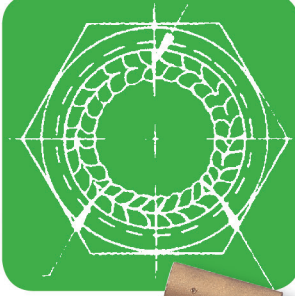
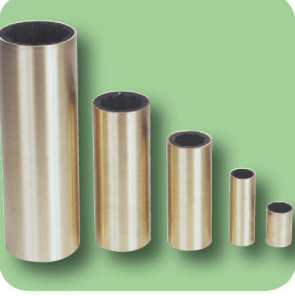
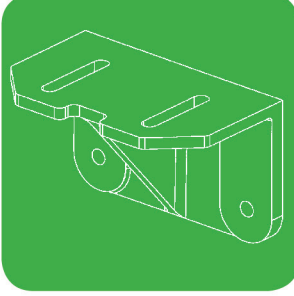
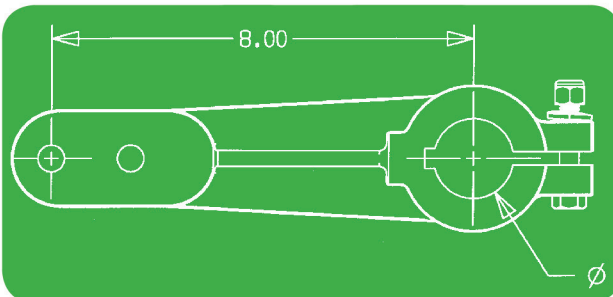
## BW-4 & SKI VEE COUPLER REMOVAL TOOL

This tool simply threads into the coupler and presses the shaft out of the coupler.

Part No.	For Shaft Dia.	Thread
CPLRTOOLASSY-01	1-1/8"	3/4"—10



# Struts & Rudders



# Process of Building a Replacement Strut

Marine Hardware™, Inc., has a wide variety of standard struts available. Give us a call to inquire. We can easily build tooling for your needs. We also remake struts from those damaged in the field, and offer excellent turnaround times to get the customer back on the water.

All Marine Hardware™, Inc. struts are cast of 70 manganese bronze, a material extremely corrosion-resistant and strong, yet malleable so it does not work-harden with vibration and stress over time. We manufacture single-leg (straight base and port/starboard angled bases), Vee-struts, and competition ski boat struts.

Struts can be machined with either countersunk mounting holes for standard flat head machine screws, or with square broached holes to firmly hold standard carriage bolts.

It is now generally accepted practice to use the latter system of carriage bolts; it facilitates a rapid single-person installation during assembly, and allows the future owner to insure bolt tightness without the need for a second person under the boat holding a screwdriver.

Our CAD programs generate 3D models and 2D drawings to confirm fitment and alignment of strut. We have decades of experience designing struts and casting patterns based on the mathematical proportions of design set out by ABYC standards, naval architects and our in-house design staff. In a matter of a few days, the model, drawing and pattern for casting will be generated from the basic dimensions the customer provided.

**Info needed:** shaft diameter, shaft angle, depth (or drop), and hull angle (if port and starboard required).



*Bent Strut*

*Pattern for Sand Casting*

*Finished Strut*

All struts are precision bored to meet ABYC and Navy standards for light press fit of brass-shelled rubber bearings. These interchangeable bearings are installed with stainless steel cup point set screws for a firm mechanical lock.

The length of the strut barrel (and bearing) is at least four times the diameter of the prop shaft. The thickness of the strut barrel is equal to at least one-fourth the diameter of the prop shaft. The average thickness of the leg(s) is determined by mathematical formula prescribed by the ABYC.

ABYC and Navy standards require backing plates or backing washers with four-bolt mounting, but not with six-bolt mounting, for shaft diameters up to four inches.

We take special pride in precision machining bases of all struts so the parts are interchangeable from boat to boat, and specified shaft angles are maintained.



## HOW TO ORDER A CUSTOM STRUT

When ordering a custom strut, please call, e-mail, or fax us with the following information:  
Please see appendix for custom strut worksheet.

### GENERAL SPECIFICATIONS

S = Shaft Diameter  
D = Drop (at aft end) B = Backsweep  
L = Barrel Length A = Shaft Angle  
T = Base Thickness C = Barrel O.D.

### BASE DIMENSIONS

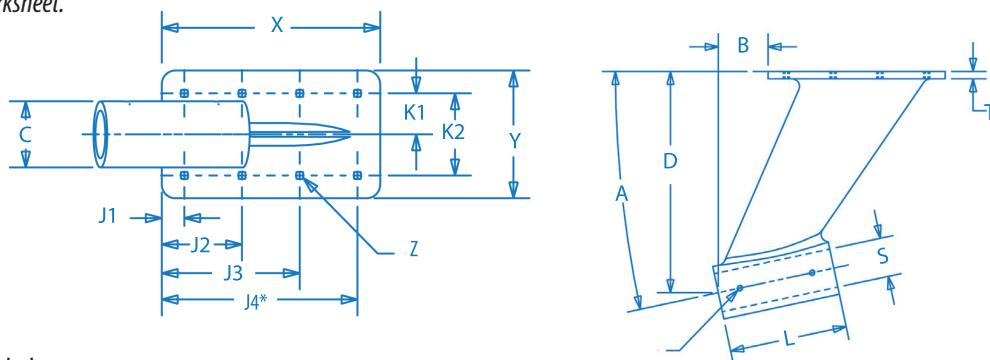
X = Length Y = Width

### HOLE PATTERN

Specify plain, countersunk, or broached hole.

Z = Nominal diameter of fasteners

J1, J2, J3, J4 (opt), K1, K2 = Hole locations

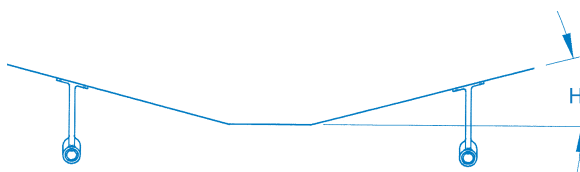


### HULL ANGLE

H = Hull Angle

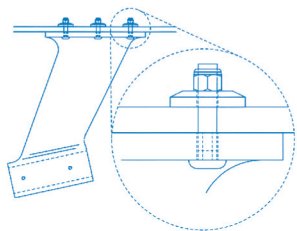
Specify port or starboard

Does not apply to single-screw boats.



## CUSTOM BACKING PLATES

Available on special order to fit all our struts.



## STRUT WASHERS

These washers replace the traditional backing plate and eliminate the problem of exact alignment of mounting holes from the strut base. Proven reliable and effective in the field.

Part No.	I.D.	O.D.	Thickness	Metal
STBW.38X1.50-B	3/8"	1-1/2"	5/16"	Brass
MMWS.50X2.00	1/2"	2"	5/16"	Aluminum

# Strut Bearings

Marine Hardware™, Inc. supplies water-lubricated brass-shelled rubber bearings with all our struts and has all bearing sizes listed below available for your replacement needs during regular maintenance of vessels.

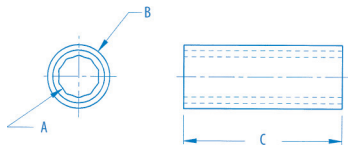
A good strut bearing reduces friction, dampens slight vibrations and misalignment, and flushes contaminants through the bearing to avoid abrasion that will mar the shaft surface. These functions are accomplished by having the bearing slightly oversized on the inside diameter, so that a thin film of water rides between the rubber surface and the stainless shaft. The grooved contour of the rubber surface is critical to the flow and circulation of water around the shaft.

A bearing worn by normal usage should be replaced during service to maintain that high level of mechanical performance.

Poor water lubrication in the bearing (usually caused by shaft misalignment or too tight a fit with the shaft) manifests itself in excessive bearing wear, transmission of shaft whip throughout the boat, and marring of the shaft surface.

When installing the strut bearing, it is important to have a light press fit between it and the bored casting, and to secure it mechanically with cup point stainless steel set screws. Be sure, however, not to collapse the bearing shell when installing the set screws, as it may then bind against the shaft.

Bearings with fiberglass outer shells are highly recommended for struts made of stainless steel, as they preclude the problem of dissimilar metals which would occur with a typical brass-shelled bearing. Fiberglass-shelled bearings with the same dimensions as listed below are available from Marine Hardware™, Inc. by special order.



## STRUT BEARINGS

Part No.	Shaft Dia.	Outside Dia.	Length
	(A)	(B)	(L)
SBRG1.00X1.25X20	1"	1-1/4"	2"
SBRG1.00X1.38X20	1"	1-3/8"	2"
SBRG1.00X1.25X40	1"	1-1/4"	4"
SBRG1.00X1.50X40	1"	1-1/2"	4"
SBRG1.00X1.62X40	1"	1-5/8"	4"
SBRG1.00X2.00X40	1"	2"	4"
SBRG1.12X1.62X45	1-1/8"	1-5/8"	4-1/2"
SBRG1.12X1.75X45	1-1/8"	1-3/4"	4-1/2"
SBRG1.12X2.00X50	1-1/8"	2"	5"
SBRG1.25X1.50X50	1-1/4"	1-1/2"	5"
SBRG1.25X1.75X50	1-1/4"	1-3/4"	5"
SBRG1.25X2.00X50	1-1/4"	2"	5"
SBRG1.25X2.12X50	1-1/4"	2-1/8"	5"
SBRG1.38X1.88X55	1-3/8"	1-7/8"	5-1/2"
SBRG1.38X2.00X55	1-3/8"	2"	5-1/2"
SBRG1.38X2.12X55	1-3/8"	2-1/8"	5-1/2"

Part No.	Shaft Dia.	Outside Dia.	Length
	(A)	(B)	(L)
SBRG1.38X2.38X55	1-3/8"	2-3/8"	5-1/2"
SBRG1.50X2.00X60	1-1/2"	2"	6"
SBRG1.50X2.38X60	1-1/2"	2-3/8"	6"
SBRG1.75X2.38X70	1-3/4"	2-3/8"	7"
SBRG1.75X2.62X70	1-3/4"	2-5/8"	7"
SBRG2.00X2.62X80	2"	2-5/8"	8"
SBRG2.00X3.00X80	2"	3"	8"
SBRG2.25X2.94X90	2-1/4"	2-15/16"	9"
SBRG2.25X3.12X90	2-1/4"	3-1/8"	9"
SBRG2.25X3.38X90	2-1/4"	3-3/8"	9"
SBRG2.50X3.12X10	2-1/2"	3-1/8"	10"
SBRG2.50X3.38X10	2-1/2"	3-3/8"	10"
SBRG2.75X3.38X11	2-3/4"	3-3/8"	11"
SBRG2.75X3.75X11	2-3/4"	3-3/4"	11"
SBRG3.00X3.75X12	3"	3-3/4"	12"
SBRG3.00X4.00X12	3"	4"	12"

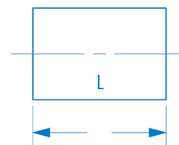
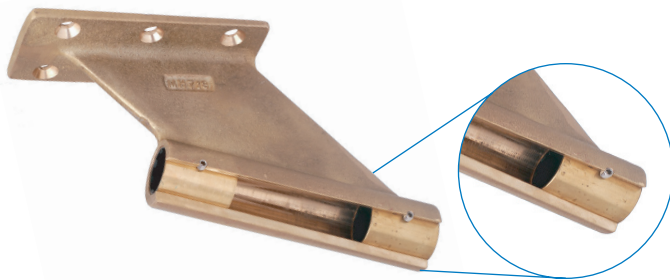
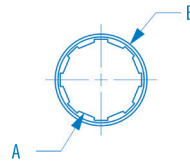


# Ski Boat Bearing

## SKI BOAT URETHANE BEARINGS

Marine Hardware™, Inc.'s proprietary blend of polyurethanes creates the ultimate ski boat strut bearing. Long endurance, thin wall, bonded to a brass shell, we can produce struts with smaller barrels allowing for a cleaner flow of water to the propeller.

Part No.	Shaft Dia.	Outside Dia.	Length
	(A)	(B)	(L)
SBRG1.12X1.38X2	1.12"	1.38"	2"
SBRG1.12X1.50X2.5	1.12"	1.50"	2.5"
SBRG1.25X1.50X2.5	1.25"	1.50"	2.5"

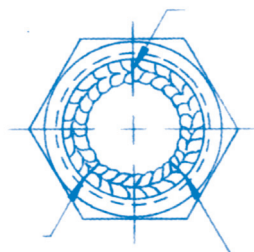
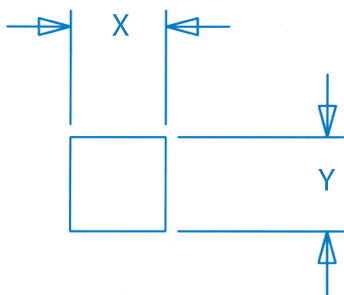


## Packing Material

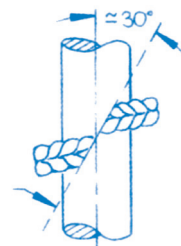
## COMPOSITE PACKING MATERIALS

A high-tech non-asbestos composite fiber impregnated with virgin PTFE in-suspension and internally saturated with a proprietary lubricant. Substantially less abrasive than asbestos, yet still able to withstand temperatures up to 500° F (200° C). Excellent watertight sealing ability with less required leakage at rest to compensate for frictional heat expansion when under way. Ideal replacement for standard flax packing material in shaft stuffing box and rudder box applications. Sold in two-foot lengths and in 1 lb. spools.

Part No.		Dimensions	
2 foot length	1 pound spool	X	Y
BPKG0.125-2	BPKG0.125-1LB (43')	1/8"	1/8"
BPKG0.188-2	BPKG0.188-1LB (36')	3/16"	3/16"
BPKG0.250-2	BPKG0.250-1LB (21')	1/4"	1/4"
BPKG0.312-2	BPKG0.312-1LB (14.5')	5/16"	5/16"
BPKG0.375-2	BPKG0.375-1LB (10.8')	3/8"	3/8"
BPKG0.438-2	BPKG0.438-1LB (8.3')	7/16"	7/16"
BPKG0.500-2	BPKG0.500-1LB (6.5')	1/2"	1/2"



Stagger seams during installation.



Cut at 30°.

# Hose Assemblies & Hoses

Marine Hardware™, Inc. stocks multi-ply reinforced marine hose for underwater and exhaust system applications. For custom lengths, please call or e-mail. Additional clamps available on request.

## SHAFT LOG HOSE ASSEMBLIES

Part No.	Dia.	Length	Clamps
HOSE1.50X4CL2	1-1/2"	3-1/2"	2
HOSE1.62X4CL2	1-5/8"	3-1/2"	2
HOSE1.75X4CL2	1-3/4"	4"	2
HOSE2.00X4CL2	2"	4"	2
HOSE2.25X4CL2	2-1/4"	4"	2
HOSE2.50X4CL2	2-1/2"	5-1/2"	2
HOSE3.00X4CL2	3"	5-1/2"	2
HOSE3.50X6CL2	3-1/2"	5-1/2"	2
HOSE4.00X6CL2	4"	6"	2
HOSE4.50X8CL2	4-1/2"	8"	2
HOSE5.00X8CL2	5"	8"	2
HOSE6.00X8CL2	6"	8"	2

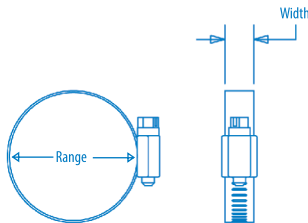


## SHAFT LOG HOSES

Part No.	Dia.	Length
HOSE1.50X4NC	1-1/2"	4"
HOSE1.62X4NC	1-5/8"	4"
HOSE1.75X4NC	1-3/4"	4"
HOSE2.00X4NC	2"	4"
HOSE2.25X4NC	2-1/4"	4"
HOSE2.50X4NC	2-1/2"	5-1/2"
HOSE3.00X4NC	3"	5-1/2"
HOSE3.50X5.5NC	3-1/2"	5-1/2"
HOSE4.00X6NC	4"	6"

\*Note: For best practice in application, we suggest using 2 clamps on each end as similarly called out by ABYC for exhaust systems.

# Clamps



## HOSE CLAMPS

All clamps have stainless steel band and components.

Part No.	SAE	Width	Range
HSCP6D0616	MINI #4	5/16"	1/4"–5/8"
HSCP6D0822	MINI #6	5/16"	5/16"–7/8"
HSCP5D1022	#06	1/2"	3/8"–7/8"
HSCP5D1125	#08	1/2"	7/16"–1"
HSCP5D1427	#10	1/2"	1/2"–1-1/16"
HSCP5D1332	#12	1/2"	1/2"–1-1/4"
HSCP5D1832	N/A	1/2"	11/16"–1-1/4"
HSCP5D1838	#16	1/2"	11/16"–1-1/2"
HSCP5D1870	N/A	1/2"	11/16"–2-3/4"
HSCP5D2144	#20	1/2"	3/4"–1-3/4"
HSCP5D2751	#24	1/2"	1"–2"
HSCP5D3357	#28	1/2"	1-1/4"–2-1/4"

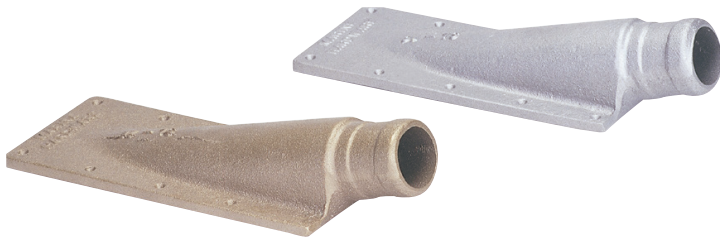
## HOSE CLAMPS

All clamps have stainless steel band and components.

Part No.	SAE	Width	Range
HSCP5D4063	#32	1/2"	1-1/2"–2-1/2"
HSCP5D4670	#36	1/2"	1-3/4"–2-3/4"
HSCP5D5276	#40	1/2"	2"–3"
HSCP5D5782	#44	1/2"	2-1/4"–3-1/4"
HSCP5D6489	#48	1/2"	2-1/2"–3-1/2"
HSCP5D7095	#52	1/2"	2-3/4"–3-3/4"
HSCP5D76101	#56	1/2"	3"–4"
HSCP5D84108	#60	1/2"	3-1/4"–4-1/4"
HSCP5D64114	#64	1/2"	2-1/2"–4-1/2"
HSCP5D76127	#72	1/2"	3"–5"
HSCP5D92140	#80	1/2"	3-1/2"–5-1/2"
HSCP5D108152	#88	1/2"	4"–6"

# Shaft Logs

Marine Hardware™, Inc., manufactures a variety of shaft log styles in aluminum or bronze to work in nearly all fiberglass boat applications, for any size shaft and shaft stuffing box you may have. These units are designed to be used with hose and clamps, allowing flexibility to compensate for shaft angle inaccuracies and shaft whip which is prevalent on long, non-supported shaft areas. Industry standards recommend a yearly inspection of the shaft log, seal, and hose; hoses should be replaced every two years. Hull inserts are available to O.E.M.s for all shaft log sizes, to aid in production uses of these items.



## ANGLED SHAFT LOGS

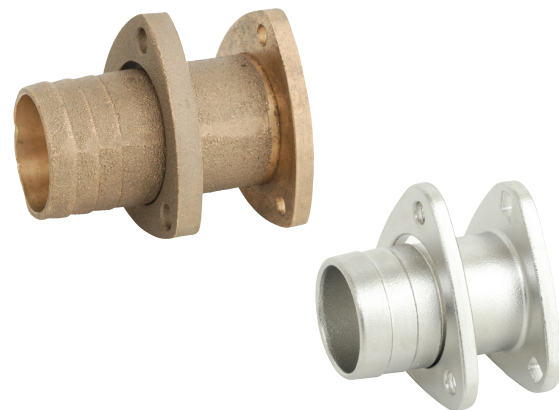
For boats without a shaft exit area cavity molded into the hull. Cast aluminum or red bronze; one size fits hose diameters of 1-1/2" and 1-5/8" up to 2, shaft angles of 12°, 14°, 15°, 16°, 17°, 18°, and 19°.

Part No.	Shaft Angle	Fits Hose Dia.
SHLG12162-B	12°	1-3/4"
SHLG14150-B	14°	1-3/4"
SHLG16150-A	15°/16°	1-5/8" - 1-3/4"
SHLG16150-B	15°/16°	1-5/8" - 1-3/4"
SHLG17DEG-B	17°	2"
SHLG18DEG-B	18°	2"
SHLG18DEG-B-EX	18°	2"
SHLG19DEG-B	19°	2"

## TRIANGLE FLANGE SHAFT LOGS

Cast red bronze, comes complete with backing plate. Square broached holes for simple carriage bolt installation. Available in aluminum by special order; please call or e-mail.

Part No.	Material	Fits Hose Dia.
TRFL1.625-B	Bronze	1-5/8"
TRFL1.625-S	S.S.	1-5/8"
TRFL1.750-B	Bronze	1-3/4"
TRFL2.500-B	Bronze	2-1/2"
TRFL3.000-B	Bronze	3"
TRFL3.500-B	Bronze	3-1/2"
TRFL3.500-S	S.S.	3-1/2"
TRFL4.500-B	Bronze	4-1/2"



## OVAL FLANGE SHAFT LOGS

Cast red bronze, available for various hose diameters of 1-3/4" – 3-1/2". 3/8" square broached holes for simple carriage bolt installation.

Part No.	Fits Hose Dia.	Neck Length
OVFL1.750-B	1-3/4"	1-3/4"
OVFL2.500-B	2-1/2"	3-1/8"
OVFL3.500-B-S	3-1/2"	3-5/8"
OVFL3.500-B-L	3-1/2"	5-1/2"



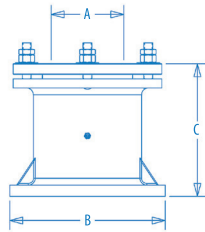
## RECTANGLE FLANGE SHAFT LOGS

Cast red bronze, available for various hose diameters of 1-5/8" – 1-3/4".

Part No.	Material	Fits Hose Dia.
RCFL1.625-B	Bronze	1-5/8"
RCFL1.750-B	Bronze	1-3/4"



# Shaft Stuffing Boxes



## COMMERCIAL STYLE - Bulkhead Mount Shaft Boxes

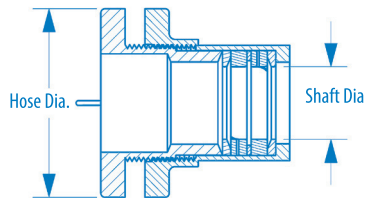
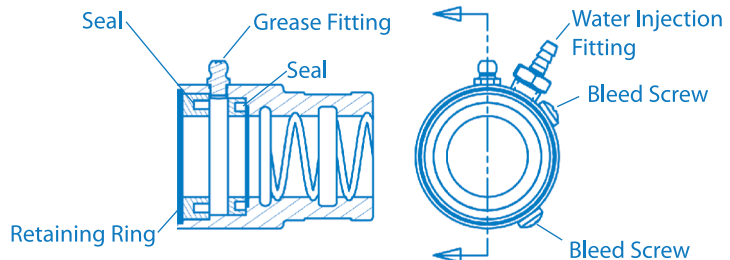
Universal style in cast red bronze with brass studs and fasteners. Available with or without lantern ring, water service, and/or special stern tube mount. Please contact our sales department with your unique specifications.

## BRASS SEAL TYPE - Shaft Stuffing Boxes

This precision-machined unit incorporates a water injected double seal design. It has a grease reservoir with a self-circulating grease supply that lubricates and cools the shaft and seals, and prevents water leakage into the boat. Our design utilizes a dual seal which balances and supports the shaft load, circulates the grease, and extends the life of the shaft seals.



Part No.	For Shaft Dia.	Fits Hose Dia.
SPST1.00X1.62-B	1"	1- 5/8"
SPST1.00-SEALKIT	1"	
SPST1.12X1.62-B	1-1/8"	1-5/8"
SPST1.12X1.75-B	1-1/8"	1-3/4"
SPST1.12-SEALKIT	1-1/8"	



## COMPOSITE SHAFT STUFFING BOX

Composite plastic designed for application in tournament ski boats. Durable material, assembled with teflon packing for years of faithful service.

Part No.	For Shaft Dia.	Fits Hose Dia.	Packing/Rows
SPNS1.000D1.75	1"	1-3/4"	5/16" — 2
SPNS1.125D1.75	1-1/8"	1-3/4"	1/4" — 2



# Shaft Stuffing Boxes

## GLAND STYLE - Shaft Stuffing Boxes

Cast red bronze, precision machined for best quality and performance. Brass studs are provided for metal compatibility and strength. Low abrasion PTFE-impregnated composite fiber packing material included. Fittings for water-cooling and electrical grounding are available, please specify if desired. Also available in cast aluminum by special order.

Part No.	Shaft Dia.	Fits Hose	Size — Packing Rows
SPGF1.25B3.0	1-1/4"	3"	5/16" — 3
SPGF1.38B2.5	1-3/8"	2-1/2"	3/8" — 3
SPGF1.38B3.0	1-3/8"	3"	3/8" — 3
SPGF1.50-SHORT	1-1/2"	2-1/2"	1/4" — 3
SPGF1.50B2.5	1-1/2"	2-1/2"	1/4" — 3
SPGF1.75B3.0	1-3/4"	3"	5/16" — 3
SPGF1.75-SHORT	1-3/4"	3-1/2"	5/16" — 3
SPGF1.75B3.50	1-3/4"	3-1/2"	5/16" — 3
SPGF2.00B3.5	2"	3-1/2"	1/4" — 3
SPGF2.25B3.5	2-1/4"	3-1/2"	3/8" — 2
SPGF2.50B3.5	2-1/2"	3-1/2"	1/2" — 2



## NUT STYLE - Shaft Stuffing Boxes

Cast red bronze with precision-machined threads. Left hand threads available on special orders only. Coolant fittings and electrical ground screw are available if specified. Unit comes complete with packing nut, jam nut, and composite fiber PTFE-impregnated packing material. Also available in cast aluminum by special order.

Part No.	Shaft Dia.	Fits Hose	Size — Packing Rows
SPNS1.00B1.6	1"	1-5/8"	1/4" — 3
SPNS1.00B1.75	1"	1-3/4"	1/4" — 3
SPNS1.125B1.62	1-1/8"	1-5/8"	3/16" — 3
SPNS1.125B1.75	1-1/8"	1-3/4"	3/16" — 3
SPNS1.125B2.25	1-1/8"	2-1/4"	3/16" — 3
SPNS1.25B2.2	1-1/4"	2-1/4"	1/4" — 3
SPNS1.25B2.5	1-1/4"	2-1/2"	1/4" — 3
SPNS1.50B2.5	1-1/2"	2-1/2"	1/4" — 3

## GLAND STYLE SERVICE BOLT



Part No.
SPGF25-ADPTR1.0

Part No.	Shaft Dia.	Fits Hose	Size — Packing Rows
SPGF2.50B4.5	2-1/2"	4-1/2"	1/2" — 2
SPGF2.75B4.5	2-3/4"	4-1/2"	N/A
SPGF3.00B4.5	3"	4-1/2"	1/4" — 3
SPGF3.50B5.0	3-1/2"	5"	N/A
SPGF4.00B6.00	4"	6"	1/2" — 2
SPGF4.50B8.0	4-1/2"	8"	1/2" — 2

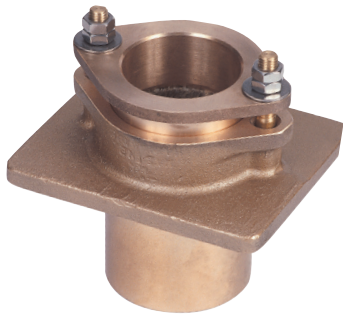
## REPLACEMENT NUTS

Replacement Packing & Jam Nuts are available. Contact Sales Department for sizing options and availability.



Part No.	Shaft Dia.	Fits Hose	Size — Packing Rows
SPNS1.75B2.5	1-3/4"	2-1/2"	5/16" — 3
SPNS1.75B3.0	1-3/4"	3"	5/16" — 3
SPNS1.75B3.50	1-3/4"	3-1/2"	5/16" — 3
SPNS2.00B3.0	2"	3"	1/4" — 4
SPNS2.50B3.5	2-1/2"	3-1/2"	3/8" — 2
SPNS2.50B4.0	2-1/2"	4"	3/8" — 2
SPNS3.00B4.5	3"	4-1/2"	N/A
SPNS3.00B5.0	3"	5"	N/A

# Rudder Stuffing Boxes



## GLAND STYLE

Manufactured of cast red bronze and machine finished to precise tolerances. Designed for internal mount, with a long neck below the flange for application in all hulls. Furnished with brass studs for metal compatibility and strength. Complete with flax packing in place. Backing plate available separately, please specify if desired. Mounting holes are optional so that these units may be fit to vessel under repair in the field. If you want factory-drilled holes, specify diameter and type of fasteners and hole location pattern, either machine screw or carriage bolt.

Part No.	Nom. Bore	Flange	Top Height	Neck Length	Size—Packing Rows
RBGF1.250-B	1-1/4"	4-1/2"x 4-1/2"	2-1/2"	2-3/8"	5/16"—3
RBGF1.375-B	1-3/8"	4-1/2"x 4-1/2"	2-1/2"	3-3/8"	1/4"—4
RBGF1.500-B	1-1/2"	4-1/2"x 4-1/2"	3-1/4"	3-1/2"	1/4"—3
RBGF1.750-B	1-3/4"	5"x 5"	3-1/2"	3-1/2"	5/16"—3
RBGF2.000-B	2"	6"x 4"	3-3/4"	4"	3/8"—3
RBGF2.250-B	2-1/4"	7"x 4-3/4"	3-3/4"	4"	7/16"—3
RBGF2.500-B	2-1/2"	7"x 4-3/4"	3-3/4"	4"	7/16"—2
RBGF2.750-B	2-3/4"	7"x 6"	3-1/2"	3-1/2"	3/8"—1
RBGF3.000-B	3"	7"x 6"	3-1/2"	3-1/2"	1/4"—4
RBGF3.500-B	3-1/2"	8"x 6-1/2"	3-5/8"	3-1/2"	3/8"—3
RBGF4.000-B	4"	8"x 6-1/2"	3-5/8"	3-1/2"	1/2"—2
RBGF5.000-B	5"	10"x 11"	4"	6"	5/8"—3

Also available in aluminum by special order. We also build heavy-duty extra-large rudder boxes for commercial vessels, please call, fax or e-mail your requirements.

Part No.	Nom. Bore	Flange (square)	Top Height	Flange Angle	Size—Packing Rows
RBNS1.000-0	1"	4-1/8"	3-1/2"	0° (flat)	1/4"—2
RBNS1.125-0	1-1/8"	4-1/8"	3-1/2"	0° (flat)	3/16"—2
RBNS1.250-0	1-1/4"	4"	4-1/2"	0° (flat)	1/4"—2
RBNS1.375-0	1-3/8"	4"	4-1/2"	0°	3/8"—2
RBNS1.375-15	1-3/8"	6"	4-3/8"	15°	3/8"—2
RBNS1.375-17	1-3/8"	6"	4-3/8"	17°	3/8"—2
RBNS1.500-0	1-1/2"	6"	5-1/2"	0° (flat)	5/16"—2
RBNS1.500-10	1-1/2"	6"	4-1/2"	10°	5/16"—2
RBNS1.500-12	1-1/2"	4-1/2"	5-3/4"	12°	5/16"—2
RBNS1.500-14	1-1/2"	6"	4-3/4"	14°	5/16"—2
RBNS1.500-15	1-1/2"	6"	4-3/4"	15°	5/16"—2
RBNS1.500-24	1-1/2"	6"	4-1/2"	24°	5/16"—2
RBNS1-750-0	1-3/4"	5"	6"	0° (flat)	1/4"—3
RBNS1-750-12	1-3/4"	6-3/16"	5-3/8"	12°	1/4"—3
RBNS2.000-0	2"	6"	6"	0° (flat)	1/4"—2
RBNS2.000-21	2"	6-1/8"	5-11/16"	21°	5/8"—2
RBNS2.250-0	2-1/4"	6"	6"	0° (flat)	3/8"—2

Also available in aluminum by special order. We also build heavy-duty extra-large rudder boxes for commercial vessels, please call, fax or e-mail your requirements.

## NUT STYLE

Cast red bronze, precision-machined, complete with flax packing, packing nut, jam nut, and backing plate. Backing plate has a large cut-out so it may be installed without removing the packing nut. Slotted backing plate for easy installation. This unit provides the best support for all styles of inboard rudders. Specify holes as counter sunk or square broached. Special tooling available for all hull angles, please specify if required.



# Rudder-Top Support Bearings

## RUDDER TOP SUPPORT BEARINGS

The rudder support bearing and safety collar work together to support stress and weight in inboard rudder installations. The support bearing holds the top of the rudder post steady, maintaining alignment and reducing "leverage" stress on the rudder box. Made of cast bronze.

Part No.	Fits Post Dia.	Mounts Bolt
IRSB-1.000-B	1"	1/4"
IRSB-1.125-B	1-1/8"	1/4"
IRSB-1.250-B	1-1/4"	3/8"
IRSB-1.375-B	1-3/8"	3/8"
IRSB-1.500-B	1-1/2"	3/8"
IRSB-1.750-B	1-3/4"	3/8"
IRSB-2.000-B	2"	1/2"
IRSB-2.500-B	2-1/2"	1/2"
IRSB-3.000-B	3"	1/2"
IRSB-3.500-B	3-1/2"	1/2"

Made of cast 70mag bronze. Precision machined.



## Safety Collars

## SAFETY COLLARS-304 Stainless Steel

The stainless steel rudder safety collar and support bearing work together to support stress and weight in inboard rudder installations. The safety collar ensures that the rudder will never drop down out of the boat should the tiller arm become loose for any reason, or if the rudder sustains a jarring blow such as a collision with a submerged obstacle.

Part No.	Fits Post Dia.	Width
IRSC1.000-S	1"	3/4"
IRSC1.125-S	1-1/8"	3/4"
IRSC1.250-S	1-1/4"	1"
IRSC1.375-S	1-3/8"	1"
IRSC1.500-S	1-1/2"	1"
IRSC1.750-S	1-3/4"	1-1/4"
IRSC2.000-S	2"	1-1/4"
IRSC2.500-S	2-1/2"	1-1/2"
IRSC3.000-S	3"	1-1/2"

Made of 304 stainless steel, precision machined. Safety collars come complete with two stainless steel set screws.



# Tiller Arms

Tiller arms are available in cast 70 manganese bronze or investment cast stainless steel. Bronze is noted for strength and resistance to work-hardening (becoming brittle). Stainless steel is noted for unsurpassed resistance to corrosion. Bores are precision-machined to ensure compatibility with rudder posts. Clevis pin holes are

drilled to precise tolerance to prevent slack and vibration in the steering feel. All length dimensions shown in part titles or tables are measured from center of bore to center of clevis pin hole. This allows easy steering ratio calculations. Every tiller arm comes complete with stainless steel clamping fasteners and nylock nut.

STRUTS/  
RUDDERS



## STRAIGHT-Ski Boat

Designed especially for competition ski boats, this "flat" style is also used as a replacement part for old style inboard boats of 16 to 20 feet. The flat style with 3/8" clevis hole fits the majority of all recent steering systems in ski boats. Comes complete with stainless steel fasteners and nylock nut.

Part No.	Material	Bore Dia.	Length	Bolt	Key
TATS1.000-5	70 Mag Brz	1"	5-1/8"	Non-intersecting	1/4"
TATS1.000X5-IB	70 Mag Brz	1"	5-1/8"	Intersecting	1/4"
TATS1.000X5-S	Stainless Steel	1"	5-1/8"	Intersecting	1/4"
TATS1.000X6-IB	Stainless Steel	1"	6"	Intersecting	1/4"
TATS1.125-5	70 Mag Brz	1-1/8"	5"	Intersecting	1/4"

## COUNTERWEIGHT SKI BOAT TILLER ARM

Otherwise known as a heavy tiller or a counter-balanced tiller, it's the function that counts. As the propeller blade passes by the leading edge of the rudder a slight pulse is felt. This pulsing or vibration is amplified as the boat is accelerating or loading on a turn. This vibration generally travels to the tiller arm and it shakes, in doing so the steering cable shakes inside its protective sleeve housing and creates both an irritable vibration noise inside the boat and puts undue stress on the steering helm gear. To eliminate this vibration and excessive wear, this mass dampened design absorbs the vibration shock and does not allow it to affect the steering cable or steering gear housing.

Part No.	Material	Bore Dia.	Length	Bolt	Key	Offset
TAGN1.005-5-SS-CW	304 SS	1"	5-1/2"	Intersecting	1/4"	5/8"

Built under license from Malibu boats.



## GOOSENECK-Ski Boat

Used extensively in many of the most current competition ski boats. Bore is offset in the vertical dimension from the level of the clevis pin hole. Comes complete with stainless steel fasteners and nylock nut.

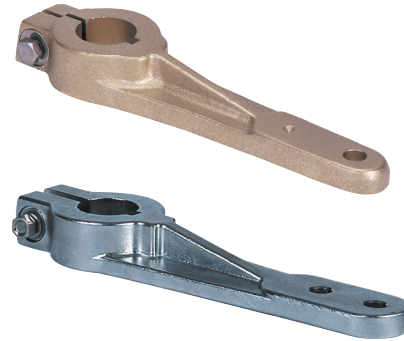
Part No.	Material	Bore Dia.	Length	Bolt	Key	Offset
TAGN-1.000-5	70 Mag Brz	1"	5-1/2"	Intersecting	1/4"	5/8"
TAGN-1.00X5.5-1.0	Stainless Steel	1"	5-1/2"	Intersecting	1/4"	1"



## 7" STANDARD TILLER ARMS

Comes complete with stainless steel fasteners and nylock nut.

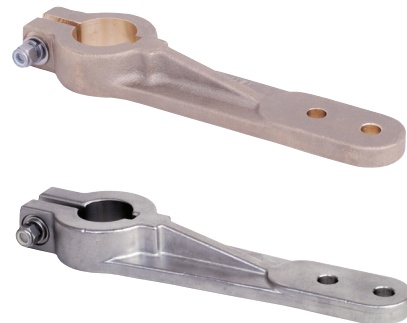
Part No.	Material	Bore Dia.	Key
TAHR1.250-7	70 Mag Brz	1-1/4"	5/16"
TAHR1.375-7	70 Mag Brz	1-3/8"	5/16"
TAHR1.500-7.5S	Stainless Steel	1-1/2"	3/8"



## 8" STANDARD TILLER ARMS

Comes complete with stainless steel fasteners and nylock nut.

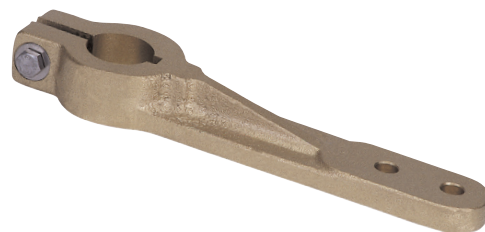
Part No.	Material	Bore Dia.	Key
TAHR1.250-8	70 Mag Brz	1-1/4"	5/16"
TAHR1.375-8	70 Mag Brz	1-3/8"	5/16"
TAHR1.500-8	70 Mag Brz	1-1/2"	3/8"
TAHR1.500-8S	Stainless Steel	1-1/2"	3/8"
TAHR1.750-8	70 Mag Brz	1-3/4"	7-16"



## 10" STANDARD TILLER ARMS

Comes complete with stainless steel fasteners and nylock nut.

Part No.	Material	Bore Dia.	Key
TAHL1.250-1	70 Mag Brz	1-1/4"	5/16"
TAHL1.375-1	70 Mag Brz	1-3/8"	5/16"
TAHL1.500-1	70 Mag Brz	1-1/2"	3/8"
TAHL1.750-1	70 Mag Brz	1-3/4"	7-16"



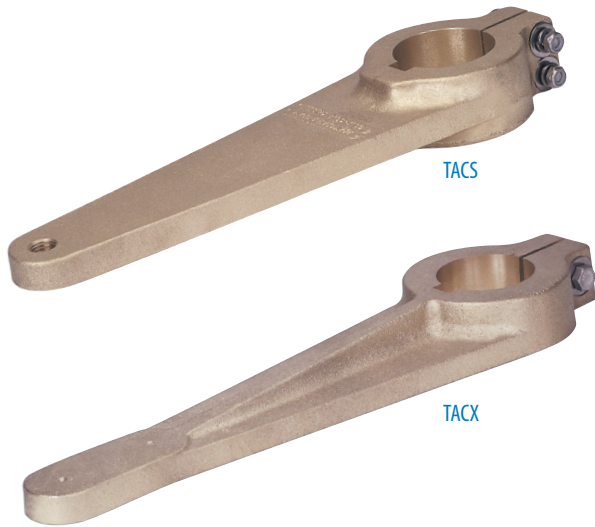
## 12" STANDARD TILLER ARMS

Comes complete with stainless steel fasteners and nylock nut.

Part No.	Material	Bore Dia.	Key
TAHL2.000-12	70 Mag Brz	2"	1/2"
TAHL2.250-12	70 Mag Brz	2-1/4"	9/16"
TAHL2.500-12	70 Mag Brz	2-1/2"	5/8"
TAHL2.00-6/12-X	70 Mag Brz	2"	1/2"
TAHL2.25-6/12-X	70 Mag Brz	2-1/4"	9/16"
TAHL2.50-6/12-X	70 Mag Brz	2-1/2"	5/8"



# Tiller Arms



## 16" STANDARD TILLER ARMS

For larger motor yachts and commercial boats. There are two styles to choose from, either centered arm (TACS) or flat under side (TACX). Comes complete with stainless steel fasteners and nylock nut.

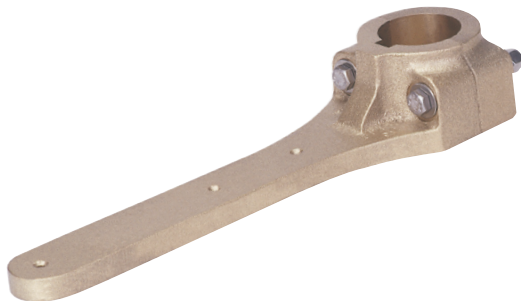
Part No.	Material	Bore Dia.	Key
TACS2.000-16	70 Mag Brz	2"	1/2"
TACS2.250-16	70 Mag Brz	2-1/4"	9/16"
TACS2.500-16	70 Mag Brz	2-1/2"	5/8"
TACX2.000-16	70 Mag Brz	2"	1/2"
TACX2.250-16	70 Mag Brz	2-1/4"	9/16"
TACX2.500-16	70 Mag Brz	2-1/2"	5/8"
TACX2.750-16	70 Mag Brz	2-3/4"	5/8"
TACX3.000-16	70 Mag Brz	3"	3/4"
TACX3.500-16	70 Mag Brz	3-1/2"	3/4"



## 18" STANDARD TILLER ARMS

Cast of 70 manganese bronze and comes complete with stainless steel fasteners and nylock nut.

Part No.	Bore Dia.	Key
TACS3.50-18	3-1/2"	3/4"
TACS3.75-18	3-3/4"	3/4"
TACS4.00-18	4"	3/4"



## 11-1/2" COMMERCIAL CLAMP STYLE

Our commercial choice for all retro fit applications. Will fit any shaft without removing the rudder. Cast of 70 manganese bronze and comes complete with stainless steel fasteners and nylock nut.

Part No.	Bore Dia.	Key	Length Range
TACR1.375-10	1-3/8"	5/16"	5"-10"
TACR1.500-10	1-1/2"	3/8"	5"-10"
TACR1.750-10	1-3/4"	7/16"	5"-10"
TACR2.000-10	2"	1/2"	5"-10"
TACL1.750-14	1-3/4"	7/16"	5"-14"
TACL2.000-14	2"	1/2"	5"-14"

# Clevises & Tie Bars

## CLEVISES

We manufacture steering tie-bars of 1" or 1-1/8" diameter stainless steel barstock for greatest strength and corrosion resistance. Ends are turned and threaded to 1"-12" at both ends to accommodate our clevises, which fit virtually any tiller arm. Assemblies include jam nuts as shown.

Part No.	Material	Thread	Pin Hole
CLVS1.00-0.50-B	70 Mag Brz	1"-12 UNF-2B	1/2"
CLVS1.00-0.50-S	S.S.	1"-12 UNF-2B	1/2"
CLVS1.00-0.75-B	70 Mag Brz	1"-12 UNF-2B	3/4"
CLVS1.00-0.75-S	S.S.	1"-12 UNF-2B	3/4"



## STEERING CLAMP

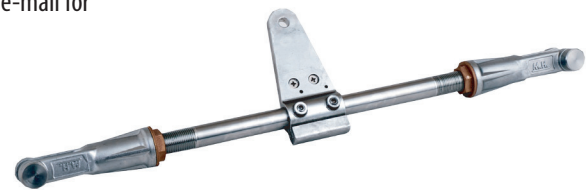
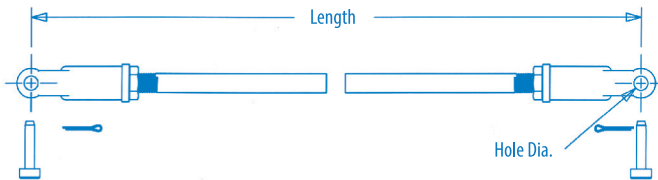
Part No.	Material
SSBT00001	SS

Unique design works with all Marine Hardware™, Inc. tie bars. These can easily be added to existing systems.



## TIE BARS

Tie-bars are custom made to your specified dimensions and clevis-pin holes drilled to your specification of pin diameter (Clevis-pins available on request). Please call, fax or e-mail for a quote.



## Motor Mounts

### MOTOR MOUNTS

All Marine Hardware™, Inc. motor mounts are sand cast of type 713 corrosion-resistant aluminum. Generally, boatbuilders have us tool for their custom design. Send us your drawing and let us create pattern and production parts for you.

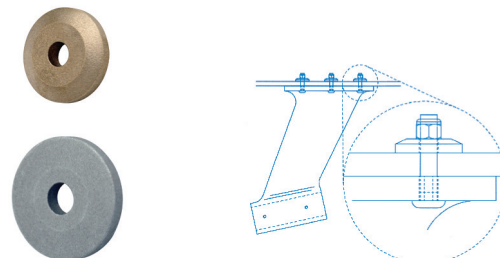
Part No.	Description
MMNT0.375-A	Motor mount with 1/2" slots & 3/8" holes
MMNT35834	Motor mount ED
MMNT53695	Motor mount with 1/2" hole (gas)
MMNT57268	Port & starboard motor mounts
MMNT59726	Motor mount gas inboard 5X5 deep w/ slots



### MOTOR MOUNT WASHERS

These heavy-duty, large O.D. washer is designed specifically for motor mount use. They spread the compression load so the fiberglass is not fractured.

Part No.	I.D.	O.D.	Thickness	Metal
MMWS.50X2.00	1/2"	2"	5/16"	Aluminum
STBW.38X1.500	3/8"	1-1/2"	5/16"	Brass



# Outboard Rudder Assemblies

Marine Hardware™, Inc. is the largest manufacturer of outboard rudder assemblies in the world. Marine Hardware™, Inc. rudder systems are designed for strength, safety, and performance. They have stood the test of time by delivering years of dependable service in the field.

Marine Hardware™, Inc.'s outboard rudder configuration is an intelligent choice for many power boats. It allows the strut and propeller to be moved further aft, sending prop noise behind the boat; it also allows use of a shallow shaft angle, which improves efficiency. This design lets the entire power plant be moved aft, in cases where interior bulkhead and engine room locations are critical.

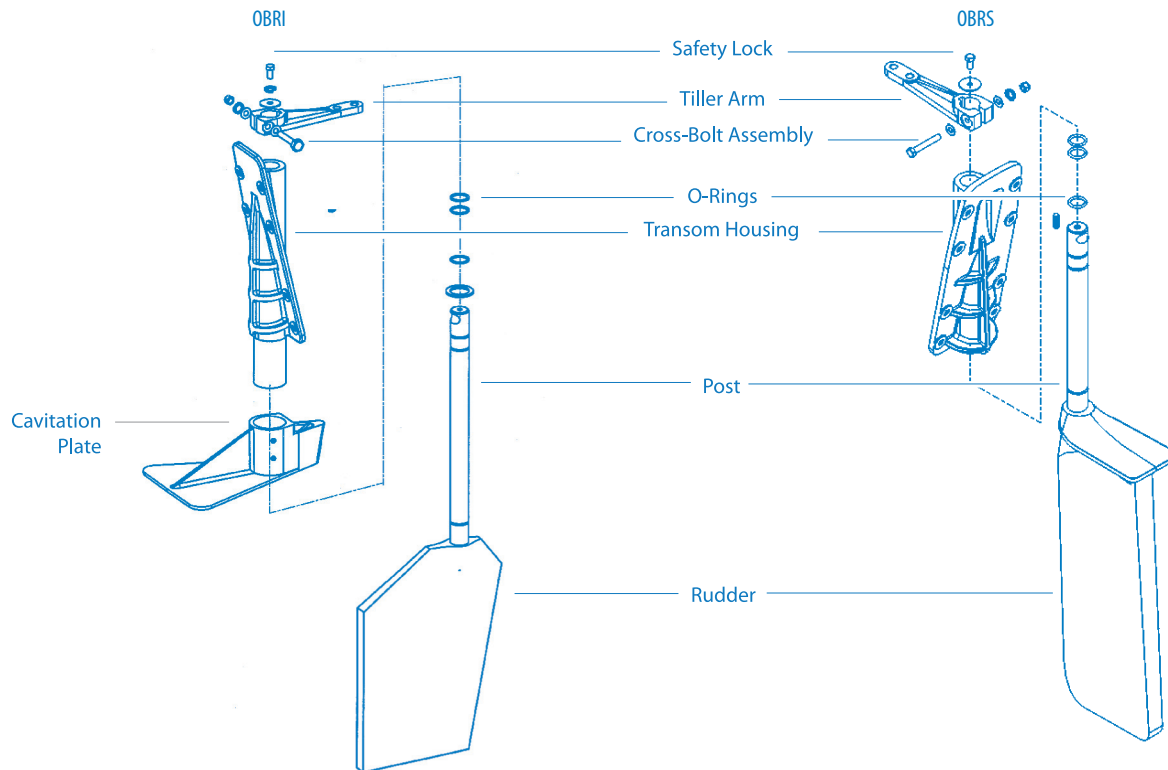
Outstanding performance is also a major consideration in our outboard rudder design. We incorporated the maximum leading edge to optimize steering, avoiding over steering yet providing adequate control in following seas. We also manufacture special blade designs to help correct any hull problems you may encounter in either transom configuration/installation or hydrodynamics.

We offer three different styles to accommodate nearly all application criteria. We invite your questions and interest in this quality Marine Hardware™, Inc. product.

**Engineering Note:** All our assemblies utilize a 70 manganese bronze blade to maximize strength and resist corrosion, yet be flexible enough to yield in high stress turns and not work-harden. This blade is cast directly onto the stainless steel post, a process



perfected by Marine Hardware™, Inc. The rudder post is engineered with an integral breakaway point. Should the blade hit an obstruction, the rudder will fail, but damage to the transom housing with its potential for serious hull leakage will be minimized.





# Outboard Rudder Assemblies

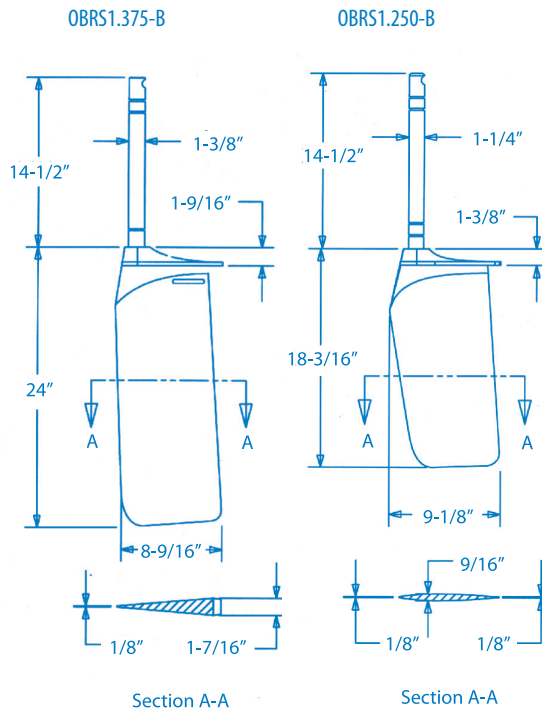
## MODEL OBRS

Our exclusive original design includes a one-piece transom housing for easy installation and alignment. Multiple o-rings for assured leak protection. Standard cavitation blade angle is designed for 8° to 12° transom angle. Mounts with eight 3/8" carriage bolts, tiller arms connect with 1/2" bolts. OBRS model blades have 120 sq. inch of surface area and 160 sq. inch respectively.

Part No.	Post Dia.	Boat Length
OBR51.250-B	1-1/4"	28' to 32'
OBR51.375-B	1-3/8"	32' to 46'

## OBRS-Replacement Parts

Part No.	Description	Application
OBR51.250-TRHS	Transom Housing	OBR51.250-B
CUSTRBP6144	Blade & Post	OBR51.250-B
OBR51.375-TRHS	Transom Housing	OBR51.375-B
CUSTRBP12059	Blade & Post	OBR51.375-B



## MODEL OBRI

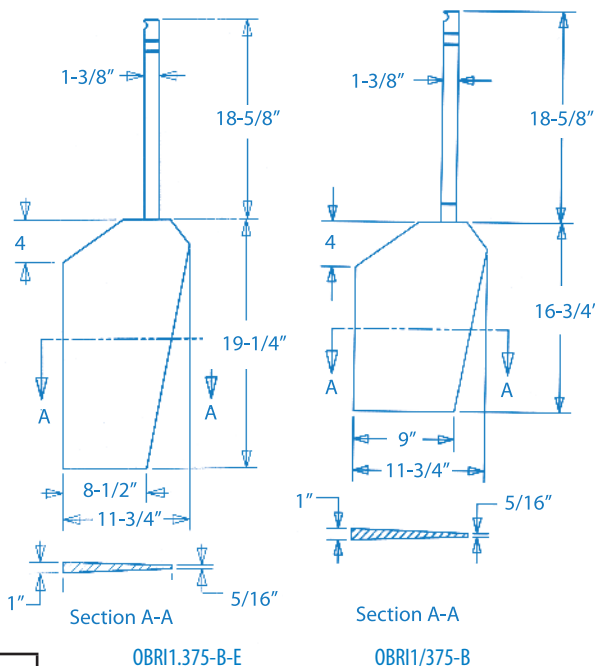
Features a separate oversized cavitation plate. In mounted position, this plate is 4" below the water surface relative to the boat bottom, and prevents air from infiltrating down to the rudder blade. This effect increases rudder pressure, resulting in better rudder performance. This blade is designed for tunnel applications. When not using tunnels, or in high speed applications, the longer-blade model is recommended to capture the high pressure from the propeller wash.

Part No.	Post Dia.	Boat Length
OBRI1.375-B	1-3/8"	28' to 46'
OBRI1.375-B-E	1-3/8"	32' to 50'

Depending on speed and steering geometry, longer tiller arms are available for these rudders. The longer-blade rudders utilize rudder posts made of material with torsional yield of minimum 70,000 lbs.

## OBRI-Replacement Parts

Part No.	Description	Application
OBRI1.375-LTRHS	Transom Housing	OBRI1.375-B/B-E
OBRI1.375-CP	Cavitation Plate	OBRI1.375-B/B-E
CUSTRBP51251	Blade & Post	OBRI1.375-B
CUSTRBP51251-E	Blade & Post	OBRI1.375-B-E



# Inboard Rudders

All Marine Hardware™, Inc., rudders are designed and refined from many years of boating experience, from uses such as recreational cruisers to record-setting inboard racing runabouts. Without a doubt, we are the inboard rudder design experts.

These rudders incorporate the swedging technique, wherein the bronze blade is cast on to a stainless steel post. This design allows us flexibility from boat to boat to accommodate tiller arm heights, engine stringers, upper support bearings, etc. We have also designed our family of rudders to incorporate breakaway points in the post. If an obstruction is hit, the blade and post will fail first at a point below the hull before disabling or breaking loose the rudder box itself, which would cause a life-threatening emergency.

Our rudders are all designed with an optimum leading edge formula to suit their application. This gives the operator an easy steering wheel feel which will not pull in either direction at any point in a turn, a problem known as over steer or under steer condition.

Our inboard rudders are designed to use our rudder boxes and top bearing support. We recommend this method of installation for all inboard rudder systems. It utilizes a rudder box support parallel with the hull laminate and gains great structural strength by tying into engine stringers. This type of installation will ensure years of trouble-free performance.

For boats with inherent handling difficulties, please contact our design department to develop a rudder to perform to your handling expectations. Our years of experience creating unique rudder shapes and profiles allow us to meet any challenge with confidence and ultimate success.



STANDARD



PERFORMANCE

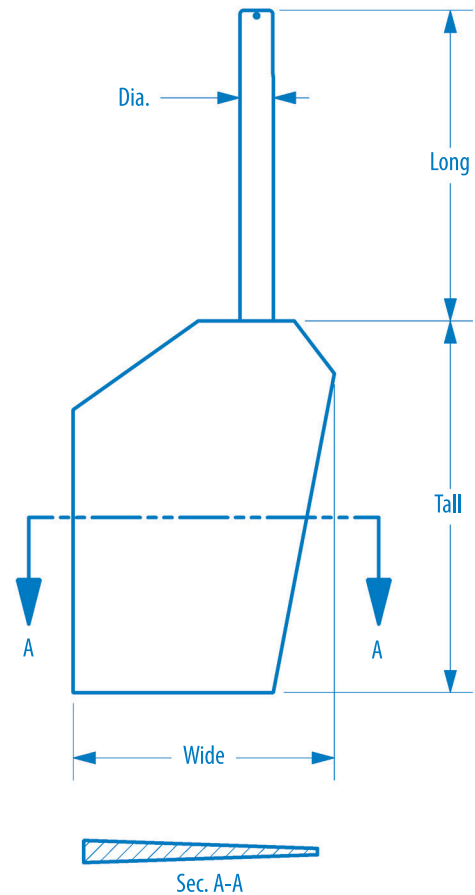


NORDIC

# Inboard Rudders

## PERFORMANCE STYLE

Marine Hardware™, Inc.'s highest performance inboard rudder is designed for vessels traveling 15 knots or faster. A wedge shape keeps maximum water contact on the blade shape at all speeds and eliminates drift or wander. This shape typically weighs significantly more than its standard counterpart. If speed and performance is desired, this is the perfect choice. Available in all sizes from 1" to 2-1/2" post. This high performance rudder, as with all Marine Hardware™, Inc.'s, units include an integral breakaway post design. All performance style rudders come complete with a standard stainless steel post. All blades are standard, 10% leading edge.



## RPBC INBOARD RUDDERS

Cast of 70 manganese bronze, stainless steel post. 10% leading edge.

Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPBC1712-1.12	17"	12"	1-1/8"	Specify
RPBC1712-1.25	17"	12"	1-1/4"	Specify
RPBC1712-1.38	17"	12"	1-3/8"	Specify
RPBC1712-1.50	17"	12"	1-1/2"	Specify
RPBC2012-1.25	20"	12"	1-1/4"	Specify
RPBC2012-1.38	20"	12"	1-3/8"	Specify
RPBC2012-1.50	20"	17"	1-1/2"	Specify
RPBC2017-1.50	20"	17"	1-1/2"	Specify
RPBC2017-1.75	20"	17"	1-3/4"	Specify
RPBC2012-1.75	20"	17"	1-3/4"	Specify

Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPBC2415-1.38	24"	15"	1-3/8"	Specify
RPBC2415-1.50	24"	15"	1-1/2"	Specify
RPBC2415-1.75	24"	15"	1-3/4"	Specify
RPBC2417-1.50	24"	17"	1-1/2"	Specify
RPBC2417-1.75	24"	17"	1-3/4"	Specify
RPBC2417-2.00	24"	17"	2"	Specify
RPBC2917-2.00	29"	17"	2"	Specify
RPBC2917-2.25	29"	17"	2-1/4"	Specify
RPBC2917-2.50	29"	17"	2-1/2"	Specify
RPBC2917-2.75	29"	17"	2-3/4"	Specify
RPBC3626-3.50	36"	26"	3-1/2"	Specify

# Inboard Rudders

## STANDARD INBOARD RUDDER

Marine Hardware™, Inc.'s standard inboard rudder family incorporates the maximum blade area that can be supported with the corresponding rudder post diameter.

The standard rudders are designed to optimize value of shape versus weight and typically work well with most hull shapes.

All standard inboard rudders have 10% leading edge to provide easy steering. As with all Marine Hardware™, Inc. rudders, a standard post is swedged into bronze casting and designed with an integral breakaway point.

This design also works well with all inboard boats utilizing tunnels or pockets relieving pressure during turning maneuvers with the blade blocking the tunnel exit.

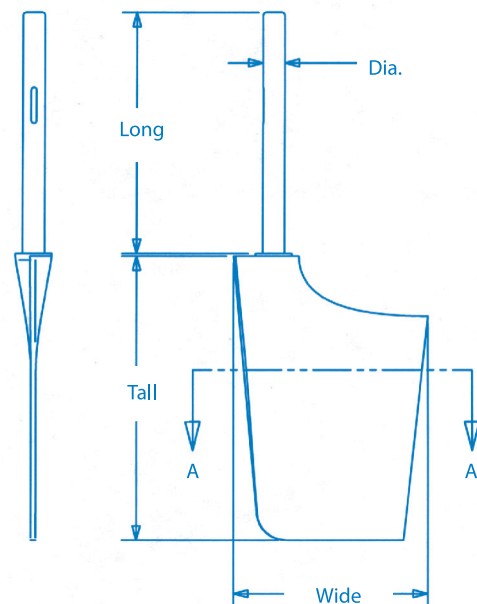
From tournament ski boats to charter vessels, thousands of our standard rudder applications are successfully in use today.



## STANDARD INBOARD RUDDERS

Cast of 70 manganese bronze, stainless steel post. 10% leading edge.

Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPTR1.000-B	13"	8-1/2"	1"	Specify
RPTR1.125-B	13"	8-1/2"	1-1/8"	Specify
RPTR1.250-B	13"	8-1/2"	1-1/4"	Specify
RPII1.250-B	15"	9"	1-1/4"	Specify
RPII1.375-B	15"	9"	1-3/8"	Specify
RPIM1.250-B	17"	11-1/2"	1-1/4"	Specify
RPIM1.375-B	17"	11-1/2"	1-3/8"	Specify
RPIL1.250-B	20"	12"	1-1/4"	Specify
RPIL1.375-B	20"	12"	1-3/8"	Specify
RPIL1.500-B	20"	12"	1-1/2"	Specify





# Inboard Rudders

## NORDIC STYLE

The oversized blade configuration is designed for vessels 35 to 65 feet long. Also for vessels that move at slower speeds to 15 knots, yet still want great docking maneuverability.

This blade shape uses a 20% leading edge and is also recommended on vessels that have a center keel. The extreme leading edge offsets the keel steering effects.

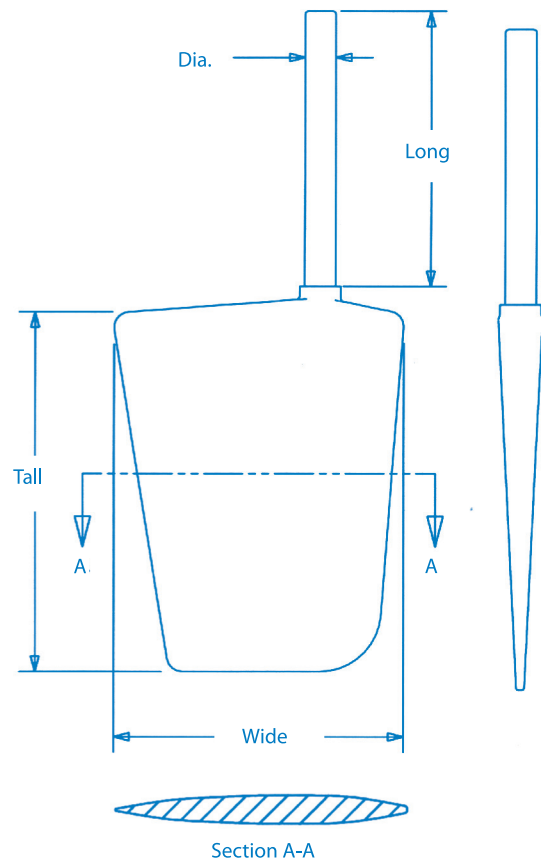
Cast of 70 manganese bronze and is manufactured with a stainless steel post. Available for vessels 35 feet and larger. Post sizes begin at 1-1/2" to 2-1/2". All Nordic blades utilize an airfoil shape and are tapered from top to bottom.



## RPIX INBOARD RUDDERS

Cast of 70 manganese bronze, stainless steel post. 10% leading edge.

Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPIX2012-1.50	20"	12"	1-1/2"	Specify
RPIX2517-1.50	25"	17"	1-1/2"	Specify
RPIX2517-1.75	25"	17"	1-3/4"	Specify
RPIX2519-1.75	25"	19"	1-3/4"	Specify
RPIX2519-2.00	25"	19"	2"	Specify
RPIX2519-2.25	25"	19"	2-1/4"	Specify
RPIX3019-2.00	30"	19"	2"	Specify
RPIX3019-2.25	30"	19"	2-1/4"	Specify



# Tournament Ski Boat Rudder Assemblies

Marine Hardware™, Inc., carries a complete line of unique rudders for enhanced performance of competition ski boats. In this type of boat, handling often makes the difference between winning and losing. The boat must work for the skier, not create a new set of obstacles. Marine Hardware™, Inc. rudder assemblies are original equipment on many major competition ski boats and the number is increasing all the time.

The benefits of factory-assembled rudder systems are assurance of quality workmanship, fast and easy installation, and ease of replacement if repair

is needed. As with our larger rudders, the 70 manganese bronze blade is cast on to the stainless steel post, assuring greatest strength and corrosion resistance.

All posts are one inch diameter, and several different blade configurations are readily available for OEM or replacement use. We are also able to manufacture rudders to your specs, working with you to create a blade to optimize the handling characteristics of your boat design.



## HOW TO TUNE A RUDDER FOR PERFORMANCE HANDLING:

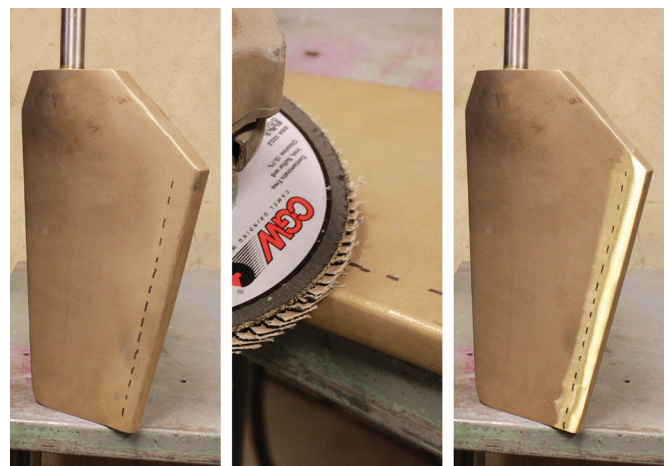
Every ski boat is different, nor is there one rudder that works perfectly in every boat, hence to optimize your boats handling you may need to tune your rudder blade to meet your own sense of feel and operation.

The most significant variable effecting the handling is the prop rotation. As the prop spins it does not throw the water straight back, in-fact it comes off the blade in a spiraling fashion either right or left depending on the prop rotation.

Since the water blasting from the prop is twisting, and if a rudder blade was manufactured perfectly symmetrical, the boat will pull either right or left. The propeller blade shape, rake and pitch also influence how the prop blast moves. Thus, the key to tuning a rudder is to run your boat first then decide which direction you want to have the boat change direction while running straight.

Since a boat rudder is essentially a vertical wing, by grinding the port or starboard trailing edge will significantly change the handling of your boat, much the same way a curve on top of a wing effects lift. To maximize the change in handling, grind the trailing edge from the back forward 2 inches and the full length of the rudders trailing edge.

We generally suggest grinding a 1/16 inch to start, go test and adjust further to your liking.



# Tournament Ski Boat Rudders Assembly

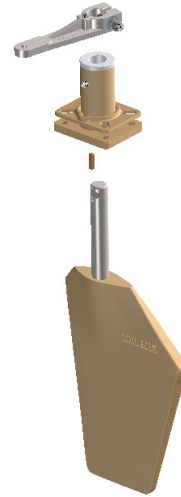
## TOURNAMENT SKI BOAT RUDDER ASSEMBLIES

Competition ski boat rudder assemblies, with two mounting options for the rudder box. This complete assembly includes RPTN rudder, our seal-type rudder box with backing plate, and the tiller arm. Thru-bolt in tiller arm intersects at rudder post.

Option 1: For customer service repair/replacement parts, the rudder box has slots with countersink angles around the edges of the slots for easy match-up and mounting in any existing holes in the boat. The backing plate is also slotted.

Option 2: For OEM's, the rudder box is available with regular countersunk holes, or as you may specify.

All components are pre-assembled in our factory. For OEM's, this saves time in assembly, inventory and purchasing departments. For repair/replacement jobs, this means no hassles with leaky seals, parts that don't mate, etc. Our posts can be keyed port or starboard, please specify.



Part No.	Description
RPTN1.00ASSY	Std. countersink holes
RPTNSLOTRBSTASSY	Slotted

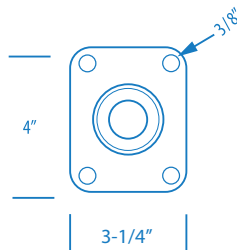
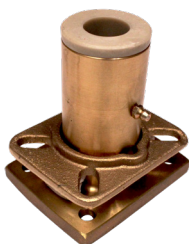
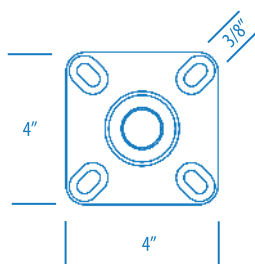
Note: As a repair/replacement part, will not fit Mastercraft Tri-Star and 86 Malibu Skier.

## Tournament Ski Boat Rudder Boxes



### REPLACEMENT RUDDER BOX SEAL KITS

Part No.	Description
RBST1.00-SEAL-KIT	Seal kit for RBST



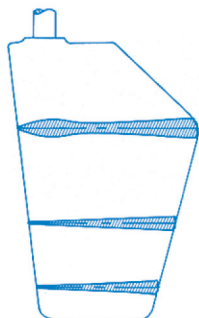
### SKI BOAT SEALED TYPE RUDDER BOXES

Part No.	Description
RBST1.00-RND-BRG	Round hole sealed rudder port
RBST1.00-SLOT-BRG	Slotted hole sealed rudder port
RBST1.12-RND-BRG	Round hole sealed rudder port
RBST1.12-SLOT-BRG	Slotted hole sealed rudder port

### SKI BOAT SEALED TYPE RUDDER BOX NARROW BASE

Part No.	Description
RBST1.00NJ-BRG	4" x 3-1/4" base round holes

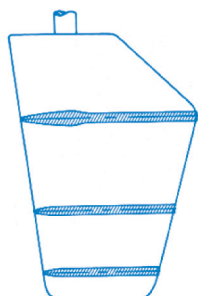
# Tournament Ski Boat Rudders



## MODEL RPT1 - (Extreme Pressure)

A universal application blade, giving best results on boats of 16' to 22'.

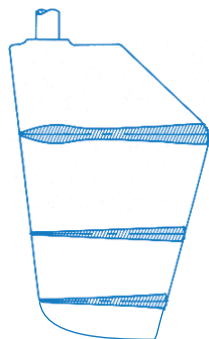
Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPT1.000-SP	12-3/4"	8-1/4"	1"	5-3/4"



## MODEL RPTN - (No Pressure)

An enhanced wedge blade, with radius trailing edge, creates less turbulence. Widely used on most recent ski/surf boat models.

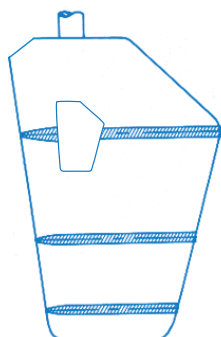
Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPTN1.000-SP	12-3/4"	8-5/8"	1"	5-3/4"



## MODEL RPTL - (Long Blade)

A longer performance blade for ski/surf boats that are using a larger propeller. Radius bottom leading edge reduces cavitation.

Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPTL1.000-SP	14"	8-3/4"	1"	5-3/4"



## MODEL RPTT - (Adjustable Tab)

An enhanced wedge blade, with radiused trailing edge, creates least turbulence for the skier. The adjustable tab allows boat owners to modify the controllability and drag of the steering.

Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPTT1.000-BP	12-3/4"	8-1/2"	1"	5-3/4"
RPTLT1.000-BP-S	14"	8-3/4"	1"	5-3/4"

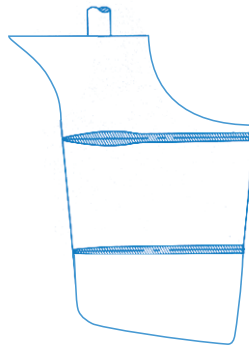


# Tournament Ski Boat Rudders

## MODEL RPTH - (Threshold)

A universal application blade, giving best results on boats of 16' to 22'.

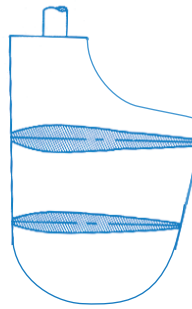
Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPTH4001.0-SP	12"	6-1/2"	1"	5-3/4"



## MODEL RPMC - (MasterCraft)

A modified version of the high-performance airfoil RPTA blade.

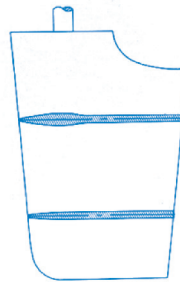
Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPMC1.000-SP	11-3/8"	8-1/2"	1"	5-3/4"



## MODEL RPTR - (Regular)

A universal application blade, giving best results on boats of 16' to 22'.

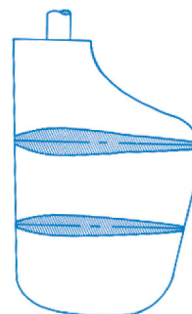
Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPTR1.000-SP	13"	8-1/2"	1"	5-3/4"



## MODEL RPTA - (Air Foil)

A high-performance airfoil blade with a balanced 12% leading edge. Gives a power steering feel, yet minimizes water disturbance.

Part No.	Blade		Post	
	Tall	Wide	Dia.	Long
RPTA1.000-SP	11-1/8"	7-3/4"	1"	5-3/4"



# Turn Fins

Marine Hardware™, Inc. proudly makes the most competitive product line of ski boat turn fins. Cast from rugged 70 manganese bronze, skillfully crafted to fit all boat builders from flat bases to V-based. Profiles and cross-sections are engineered to work on every boat made today and yesterday. Blunt nose style to limit noise, hi-aspect ratio to maximize bite in turns, to the original challenge style designed for optimum tracking while pulling a skier.

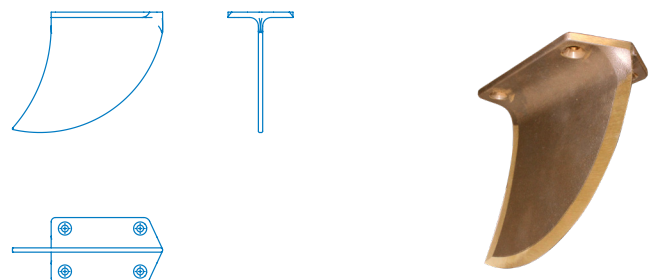
STRUTS/  
RUDDERS



## STANDARD FLAT BASE TURN FIN

Full radiused leading edge to airfoil shape. Designed for noise reduction. Standard flat base to fit most applications.

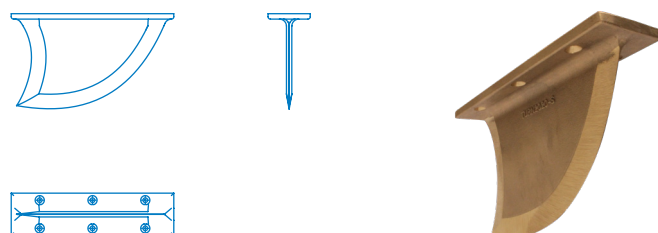
Part No.	Base Dimensions	Blade Depth	Material
TURN1050	3-3/4" x 6-1/2"	6-3/4"	Bronze



## CHALLENGER TURN FIN

A large surface area for when a boat only has access for one fin. Shaped trailing edge for noise reduction. Available in two heights.

Part No.	Base Dimensions	Blade Depth	Material
TURN2020	3" x 11-35/64"	8"	Bronze
TURN2020-S	3" x 11-35/64"	6"	Bronze



# Turn Fins

Marine Hardware™, Inc., cast type 70 manganese bronze both for flat base and V-base competition standard ski boat fins. The bases are machined and CNC—drilled for easy installation. We can also tool up and manufacture custom turn fin designs.

## STANDARD FLAT BASE TURN FIN

Standard flat base fin is cast 70 manganese bronze. Fits most applications. Custom bolt patterns are available.

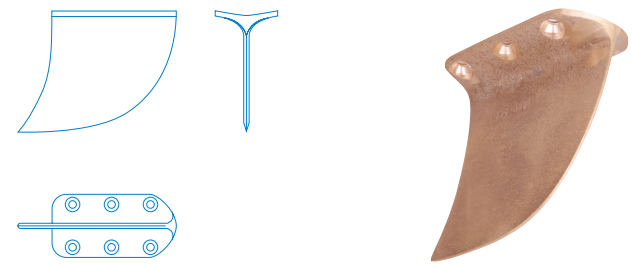
Part No.	Base Dimensions	Blade Depth	Material
TURN6.00F-B	4" x 6"	6-3/4"	Bronze



## STANDARD V-BASE TURN FIN

Standard V-base is cast 70 manganese bronze and is designed to fit most boats that were not built with a flat keel area. Custom bolt patterns are available.

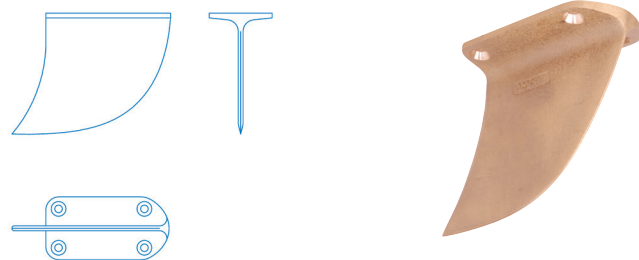
Part No.	Base Dimensions	Blade Depth	Material
TURN6.00V-B	3-1/4" x 6-7/8"	6"	Bronze



## BLUNT NOSE TURN FIN

Full radiused leading edge to airfoil shape. Designed primarily for noise reduction.

Part No.	Base Dimensions	Blade Depth	Material
TURN2010	3-1/2" x 6-1/2"	6"	Bronze



## HI-ASPECT RATIO TURN FIN

Traditional hi-aspect ratio fin provides great handling with reduced noise on the hull. Designed for three units per boat.

Part No.	Base Dimensions	Blade Depth	Material
TURNECHELON-F-B	2-5/16" x 9"	5-13/16"	Bronze
TURNECHELON-F-S	2-5/16" x 9"	5-13/16"	S.S.



# SERVICE PARTS

## Boatyards and Repair Shops

### Prop Shafts, Struts, Rudders, Turn Fins, etc.

For all types of boats – Yachts, Cruisers, Sport fishers, Competition Ski Boats, Commercial and Fishing Vessels



Our shop is set up to expedite your urgent replacement part orders. We can fill your order in as little as one day, when extra rush service is requested.



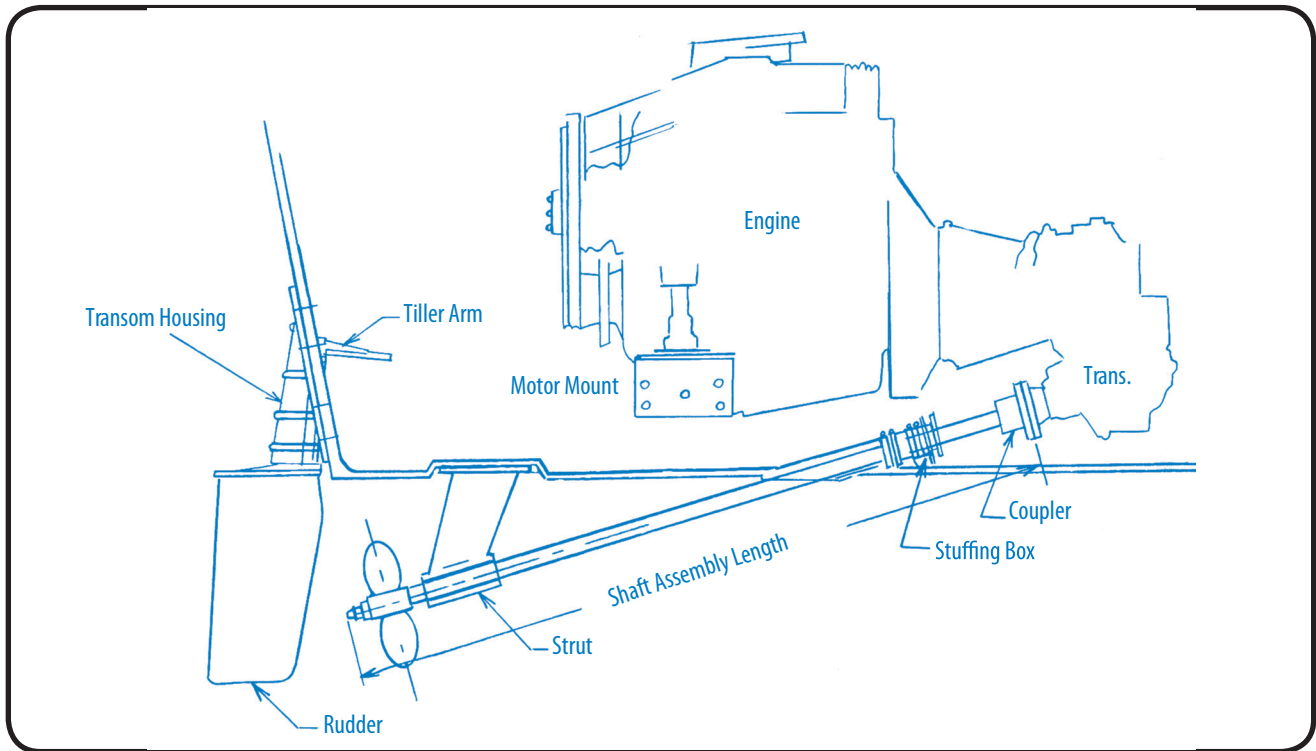
We machine top quality prop shaft assemblies and other underwater hardware quickly, to your exact specifications. Fax us a sketch or diagram with pertinent dimensions, or simply send us the bent or broken part and we can cast and machine a duplicate.



We have hundreds of patterns in stock for struts, rudders, fins, etc., and also keep an extensive finished inventory in our warehouses.



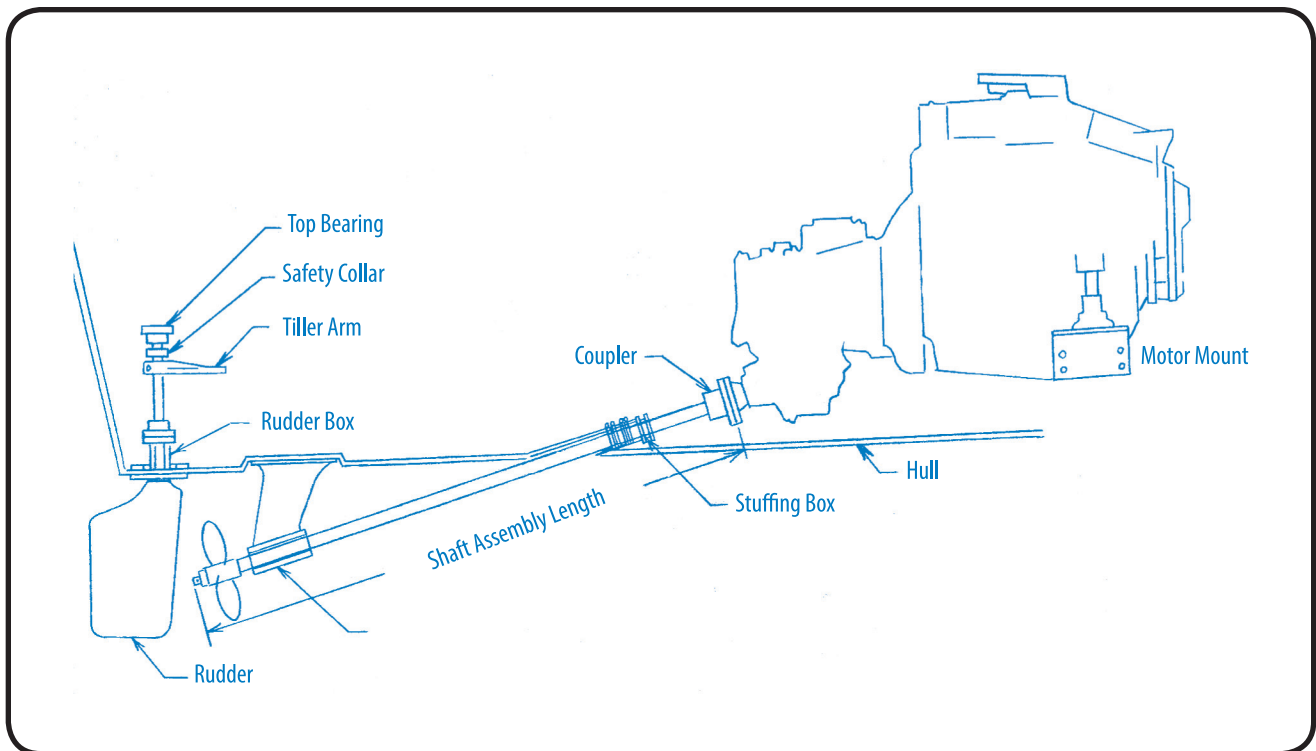
# Customer Service Parts Worksheet



**Call our toll-free number to order:**

**(800) 526-5971**

**Email us at: [mhsales@marinehardware.com](mailto:mhsales@marinehardware.com)**



# INBOARD RUDDER WORKSHEET

## Ski Boat

### GENERAL SPECS NEEDED

Post Dia. (D): \_\_\_\_\_

Post Length Above Blade (L): \_\_\_\_\_

Keyway Length (K): \_\_\_\_\_

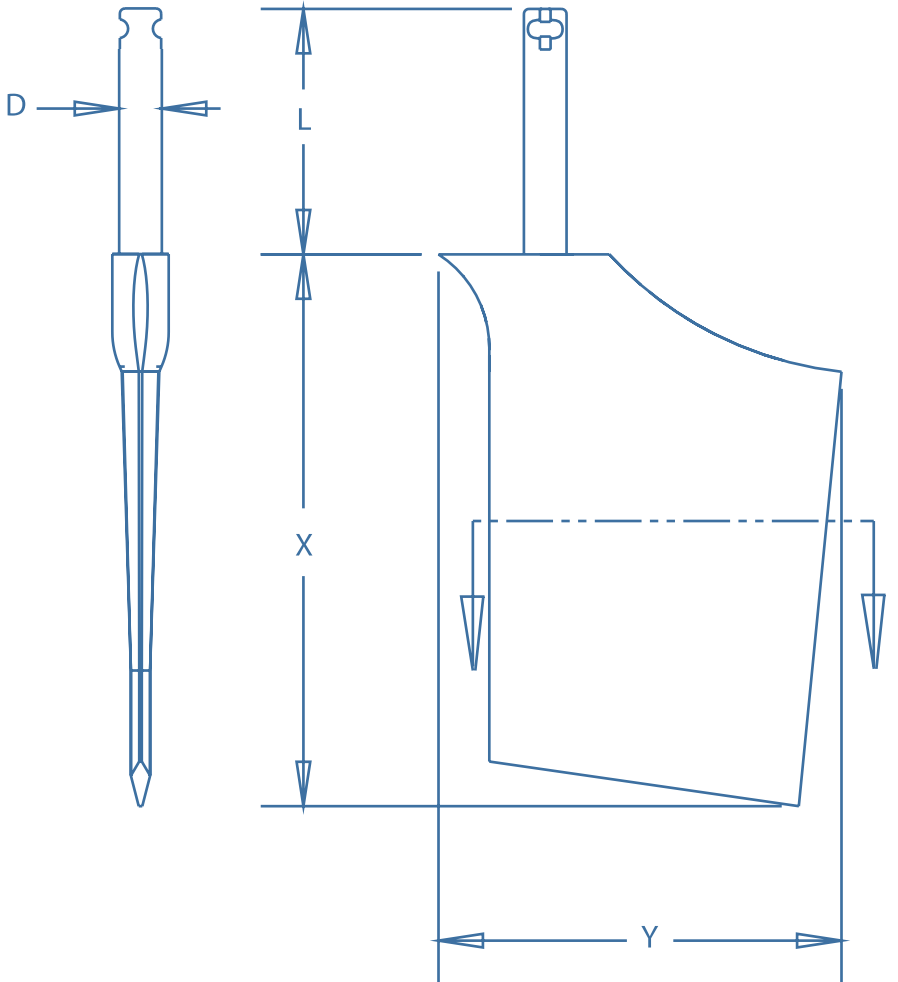
Height of Blade (X): \_\_\_\_\_

Width of Blade (Y): \_\_\_\_\_

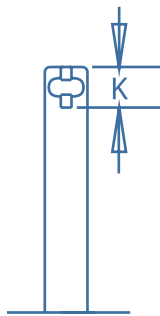
Keyway Location: \_\_\_\_\_

*Customer to specify with Sales agent*

*MH Customer Service Standard for Ski boat rudder posts are double-notch & double keyway.*



Double Notch



Double Keyway

Your Company:	_____
Your Name:	_____
Phone:	_____
Your Email:	_____
Boat Manufacturer:	_____
Year:	_____ Boat Length: _____

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# INBOARD RUDDER WORKSHEET

## Ski Boat

### GENERAL SPECS NEEDED

Post Dia. (D): \_\_\_\_\_

Post Length Above Blade (L): \_\_\_\_\_

Keyway Length (K): \_\_\_\_\_

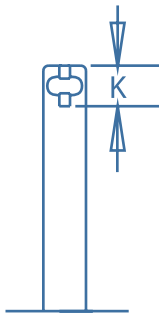
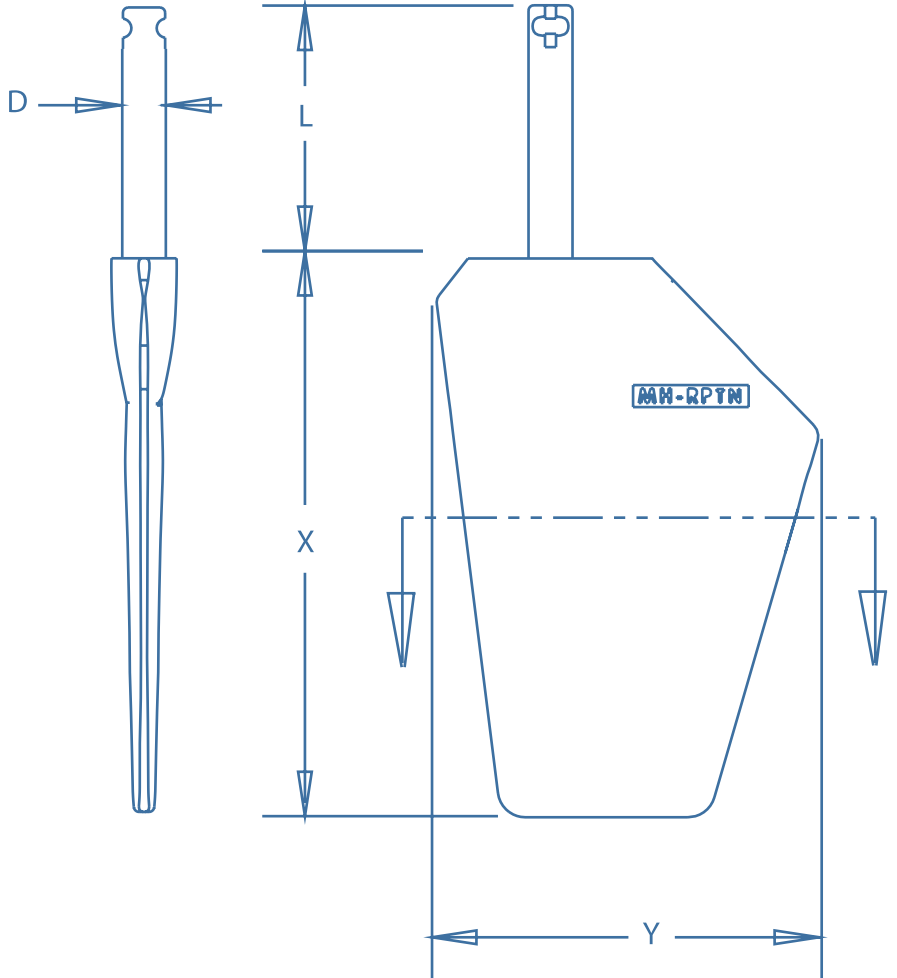
Height of Blade (X): \_\_\_\_\_

Width of Blade (Y): \_\_\_\_\_

Keyway Location: \_\_\_\_\_

*Customer to specify with Sales agent*

*MH Customer Service Standard for Ski boat rudder posts are double-notch & double keyway.*



Double Notch

Double Keyway



Your Company:	_____
Your Name:	_____
Phone:	_____
Your Email:	_____
Boat Manufacturer:	_____
Year:	_____ Boat Length: _____

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# INBOARD RUDDER WORKSHEET

## Standard

### GENERAL SPECS NEEDED

Post Dia. (D): \_\_\_\_\_

Post Length Above Blade (L): \_\_\_\_\_

Key Length (K): \_\_\_\_\_

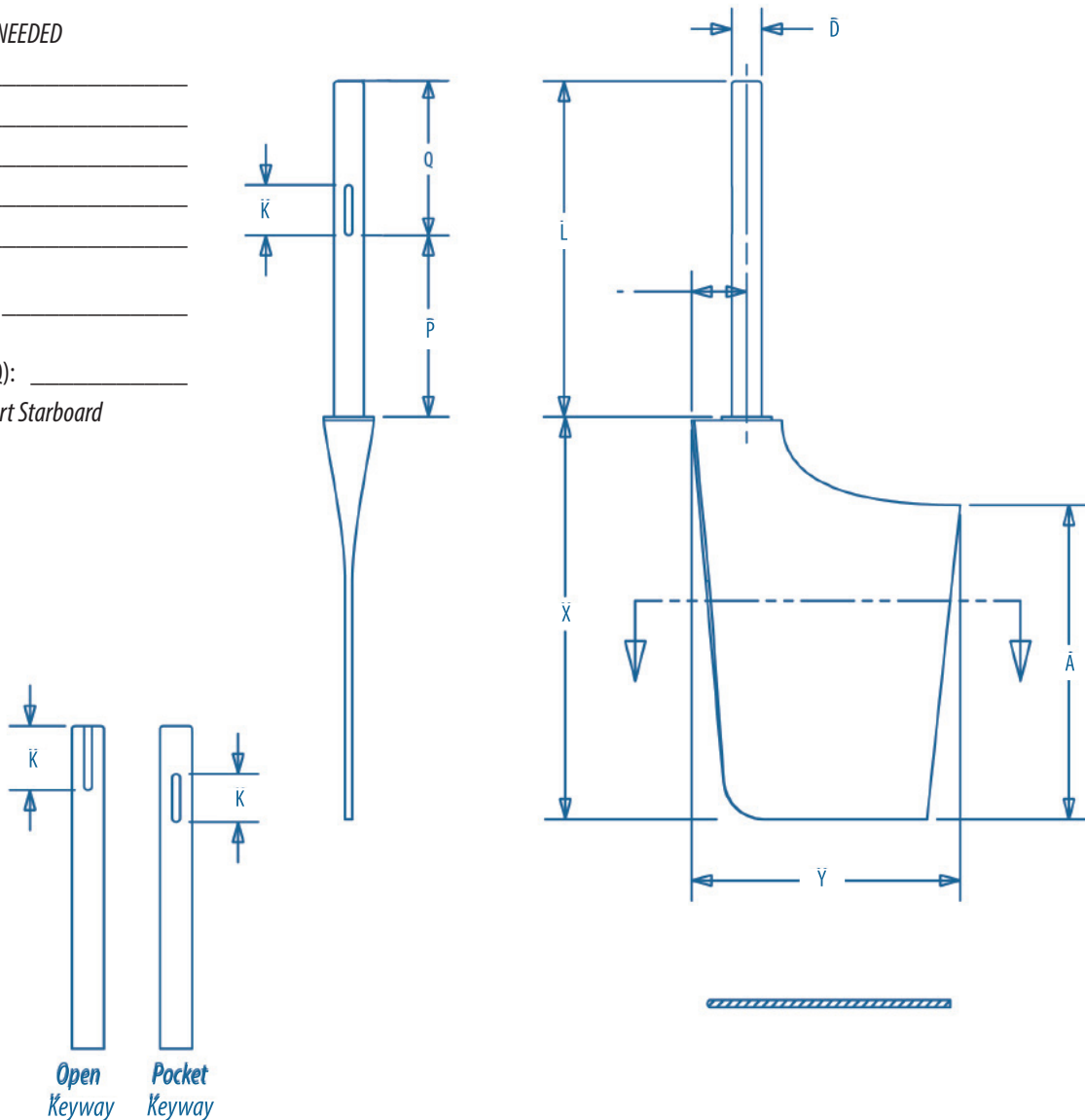
Height of Blade (X): \_\_\_\_\_

Width of Blade (Y): \_\_\_\_\_

Distance From Cast Line of Blade to Bottom of Keyway (P): \_\_\_\_\_

Distance from top of post to bottom of keyway-Alternative (Q): \_\_\_\_\_

Keyway Location: *Forward Aft Port Starboard*



Your Company: \_\_\_\_\_

Your Name: \_\_\_\_\_

Phone: \_\_\_\_\_

Your Email: \_\_\_\_\_

Boat Manufacturer: \_\_\_\_\_

Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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# INBOARD RUDDER WORKSHEET

## Nordic

### GENERAL SPECS NEEDED

Post Dia. (D): \_\_\_\_\_

Post Length Above Blade (L): \_\_\_\_\_

Keyway Length (K): \_\_\_\_\_

Height of Blade (X): \_\_\_\_\_

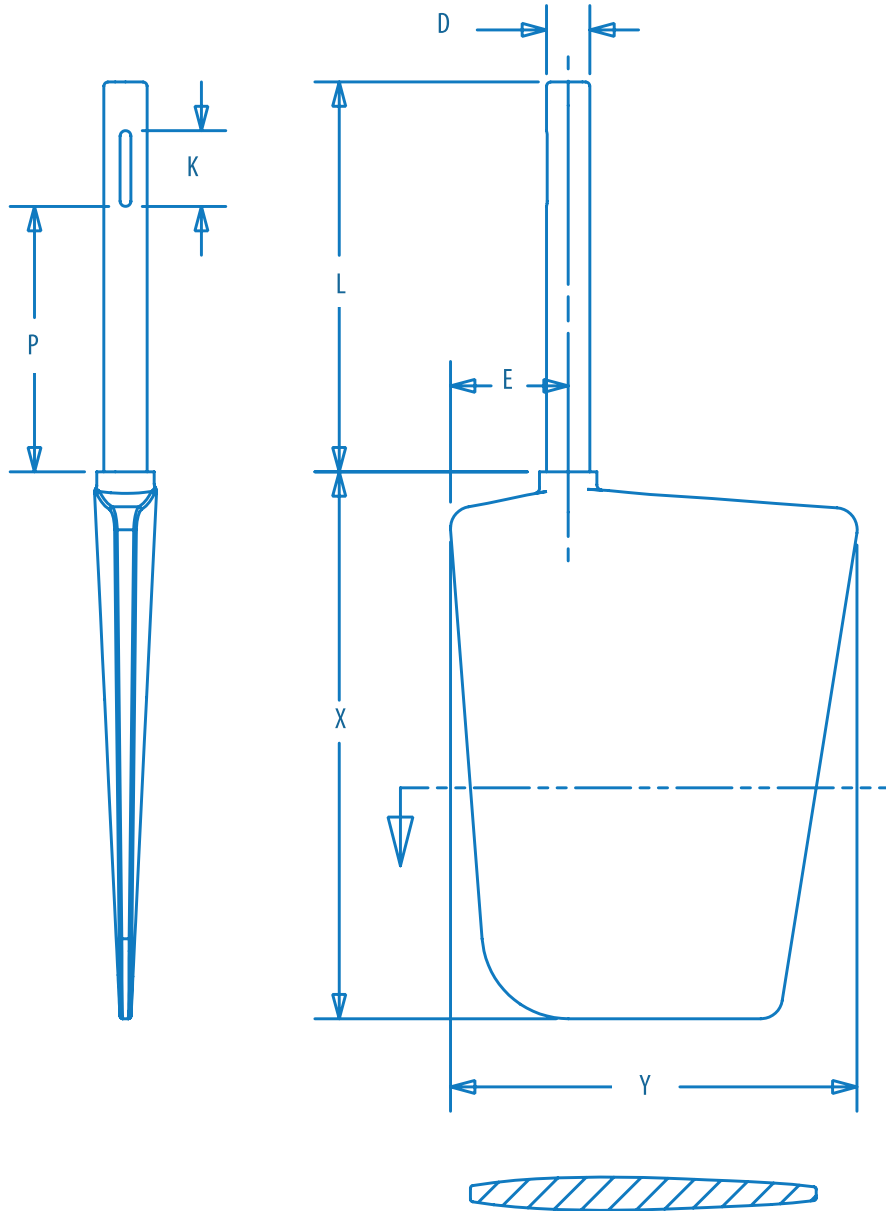
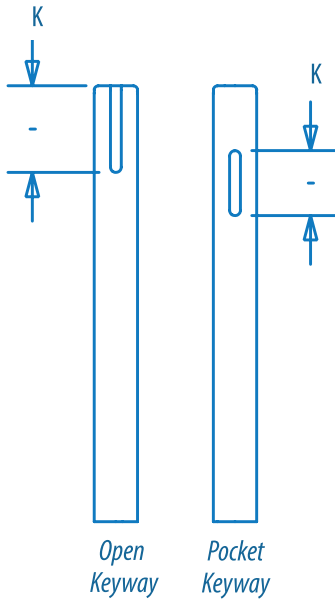
Width of Blade (Y): \_\_\_\_\_

Leading Edge (E): \_\_\_\_\_

Distance From Cast Line of Blade to Bottom of Keyway (P): \_\_\_\_\_

Keyway Location: *Forward Aft Port Starboard*

Keyway Style: *Open Keyway Pocket Keyway*



Your Company: \_\_\_\_\_  
 Your Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Your Email: \_\_\_\_\_  
 Boat Manufacturer: \_\_\_\_\_  
 Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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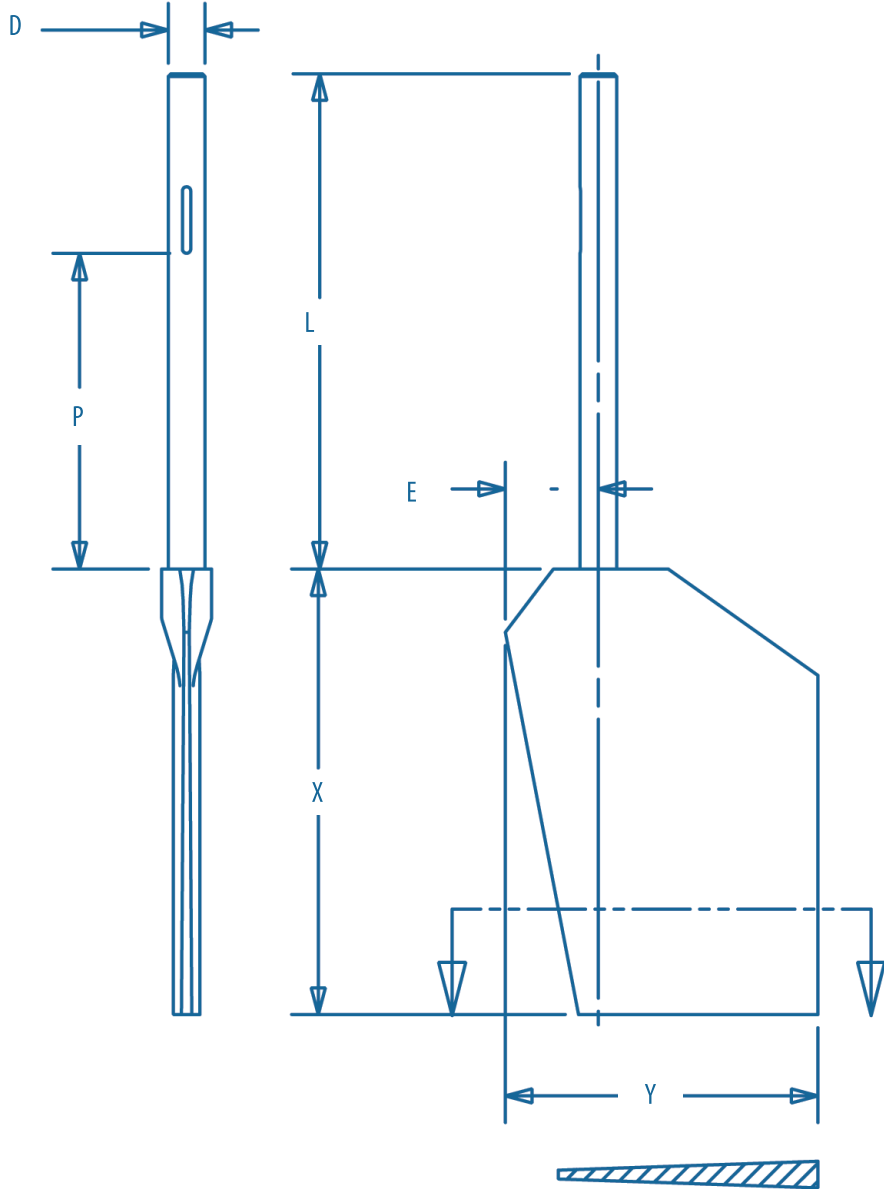
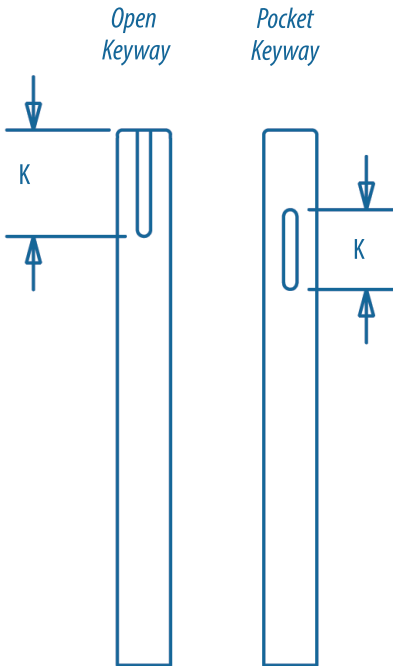
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# INBOARD RUDDER WORKSHEET

## Performance

### GENERAL SPECS NEEDED

Post Dia. (D): \_\_\_\_\_  
 Post Length Above Blade (L): \_\_\_\_\_  
 Keyway Length (K): \_\_\_\_\_  
 Height of Blade (X): \_\_\_\_\_  
 Width of Blade (Y): \_\_\_\_\_  
 Leading Edge (E): \_\_\_\_\_  
 Distance From Cast Line of  
 Blade to Bottom of Keyway (P): \_\_\_\_\_  
 Keyway Location: *Forward Aft Port Starboard*  
 Keyway Style: *Open Keyway Pocket Keyway*



Your Company: \_\_\_\_\_  
 Your Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Your Email: \_\_\_\_\_  
 Boat Manufacturer: \_\_\_\_\_  
 Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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GENERAL SPECS NEEDED

Shaft Dia : \_\_\_\_\_

Shaft Angle (A): \_\_\_\_\_

Strut Bore (S): \_\_\_\_\_

Barrel O.D. (C): \_\_\_\_\_

Aft End Drop (D): \_\_\_\_\_

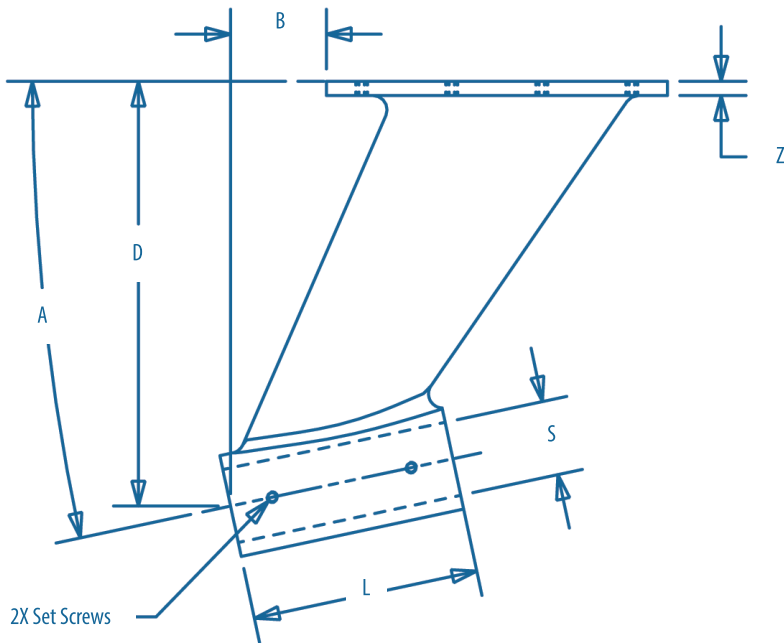
Back Sweep (B): \_\_\_\_\_

Barrel Length (L): \_\_\_\_\_

Base Length (X): \_\_\_\_\_

Base Width (Y): \_\_\_\_\_

Base Thickness (Z): \_\_\_\_\_



No. Mount Holes: \_\_\_\_\_

Dia. of Mount Holes: \_\_\_\_\_

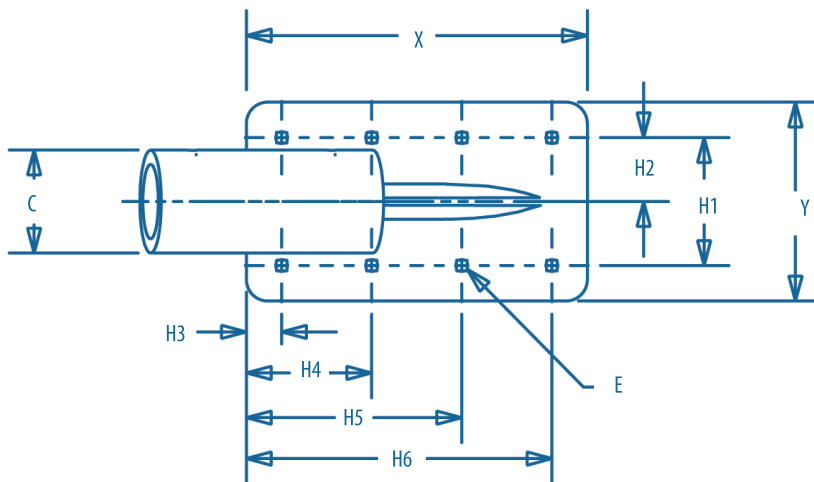
Mount Hole Type (E): \_\_\_\_\_

HOLE LOCATION

H1 \_\_\_\_\_ H4 \_\_\_\_\_

H2 \_\_\_\_\_ H5 \_\_\_\_\_

H3 \_\_\_\_\_ H6 \_\_\_\_\_



Your Company: \_\_\_\_\_  
 Your Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Your Email: \_\_\_\_\_  
 Boat Manufacturer: \_\_\_\_\_  
 Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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INC.

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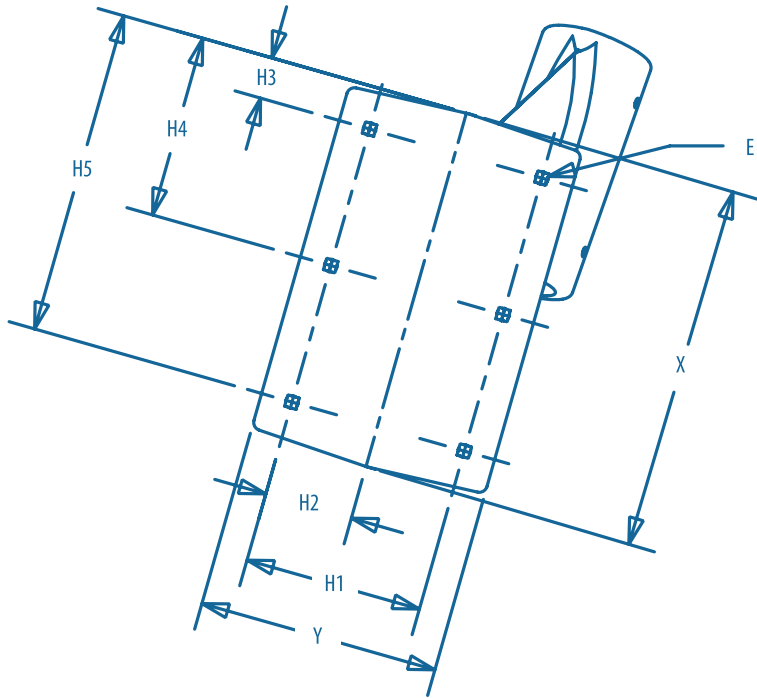
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 FAX: (425) 869-1232              FAX: (386) 676-3869

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# ANGLE BASE STRUT WORKSHEET

GENERAL SPECS NEEDED

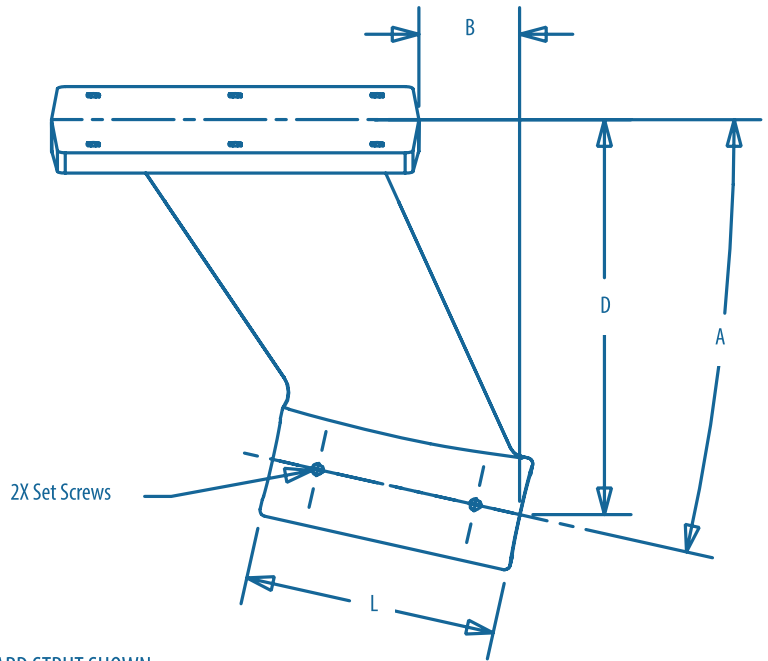
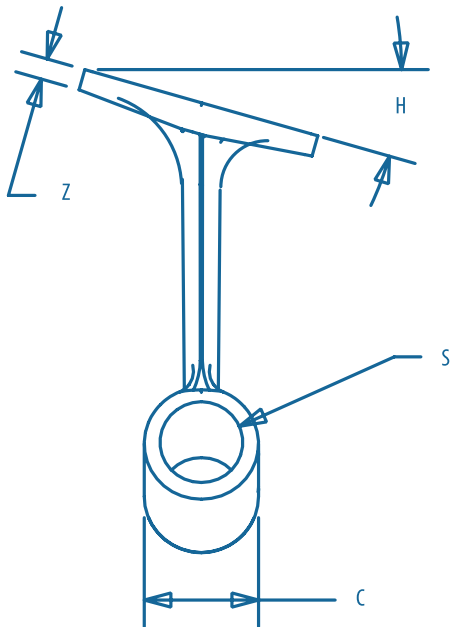


Shaft Dia.: \_\_\_\_\_  
 Shaft Angle (A): \_\_\_\_\_  
 Hull Angle (H): \_\_\_\_\_  
 Strut Bore (S): \_\_\_\_\_  
 Barrel O.D. (C): \_\_\_\_\_  
 Aft End Drop (D): \_\_\_\_\_  
 Back Sweep (B): \_\_\_\_\_  
 Barrel Length (L): \_\_\_\_\_  
 Base Length (X): \_\_\_\_\_  
 Base Width (Y): \_\_\_\_\_  
 Base Thickness (Z): \_\_\_\_\_

No. Mount Holes: \_\_\_\_\_  
 Dia. of Mount Holes: \_\_\_\_\_  
 Mount Hole Type (E): \_\_\_\_\_

HOLE LOCATION

H1 \_\_\_\_\_ H4 \_\_\_\_\_  
 H2 \_\_\_\_\_ H5 \_\_\_\_\_  
 H3 \_\_\_\_\_ H6 \_\_\_\_\_



STARBOARD STRUT SHOWN.  
 PORT IS MIRROR OPPOSITE.

Your Company: \_\_\_\_\_  
 Your Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Your Email: \_\_\_\_\_  
 Boat Manufacturer: \_\_\_\_\_  
 Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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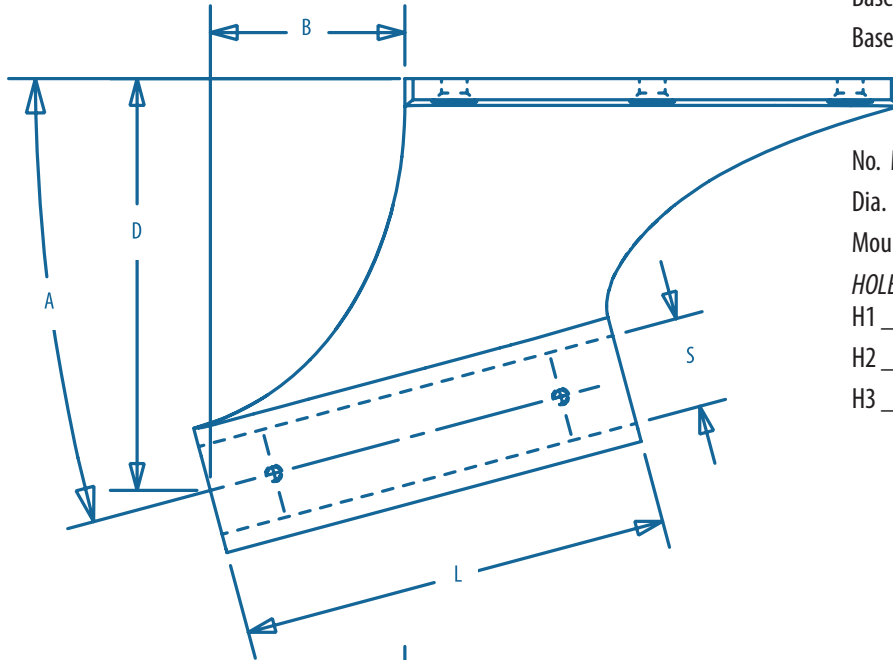
Email: [mhsales@marinehardware.com](mailto:mhsales@marinehardware.com)



# SKI BOAT STRUT WORKSHEET

GENERAL SPECS NEEDED

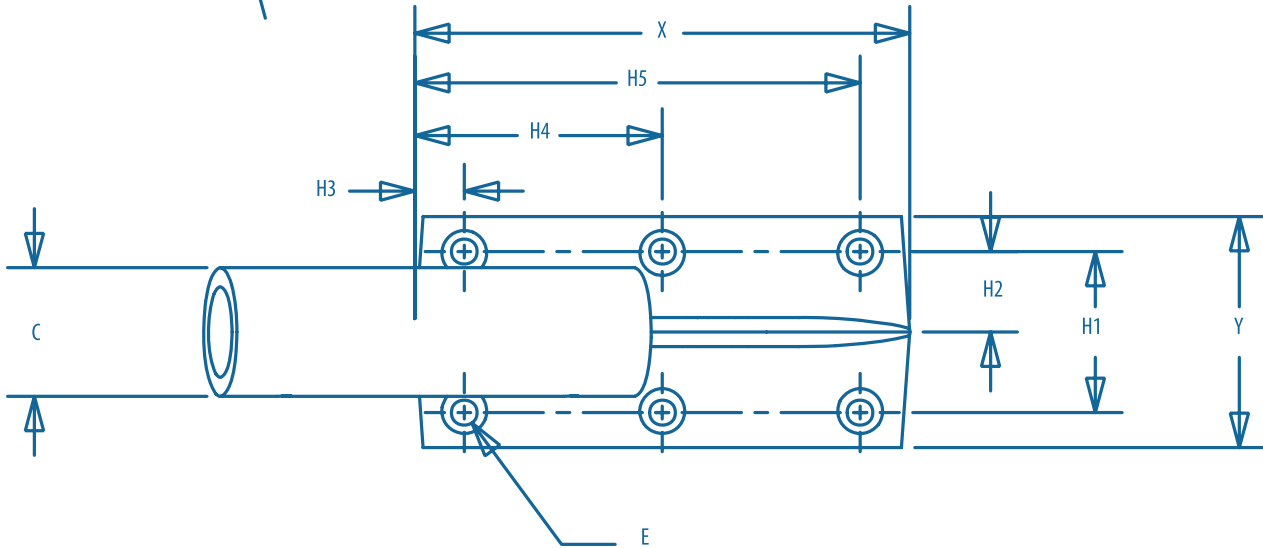
Shaft Dia.: \_\_\_\_\_  
 Shaft Angle (A): \_\_\_\_\_  
 Strut Bore (S): \_\_\_\_\_  
 Barrel O.D. (C): \_\_\_\_\_  
 Aft End Drop (D): \_\_\_\_\_  
 Back Sweep (B): \_\_\_\_\_  
 Barrel Length (L): \_\_\_\_\_  
 Base Length (X): \_\_\_\_\_  
 Base Width (Y): \_\_\_\_\_



No. Mount Holes: \_\_\_\_\_  
 Dia. of Mount Holes: \_\_\_\_\_  
 Mount Hole Type (E): \_\_\_\_\_

**HOLE LOCATION**

H1 \_\_\_\_\_ H4 \_\_\_\_\_  
 H2 \_\_\_\_\_ H5 \_\_\_\_\_  
 H3 \_\_\_\_\_ H6 \_\_\_\_\_



Your Company: \_\_\_\_\_  
 Your Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Your Email: \_\_\_\_\_  
 Boat Manufacturer: \_\_\_\_\_  
 Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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Email: mhsales@marinehardware.com	

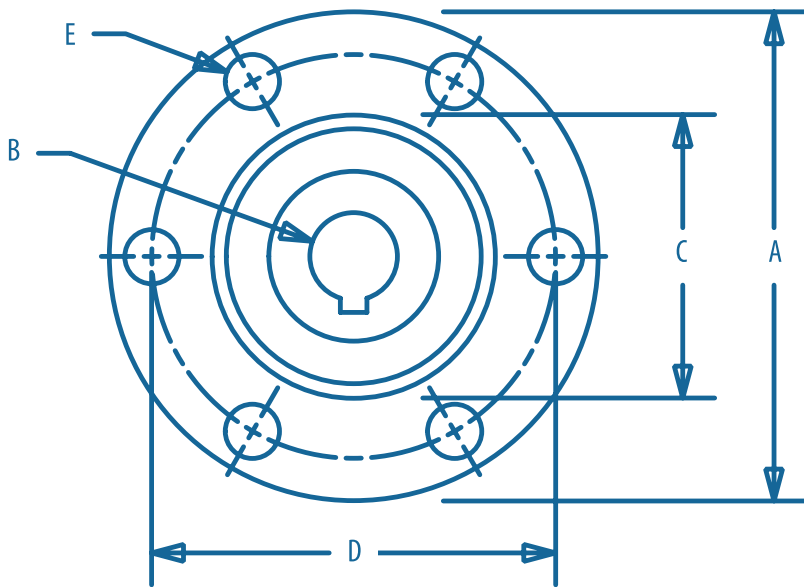
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# DIRECT DRIVE IN-LINE COUPLER WORKSHEET



### GENERAL SHAFT SPECS NEEDED

Shaft Dia. : \_\_\_\_\_  
 Assembled Length (L): \_\_\_\_\_  
 Material Grade: 17 19 22 22HS  
 Keyway Size (Coupler End): \_\_\_\_\_  
 Nuts & Keys: Yes No  
 Fit: *Loose Fit* or *Tight Fit*



### GENERAL COUPLER SPECS NEEDED

Flange O.D. (A): \_\_\_\_\_  
 Bore/Shaft Dia. (B): \_\_\_\_\_  
 Register Dia. (C): \_\_\_\_\_  
 Bolt Circle Dia. (D): \_\_\_\_\_  
 Dia. of Bolts (E): \_\_\_\_\_  
 Number of Bolts: \_\_\_\_\_  
*Male* or *Female*  
 Bore: *Tapered* or *Straight*  
 Transmission Designation: \_\_\_\_\_

Your Company: \_\_\_\_\_  
 Your Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Your Email: \_\_\_\_\_  
 Boat Manufacturer: \_\_\_\_\_  
 Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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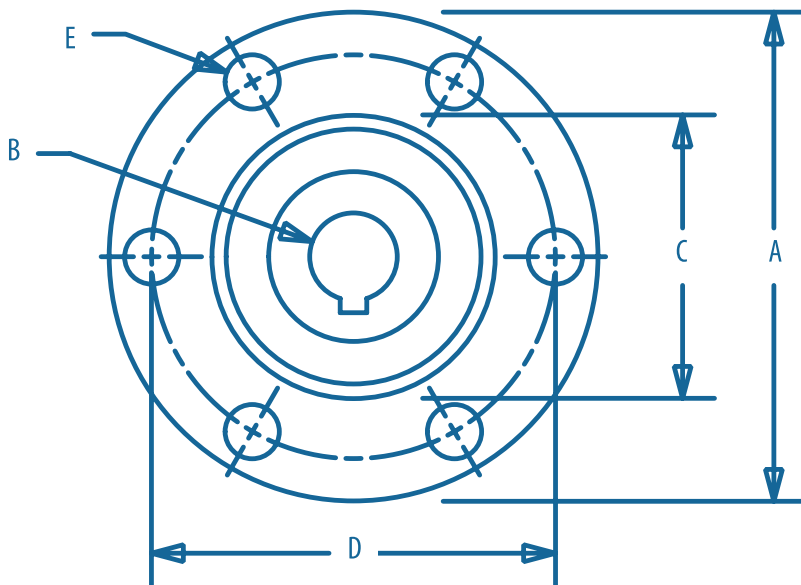
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# V- DRIVE WITH REVERSE COUPLER WORKSHEET



*GENERAL SHAFT SPECS NEEDED*

Shaft Dia. : \_\_\_\_\_  
 Assembled Length (L): \_\_\_\_\_  
 Material Grade: 17 19 22 22HS  
 Keyway Size (Coupler End): \_\_\_\_\_  
 Nuts & Keys: Yes No  
 Fit: Loose Fit or Tight Fit



*GENERAL COUPLER SPECS NEEDED*

Flange O.D. (A): \_\_\_\_\_  
 Bore/Shaft Dia. (B): \_\_\_\_\_  
 Register Dia. (C): \_\_\_\_\_  
 Bolt Circle Dia. (D): \_\_\_\_\_  
 Dia. of Bolts (E): \_\_\_\_\_  
 Number of Bolts: \_\_\_\_\_  
 Male or Female  
 Bore: Tapered or Straight  
 Transmission Designation: \_\_\_\_\_

Your Company: \_\_\_\_\_  
 Your Name: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Your Email: \_\_\_\_\_  
 Boat Manufacturer: \_\_\_\_\_  
 Year: \_\_\_\_\_ Boat Length: \_\_\_\_\_

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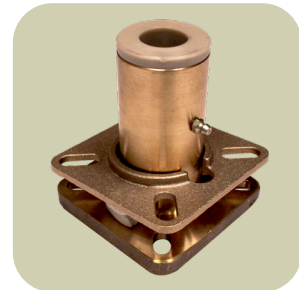
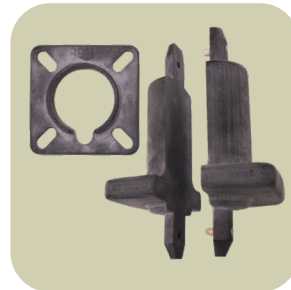
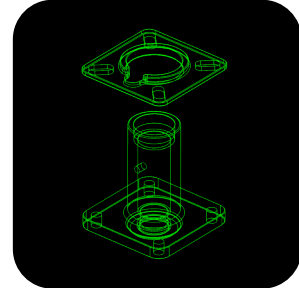
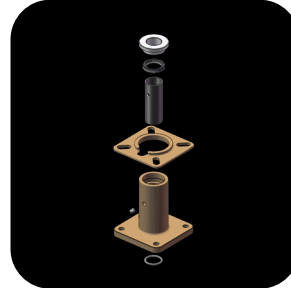
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# FROM CONCEPT... TO PRODUCTION... TO FULLFILLMENT...

## CONCEPT...

Send us a 2D, 3D or simple sketch of your concept--we will work as a team to develop the part you need. A typical job begins in our CAD department where we analyze or design your part using Solidworks and other CAD programs. We will save valuable time and costs for your prototyping needs using our in-house 3D printer. Once the design is approved, we can build patterns and tooling using various methods of casting from investment (lost wax) to sand castings.



## PRODUCTION...

Once the part samples arrive, we have multiple in-house inspection processes to verify the part is in compliance. Materials are verified using a spectrometer and parts must pass our 200hr salt-spray chamber test. First Article Inspections are a standard procedure of the Part Approval Process we use before production runs begin.



## FULLFILLMENT...

We pride ourselves on our 99% on-time delivery. We utilize advanced inventory controls and bar-coding systems. With our three warehouses and support of global vendors, we are able to support OEM production on the entire continent.

- 📍 Redmond, Washington
- 📍 Ormond Beach, Florida
- 📍 Algonac, Michigan



# General Policies

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**CREDIT:** A credit application is available upon request, fill out, sign and send back together with at least three Trade References via email to: [acctdept@marinehardware.com](mailto:acctdept@marinehardware.com) and include a copy of your State State Resale Certificate. Once application is approved, the standard payment terms are N10 days.

**TAXES:** The appropriate State Sales Tax will be collected if shipping to addresses in WA, FL, and MI. Unless a State Tax Exempt document is available. For Sales Tax Exemption, we need a copy of the following:

WA Address: WA State Reseller Permit

FL Address: FL State Resale Certificate

MI Address: MI State Tax Exemption Form or Blanket Exemption Form.

**SHIPPING:** MH standard parcel carrier is UPS, FOB Origin from either of our three warehouses; Redmond, WA, Ormond Beach, FL or Algonac, MI. We do not insure any shipments. Should you prefer to include shipping insurance on your orders, you must specify when placing the order and supply us with your UPS/FedEx account number.

LTL shipments are shipped Freight Collect, if you have a preferred carrier, you must specify, otherwise we use a common carrier, Freight Collect.

If you notice damaged packages; damaged pallets upon carrier delivery, you must have the driver sign the Bill of Landing noting the condition upon delivery. The note helps if in case a claim to the carrier for damaged goods is needed.

**COUNT DISCREPANCIES/RETURNS:** Please report/call Marine Hardware, Inc. (425) 883-0651 or send an email:

[mhsales@marinehardware.com](mailto:mhsales@marinehardware.com) within 10 days of receipt if you find count discrepancies so that it can get researched and resolved in a timely manner. If you suspect a defective item, you must request for a Return Merchandise Authorization (RMA) and ship back for inspection/evaluation. Once you receive the RMA, please attach a copy onto the outside of the box/packaging for easy identification during receiving. The product must be returned within 30 days from the RMA issuance date.

All custom manufactured items are not returnable, some special cases, it can be returned for scrap value. We charge a 15% Restocking Fee on standard items approved for returns that are in original packaging and new condition.

**MINIMUM ORDER:** We require a \$25 minimum order, not including shipping.

Please feel free to call (800) 526-5971 for any questions or any other details.

# LIMITED WARRANTY & DISCLAIMER OF WARRANTY

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Marine Hardware™, Inc. (Herein called “Marine Hardware”) warrants the products described herein and manufactured by Marine Hardware to be free from defects in material and workmanship for a period of ONE (1) YEAR LIMITED WARRANTY from date of shipment by Marine Hardware, under normal use and service. Its sole obligation under warranty being limited to repairing and replacing, (as hereinafter provided) at its option, any product found to Marine Hardware’s satisfaction to be defective upon examination of it, provided that such product shall be returned for inspection, freight prepaid, to Marine Hardware’s factory within 90 days after discovery of the defect.

The repair or replacement of defective products will be made without charge for parts or labor.

This warranty shall not apply to parts or products not manufactured by Marine Hardware, the warranty for such items being limited to the actual warranty extended to Marine Hardware by its supplier.

This warranty shall not apply to any product which has been subjected to abuse, negligence, accident, improperly installed, or misapplication, or to any product which shall have been altered or repaired by others than Marine Hardware, nor to normal maintenance services and the replacement of service items (such as, but not limited to: washers, gaskets, lubricants, etc.) made in connection with such purchases.

This limited warranty does not cover problems caused by improper maintenance, storage, cradling, blocking, normal wear and tear, lack of bonding or cathodic protection, misuse, neglect, accident, corrosion, electrolysis, or improper operation.

TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, MARINE HARDWARE DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, ARISING BY OPERATION OF LAW, COURSE OF DEALING, CUSTOM AND PRACTICE OR OTHERWISE, INCLUDING, BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. This limited warranty gives the purchaser specific rights that vary from state to state or from jurisdiction to jurisdiction.

To the maximum extent permissible by applicable law, in no event shall Marine Hardware be liable for any damages whatsoever (including, without limitation: special, incidental, consequential or indirect damages for personal injury, loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use or inability to use the products described herein, even if Marine Hardware has been advised of the possibility of such damages. Some states or jurisdictions do not allow the exclusion of limitation of liability for consequential or incidental damages, therefore the above limitation may not apply to the purchaser.

IT IS THE RESPONSIBILITY OF THE BUYER TO STUDY THE PARTICULAR HYDRODYNAMICS AND MECHANICAL NEEDS OF THEIR BOATS AND EVALUATE MARINE HARDWARE’S PRODUCTS FOR FITNESS AND APPLICABILITY THROUGH A TESTING PROGRAM AS MAY BE NECESSARY.

THE BUYER ACKNOWLEDGES THAT NO OTHER REPRESENTATIONS, AGREEMENTS, GUARANTEES, OR WARRANTIES, WRITTEN OR ORAL, WHICH ARE NOT EXPRESSED HEREIN, WERE MADE TO HIM OR HER OR RELIED UPON BY THE BUYER WITH RESPECT TO THE QUALITY, COMPOSITION, DESIGN, AND FUNCTION OF THE GOODS.

*Rev. 11/07*



## Working with partners around the world



### Redmond, WA

Toll Free Phone: 800-526-5971  
Local Phone: 425-883-0651  
Fax: 425-869-1232

Office Hours:  
8:00am - 5:00pm PST M-F

Shipping Address:  
14560 NE 91st Street  
Redmond, WA 98052

Mailing Address:  
PO Box 3099  
Redmond, WA 98073-3099

### 2021

Email:  
[mhsales@marinehardware.com](mailto:mhsales@marinehardware.com)

### Ormond Beach, FL

Phone: 386-677-0687  
Fax: 386-676-3869

Office Hours:  
8:00am - 5:00pm EST M-F

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Ormond Beach, FL 32174

[www.marinehardware.com](http://www.marinehardware.com)

Quality materials make it strong... *Our designs make it better.*