

Compact Steering System

Installation and Service Manual

**IB 262/631
SYSTEM**

THIS MANUAL SHOULD BE KEPT ON BOARD YOUR VESSEL



*Imo Industries Inc.
Morse Controls Division*

1579 BARBER ROAD • SARASOTA, FLORIDA 34240

PHONE: 813-379-0500 • FAX: 813-379-0496

LIMITED WARRANTY POLICY
"HYNAUTIC" TRADEMARK PRODUCTS

IMO Industries, Inc. - Morse Controls Division warrants that products manufactured by its **Hynautic Operations** shall be free from defects in materials and workmanship for a period of twenty-four (24) months from the date of original manufacture. **Hynautic** will rebuild or replace, at its option, all products of its manufacture proven to its satisfaction to be defective within such warranty period and returned to **Hynautic**, transportation charges prepaid. **Hynautic's** sole obligation, and buyer's exclusive remedy hereunder, is limited to such rebuilding or replacement.

No products may be returned to any **Hynautic** factory unless the prior consent for said return shall have been obtained from the **Hynautic** Customer Service Department in Sarasota, Florida. This Limited Warranty does not cover shipping costs to the **Hynautic** factory, any costs for labor or otherwise related to product removal or replacement, or any other costs of any nature without prior consent by **Hynautic**.

Parts, products and accessories made by others are warranted only to the extent of the original manufacturer's warranty to **Hynautic**.

This warranty shall not apply to acts of God, war or civil insurrection, nor shall it apply to products which, in the sole judgement of **Hynautic**, have been subject to negligence, abuse, sanctioned racing events, accident, misapplication, tampering, alteration; nor due to improper installation, operation, maintenance or storage; nor to other than normal application, use of service, including but not limited to, operational failures caused by foreign materials in the system, or operation at pressures in excess of recommended maximums.

Purchaser shall be solely responsible for determining suitability for use of the **Hynautic** products. **Hynautic** shall not, in any event whatsoever, have any liability with respect to such determination.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. **HYNAUTIC** SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL OR CONTINGENT DAMAGES WHATSOEVER.

NOTE TO CONSUMERS: THIS LIMITED WARRANTY IS EXTENDED TO THE COMMERCIAL CUSTOMERS, DEALERS, AND INSTALLERS OF **HYNAUTIC** ONLY. THE SUPPLIER/INSTALLER WILL EXTEND WARRANTY COVERAGE TO YOU WHICH COVERS **HYNAUTIC'S** PRODUCTS. **HYNAUTIC'S** WARRANTY TO SUCH CUSTOMERS, DEALERS, AND INSTALLERS IS INTENDED TO SUPPORT THE WARRANTY EXTENDED TO THE CONSUMER.



PLUMBING REQUIREMENTS FOR TUBING AND HOSES

Hydraulic Hose or Reinforced Tubing

High pressure hose suitable for system use must meet SAE 100 R-7 standards and must be capable of 1000 psi working pressures. Hose meeting this criteria may be used throughout a system having a relief valve setting of 1000 psi. Hoses must be used to connect any component which has the ability to move in its application.

Helms with volumetric displacements up to 2.75 cubic inch per revolution require a minimum -5, (5/16" inside diameter) high pressure hose for the "P" and "S" steering lines. The use of -6, (3/8" inside diameter) high pressure hose is recommended to reduce steering wheel effort.

Plastic Tubing—Non-Reinforced

Black (insensitive to ultraviolet light), solid wall plastic tubing is available in varying grades and compositions. As a result the maximum working pressure capability may vary greatly for tubing with the same physical size and appearance. Avoid unmarked and unknown brand tubing.

Generally, plastic tubing, when properly matched to the system, is only suitable for light steering loads where pressures are controlled so as not to exceed 500 psi. Solid wall plastic tubing must not be used for the "P" and "S" steering lines in systems with the ability to operate at 1000 psi or higher (1000 psi relief valve setting).

When installing plastic tubing, care should be taken to prevent kinking, contact with sharp

corners, hot surfaces, or areas in excess of 140 degrees F., as this will greatly reduce strength and pressure rating.

Hynautic low pressure systems (500 psi relief setting) are intended for small boats with light steering loads.

"R" Reservoir Lines

In multi-station applications, an additional line is required between the helms: 1/4" outside diameter and larger copper tubing, or -4 (1/4" inside diameter) and larger hose or tubing (250 psi minimum) are suitable for the reservoir port connections. We recommend Hynautic's 3/8" O.D. nylon tubing or 5/16" I.D. hose for this line. The "R" line is provided in Kit HF-42.

Copper Tubing

Acceptable tubing is a soft, annealed, seamless (refrigeration) type, having a minimum .032" wall thickness. Connections must be made by flaring the tubing and using a flare nut, or by using an approved compression/ferrule type fitting suitable for working pressures of 1000 psi. Solder joints are not acceptable.

When routing copper tubing, make sure that it is properly secured at least every 18 inches to minimize vibrations, or tubing will become fatigued and break with time. Do not attach copper tubing

to components, such as cylinders, which can move in application. Do not use long unsupported lengths of copper tubing. Isolate tubing from other steel, aluminum; or metal in the boat so as to avoid electrolysis.

Systems using helms with volumetric displacements of up to 2.75 cubic inch per revolution require 3/8" outside diameter tubing for the "P" and "S" lines.

⚠ CAUTION INSPECT HYDRAULIC LINES ANNUALLY. VARIOUS FACTORS SUCH AS; EXTERNAL WEAR OR EXTREMES IN TEMPERATURES COULD CAUSE THE DETERIORATION OF THE HYDRAULIC LINES. IT IS HIGHLY RECOMMENDED THAT YOU REPLACE THE HYDRAULIC LINES EVERY 2 YEARS IN ORDER TO KEEP THE LINES IN EXCELLENT WORKING CONDITION.

Hynautic Part Numbers

Part Number	Description
2021XX	Hose, 5/16" I.D. (Cut to Length)
2031XX	Hose, 3/8" I.D. (Cut to Length)
690011	Adapter, 1/4" NPT (For Hynautic Hose)
690110	Reusable Fitting, 5/16" I.D. Hose
690130	Reusable Fitting, 3/8" I.D. Hose
690961	Compression Nut
691961	Adapter, 1/4" NPT - 3/8" O.D. Nylon Tubing
MSH5-100	Hose, 5/16" I.D. x 100Ft. Long
MSH6-100	Hose, 3/8" I.D. x 100Ft. Long
MSH2 100	Tubing, 3/8" O.D. x 100Ft. Long

Note 1: Reinforced hose is sold in two sizes, -5(5/16" I.D.) and -6(3/8" I.D.). Either fixed length (to the nearest foot) with swaged ends, or rolls with reusable fittings may be used.

Note 2: Nylon tubing for steering is 3/8" O.D. compression Fittings are available.



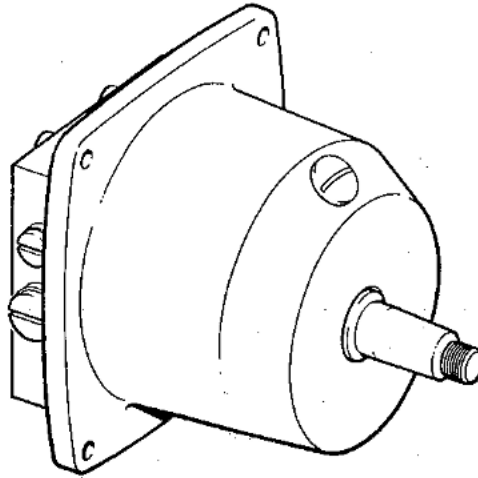
Marine Systems and Products - 1579 Barber Road, Sarasota, FL 34240 Tel. 813-379-0500 FAX 813-379-0496

IMO
Imo Industries Inc.
Morse Controls Division

COMPONENT FACT SHEET

H-60 Series 2-Line Helm Unit

(H-60, H-61, H-62)



Description

The Hynautic H-60 Series Hydraulic Helm Unit is a bi-directional axial piston pump, coupled to pilot-check and make up check valving.

The patented pump section utilizes seven pistons, each stroked nine times with one shaft revolution, pushing fluid thru a porting block into the valve section.

The valve section includes holding valves to prevent feedback and to isolate the unit, and compensation valves to allow the use of unbalanced cylinders.

H-60 Series Helm Units incorporate a reservoir and a relief valve within each unit. (Relief setting is specified as 500 psi or 1000 psi.) Clockwise rotation of the shaft discharges fluid thru the "S" port; counter clockwise rotation effects "P" port discharge. The "R" port is only used on two (2) station applications. Port size is 1/4" NPTF.

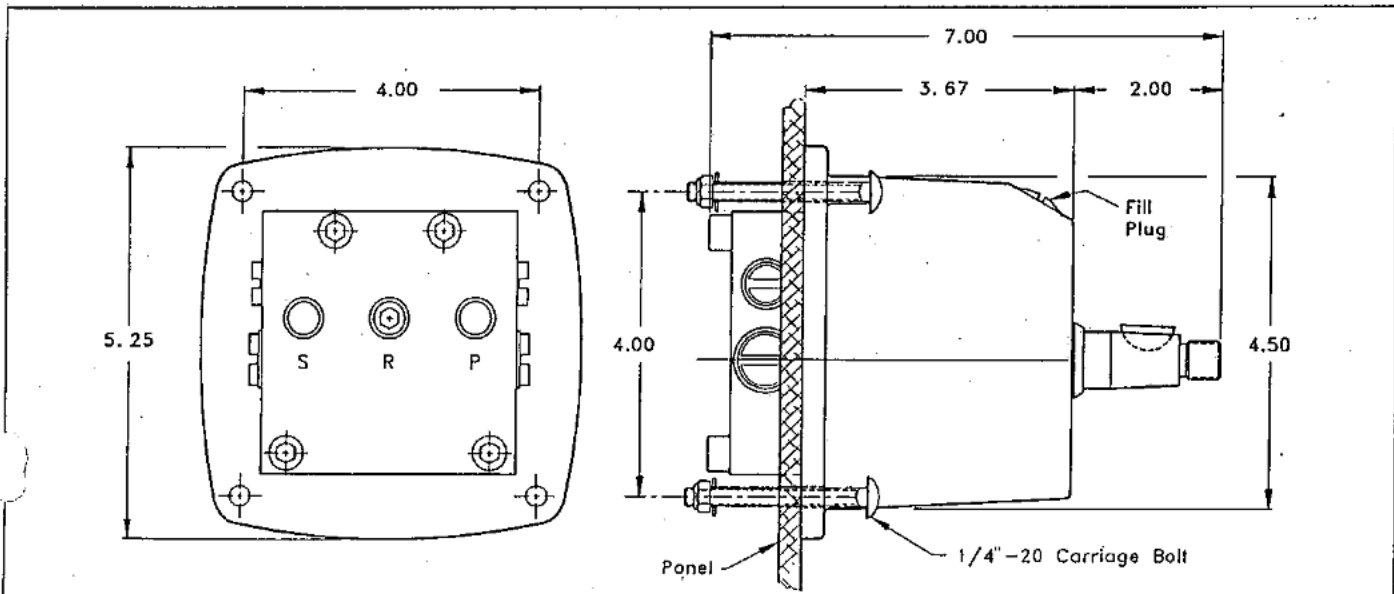
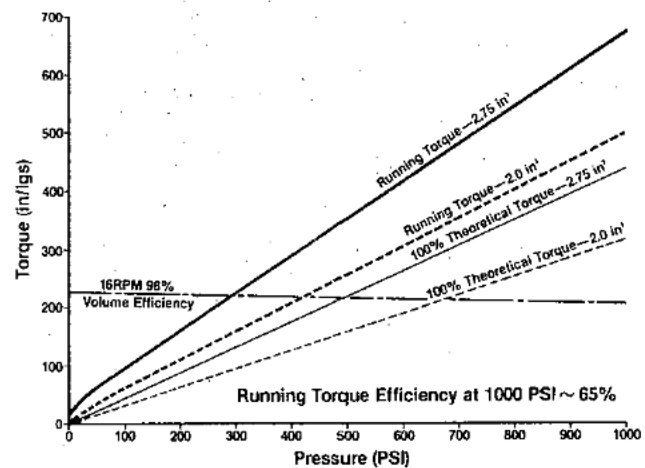
Construction

Exterior casting is 356-T6 aluminum painted with polyurethane. Shaft is stainless steel. Internal components-ferrous metal porting block and cylinder barrel with ground mating surfaces, hardened and ground steel pistons, drive keys, needle thrust bear-

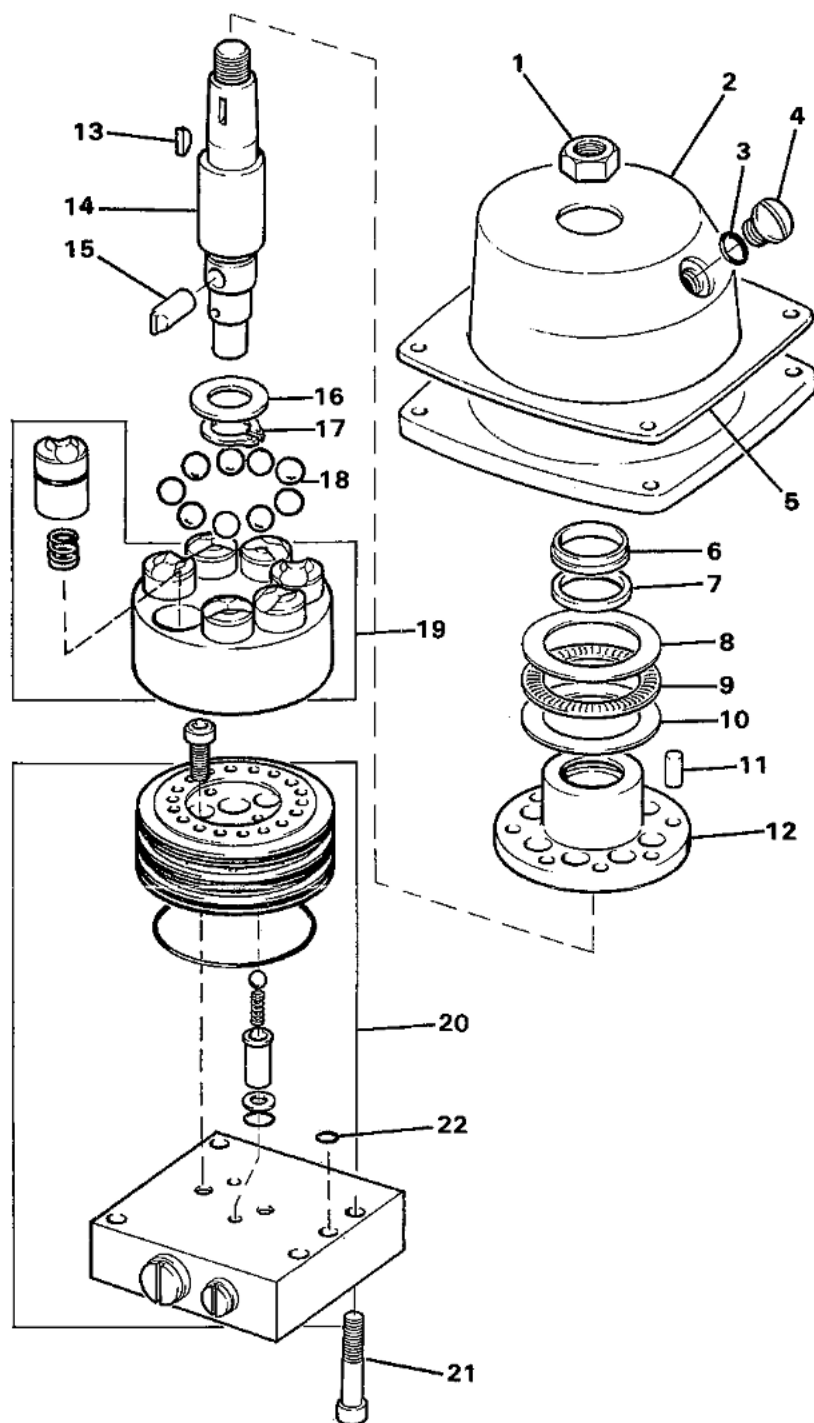
ings, Buna "N" seals, TFE seal backups and piston glyd rings. Other components are of friction and wear resistance materials to reduce operating torque and prolong life.

Performance

Volumetric efficiency: 90% at 1000 psi and 12 rpm. Running torque vs. pressure:



ILLUSTRATED PARTS BREAKDOWN



Parts Description

Item	Description	Helm Models	Part No.	Qty.
1.	Nut	ALL	270037	1
2.	Helm Body	ALL	901024	1
3.	O-Ring	ALL	211906	1
4.	Fill Plug	ALL	380544	1
5.	Trim Plate	ALL	520604	1
6.	Wiper	ALL	700068	1
7.	Quad-Ring Seal	ALL	224015	1
8.	Bearing Race-thin	ALL	190010	1
9.	Bearing-thrust	ALL	190011	1
10.	Bearing Race-thick	ALL	190009	1
11.	Pin	ALL	290146	9
12.	Ball Cage	ALL	620028	1
13.	Key	ALL	650027	1
14.	Shaft	ALL	400257	1
15.	Key	ALL	650026	1
16.	Washer	ALL	190012	1
17.	Retaining Ring	ALL	300046	1
18.	Ball	ALL	234066	9
19.	Cyl. Barrel Assy.	H-60	510110	1
		H-61	510120	1
		H-62	510130	1
20.	Valve Body Assy.			
		H-60-001	900450	1
		H-61-001	900450	1
		H-62-001	900450	1
21.	Screw	ALL	240467	4
22.	O-Ring	ALL	211009	1
A.	Seal Kit	ALL	HS-06	1
B.	Fill Kit	ALL	HF-35	1

WARNING

The Helm Units are manufactured under strict controls and testing procedures. Disassembly of item no. 20 will void any existing warranty. The Valve Body Assembly is under heavy spring load and disassembly could cause some pieces to be projectiles which could cause bodily harm.

It is recommended that the unit be returned to Hynautic or the point of purchase for authorized repair and retesting.

H-6 X - X X X

Helm Unit Model Number

Color Code
0 = Black

Relief Setting
1 = 1000 PSI
2 = 500 PSI

Displacement
0 = 2.0 Cu. in.
1 = 2.75 Cu. in.
2 = 1.65 Cu. in.



Marine Systems and Products - 1579 Barber Road, Sarasota, FL 34240 Tel. 813-379-0500 FAX 813-379-0496



60-SERIES HELM INSTALLATION

Description

A Hynautic Steering System is comprised of two basic elements; the Helm Unit and the Cylinder.

The 60 Series Helm Unit is a single component which consists of a hydraulic pump, pilot check valve assembly, relief valve and reservoir.

While rotating the ship's wheel, seven (7) small pistons move in a rhythmic, but controlled pattern within the Helm Unit. These pistons, in turn, pump hydraulic fluid to the steering cylinder. Internally located in the steering helm are two pilot check valve assemblies. These isolate each steering station from all others. They also lock the rudder and eliminate 'kickback' from the rudder to the steering wheel.

Hydraulic fluid is maintained in a reservoir that is built into each 60 series Helm. The fluid is accessed by a fill plug in the front of the unit.

A relief valve has been built into the H-60 series helm. It not only protects the hydraulic steering system, but it will protect the mechanical portion of the rudder in the event the rudder hits a solid object. The relief valve is factory set at either 500 or 1000 psi.

Steering cylinder assemblies are double acting, either double rod end, or single rod end types. The cylinder can be rigidly mounted or universally mounted. The cylinder rods are high strength, corrosion resistant stainless steel.

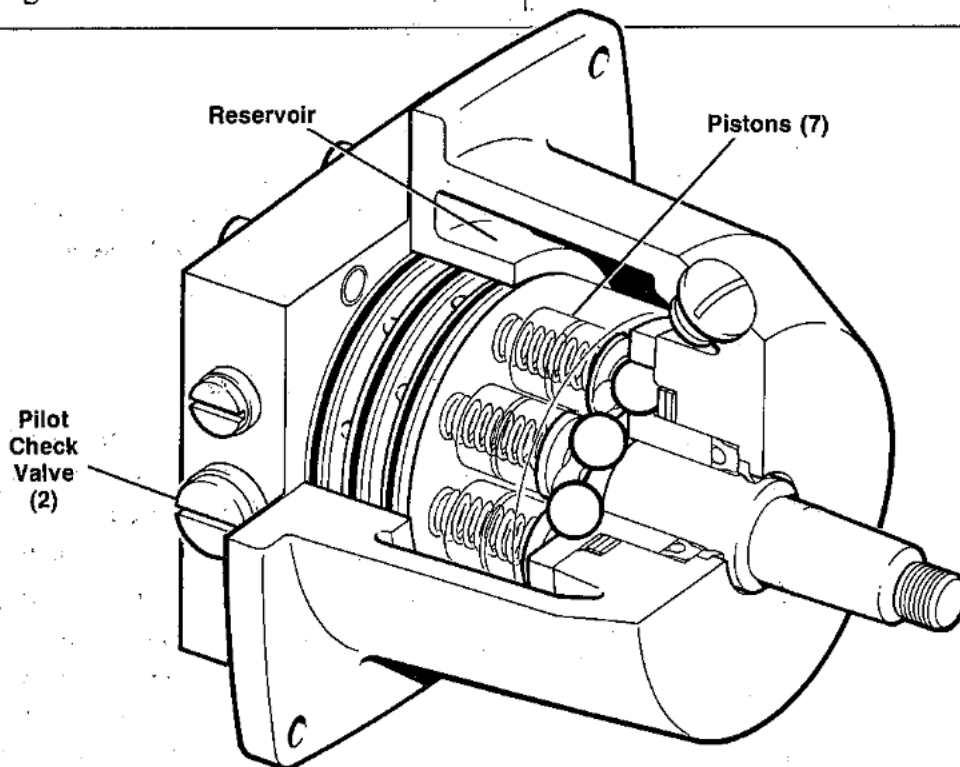


Figure 1.

182031 REV 1

Manual hydraulic steering can be used on any boat which can be steered manually. Should a greater torque be required on the rudder than is shown in the system performance data for the system received, the rudder arm length may be increased. This will increase the torque on the rudder while decreasing the total rudder arc. A second method would be to increase the cylinder's bore size. This would increase the system output force while keeping the rudder arm length the same, but the number of helm turns would increase. Another method would be to add a second steering cylinder in parallel with the first steering cylinder to the system. This will double both the turning torque on the rudder and the number of turns from hardover to hardover.

Preparation For Installation

NOTE *Read the installation instructions before any work is started*

Purging and Troubleshooting Instructions have been included in the system box, while component installation instructions have been packed with the specific component. Missing instructions can be obtained from HYNAUTIC, INC., or your HYNAUTIC distributor.

Before installation is started, verify that a complete system has been received. It is recommended that all system components be installed prior to running the system tubing. This allows the tubing to be run between two definite points with less chance of a hook-up error.

If it is necessary for the tubing to be installed first, a system of marking the different tubing runs should be used.

⚠ CAUTION DRY SEAL THREADS AND HIGH QUALITY FITTINGS ARE USED THROUGHOUT YOUR HYNAUTIC SYSTEM. DO NOT USE ANY LUBRICANT OR SEALER ON THE FLARED TUBE FITTINGS. DO NOT USE PERMATEX, FORMATEX, OR SIMILAR TYPE THREAD SEALANTS, ON THE PIPE JOINTS. SHOULD THIS SEALANT BE INTRODUCED INTO YOUR SYSTEM, A MALFUNCTION COULD RESULT. THE ONLY SEALANT HYNAUTIC RECOMMENDS FOR PIPE THREADS IS LOCTITE HYDRAULIC SEALANT #69-31, AND LOCQUIC PRIMER GRADE T

#47-56, HOWEVER, THIS SEALANT SHOULD BE USED SPARINGLY AND WITH CARE.

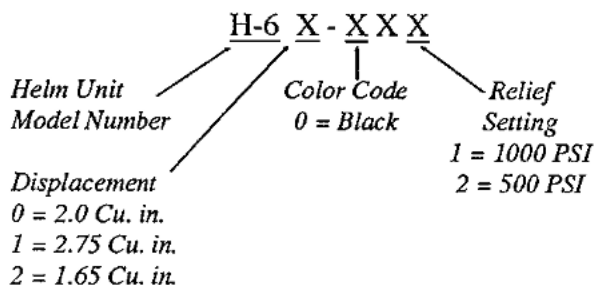
Cleanliness is Extremely Important. Care should be taken to prevent chips or any foreign matter from getting into the components or tubing before or during installation.

Installation instructions have been made as complete, but as brief as practical. If you have any questions contact HYNAUTIC, INC., or your distributor.

Mounting the Helm

All Helm Units are stamped with a part number and date code of manufacture. Shown below is a description of the part number code for the 60 series helms.

Helm units may be mounted in front of or behind the panel. Dimensions for the helm unit are



shown in **Figures 2 and 3.**

Select a suitable mounting location that is capable of supporting the helm and a minimum load. Nothing must interfere with the helm plumbing or steering wheel use.

Front Mount Installation

Mount the helm from the front of the console by cutting either a 5" diameter hole, or a rectangular hole through the panel using the template that has been supplied at the end of this manual.

Locate the helm in the mounting hole making sure that the helm fill plug is on the upper surface of the helm, **Figure 2.** Use the holes on the helm flange as a template to mark the location of the four holes for the carriage bolts. Remove the

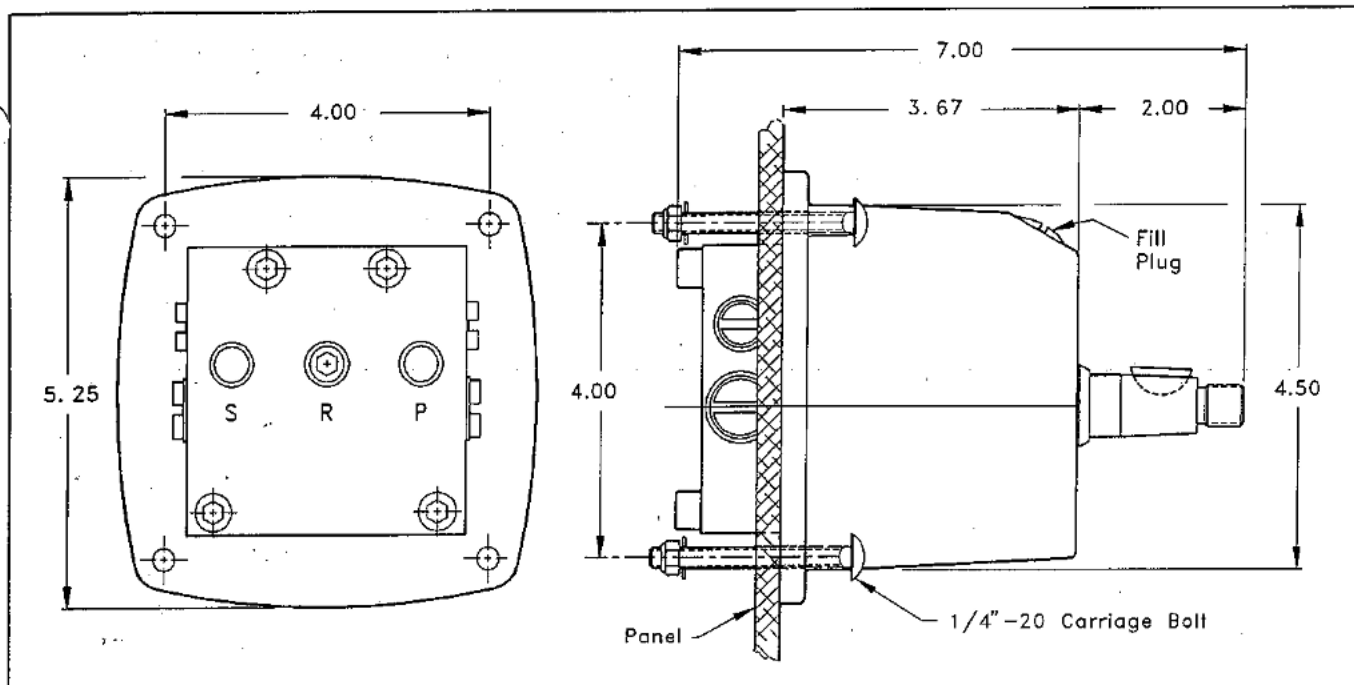


Figure 2.

helm and drill four 5/16" diameter holes at the marked location.

Install the helm back into the mounting hole and insert the four 1/4" carriage bolts provided into the mounting bolt holes. Lightly tap bolts into the helm flange with a hammer to prevent rotation when nuts are installed.

On installation with a thin mounting panel, it may be desirable to mount the decorative trim ring behind the panel for added strength to the helm installation.

Install washer and nuts from back side of panel. Tighten nuts until heads of carriage bolts are pulled flush against flange of helm. Torque nuts to 75 in-lb.

Rear Mount Installation

Use the decorative trim ring provided as a template to mark the location of a 4-1/2" mounting hole and the four holes for the carriage bolts. Cut the 4-1/2" mounting hole out and drill the four bolt holes with a 5/16" dia. drill.

Place the trim ring on front of panel, **Figure 3**, and insert the four 1/4"

carriage bolts through the ring and the panel so that the square neck of the carriage bolts are in the squares on the trim ring.

With the helm bolt holes aligned with the protruding carriage bolts insert the helm unit from the rear of the panel. Make sure that the helm fill plug is on the upper surface of the helm. Install washers and nuts on the carriage bolts. Tighten the nuts until heads of carriage bolts are pulled flush against the trim ring. Torque nuts to 75 in-lb.

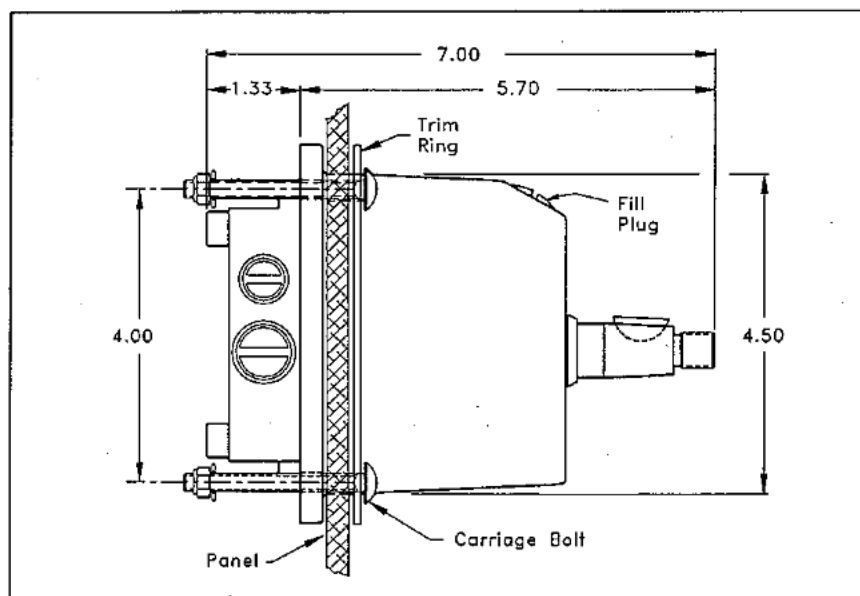


Figure 3.

Porting Information

All helm ports are 1/4-18 NPTF (female) pipe threads. Suitable adapters for nylon tubing, copper tubing or high pressure hose must be used. The "R" (center) port is plugged and will not be used on single station application. Adapters may be installed prior to Helm installation. In a 2 station application, **Figure 4**, the plugs in the "R", or center ports, of the helm units should be removed and replaced with suitable fittings and hose.

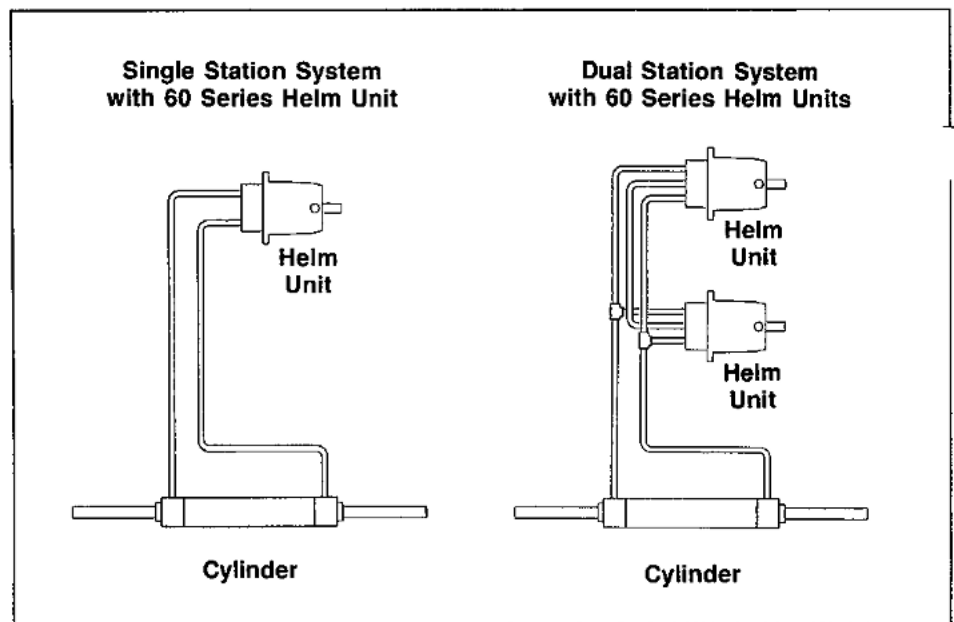
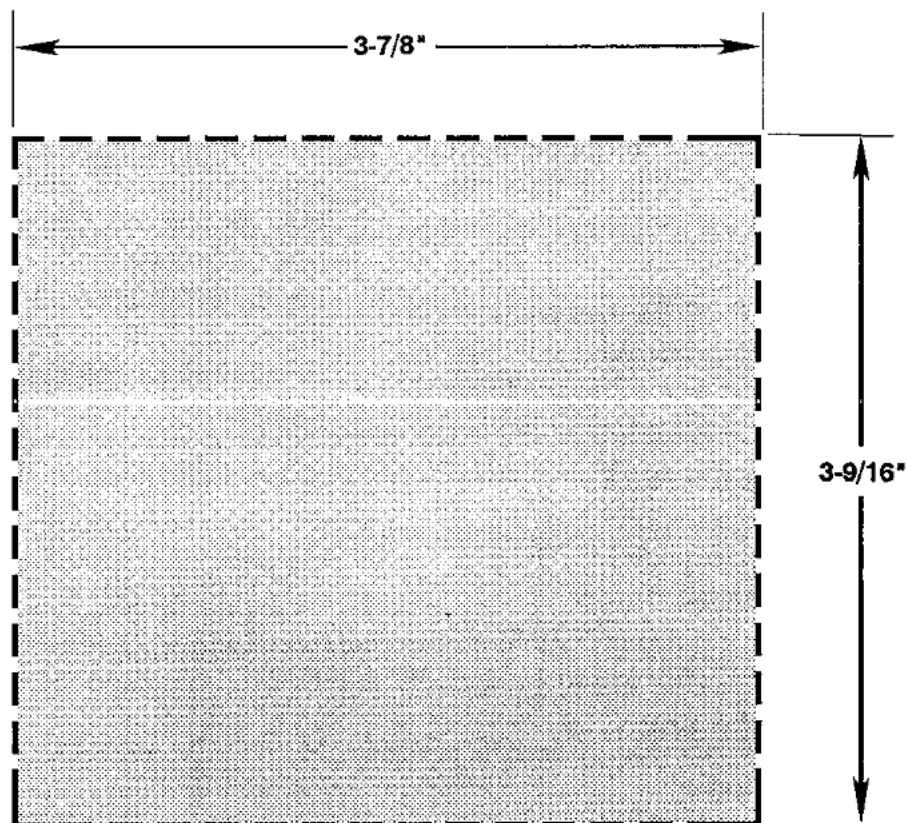


Figure 4.



Cut out an area this size when using a rectangular hole for front dash mounting of H-60 Series Helm Units

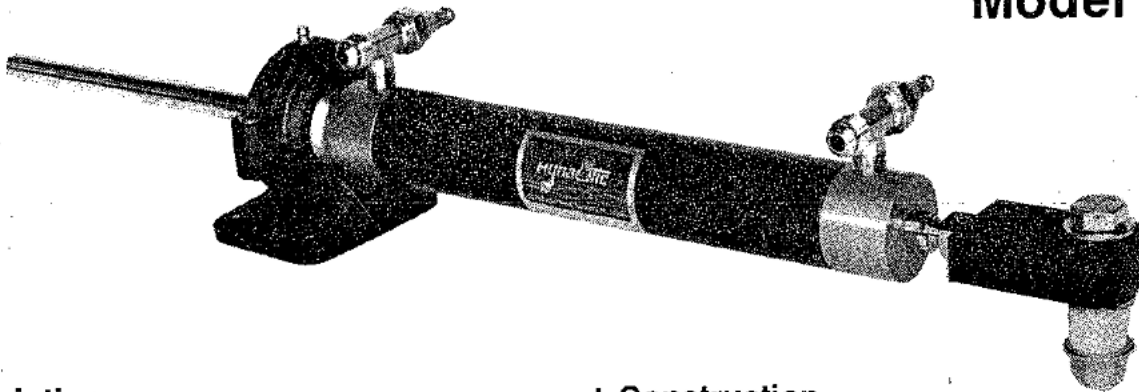


Marine Systems and Products - 1579 Barber Road, Sarasota, FL 34240 Tel. 813-379-0500 FAX 813-379-0496

COMPONENT FACT SHEET

Aluminum Cylinder

Model K-51



Description

The Hynautic K-51 balanced cylinder is double rod ended, each end held in place with internal wire ties.

Each cylinder is equipped with a swivel joint at the rod end and a ball joint at the cylinder end. The ball joint bracket at the cylinder end provides for a fixed mount attachment point and contains a zerk-type fitting for lubrication. The swivel joint at the rod end allows for free movement of the cylinder without binding when attached to the rudder arm.

Porting is through two 1/4" NPTF ports at each end of the cylinder. Also provided are two bleed screws with washers.

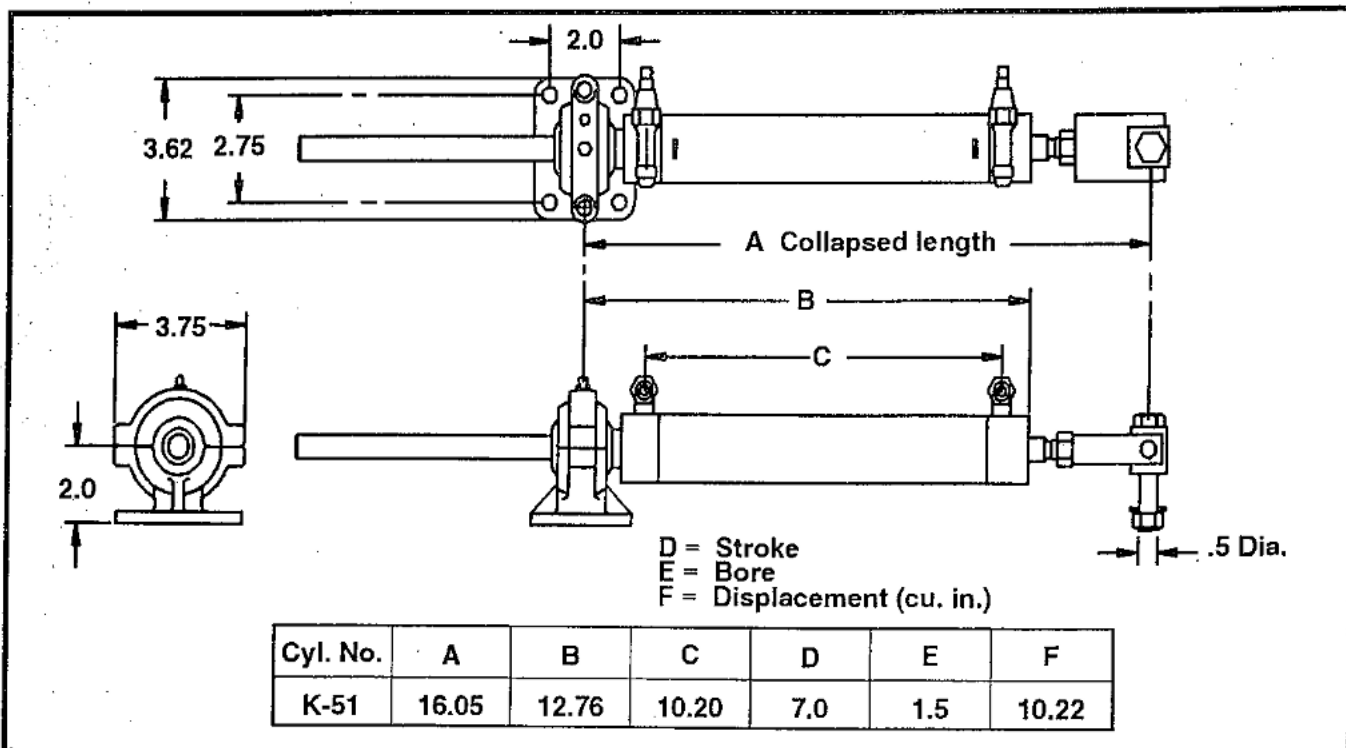
Construction

The cylinder tube is made of anodized 6063 aluminum, while the ends are anodized 6061 aluminum. The cylinder rod is polished 17-4 stainless steel.

Seals are buna "N" type with TFE backup. Wiper ring is molythane 959.

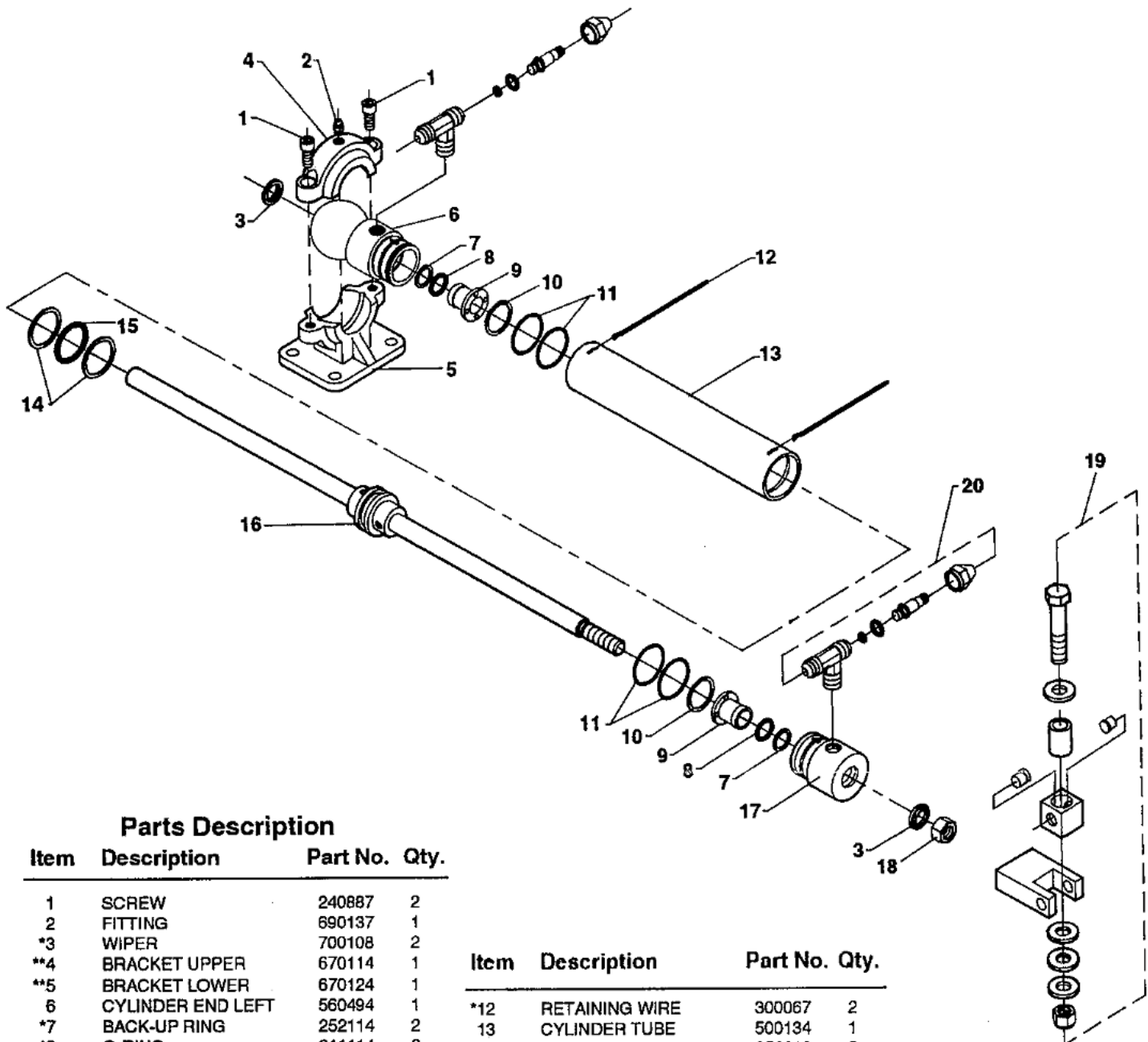
Rating

Cylinder rated working pressure is 950 PSI. Proof pressure is established at 4500 PSI. Burst pressure is 7000 PSI. Cylinder output force at 950 PSI is 1390 Lbs.



ILLUSTRATED PARTS BREAKDOWN

Model K-5



Parts Description

Item	Description	Part No.	Qty.
1	SCREW	240887	2
2	FITTING	690137	1
*3	WIPER	700108	2
**4	BRACKET UPPER	670114	1
**5	BRACKET LOWER	670124	1
6	CYLINDER END LEFT	560494	1
*7	BACK-UP RING	252114	2
*8	O-RING	211114	2
9	BEARING	640118	2
*10	RETAINING RING	300086	2
*11	O-RING	211028	4

Item	Description	Part No.	Qty.
*12	RETAINING WIRE	300067	2
13	CYLINDER TUBE	500134	1
*14	BACK-UP RING	252218	2
*15	O-RING	211218	1
16	ROD ASSEMBLY	550550	1
17	CYLINDER END RIGHT	560484	1
18	NUT	270037	1
19	ROD END ASSEMBLY	670310	1
+20	BLEED FITTING KIT	532090	1

* INCORPORATED IN SEAL KIT KS-14

+ INCORPORATED IN BLEED FITTING KIT KF-80

**UPPER AND LOWER BRACKETS SOLD ONLY AS A SET



Marine Systems and Products - 1579 Barber Road, Sarasota, FL 34240 Tel. 813-379-0500 FAX 813-379-0496



INSTALLATION INSTRUCTIONS: FOR K-51 CYLINDER

Important Notes:

1. System contamination is the main cause of steering failure. It is most important to keep dirt and foreign matter out of the system's components. Use extra care when installing fittings. Never leave cylinder ports exposed.
2. Care should be taken not to nick or scratch the cylinder rod, or leaking will result.
3. See **Figure 1** below for correct mount angle of cylinder to tiller arm. The tiller arm and cylinder must swing together in parallel planes.
4. The universal mount and rod ball joint will allow for some misalignment in the installation, but will not withstand the continual loading of extreme misalignment.
5. Mount the cylinder in such a way to insure that the hose ports (and the bleed fittings) are on the top surface.
6. Before installing the jam nut on the ball joint stud, insure that the threads are coated with a moly-disulphide or graphite grease. If not, severe galling may occur.
7. After installation, check mount bolts for tightness and lubricate universal mount and rod ball joint.

Mounting The K-51 Cylinder.

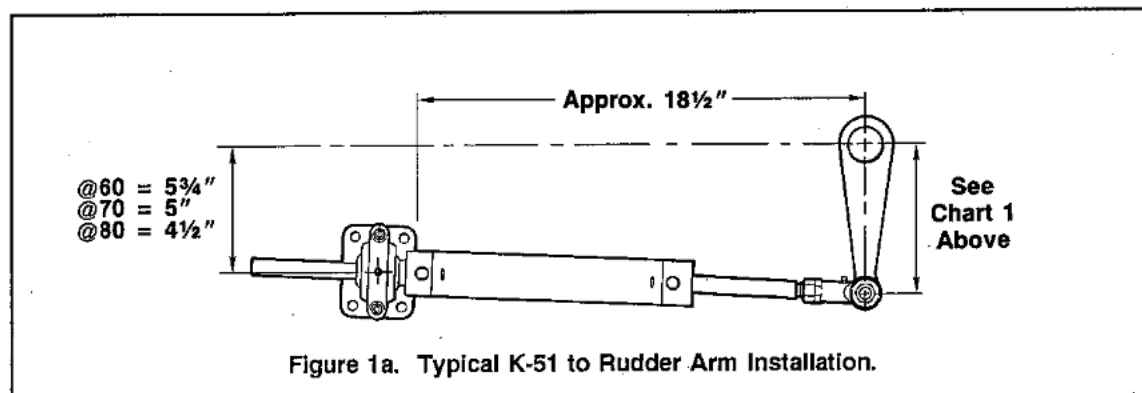
1. Using **Chart 1** as a guide, carefully machine a 1/2" diameter hole in the rudder arm at the proper location for arc desired. A close fitting hole will ensure the best possible life expectancy to the ball stem and joint.
2. Extend the rod of the cylinder to its midstroke position (approximately 3 1/2") and place the rudder in a midship position.
3. Place the cylinder ball joint stud into the 1/2" hole in the rudder arm.
4. Use **Figure 1** below to determine the mounting position for the universal mount.

Chart 1. Rudder Arm Hole Location.

Total Rudder Arc	Dimension *
60 deg.	7 in.
70 deg.	6 in.
80 deg.	5.5 in.

* Center of Rudder Post to Center of Bolt

NOTE: Care should be taken when selecting a mounting location. The structure to which the cylinder is mounted must withstand forces in excess of 1500 lbs. There must be no binding in the cylinder movement nor any obstruction in the steering arc.



Note: All dimensions determined by installer to insure unobstructed movement.

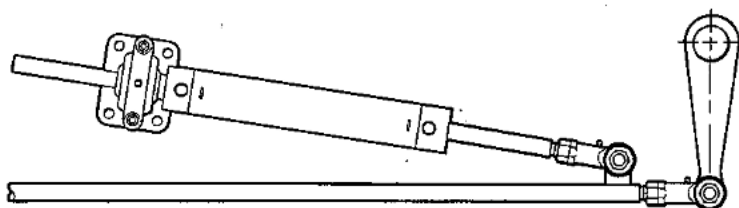


Figure 1b. Optional K-51 to Tie Bar Installation.

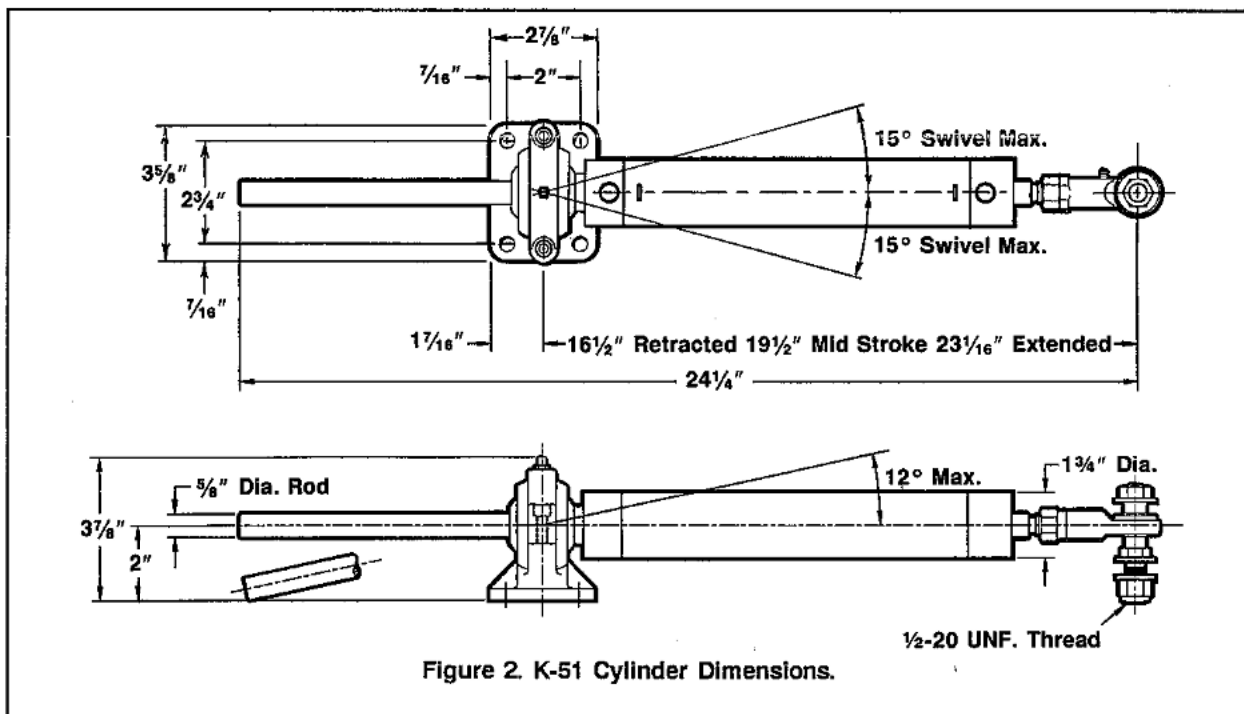
5. Use the mount base as a template and mark the four holes. Drill for 3/8 " stainless cap screws (not provided).
6. Remove the port plugs on the cylinder and carefully install the fittings. Thread sealants may be used sparingly, with care. **Do not overtighten the fittings.**
7. Mount cylinder. Tighten and torque ball joint jam nut to 43 ft.-lb. Tighten nuts for 3/8" stainless cap screws to 20 ft.-lb.
8. Once the cylinder is secure, swing the tiller arm through its full arc and verify that no binding occurs. (If the cylinder ports are plugged, it may be necessary to temporarily open the fittings to allow the cylinder piston to move.)

Plumbing Notes.

1. Use appropriate hose or tubing.
 - (A) A system with a 500 psi. relief valve requires unplasticised nylon tubing, minimum 3/8" O.D., 500 psi. Working Pressure.
 - (B) A system with a 950 psi. relief valve requires high pressure hydraulic hose or copper tubing. For hose, use either the Hynautic-supplied MSH hose or its equivalent (SAE 100R rated, minimum 5/16" I.D., 1000 psi. Working Pressure). Copper tubing should be .032" wall thickness, soft refrigeration tubing.
2. **Copper Tubing must not be connected directly to the cylinder.**
3. Install lines in such a way that there is no interference with steering movement, no tubing chafe, and no hindrance of cylinder stroke. Where possible, hydraulic lines should be positioned to run parallel to the cylinder, minimizing the amount of swing and travel.

Fluids

1. Use Hynautic PN MCO-01, or another fluid meeting the generic military specification MIL-O-5606 such as: Texaco No. 15, Shell Tellus 15, or Exxon Unisvis J14. **LIGHT VISCOSITY OILS ARE RECOMMENDED; HEAVIER OILS WILL CAUSE THE SYSTEM TO FEEL STIFF.**
2. Automatic transmission fluid (ATF) Dexron II may be used in emergency. **Never use Brake Fluid.**





Air Purge Instructions – 2-Line Systems

Please Read All Instructions Carefully Before Purging

This document pertains to purging a dual or single station system. There is a special section for purging dual or single systems with a single unbalanced cylinder. If you are purging a system with a single unbalanced cylinder read the section on setting up the cylinder and helm units, then go on to the Special Purging Instructions for Unbalanced Cylinders.

Filling and Purging the System with Purge Kit No. HF-35

Tools and Materials:

- FLAT HEAD SCREWDRIVER
- 5/8" WRENCH (FOR NYLON TUBING) OR A 3/4" WRENCH (FOR HOSE)
- 5/16" I.D. CLEAR TUBING (3 FEET LONG)
- 1 GALLON OF HYNAUTIC STEERING FLUID
Use Hynautic Steering Oil or light viscosity hydraulic oil, such as Texaco No. 15, Exxon Unavis J-134, Castrol AWH-15, that meet the Aircraft hydraulic fluid spec Mil-H-5606.
- 1 FILL KIT HF-35 contains:
 - 1-Plastic Spout
 - 1-Purge Adapter (helm to clear tube)
 - 1/2" I.D. Clear Tubing (3 feet long)
- 1 BLEED FITTING KIT (KF-80 OR KF-90) contains:
 - 2-Bleed Fitting Tees
 - 5/16" I.D. Clear Tubing (3 feet long)*

Prepare for purging by setting up the cylinder and the helm as described below. The steps for purging must be followed in the order in which they appear.

Setting Up the Cylinder

1. Make certain the bleed fittings are closed. (Refer to **Instructions** for use of bleed fittings.)
2. Clean the ends of the bleed fittings thoroughly, being sure they are free of any oil and dirt. Connect the bleed fittings by sliding each end of the 3 Ft. long clear tubing onto the bleed fitting nipples. See **Figure 1**.
3. Open the bleed fittings following the **Instructions** packaged with the KF-80 or KF-90 bleed fitting kits.

Setting Up the Helm

1. Remove the helm fill plug and install the purge adapter. (hand tighten)
2. Remove the lid from the Hynautic oil container and replace it with the plastic spout provided in the Purge Kit. Make sure the spout is clean then slide one end of the clear tubing (1/2" I.D.) onto the nose of the spout. Slide the other end of the tubing onto the nose of the purge adapter. See **Figure 2**.

Purging

Single or Dual Station Systems

NOTE

For dual station installation, purge first at lower helm.

1. Holding the container of oil above the helm unit, invert the container and fill the helm for 20-30 seconds. Slowly turn the steering wheel 5 revolutions (about 2 seconds per revolution) in each direction.

*If a KF-80 or KF-90 bleed fitting kit (including 3 ft. long tubing) was not supplied with the cylinder, contact Hynautic or your Hynautic distributor.

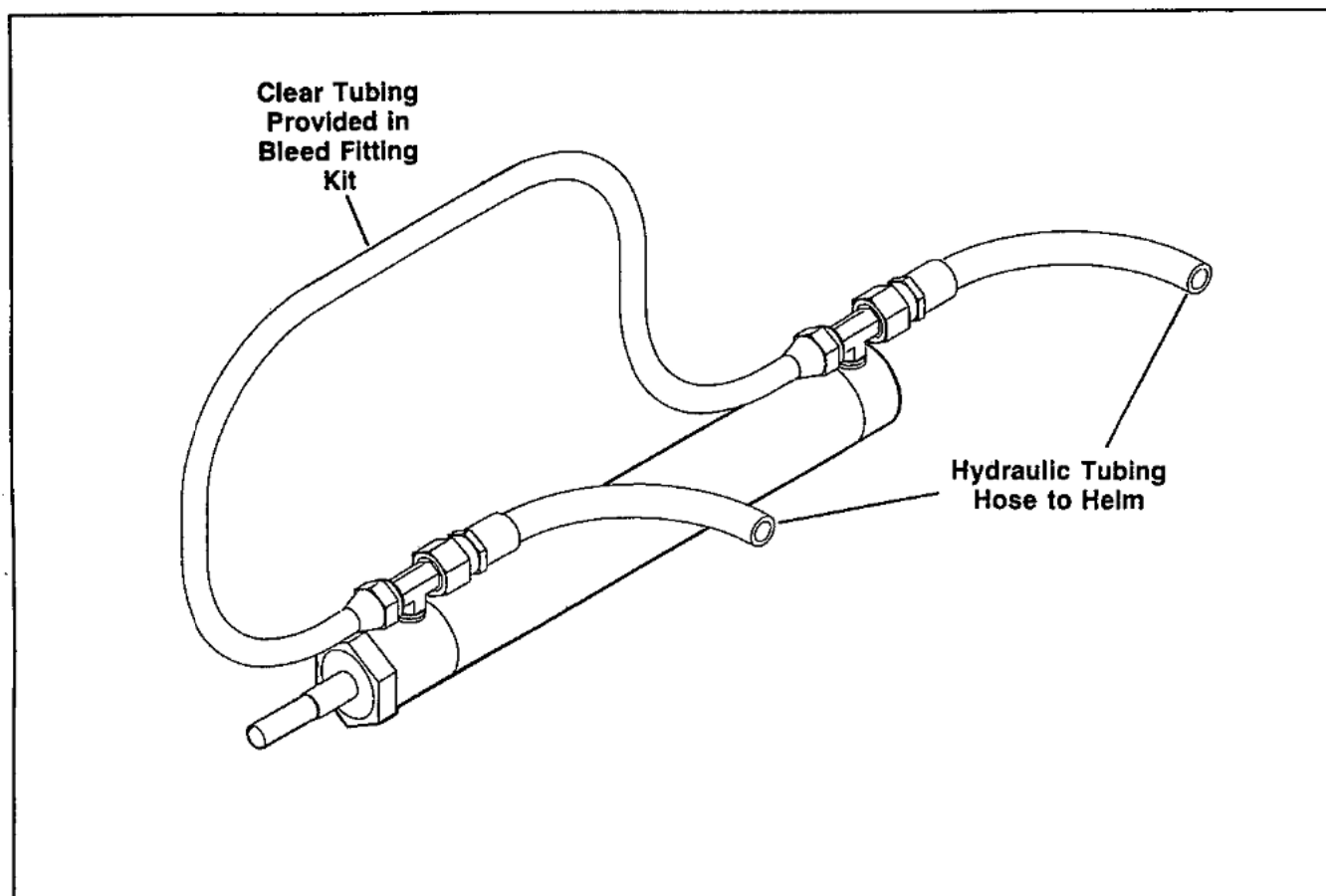


Figure 1

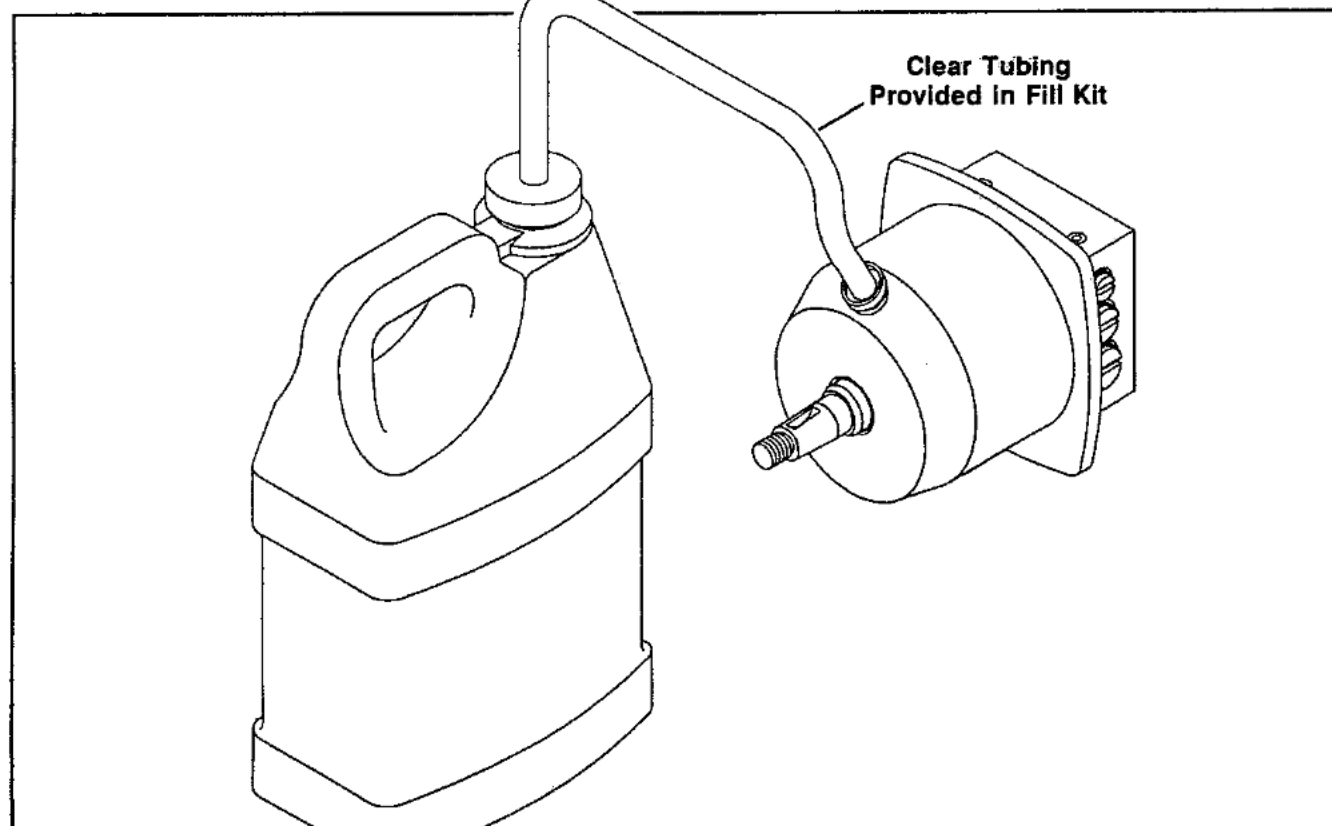


Figure 2

2. Continue this procedure until the air "burping" from the helm diminishes; now you can increase the speed and revolutions in each direction.

When it appears the "burping" has stopped, carefully right the oil container and set it down being careful not to disconnect the purge tube.

4. Close the bleed fittings at the cylinder, then return to the helm unit and steer the cylinder to a hardover position.

5. Loosen the cylinder bleed fitting nuts.

- At the helm unit, invert the oil container and turn the wheel 10-15 turns, alternating directions until "burping" stops.
- Repeat steps 3 thru 5 steering cylinder to hardover in the opposite direction.

6. Right the oil container and hold it lower than the helm allowing oil from the tube to drain back into the container.

- Disconnect the purge adapter from the helm unit. (A rag or paper towel may be needed to catch excess oil.)
- Remove Purge Adapter and replace with the original fill plug.

Note

When purging a system with dual helms, go to the upper helm and connect the oil container to it; repeat steps 1 thru 6.

7. Tighten the bleed fitting nuts at the cylinder and remove the clear tubing. (A rag or paper towel may be needed to catch excess oil.)

8. Steer 1/2 turn past hardover on the highest helm unit. (This will require some effort.) Loosen helm fill plug 2-1/2 turns to release air caused by line expansion. Making sure the helm is still hardover, retighten the fill cap.

Note

This action will create a normal pressure head on the system.

9. Check for leaks at the plumbing connections. If there are no leaks the steering system is ready for use.

Caution

Any air left in the system will tend to accumulate in the helm. During the first few hours of operation, check the oil level in the unit(s) before use. When checking the oil level, make sure the steering wheel is not hardover. The oil level should be high enough that there is just room to install the fill plug. After checking oil level, repeat step No. 8 so that the system has a pressure Head.



WARNING

LOSS OF STEERING COULD OCCUR IF STEPS 8 AND 9 ARE NOT PERFORMED CORRECTLY. This loss of steering is usually the result of fluid contraction due to temperature changes.

Special Purging Instructions for Systems with a Single Unbalanced Cylinder

Note

For dual station installation, purge first at the lower helm.

1. Holding the container of oil above the helm unit, invert the container and fill the helm for 20-30 seconds. Slowly turn the steering wheel 5 revolutions (about 2 seconds per revolution) in each direction.
2. Continue this procedure until the air "burping" from the helm diminishes; now you can increase the speed and revolutions in each direction.
3. When it appears the "burping" has stopped, carefully right the oil container and set it down being careful not to disconnect the purge tube.
4. Close the bleed fittings at the cylinder. Go to the helm unit and steer the cylinder to a hardover position so **cylinder rod is fully extended**. Loosen the bleed fitting nuts on the cylinder. Return to the helm unit and invert the oil container; turn wheel 10 - 15 turns, alternating the wheel direction until "burping" stops.

5. Repeat step 4 with cylinder hardover in opposite direction so that the **cylinder rod is retracted**.
6. Right the oil container and hold it lower than the helm allowing oil from the tube to drain back into the container.
 - Disconnect the purge adapter from the helm unit. (A rag or paper towel may be needed to catch excess oil.)
 - Remove Purge Adapter and replace with the original fill plug.

Note

When purging a system with dual helms, go to the upper helm and connect the oil container to it; repeat steps 1 thru 6.

7. Tighten the bleed fitting nuts at the cylinder and remove the clear tubing. (A rag or paper towel may be needed to catch excess oil.)
8. At the highest station, remove the fill plug and steer the cylinder hardover until the **cylinder rod is retracted**.
9. Now, steer the cylinder to hardover in the opposite direction so that the **rod is extended**. You will notice the oil level in the helm becomes lower.
 - Turn the wheel 1/2 turn past hardover
 - With wheel past hardover, install the fill plug in the helm unit.

NOTE

This will create a normal pressure head on the system.

10. Check for leaks at all plumbing connections. If there are no leaks, the steering system is ready for use.

Caution

Any air left in the system will tend to accumulate in the helm. During the first few hours of operation, check the oil level in the unit(s) before use. When checking the oil level, make sure the steering wheel is NOT hardover. The oil level should be high enough that there is just room to install the fill plug. After checking oil level, repeat steps No. 8 and 9 so that the system has a pressure head.



WARNING

LOSS OF STEERING COULD OCCUR IF STEPS 8 AND 9 ARE NOT PERFORMED CORRECTLY. This loss of steering is usually the result of fluid contraction due to temperature changes.



Marine Systems and Products - 1579 Barber Road, Sarasota FL 34240 Tel. 813-379-0500 FAX 813-379-0496



Imo Industries Inc.
Morse Controls Division



AUTOPILOT INTEGRATION

Hynautic steering systems are compatible with most autopilots. Remember that the proper autopilot model to be used is a recommendation reserved for the pilot manufacturer. They know our equipment and how it interacts with their components.

Here are a few items to note when selecting an autopilot.

1. Autopilot selection is usually based upon the hydraulic cylinder in use. However, sometimes boat size and, to a lesser degree, boat speed and steering geometry may be important.

2. The autopilot's power unit may be of two styles: A) a complete power hydraulic unit with integral hydraulic pump, or B) an electro-mechanical power unit which is to be attached to a Hynautic H-29 or H-30 autopilot helm.

Autopilot systems with complete units are the simplest to install. Those systems coupled to a Hynautic autopilot helm offer the greatest flexibility in changing performance.

3. An autopilot system must have not only enough POWER to sustain the rudder resistance, but also must supply a proper RATE OF FLOW, which determines rudder speed.

4. Any hydraulic autopilot added to a Hynautic system must incorporate a lock-out valve, either internal or external to the autopilot pump.

5. Attachment of an electro-mechanical power unit to a Hynautic autopilot helm can be either with chain and sprocket, or by direct coupling.

Obviously, direct coupling only allows a one to one ratio.

Sprockets are sized by teeth. A 2 to 1 ratio would require a 20 tooth sprocket chain to a 10 tooth sprocket, or a 30 tooth to a 15 tooth, etc.

6. Most autopilots have a feedback system that makes rudder correction proportional to the heading error. With Hynautic steering systems, this autopilot feedback device must be connected to the rudder (or cylinder). The steering wheel will not accurately indicate rudder position.

Cylinder Model No.	Bore and Stroke (in.)	Displ't (cu. in.)
K-1	1-1/2 x 9	12.1
K-2	1-3/4 x 9	17.6
K-3	2 x 9	23.1
K-4	2 x 12	30.5
K-7	1-1/2 x 9-1/2	12.6
K-8	2-1/2 x 9-1/2	39.2
K-10	1-1/4 x 9-1/2	7.5
K-11*	1-1/4 x 9	*11.0
K-12*	1-1/4 x 7	*8.6
K-13*	1-1/4 x 9	*11.0
K-14*	1-1/4 x 7	*8.6
K-16*	1-1/4 x 9	*11.0
K-18	1-1/4 x 7	7.0
K-19	1-1/4 x 9	9.0
K-21	1-1/2 x 9	12.1
K-22	1-1/2 x 10	13.3
K-24	1-1/2 x 5	6.6
K-25	1-1/2 x 10	13.3
K-26	1-1/2 x 12	16.0
K-27	1-1/2 x 10	13.3
K-28	1-1/2 x 12	16.0
K-29	1-1/2 x 12	16.0
K-31	2 x 10	25.5
K-32	2 x 8	20.0
K-33	2 x 9	23.1
K-51	1-1/2 x 7	10.2

*Displacement when Pressurizing the Head End of Cylinder



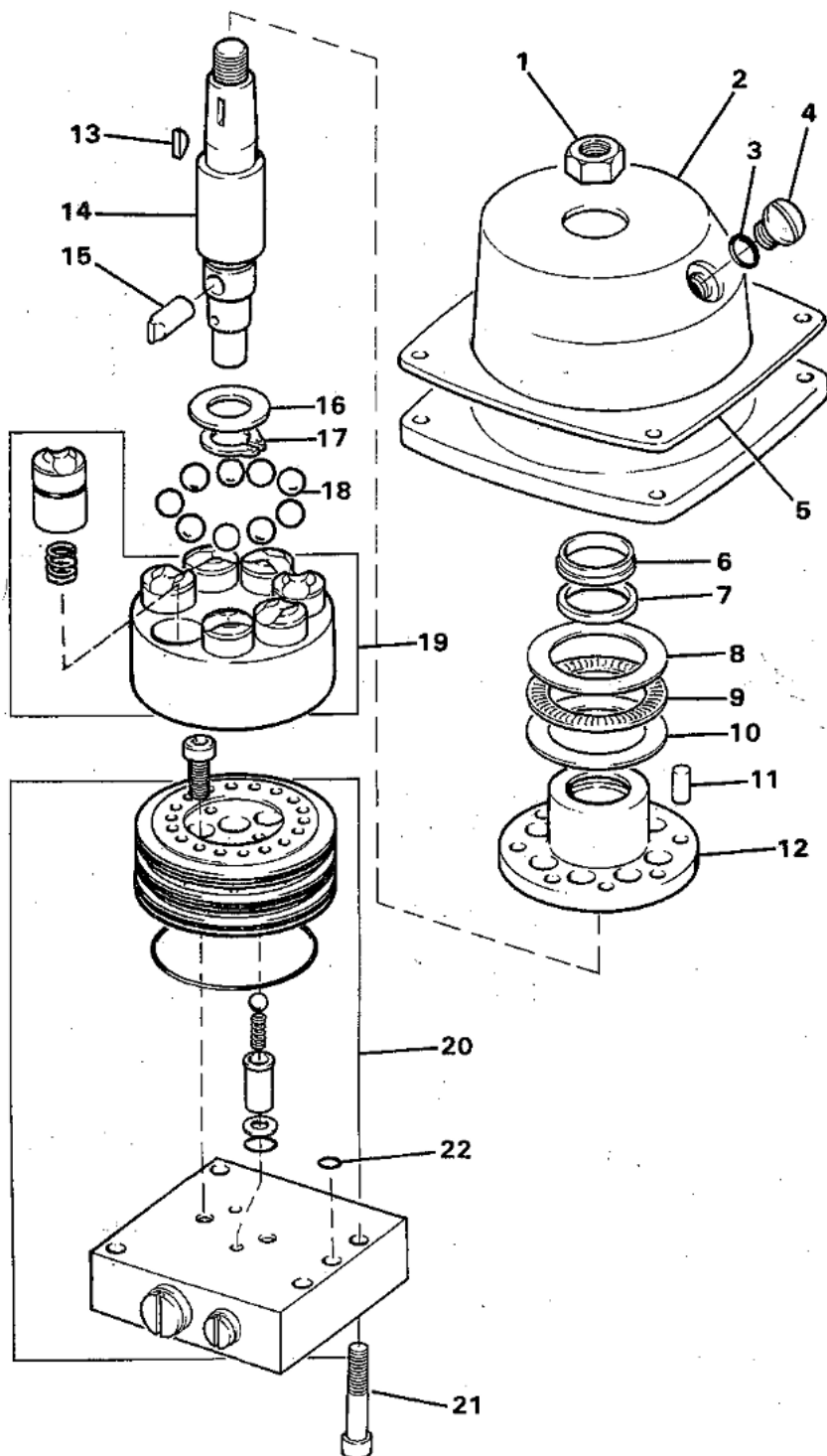
Marine Systems and Products - 1579 Barber Road, Sarasota, FL 34240 Tel. 813-379-0500

FAX 813-379-0496



Imco Industries Inc.
Morse Controls Division

ILLUSTRATED PARTS BREAKDOWN



Parts Description

Item	Description	Helm Models	Part No.	Qty.
1.	Nut	ALL	270037	1
2.	Helm Body	ALL	901024	1
3.	O-Ring	ALL	211906	1
4.	Fill Plug	ALL	380544	1
5.	Trim Plate	ALL	520604	1
6.	Wiper	ALL	700068	1
7.	Quad-Ring Seal	ALL	224015	1
8.	Bearing Race-thin	ALL	190010	1
9.	Bearing-thrust	ALL	190011	1
10.	Bearing Race-thick	ALL	190009	1
11.	Pin	ALL	290146	9
12.	Ball Cage	ALL	620028	1
13.	Key	ALL	650027	1
14.	Shaft	ALL	400257	1
15.	Key	ALL	650026	1
16.	Washer	ALL	190012	1
17.	Retaining Ring	ALL	300046	1
18.	Ball	ALL	234066	9
19.	Cyl. Barrel Assy.	H-60	510110	1
		H-61	510120	1
		H-62	510130	1
20.	Valve Body Assy.	H-60-001	900450	1
		H-61-001	900450	1
		H-62-001	900450	1
21.	Screw	ALL	240467	4
22.	O-Ring	ALL	211009	1
A.	Seal Kit	ALL	HS-06	1
B.	Fill Kit	ALL	HF-35	1

WARNING

The Helm Units are manufactured under strict controls and testing procedures. Disassembly of item no. 20 will void any existing warranty. The Valve Body Assembly is under heavy spring load and disassembly could cause some pieces to be projectiles which could cause bodily harm.

It is recommended that the unit be returned to Hynatic or the point of purchase for authorized repair and retesting.

H-6 X - X X X

Helm Unit
Model Number

Color Code
0 = Black

Relief
Setting
1 = 1000 PSI
2 = 500 PSI

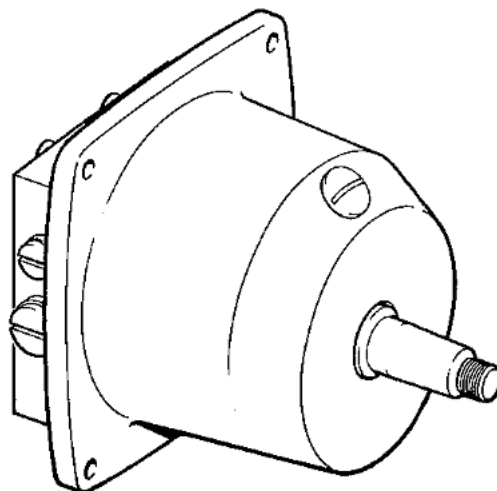
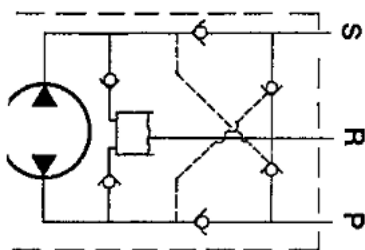
Displacement
0 = 2.0 Cu. in.
1 = 2.75 Cu. in.
2 = 1.65 Cu. in.



COMPONENT FACT SHEET

H-60 Series 2-Line Helm Unit

(H-60, H-61, H-62)



Description

The Hydraulic H-60 Series Hydraulic Helm Unit is a bi-directional piston pump, coupled to pilot-check and make up check valve.

The patented pump section utilizes seven pistons, each stroked 18 times with one shaft revolution, pushing fluid thru a porting block into the valve section.

The valve section includes holding valves to prevent feedback to isolate the unit, and compensation valves to allow the use of unbalanced cylinders.

The H-60 Series Helm Units incorporate a reservoir and a relief valve in each unit. (Relief setting is specified as 500 psi or 1000 psi). Clockwise rotation of the shaft discharges fluid thru the "S" port. Counter clockwise rotation effects "P" port discharge. The "R" port is only used on two (2) station applications. Port size is NPTF.

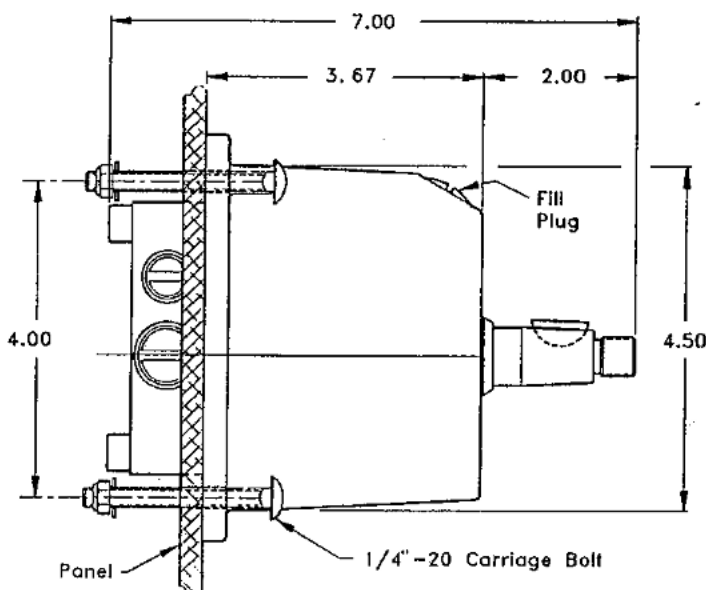
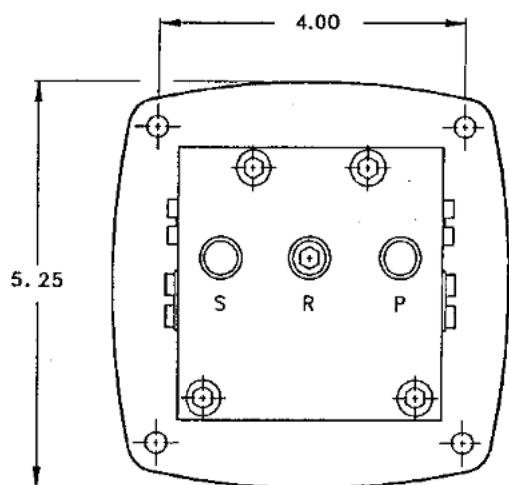
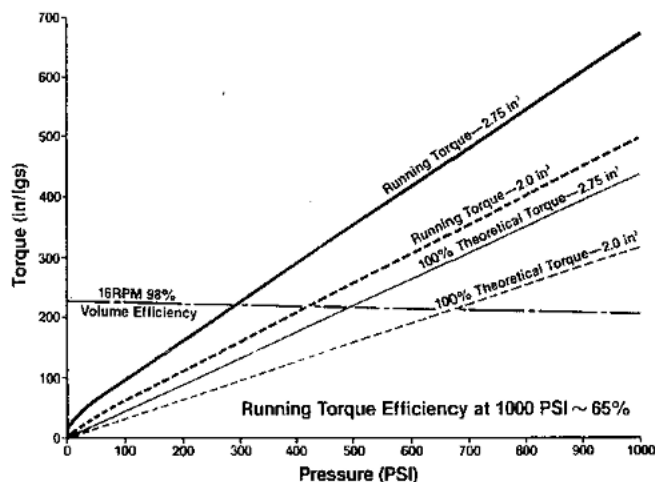
Construction

The exterior casting is 356-T6 aluminum painted with polyurethane. The interior is stainless steel. Internal components-ferrous metal port block and cylinder barrel with ground mating surfaces, hardened and ground steel pistons, drive keys, needle thrust bear-

ings, Buna "N" seals, TFE seal backups and piston glyd rings. Other components are of friction and wear resistance materials to reduce operating torque and prolong life.

Performance

Volumetric efficiency: 90% at 1000 psi and 12 rpm. Running torque vs. pressure:





TROUBLESHOOTING GUIDELINES

The Hynautic System on board your vessel is considered one of the best hydraulic steering systems on the market today. Over twenty years of development and customer satisfaction are behind the success of Hynautic and the systems it provides.

Each component in your Hynautic System has been thoroughly tested at the factory prior to shipment. Helm units have been tested for volumetric efficiency and leakage. Relief valves have been checked for leakage and factory-set at the proper relief pressure. Cylinders have been tested for leakage and operation at 1000 psi.

You should be aware that Hynautic manufactures manual hydraulic steering, not power steering (unless special

ordered), so that the effort required to turn the wheel will increase as the system is called on to exert more force on the rudder or outdrive. Therefore, this system will not turn as easily as a car's power steering.

When turning the ship's wheel, the operator will become aware of a rhythmic pulsing. This is a normal action caused by the releasing of the pilot check valve.

Problems with your Hynautic System will usually occur during, or immediately after, installation and are the result of system contamination. The following is a listing of some common problems encountered, the probable causes, and solutions.

<u>PROBLEM</u>	<u>CAUSE</u>	<u>SOLUTION</u>
Steering is stiff both at the dock and underway*	High viscosity oil used in the system.	Drain fluid from system and replace with low viscosity hydraulic oil. Such as Texaco #15, Exxon Univas J-13, Castrol AWH-15, that meet the Aircraft Hydraulic Fluid Spec MIL-H-5606.
	Restriction in the "P" or "S" lines tubing or fittings.	Find restriction and correct. When the tubing is bent it can become kinked and this restriction can cause stiff steering.
	"P" and "S" line size too small.	Refer to the installation instructions for the correct size tubing to use with the Hynautic System. Inadequate line size will definitely cause viscous loss and above-average steering effort.

**First, determine whether the system is operating within the designed limits. While the vessel is at the dock, disconnect the cylinder from the rudder or outdrive. With the system in this configuration, the designed torque limits are as shown in Table 1.*

If the torque is within, or below, the indicated limits when you turn the ship's wheel, Hynautic considers the system to be operating satisfactorily. It should be remembered that the torque on the wheel will increase as the loads on the rudder increase.

If it has been determined that the torque is in excess of the above limits, then review the following causes and solutions.

PROBLEM

CAUSE

SOLUTION

(Continued)

Steering is satisfactory until it is attached to the rudder or outdrive system, then it becomes stiff.

Cylinder is misaligned or improperly mounted, causing internal binding.

Fittings in cylinder have been over-tightened. This is a common problem on aluminum cylinders. The result is that the fitting begins to bear down on the internal bearing distorting it, and fluid flow is restricted.

Remount cylinder per the installation instructions. If the cylinder has been damaged return it to Hynautic for repair.

Remove fitting and inspect bearing. If a definite circular mark is evident, the fitting has been over-tightened and damaged. Replace with new fitting; do not overtighten. If steering is still stiff return the cylinder to Hynautic for bearing replacement. Remember, there is a bearing at each end of a balanced cylinder.

Rudder post gland rings are too tight, or rudder post is bent. Steering linkages or outdrives could also be mechanically binding.

Correct problem as required.

Outdrive or outboard swivel bracket requires lubrication.

Lubricate per maintenance manual.

Tilt tube on outboard, or guide tube on outdrive, has become corroded and the adapter rod has become, or is becoming, frozen in place.

Tilt and guide tubes must be thoroughly cleaned and regularly lubricated with a high quality marine grease. If this is not done the adapter rod can become frozen within the tube, which can result in major repair costs. A tilt tube wire brush may be necessary to clean inside of the tube.

Steering is easy at dock but becomes stiffer as boat is underway.

System is inadequate to handle the boat.

By using a larger diameter wheel the operator increases his mechanical advantage, thereby, reducing the steering effort proportionally to the increase in the wheel's diameter. Hynautic's recommended minimum wheel diameters are shown in Table 1.

Component leaking fluid from parting line, rod or shaft.

Worn rod or shaft seal.

Return unit to Hynautic for repair. Unit should be returned for repair as quickly as possible as shaft leaks will get progressively worse.

Pinched or cut parting line o'ring.

Return unit to Hynautic for repair.

Helm pumps in one direction but not in the other.

Malfunction in pilot check valve area of helm.

For a single station installation, remove the helm and return the unit to Hynautic for repair.

For a dual station installation, remove the helm that is pumping properly and cap off the lines. If after operating the remaining helm the problem no longer exists, the faulty helm is the unit that has been removed. If the problem persists, the faulty helm is the unit that is still installed. Return the faulty unit to Hynautic, for repair.

PROBLEM**CAUSE****SOLUTION**

(Continued)

Dirt in the makeup check valve.

Return faulty helm to Hynautic for repair. Repair requires complete unit tear-down, which Hynautic recommends be done by factory trained personnel only.

Air still in system.

Purge system according to the AIR PURGE INSTRUCTIONS.

Helm unit shows no definite stop in either direction. *

Air in the system.

Re-purge system according to the AIR PURGE INSTRUCTIONS.

Helm takes excessive turns going from hardover to hardover.

Low oil level

Add oil to the system following the AIR PURGE INSTRUCTIONS.

Air in system.

Re-purge system according to the AIR PURGE INSTRUCTIONS.

Incorrect helm displacement.

Verify helm number and helm displacement. Check installation instructions and re-verify turns hardover to hardover.

Fluid contraction due to cold weather

See Air Purge Instructions regarding "Adding Pressure Head."

System seems not to be purged even though it had just been purged the day before.

Low oil level.

Re-purge system according to the AIR PURGE INSTRUCTIONS.

Rudder drifts excessively (must continually correct steering in one direction) when underway.

Internal leakage of the relief valve.

Return unit to Hynautic for repair.

If a secondary relief valve has been added to the system it could be malfunctioning. Secondary reliefs are used in some auto-pilots.

Isolate the secondary relief and see if the problem persists.

If the cylinder has had many seasons of usage the internal seals may be worn and fluid is then being bypassed within the cylinder.

Return cylinder to Hynautic for repair.

Steering is stiff only in one direction, even at the dock.

System with a single unbalanced cylinder is improperly filled.

Refill system per special instruction found in the manual for Air PURGING.

Damaged Hynautic nylon tubing, causing fluid leakage.

Tubing run across hot spot on engine or against a sharp protrusion.

If tubing is readily available, and the installation lends itself, run a new length of tubing. However, in most cases the tubing must be spliced together. First, cut the tubing at damaged point (the cut must be square). Join the two ends together with a HYN# 530115 Union and a CF-02 Fitting Package, if tubing is 5/16" outside diameter. If tubing is 3/8" outside diameter, use HYN# 690971 Union Adaptor.

* It should be noted that when the operator has reached hardover, with a constant pressure maintained on the wheel, it is normal for the wheel to continue to turn past the hardover position. This action occurs because helm function is not 100% efficient. The degree and speed of wheel movement is determined by the unit's efficiency. However, if the wheel is easily turned past hardover a problem may exist.

Table 1.

Helm Displacement	Torque Limits	Min. Required Wheel Dia.
1.65 CU-IN.	22-30 IN.LBS.	15 IN.
2.00 CU-IN.	25-35 IN.LBS.	15 IN.
2.75 CU-IN.	35-45 IN.LBS.	18 IN.

REPLACEMENT PARTS

MISCELLANEOUS KITS:

PART#	ITEM	PART #	ITEM
270037	NUT FOR 3/4" TAPER HELM SHAFT, 1/2-20 THDS	HS-05	HELM SEAL KIT FOR H-50 SERIES
650027	WOODRUFF KEY FOR 3/4" TAPER HELM SHAFT	HS-06	HELM SEAL KIT FOR H-60 SERIES
670310	ROD END FOR K-11 AND K12 CYLINDERS	KS-01	CYLINDER SEAL KIT FOR K-11 THRU K-17
670310	ROD END AND MOUNT END FOR K-18 AND K19 CYLINDERS	KS-02	CYLINDER SEAL KIT FOR K-18 THRU K-20
670320	MOUNT END FOR K-11 AND K12 CYLIDERS	KS-07	CYLINDER SEAL KIT FOR K-10
690110	FITTING, 5/16" REUSABLE, FOR MSH 5	KS-08	CYLINDER SEAL KIT FOR K-7
690130	FITTING, 3/8" REUSABLE, FOR MSH 6	MCO-01	ONE QUART MIL-H-5606 AIR CRAFT HYDRAULIC FLUID
		MCO-02	ONE GALLON MIL-H-5606 AIR CRAFT HYDRAULIC FLUID
		KF-60	STRAIGHT, 3/8" FLARE (2 EA. 690011)
		KF-70	ELBOW, 3/8" FLARE (2 EA. 690051)
		KF-80	BLEED TEE, 3/8" FLARE
		KF-90	BLEED TEE, 3/8" O.D. NYLON
		FK-1970	STRAIGHT, 3/8" NYLON (2 EA. 690961, 691061)
		FK-1980	ELBOW, 3/8" NYLON (2 EA. 690961, 691071)
		MST 2-50	NYLON TUBING, 3/8" O.D. x 50 FT. LG. ROLL
		MST 2-100	NYLON TUBING, 3/8" O.D. x 100 FT. LG. ROLL
		MSH 5-50	HOSE, 5/16" I.D. x 50 FT. LG., 1000 PSI
		MSH 5-50	HOSE, 5/16" I.D. x 50 FT. LG., 1000 PSI



Marine Systems and Products - 1579 Barber Road, Sarasota FL 34240 Tel. 813-379-0500

©1992 Imo Industries Inc., Hynautic Operations, Morse Controls Division



Imo Industries Inc.
Morse Controls Division
FAX 813-379-0496

Imo Industries Inc.
Hynautic Operations
Morse Controls Division
1579 Barber Road
Sarasota, Florida 34240
813-379-0500
FAX 813-379-0496



HYNAUTIC STOCKING DISTRIBUTORS

ALABAMA

ACTIVATION, INC.
153 West Valey Ave.
P.O. Box 59667
BIRMINGHAM, AL 35259
205/942-1753

ALASKA

NORTHERN HYDR.
4510 Gambell St.
ANCHORAGE, AK 99503
907/562-2656

ALASKA HYDRAULICS
412 Shelikof
P.O. Box 1849
KODIAC, AK 99615
907/486-5970

CALIFORNIA

BOATECH, INC.
799 Miraflores
SAN PEDRO, CA 90731
213/519-1114

FOX MARINE
2598 E. 28th. Street
LONG BEACH, CA 90806
714/846-4477 or 310/426-7111

KETTENBURG MARINE
2810 Carleton Street
SAN DIEGO, CA 92106
619/224-8211

MERCURY MARINE MART
619 Lindaro Street
SAN RAFAEL, CA 94901
415/457-7070

MOSS LANDING MARINE
Sandholdt Rd.
MOSS LANDING, CA 95039
408/633-2133

CONNECTICUT

ESSEX MACHINE WORKS
50 West Avenue
ESSEX, CT 06426
203/767-8285

FLORIDA

BYFIELD MARINE
175 Olive Road
PENSACOLA, FL 32514
904/477-8011

GLENN MAR MARINE
6870-142nd Ave. North
LARGO, FL 34641
813/536-1955

LEWIS MARINE SUPPLY
217 S.W. 32nd Court
FT. LAUDERDALE, FL 33315
305/523-4371

LYON MARINE SUPPLY
709 Clear Lake Road
COCOA, FL 32922
407/632-8484

PANAMA MARINE
202 W. 6th Street
PANAMA CITY, FL 32401
904/785-4661

PARDISCO, INC.
940 E. Adams Street
JACKSONVILLE, FL 32202
904/354-5469

UNITED MARINE
490 N.W. South River Drive
MIAMI, FL 33128
305/545-8445

UNITED MARINE
1400 NW 159th Street
MIAMI, FL 33169
305/620-4111

UNITED MARINE
2894 Palm Beach Blvd.
FT. MYERS, FL 33916
813/332-1987

UNITED MARINE
2904 44th Avenue North
ST. PETERSBURG, FL 33714
813/527-6457

HAWAII

SERVCO MARINE SUPPLY
1125 Ala Moana Blvd.
HONOLULU, HI 96814
808/524-6150

LOUISIANA

BEACON SUPPLY CO.
821 Industry Road
KENNER, LA 70062
504/467-9200

DONOVAN MARINE, INC.
400 N. Carrollton Avenue
NEW ORLEANS, LA 70119
504/488-5731

SKIPPER HYDRAULICS
1304 Peters Road
HARVEY, LA 70058
504/368-4211

COASTAL MARINE
1900 Industrial Blvd.
HARVEY, LA 70058
504/341-1414

MAINE

MANSET MARINE SUPPLY
50 New County Road
ROCKLAND, ME 04841
207/596-6464

MARYLAND

MC CLEAN BROTHERS
122 N. Langley Road
GLEN BURNIE, MD 21061
301/761-9200

MASSACHUSETTS

ROSE MARINE COMPANY
375 Main Street
GLOUCESTER, MA 01930
508/283-3335

MICHIGAN

MIDWEST MARINE
24300 Jefferson Avenue
ST. CLAIR SHORES, MI
48080
313/778-8950

NEW JERSEY

**MARINE EQUIPMENT &
SUPPLY**
1401 Metropolitan Avenue
THOROFARE, NJ 08086
609/853-8320

NEW YORK

ALLSTATE MARINE DIST.
4365 Austin Blvd.
ISLAND PARK, NY 11558
516/431-0288

EAST END MARINE SUPPLY

230 Corwin Street
GREENPORT, L.I., NY 11944
516/477-1900

FREEPORT MARINE
47 West Merrick Road
FREEPORT, NY 11520
516/379-2610

SEACOAST DISTR.
105 Wartburg Avenue
COPIAGUE, NY 11726
516/842-2338

NORTH CAROLINA

BARBOUR'S MARINE
216 West Front Street
BEAUFORT, NC 28516
919/728-2136

OREGON

ENGLUND MARINE
Foot of 15th Street
ASTORIA, OR 97103
503/325-4341

HYDRAULIC OUTFITTER
213 N.W. 10th Street
PORTLAND, OR 97209
503/223-5345

SOUTH CAROLINA

HAROLD T. MCGILL DIST.
1903 Longstreet St. N.
KINGSTREE, SC 29556
803/354-7404

TEXAS

AER MARINE SUPPLY
2301 NASA Road #1
SEABROOK, TX 77586
713/474-3276

**MARINE & INDUSTRIAL
SUPPLY**
101 Highway 35
ROCKPORT, TX 78382
512/7291318

SHAW DISTRIBUTORS
1106 Hub
HOUSTON, TX 77023
713/923-2615

UTAH

ROBERTSON'S MARINE
1045 S. Main Street
SALT LAKE CITY, UT 84111
801/534-1111

VIRGINIA

NORFOLK MARINE DIST.
1340 Azalea Garden Road
NORFOLK, VA 23502
804/853-7658

PAXTON COMPANY
1111 Ingleside Road
NORFOLK, VA 23502
804/853-6781

WASHINGTON

FISHERIES SUPPLY CO.
1900 N. Northlake Way
SEATTLE, WA 98103
206/632-4462

KOLSTRAND MARINE
4749 Ballard Avenue NW
SEATTLE, WA 98107
206/789-1500

LFS, INC.
851 Coho Way
BELLINGHAM, WA. 98225
206/734-3336

NEDDER HYDRAULICS
1411 Roeder Avenue
BELLINGHAM, WA 98225
206/734-9829

**SEATTLE MARINE &
FISHING SUPPLY**
2121 W. Commodore Way
SEATTLE, WA 98199
206/285-5010

Helm 1/4" NPT

Hose 3/8 OD
5/16 ID

Fittings

30' Hose

2 gals Hydraulic steering or Texaco 17

2 TS

4 Z ends