

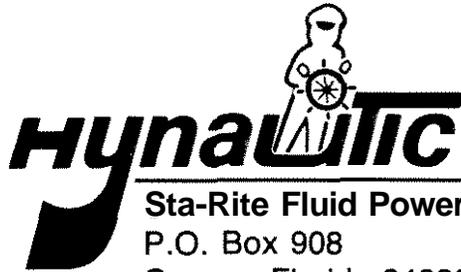
OWNERS MANUAL



MANUAL HYDRAULIC STEERING INSTALLATION AND SERVICE MANUAL

**MS-1150/1175
1200 SYSTEMS**

THIS MANUAL SHOULD BE KEPT ON BOARD YOUR VESSEL.



Sta-Rite Fluid Power Group,
P.O. Box 908
Osprey, Florida 34229
(813) 966-2151

LIMITED WARRANTY POLICY
"HYNAUTIC" TRADEMARK PRODUCTS

STA-RITE/ a WICOR company

The Hynautic Division of Sta-Rite Industries, Inc. warrants that its manufactured products 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 Osprey, Florida. This Limited Warranty does not cover shipping costs to and from 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 judgment 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 or 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. Neither Sta-Rite nor Hynautic shall, 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 WILL BACK UP THE WARRANTY EXTENDED TO THE CONSUMER.

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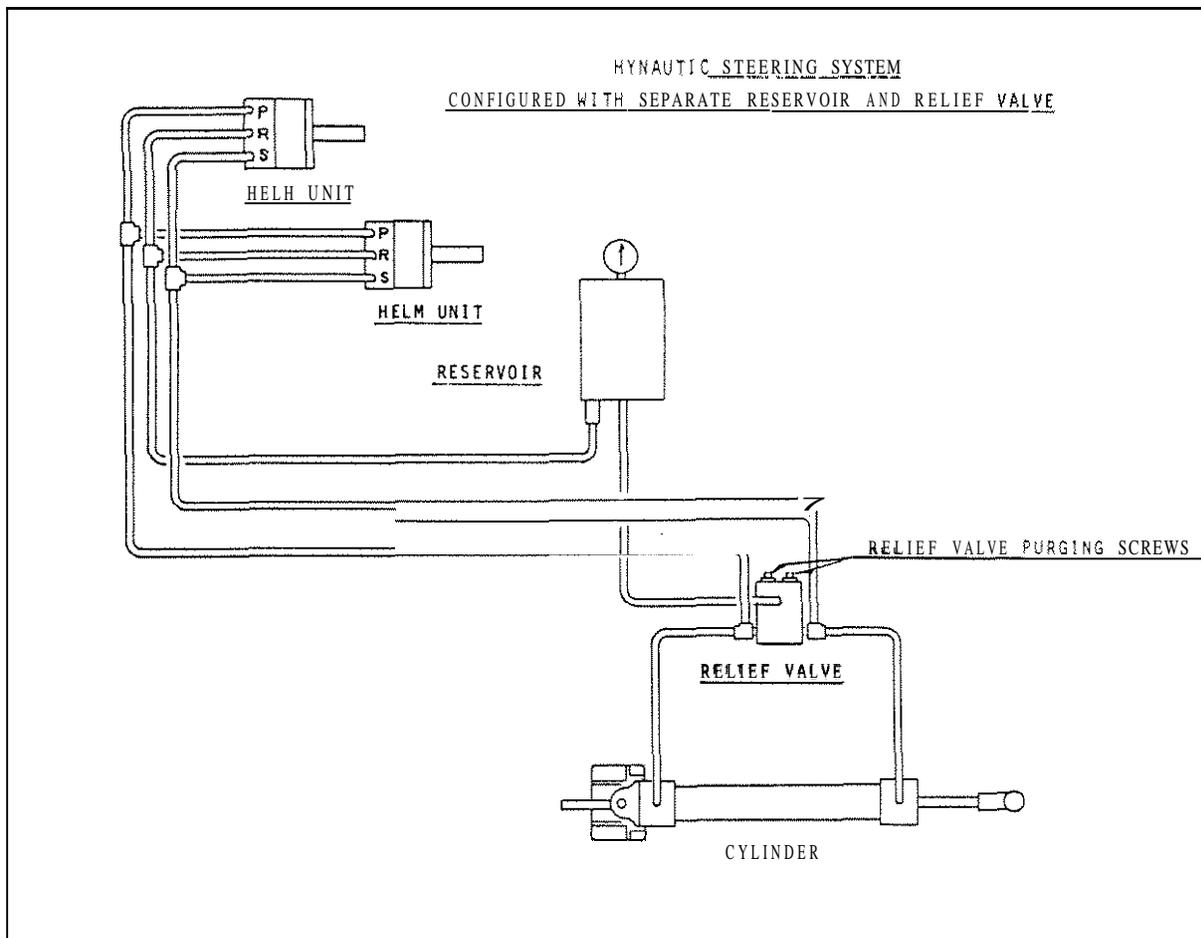
INSTALLATION INSTRUCTIONS: HOW AND WHY YOUR HYNAUTIC STEERING SYSTEM WORKS

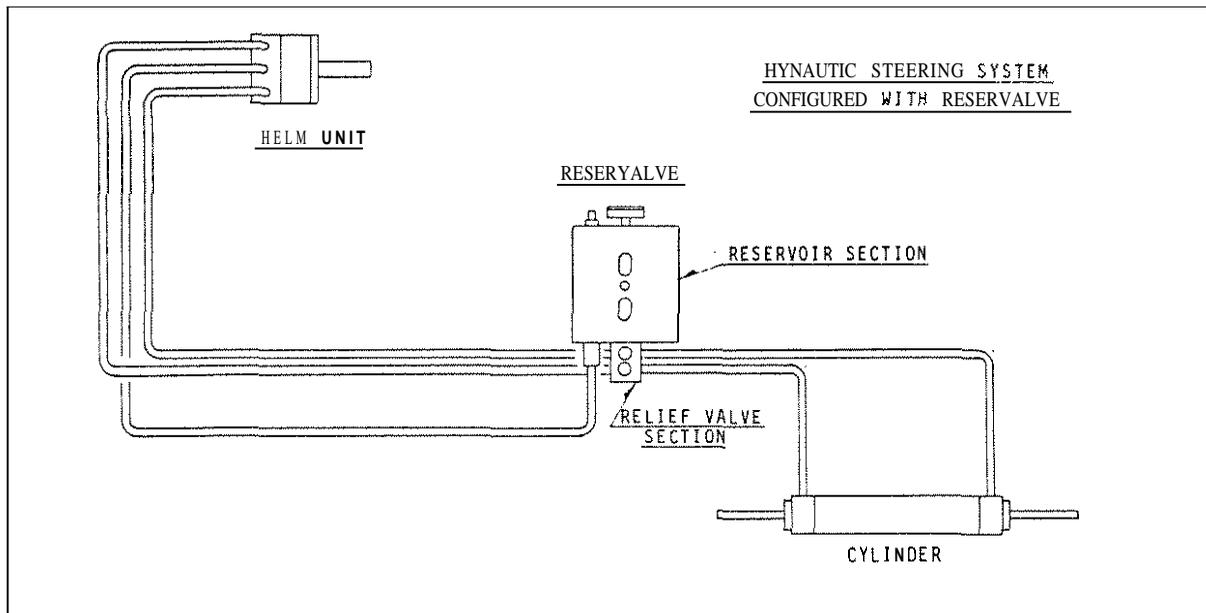
There are four basic elements to your Hynautic Steering System: the helm, the reservoir, the relief valve and the cylinder. In some Hynautic systems the relief valve has been mounted directly to the bottom of the reservoir, with the complete assembly being termed a reservoir.

The steering station assembly includes a hydraulic pump and pilot check valve assembly. Rotating the ship's wheel moves seven small pistons in a rhythmic, but controlled, pattern. These pistons, in turn, pump hydraulic fluid to the steering cylinder. Internally located in the steering sender 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.

Extra hydraulic fluid and a pressure head for the system is maintained by the reservoir (or reservoir). The reservoir stores approximately two quarts of hydraulic fluid (the reservoir stores one quart) under a pressure of 20 psi. This prevents air from entering the system. Located on the reservoir (or reservoir) is an air valve and a pressure gauge, which shows that the reservoir (or reservoir) is charged to the proper pressure. The hydraulic fluid in the reservoir (or reservoir) passes through a sintered bronze filter upon its exit from the reservoir (or reservoir), thereby preventing dirt from entering the system. Hydraulic fluid from the reservoir (or reservoir) passes into the system through check valves located in the helm pump.

Protection of both the mechanical portion of the rudder (should the rudder strike a solid object) and hydraulic system is handled by a relief valve assembly, factory set at 500 or 950 psi. The relief valve is connected between the steering cylinder and the reservoir (in the case of the reservoir it is mounted directly to the bottom of the reservoir). Located in the relief valve are two small sintered bronze filters and as the unit relieves hydraulic fluid to the reservoir, they filter out any foreign material that may have been entrapped in the lines of the fluid. This relieving feature allows air to be easily removed from the system by a constant rotation of the steering wheel in the same direction after it has reached hardover. This action progressively forces all the air out of the system through the relief valve and into the reservoir.





The relief valve-reservoir relationship in the system prevents thermal expansion or contraction due to temperature changes from rupturing or causing 'air pockets' in the system.

Steering cylinder assemblies are double acting, either double rod end or single rod end types, rigidly mounted, ball joint mounted or universally mounted. Cylinder rods are non-magnetic stainless steel.

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 would increase the torque on the rudder but decrease the total rudder arc. A second method would be to increase the cylinder's bore size, this would increase the system's output force, the rudder arm length would remain the same, but the 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 would double the turning torque on the rudder, but it would also double the number of turns from hardover to hardover.

If you question the installation or application of a Hynautic system, contact Hynautic, Inc., P.O. Box 908, Osprey, FL 34229, (813)/966-2161).

INSTALLATION INSTRUCTIONS: PREPARATION FOR INSTALLATION

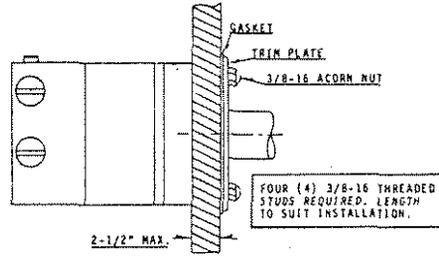
1. Read the installation instructions before any work is started. Purging and Troubleshooting instructions have been included in the system box, while component installation instructions have been packed with the specific component. Missing instructions can be obtained from your Hynautic distributor, or Hynautic, Inc.
2. Before installation is started, verify that a complete system has been received.
3. 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.
4. If it is necessary for the tubing to be strung first, a system of marking the different tubing runs should be used.
5. Do not use any thread lubricant or sealer on the flared tube fittings. When using thread lubricant on the pipe fittings, take care not to induce the substance into the system.
6. Dry seal threads and high quality fittings are used throughout your Hynautic system. Do not use Permatex or Formatek, or similar type thread sealants, on the pipe joints when installing the fittings. 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 Loctite Primer Grade T #47-56. Again, this sealant should be used with caution and very sparingly.
7. 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.
8. Installation instructions have been made as complete, but as brief, as practical. If you have any questions, contact your distributor, or Hynautic, Inc.

HYNAUTIC, INC.

P.O. Box 908 Osprey, Florida 34229 Telephone 813-966-2151

INSTALLATION INSTRUCTIONS: MOUNTING SERIES 20 AND SERIES 40 HELM UNITS

1. Helm unit dimensions and layouts are given on the back of this sheet.
2. The helm units may be mounted with the tubing ports up, down or in any position. The shaft may be at an angle if so desired. Verify after mounting that the helm unit's shaft does not bind on the panel.
3. A template is provided, this may be used for locating the shaft and mounting holes. If this template is used, the direction of the tubing ports will correspond to the horizontal and vertical liner drawn on the template.
4. For the helm unit's Shaft a 1-1/4" diameter hole provides the proper clearance.



NOTE: STUD LENGTH NOT TO EXCEED 7/8" PLUS PANEL THICKNESS

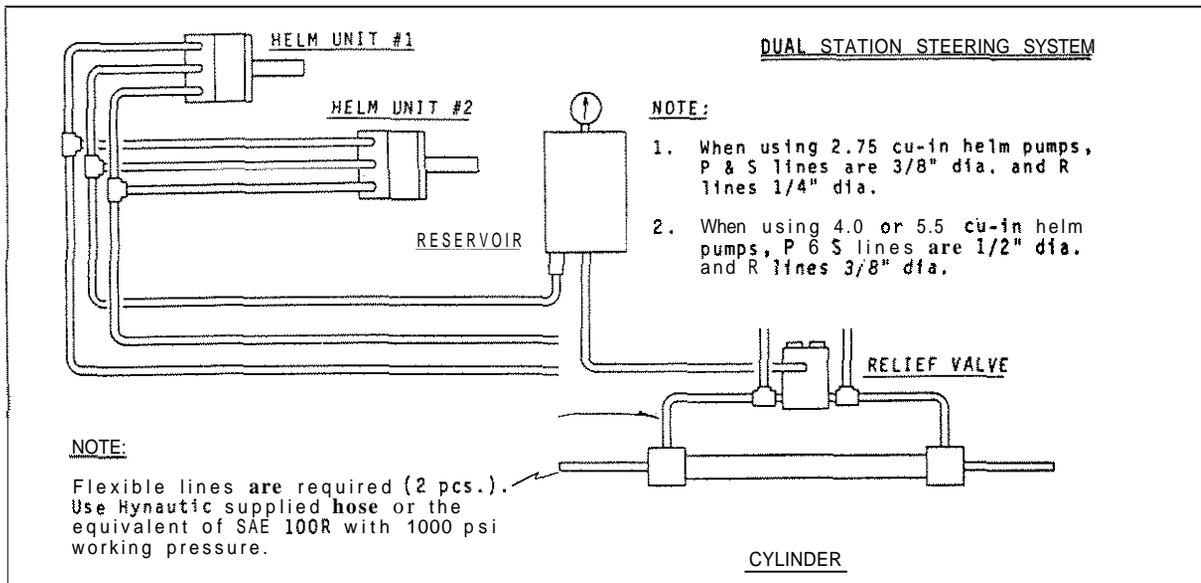
5. Extreme care must be taken to use the correct length 3/8-16 NF studs. These are provided by the boat builder, or owner, and should not exceed the thickness of the console by more than 7/8 of an inch.
6. The steering ports are marked 'S' and 'P'. Rotating the steering wheel in a clockwise direction will pressurize 'S', rotating it in the counterclockwise direction will pressurize 'P'.

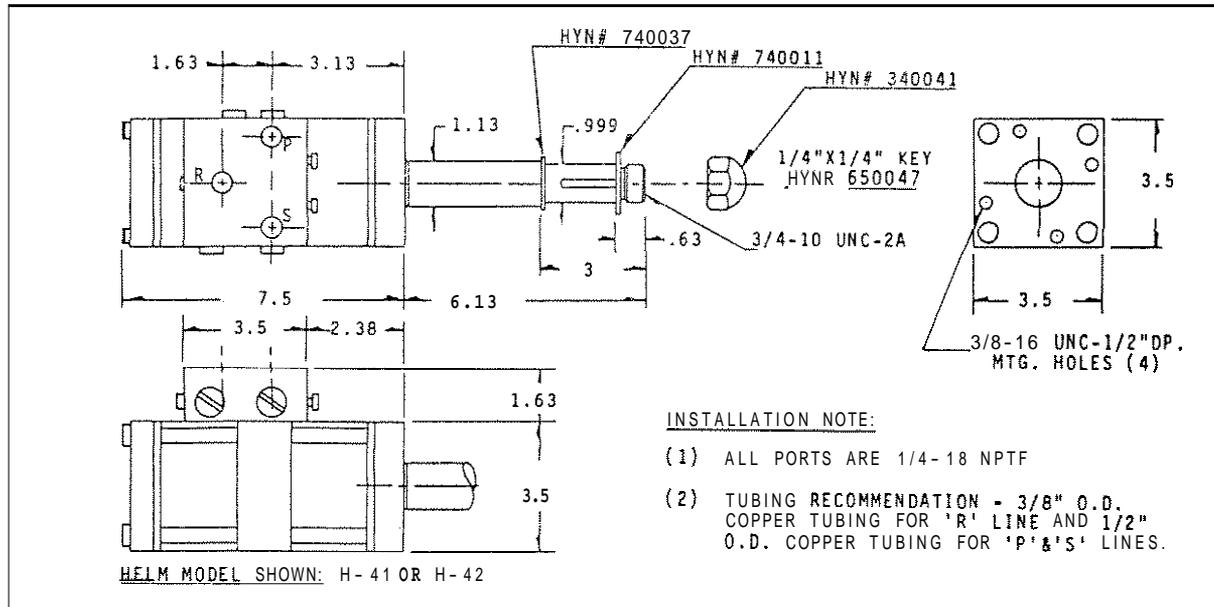
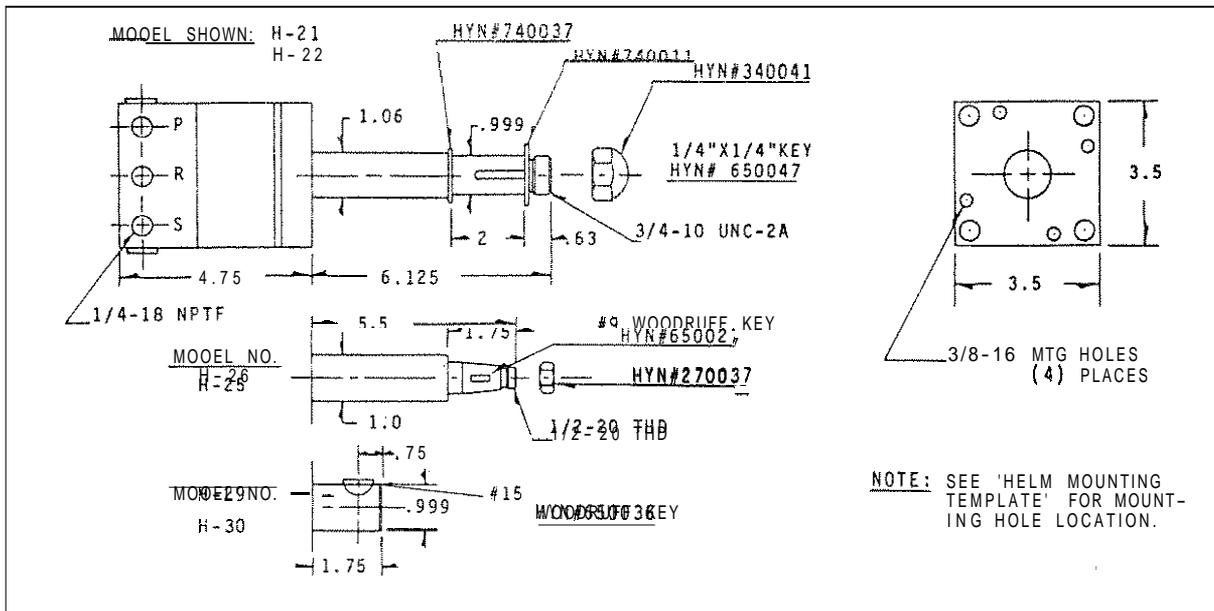
INSTALLATION INSTRUCTION: TUBING

1. COPPER TUBING - .032" wall thickness. Copper tubing can be used on high pressure applications. P S lines require 3/8" or 1/2" compression or flare fittings. R liner require 1/4" compression or flare fittings.
2. HOSE - High pressure hose may be used throughout your system. Use either Hynaumatic supplied hose or the equivalent of Aeroquip 2651 (SAE 100R with 1000 psi working pressure). P & S lines require 3/8" or 1/2" lines, R lines require 1/4".

INSTALLATION INSTRUCTION: FLUIDS

1. Use MIL-0-5606 Aircraft Hydraulic Fluid, Texaco #15, Shell Tellus 15 (ISO-Tellus 10) or Chevron EP-Machine Oil 10. LIGHT VISCOSITY OILS ARE RECOMMENDED. HEAVIER OILS WILL CAUSE SYSTEM STIFFNESS.





HELM UNIT SPECIFICATIONS

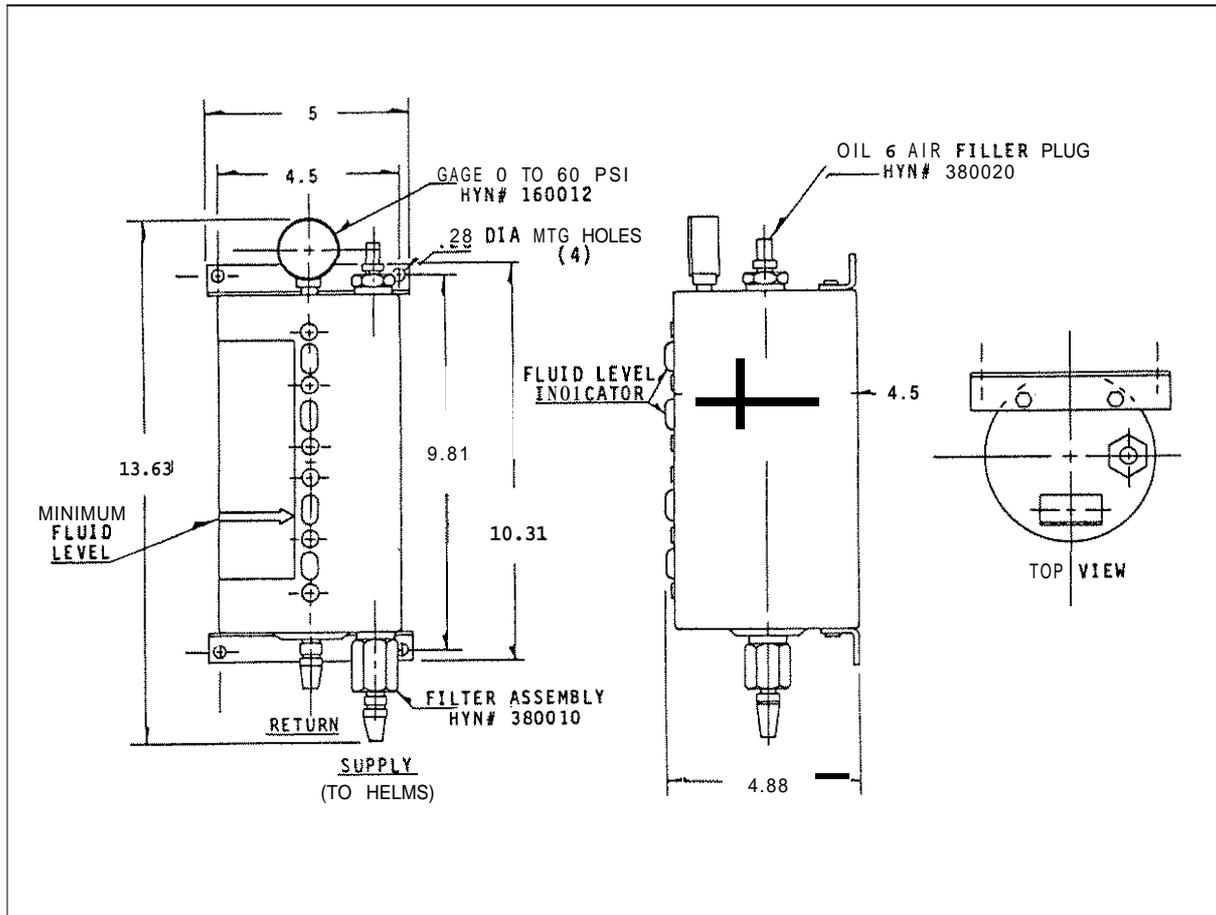
- 'S' Port Clockwise Rotation Discharge
- 'P' Port Counter Clockwise Rotation Discharge
- 'R' Port Reservoir

Service Pressure: 1000 psf.
 Maximum Shaft Speed: 75 rpm.
 Fluid: Clean Petroleum Oil, 50 to 200 S.U.S. @ 100 F

HELM UNIT NO.	H-21	H-22	H-25	H-26	H-29	H-30	H-41	H-41-02	H-42	H-42-02	H-45
SHAFT STYLE											
1" Straight	X	X					X	X	X	X	
Teleflex Taper (1"/ft.)			X	X				X		X	
Auto Pilot					X	X					
HELM DISPLACEMENT											
2.00 cu-in/rev.		X		X		X					
2.75 cu-in/rev.	X	X		X							
4.00 cu-in/rev.								X	X		
5.50 cu-in/rev.							X	X		X	

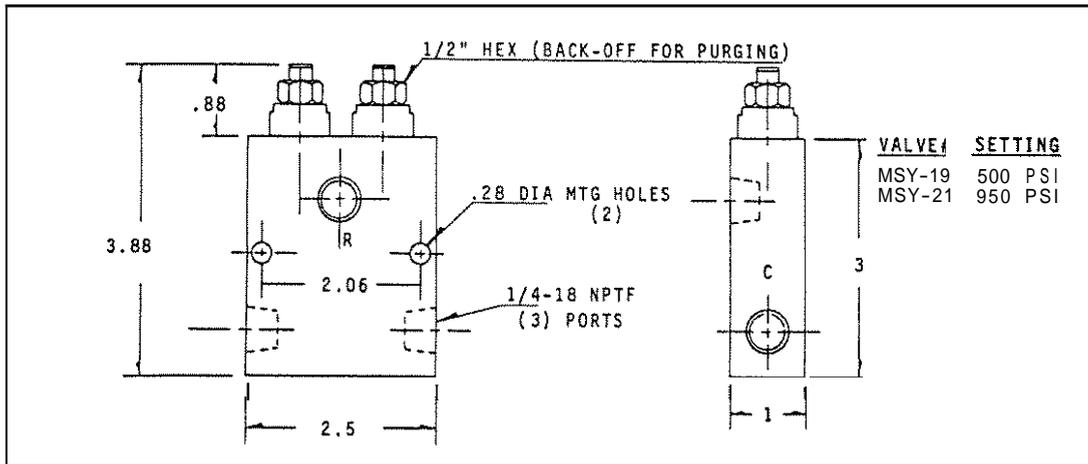
INSTALLATION INSTRUCTIONS: MOUNTING THE RESERVOIR (R-06, R-07 AND R-08)

1. Mount the reservoir in an upright position where it will be easy to fill, pressurize. read the pressure gauge and view the fluid level indicators.
2. INSTALLATION NOTE
While the reservoir can be located any Place in the boat. system purging will be easier if it is near the helm units. This is particularly important where long runs of tubing are involved, as in very large boats. houseboats and sportfirherman with tuna towers. In these instances it is recommended that the reservoir be mounted forward, high in the boat. and close to the helm units.
3. It should be noted that the port on the bottom of the hexagonal filter plug is the supply port. The line from this port goes to the helm units.
4. The port on the bottom of the reservoir body is the return port. The line from this port goes to the relief valve.
5. When tightening fittings at the reservoir, use a backup wrench. This will prevent distortion of the fitting assemblies on the reservoir.
6. A complete set of purging instructions are affixed to the side of the reservoir. Should an additional. or replacement, copy be required, contact Hynautic, Inc.
7. CAUTION
Dirt and foreign matter in the hydraulic system causes damage and nalfunction. Use due care in piping and filling system. Sealants may be used with care.



INSTALLATION INSTRUCTIONS: MOUNTING THE RELIEF VALVE (MSV-19 AND MSV-21)

1. The relief valve should be mounted above the cylinder in order to help the purging process.
2. **INSTALLATION NOTE**
You **must** have **access** to this valve for Purging. Mount it where you can get at the brass screws.
3. It is better to mount this valve with the brass screws up.
4. **WARNING**
After purging, screw down the valve screws or the cylinder will be bypassed, this will result in no steering!
5. **CAUTION**
Dirt and foreign matter in the hydraulic system causes damage and malfunction. Use due care in piping and filling system. Sealants may be used with care.

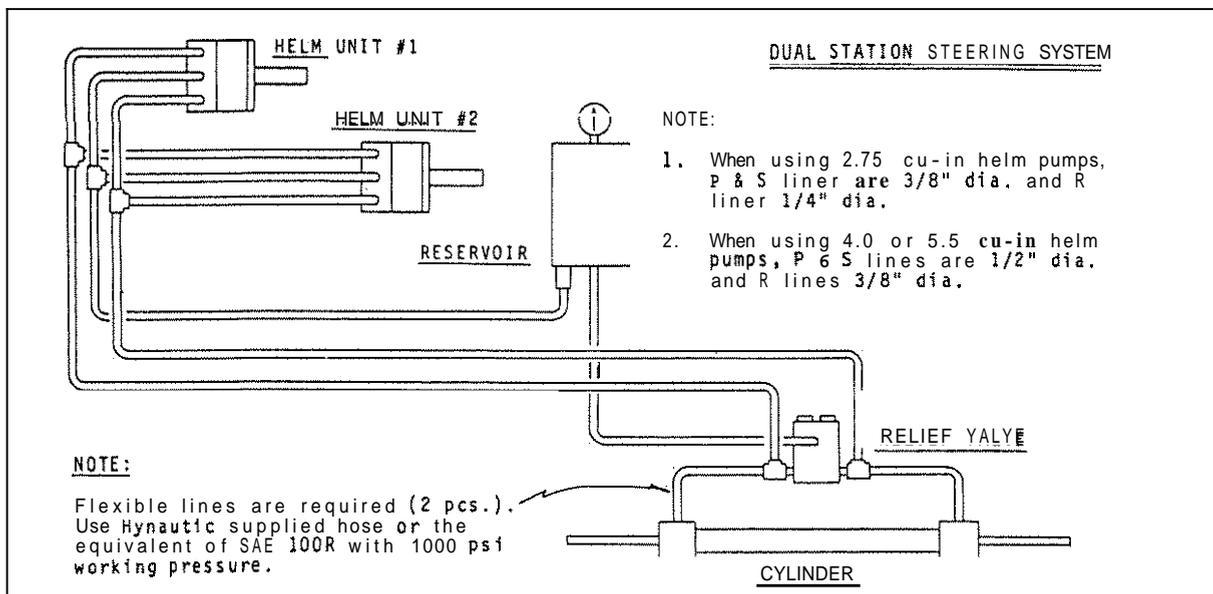


INSTALLATION INSTRUCTION: TUBING

1. **COPPER TUBING** - .032" wall thickness. Copper tubing can be used on high pressure applications. P & S liner require 3/8" or 1/2" compression or flare fittings. R lines require 1/4" compression or flare fittings.
2. **HOSE** - High pressure hose may be used throughout your system. Use either Hynautic supplied hose or the equivalent of Aeroquip 2651 (SAE 100R with 1000 psi working pressure). P & S liner require 3/8" or 1/2" liner, R lines require 1/4".

INSTALLATION INSTRUCTION: FLUIDS

1. Use MIL-0-5606 Aircraft Hydraulic Fluid, Texaco #15, Shell Tellus 15 (ISO-Tellus 10) or Chevron EP-Machine Oil 10. LIGHT VISCOSITY OILS ARE RECOMMENDED, HEAVIER OILS WILL CAUSE SYSTEM STIFFNESS.



STEM PURGING YHM RELIEF VALVE AND SEPARATE RELIEF VALVE ARE USED IN THE SYSTEM

FILLING AND PRESSURIZING THE SYSTEM

USE HYNAUTIC STEERING OIL OR LIGHT VISCOSITY HYDRAULIC OIL THAT MEETS THE AIRCRAFT HYDRAULIC FLUID SPEC MIL-11-5606, SUCH AS TEXACD #15, EXXON UNIVIS J-13, CASTROL AWH-15, CASTROL AERO-585-B, OR SHELL TELLUS 15. HEAVIER OILS, SUCH AS AUTOMATIC TRANSMISSION OIL TYPE A OR OEXTRON 11. MAY BE USED BUT WILL CAUSE HARDER STEERING.

1. Locate the two screws with pinned 1/2" hex nuts on the top of the relief valve. Loosen and back off by hand, turning Counterclockwise until they Stop.
2. Remove the hex plug from top of the reservoir and fill with oil to within 1/2" of the top and replace the hex plug.
3. The reservoir is equipped with a tire type air valve. Any tire air pump or compressed air supply can be used to pressurize the system. Slowly pressurize the reservoir to 40-45 psi. As pressure is applied, oil will flow into the System. When the oil level drops to within 2 inches of the bottom of the reservoir, stop pressurizing. Exhaust the air pressure through the air valve, remove the hex fill plug, refill, and replace the fill plug. Repressurize until the reservoir oil level stabilizes and gage pressure reads between 40-45 psi. Check all connections for leakage.
4. Go to the highest helm and bleed the air out of the (P) port and (S) starboard lines by cracking Open the fitting connections. Allow the air to escape until oil appears, and then retighten.
5. Disconnect the clevis or rod end of the cylinder from its engine or rudder mounting if at all possible, making certain it is free to stroke without interference. This will assist in purging the air from the cylinder.
6. Bleed both ends of the cylinder by backing off the socket head cap screw bleeders one turn. If the cylinder is not equipped with bleeders, crack open the fitting Connections. Hold the cylinder so bleeding will be performed on the highest end of the cylinder. Allow the air to escape until oil appears and then close.
7. Verify that the reservoir is at least 3/4 full and the gage reads between 40 and 45 psi. If oil level is below 1/2 full, exhaust the air pressure through the air valve, remove the fill plug, refill, and replace the fill plug. Repressurize to 40-45 psi.

PURGING THE SYSTEM OF AIR

The following procedure is a process by which helm(s) and autopilot are sequentially operated to pump oil into the (P) port and (S) starboard hydraulic lines, displacing the air-infiltrated oil out through the relief valve and into the reservoir where the air separates from the oil. Solid oil from the bottom of the reservoir is then fed back to the helm and autopilot through the (R) line as needed.

The number of wheel turns specified below have been established for average tubing lengths of 20 feet between components. If tubing lengths exceed 20 feet, increase the number of turns by 2 for every extra foot of tubing length.

1. Go to the highest helm and turn slowly (2 to 3 sec/rev.) 60 times in one direction.
2. Repeat Step 1 at each successively lower helm and autopilot

NOTE Purging air from an hydraulic autopilot is accomplished by setting a course on the autopilot to the same direction you are steering the helm(s). If you are steering the helm(s) to the Starboard (clockwise) direction, set a starboard course heading on the autopilot and allow it to run for 1 to 2 minutes.
3. Once more, crack the bleeders at the cylinder. If bleeders are not available, crack the fittings at the appropriate ends and allow the air to bleed out. Retighten when solid oil appears.
4. Check the reservoir pressure and oil level. If oil level is below the half full mark, exhaust the air pressure through the air valve, remove the oil fill plug, refill, and replace fill Plug. Repressurize to 40-45 psi.
5. Go to the highest helm and turn the wheel slowly 60 turns in the OPPOSITE direction. Repeat at each successively lower helm and autopilot.
6. Close the two relief valve screws with pinned hex nuts by turning clockwise, and snug with a wrench.

WARNING Loss of steering will occur if the relief valve screws are not closed. When securing these screws with a wrench, do not apply heavy force or damage to the screw and relief valve will result.
7. Go to a helm Station and turn in one direction until hardover is felt.
8. Go to the cylinder and open the bleeder or crack the fitting at the end of the cylinder that the rod is extended from, closing when solid oil appears.
9. Again go to a helm Station and turn now in the opposite direction until hardover is felt.
10. Go to the cylinder and bleed until solid oil appears at the opposite end of the cylinder previously bled and then reclose.
11. verification of a complete purge is accomplished by rotating the helm and achieving, within 1/2 turn, the corresponding number of turns hardover to hardover shown on the chart below. An excessive number of turns indicates air in the system and Steps 1-10 must be repeated

HELM NO.	HELM TURNS HARDOVER TO HARDOVER								
	CYLINDER NO.								
	K-1	K-2	K-3	K-22 K-27	K-28 K-29	K-31	K-32	K-33	K-5 (1) PAIR
H-21, H-25, H-29	4.4	6.5	8.4	5.0	6.0	10.0	7.3	8.4	10.0
H-42	3.0	4.5	5.8	3.5	4.0	6.5	5.0	5.8	6.5
H-41	2.2	3.3	4.2	2.5	3.0	5.0	3.7	4.2	5.0

- To verify relief operation and system integrity, go to I helm and turn past hardover, forcing oil over the relief valve for a turn or two at each hardover position. A squeak may be heard as the relief valve unloads.
- Secure the cylinder to the mounting structure and to the engine or tiller arm. Check the reservoir for fluid level and pressure. Leave the reservoir 1/2 to 2/3 full and at 20-30 psi.

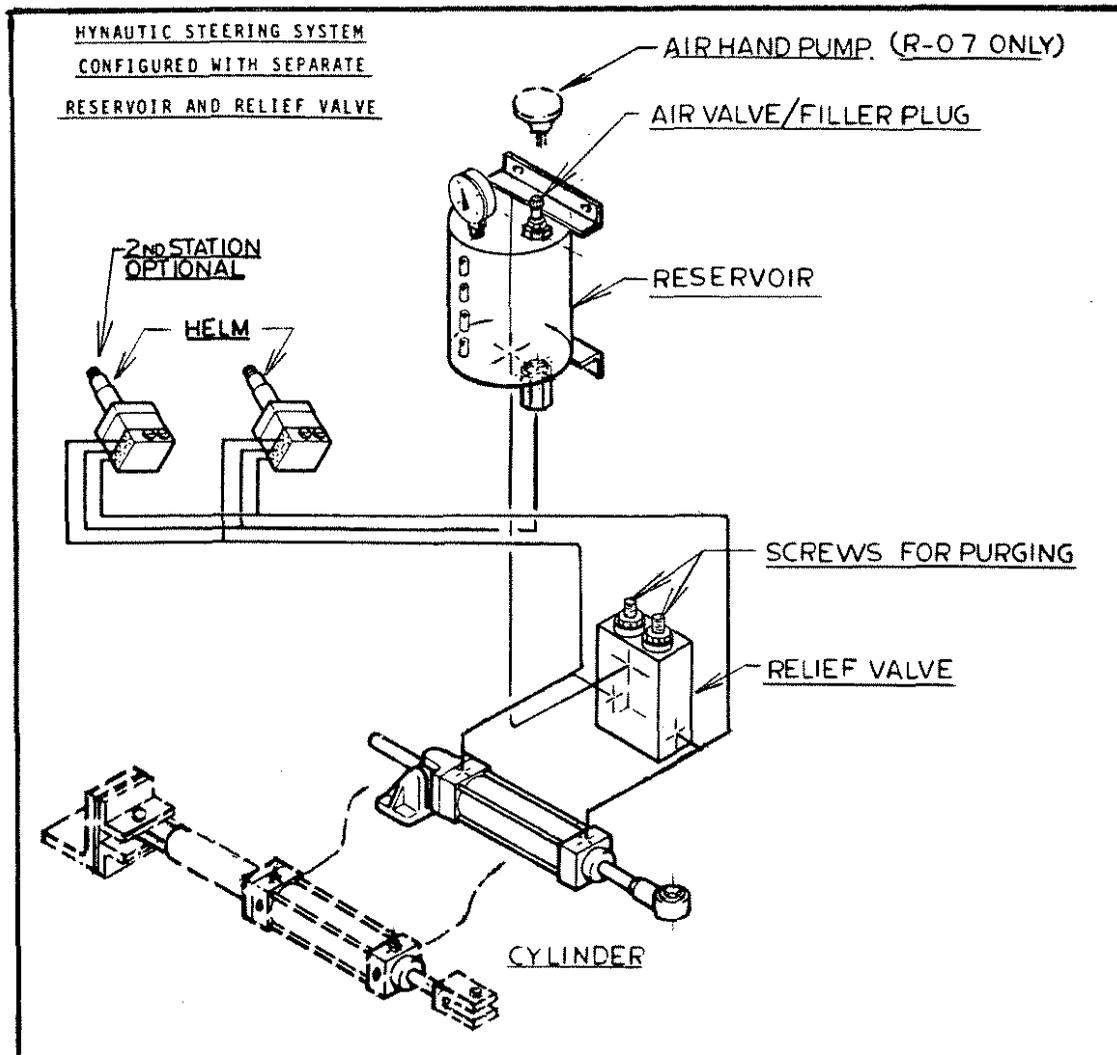
SYSTEM CHECK AND FINAL PURGING

It is recommended that you check the system and perform a short, final purge after approx. 24 hours. After this time, any leaks will be detected; and any remaining small bubbles will have formed larger bubbles which are easily removed.

- Observe system for oil leaks and reservoir gage for possible pressure loss.

NOTE It is common to observe a 5 psi pressure fluctuation on systems that are subject to a temperature change of 20°F, or more.
- Open the relief valve screws.
- Starting at the upper helm, turn 40 turns in one direction, repeating at successively lower helms. Again in the same manner, turn the helm(s) in the opposite direction.
- Close the relief valve screws and snug with a wrench.
- Verify that the proper number of turns hardover to hardover has been obtained. Recheck the oil level (1/2 to 2/3 full) and reservoir pressure (20-30 psi).

NOTE If a line must be disconnected, exhaust the air pressure from within the reservoir and remove the filler plug. Then open the relief valve screws to relieve all pressure in the lines. After work is completed, reconnect lines and repurge the system of air.

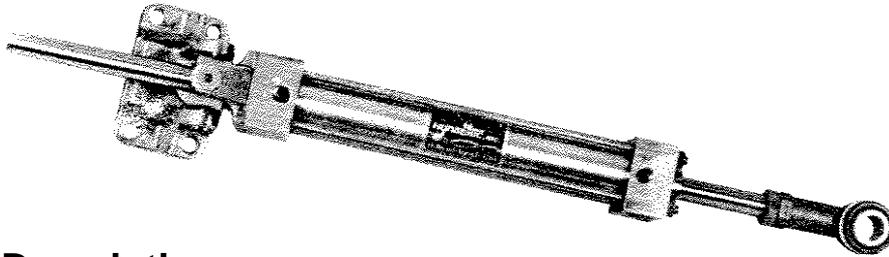




COMPONENT FACT SHEET

K-1, K-2, K-3

Brass Cylinders



Description

The Hynautic K-1, K-2 and K-3 are double rod end, tie rod constructed hydraulic cylinders. Each has a universal mount which allows two planes of pivot freedom.

Each model cylinder may be equipped with either a stainless steel ball joint (designated with the suffix 'B') or a brass clevis with stainless steel clevis pin (distinguished by the suffix 'C').

Porting is through two 1/4" NPTF holes at each end of the cylinder. As installed, ports should be located facing up to facilitate cylinder purge.

Construction

Cylinder tube is seamless brass alloy 330 and ends are machined ASTM 8-16 brass. The cylinder and ends are held in place by four tie rods of ASTM 8-16 brass. The rod is ARMCO Aquamet 17, or equivalent, stainless steel.

Cylinders may be equipped with either stainless steel ball joint or machined brass clevis.

Mount is cast manganese bronze with stainless steel bearings and Grade 5-rated 1/2-13 stainless screws.

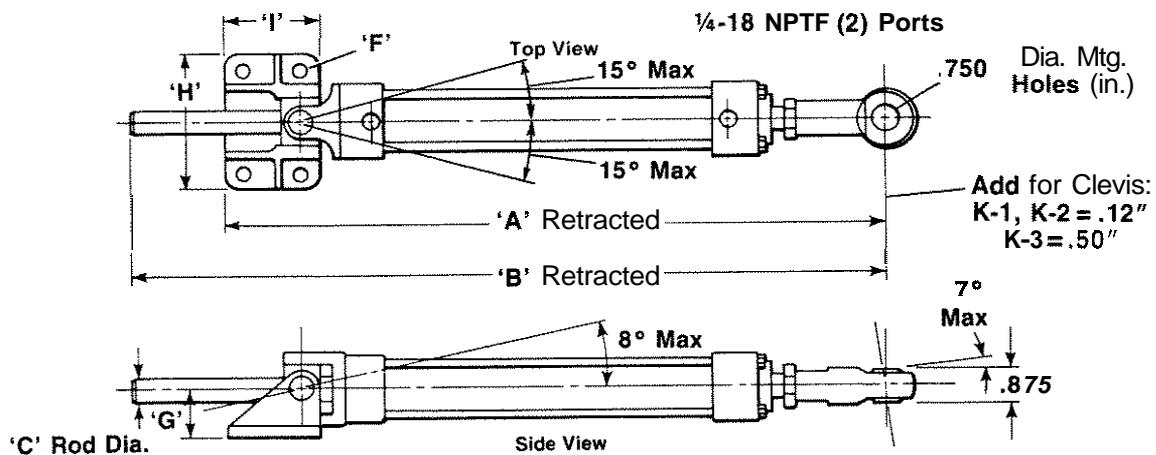
Seals are buna "N" type with TFE backup.

Rating

950 psi rated working pressure. Proof pressure is established at 4500 psi. Burst pressure is 6800 psi which is governed by tie rod strength.

Cylinder output force @ 950 psi:

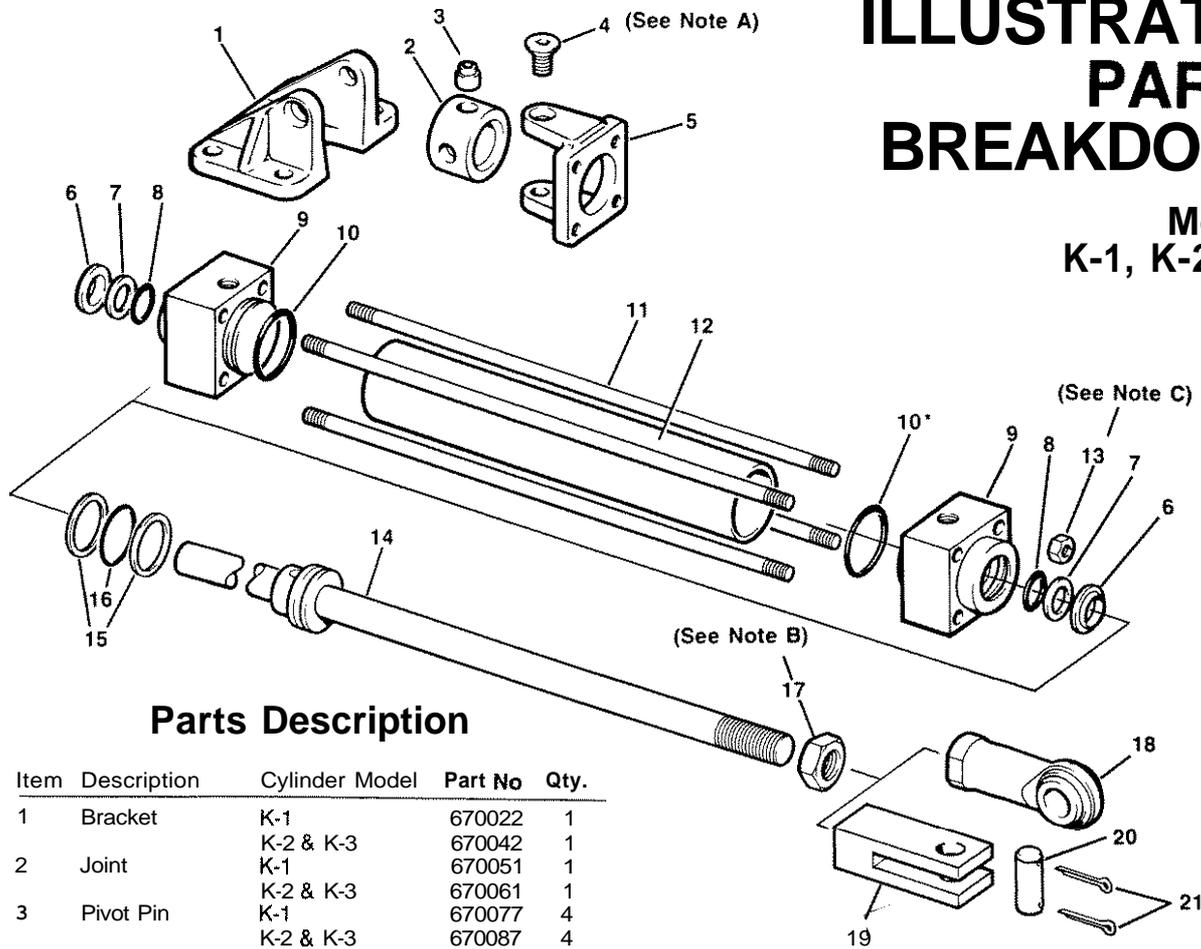
- K-1 = 1250 lbs.
- K-2 = 1850 lbs.
- K-3 = 2400 lbs.



Cyl. No.	A	B	C	D	E	F	G	H	I
K-2	21.44	26.18	.750	1.75	17.7	.53	2.12	5.75	4.00
K-3	21.44	26.18	.875	2.00	22.9	.53	2.12	5.75	4.00

ILLUSTRATED PARTS BREAKDOWN

Models
K-1, K-2, K-3



Parts Description

Item	Description	Cylinder Model	Part No	Qty.
1	Bracket	K-1	670022	1
		K-2 & K-3	670042	1
2	Joint	K-1	670051	1
		K-2 & K-3	670061	1
3	Pivot Pin	K-1	670077	4
		K-2 & K-3	670087	4
4	Screw	K-1	240577	4
		K-2 & K-3	240667	4
5	Bracket	K-1	670012	1
		K-2 & K-3	670032	1
6'	Rod Wiper	K-1 & K-2	700088	2
		K-3	700078	2
7'	Back-up Ring	K-1 & K-2	252210	2
		K-3	252212	2
8'	O-Ring	K-1 & K-2	211210	2
		K-3	211212	2
9	Cylinder End	K-1	560281	2
		K-2	560301	2
		K-3	560291	2
10*	O-Ring	K-1	211028	2
		K-2	211030	2
		K-3	211032	2
11	Tie Rod	K-1	420271	4
		K-2 & K-3	420281	4
12	Cylinder Tube	K-1	500191	1
		K-2	500211	1
		K-3	500181	1
13	Nut	K-1	270051	4
		K-2 & K-3	270011	4
14	Rod Assembly	K-1	550390	1
		K-2	550420	1
		K-3	550410	1

Item	Description	Cylinder Model	Part No.	Qty.
15'	Back-up Ring	K-1	252125	2
		K-2	252222	2
		K-3	252224	2
16'	O-Ring	K-1	211125	1
		K-2	211222	1
		K-3	211224	1
17	Nut	All	270117	1
18	Bail Joint	K-1, K-2 & 8		
		K-3 "B"	670220	1
19	Clevis	K-1 "C"	680261	1
		K-2 "C"	680251	1
		K-3 "C"	680201	1
20	Pin	K-1 "C"	680097	1
		K-2 "C"	680047	1
		K-3 "C"	680067	1
21	Cotter Pin	K-1, K-2 & 8		
		K-3 "C"	290207	2

* Incorporated in Hynaulic Seal Kits No. KS-11 for K-1, KS-12 for K-2 and KS-13 for K-3.

Note A: Clean and secure with "Loctite 680." Apply 32-34 ft. lbs. torque for model K-1, 60-63 ft. lbs. torque for models K-2 and K-3.

Note B: Clean and secure with "Loctite 680" to thread area. Apply 40-45 ft. lbs. torque.

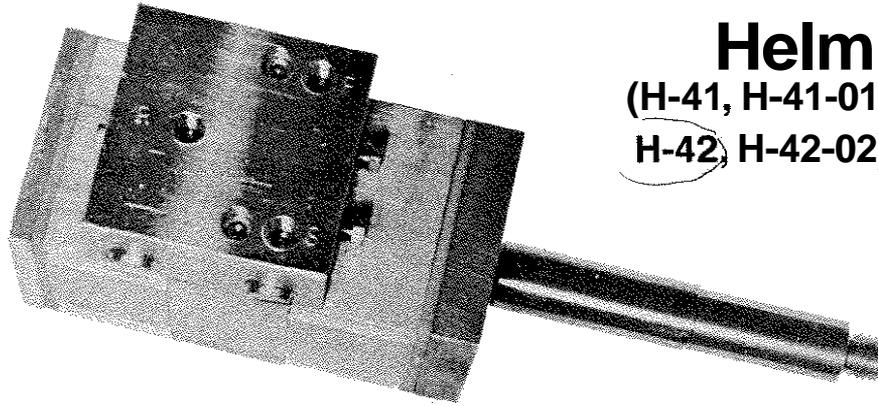
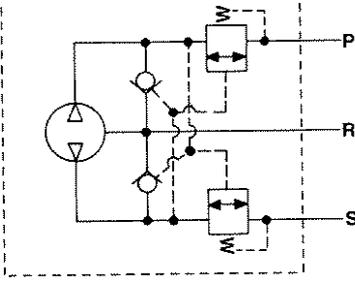
Note C: Clean and apply 75-78 in. lbs. torque for model K-1, 160-165 in. lbs. for models K-2 and K-3.

COMPONENT FACT SHEET

H-40 Series

Helm Unit

(H-41, H-41-01, H-41-02, H-42, H-42-02)



Description

The Hynautic H-40 Series Hydraulic Helm Unit is a bi-directional, dual element, fixed displacement, axial piston pump, coupled to pilot-check and make-up checkvalving.

The Dated pump sections utilize fourteen pistons, each stroked nine times with one shaft revolution, pushing fluid thru porting blocks 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.

Clockwise rotation of the shaft discharges fluid thru the "S" port; counterclockwise rotation effects "P" port discharge. The "R" port is for the reservoir connection. Port size is 1/4" NPTF.

Service pressure is 1000 psi maximum with proof pressure established at 2000 psi. Maximum speed is 120 rpm.

Construction

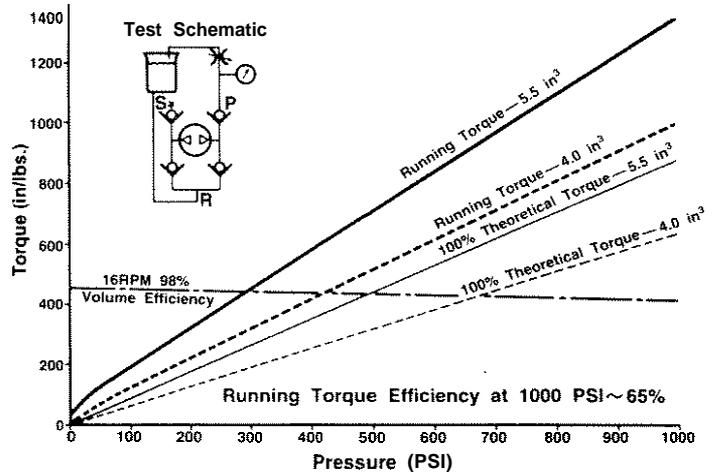
Exterior is corrosion resistant aluminum and stainless steel. Internal components — ferrous metal porting block and cylinder barrel with ground mating surfaces, hardened and ground steel pistons, drive keys, needle thrust bearings, Buna "N" seals, TFE

seal backups and piston glyd rings. Other components are of friction and wear resistance materials to reduce operating torque and prolong life.

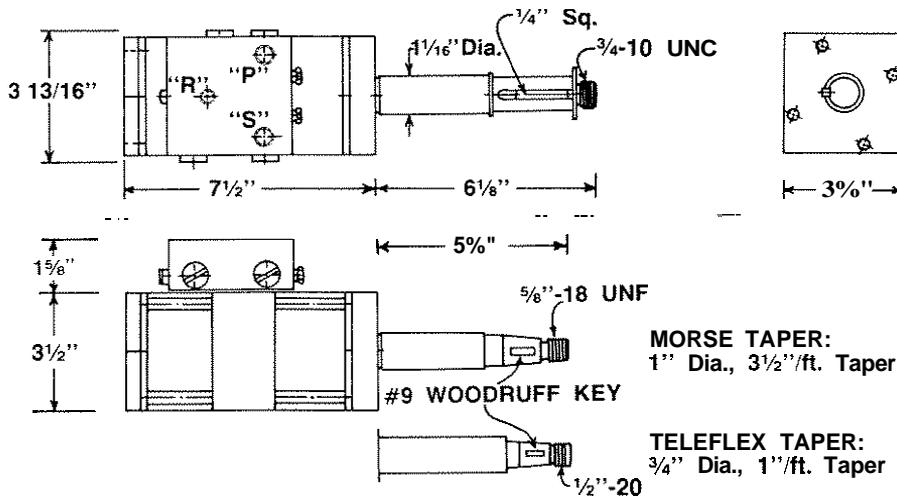
Performance

Volumetric efficiency: 90% at 1000psi and 12rpm.

Running torque vs. pressure:

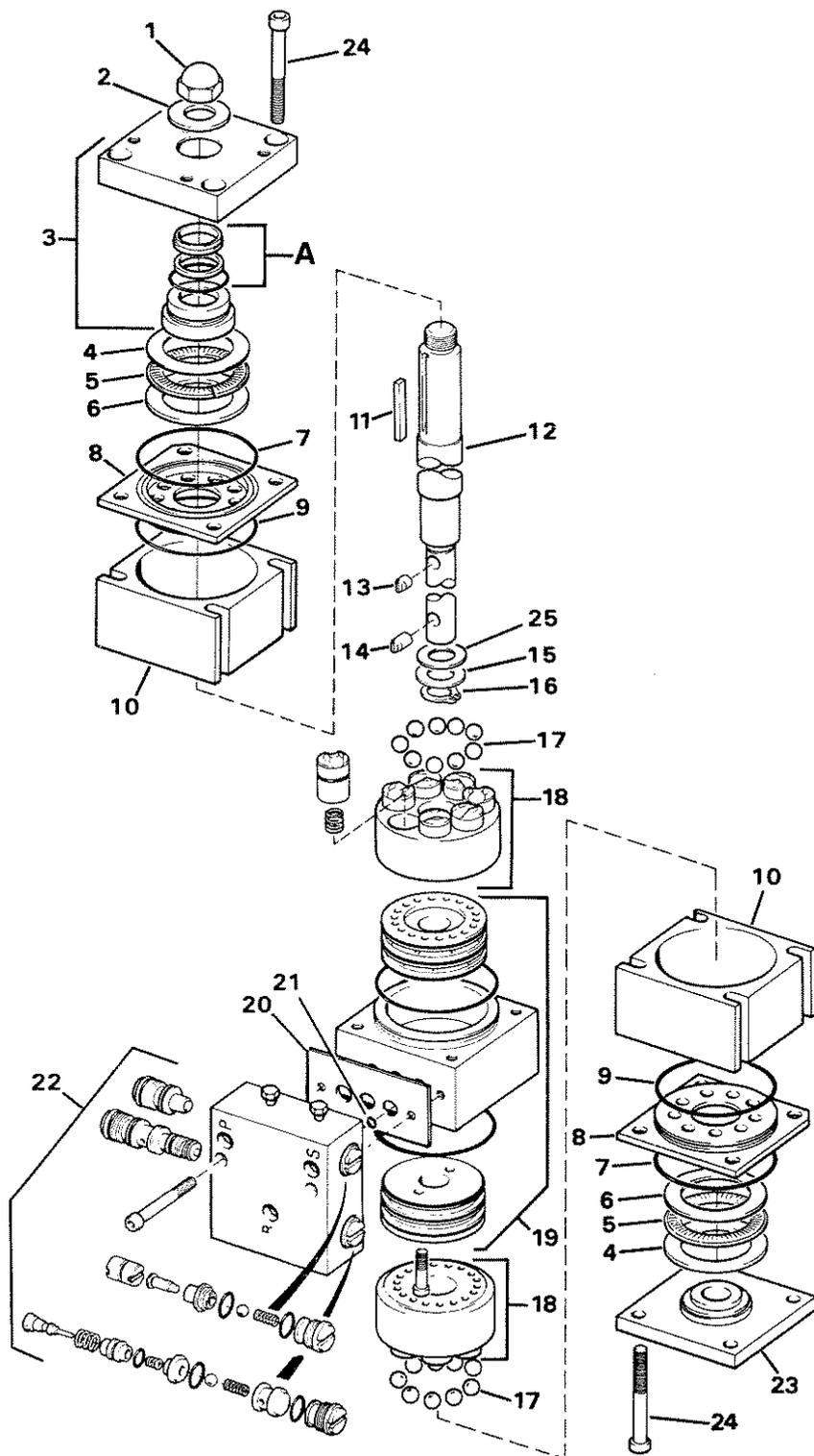


OTHER SHAFT CONFIGURATIONS ARE AVAILABLE UPON REQUEST



Helm Unit	H 41	H 42	H 41-01	H 41-02	H 42-02
1" Straight	x	x			
Morse Taper			x		
Teleflex Taper				x	x
4.0 Cu. In./Rev.		x			x
5.5 Cu. In./Rev.	x		x	x	

ILLUSTRATED PARTS BREAKDOWN



Parts Description

Item	Description	Hdm Models	Part No.	Qty.
1.	Nut	H-41	340041	1
		H-42	340041	1
		H-41-01	270071	1
		H-42-01	270071	1
		H-41-02	270037	1
		H-42-02	270037	1
2.	Washer	H-45	340041	1
		H-41	740011	1
		H-42	740011	1
3.	Front Cover Assy	H-45	900310	1
		All Others	900300	1
4.	Bearing Race-thin	ALL	190004	2
5.	Bearing-thrust	ALL	190001	2
6.	Bearing Race-thick	ALL	190003	2
7.	O-Ring	ALL	211040	2
8.	Ball Cage	ALL	620018	2
9.	O-Ring	ALL	211039	4
10.	Body Spacer	ALL	900264	2
11.	Key	H-41/42/45	650047	1
		All Others	650027	1
12.	Shaft	H-41	400187	1
		H-42	400187	1
		H-41-01	400197	1
		H-42-01	400197	1
		H-41-02	400227	1
		H-42-02	400227	1
13.	Key-short	ALL	650076	1
		ALL	650026	1
14.	Key-long	ALL	650026	1
15.	Bearing Race	ALL	190012	1
16.	Retaining Ring	ALL	300046	1
17.	Ball	ALL	234066	18
18.	Cyl. Barrel Assy	H-41	510080	2
		H-42	510070	2
		H-41-01	510080	2
		H-42-01	510070	2
		H-41-02	510080	2
		H-42-02	510070	2
19.	Body Assy	H-45	510080	2
		ALL	900290	1
20.	Plate	ALL	520394	1
21.	O-Ring	ALL	211110	3
22.	Valve Body Assy	H-45	860031	1
		All Others	860030	1
23.	Rear Cover Assy	ALL	710010	1
24.	Sec. Hd. Cap Screw	ALL	240367	8
25.	Washer	ALL	740078	1
A.	Seal Kit	ALL	HS-04	

CAUTION

Disassembly of item no's. 19 & 22 will void any existing warranty. If you disassemble the entire unit, the ball cages (No. 8) must be properly aligned with the body spacers (No. 10) and body assembly (No. 19). Failure to do so will result in poor pump performance. To insure proper lining, align the notched corners of the ball cages as illustrated with the corners of the body spacers and body assembly, using as reference the porting of the body assembly.

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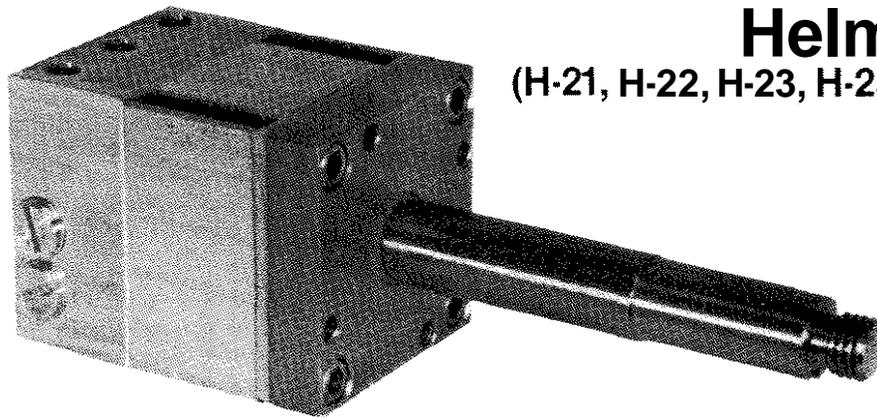
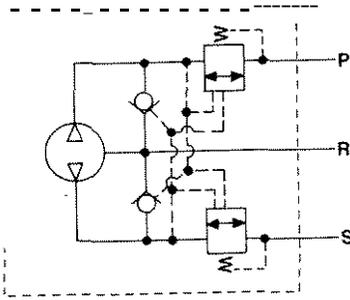
HYDRAULIC inc.
Maine Hydraulic Systems and Products

P.O. Box 908 Osprey, Florida 34229 Telephone 813-966-2151

COMPONENT FACT SHEET

H-20 Series Helm Unit

(H-21, H-22, H-23, H-25 & H-26)



Description

The Hynautic H-20 Series Hydraulic Helm Unit is a bi-directional, fixed displacement, 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.

Clockwise rotation of the shaft discharges fluid thru the "S" port; counterclockwise rotation effects "P" port discharge. The "R" port is for the reservoir connection. Port size is 1/4" NPTF.

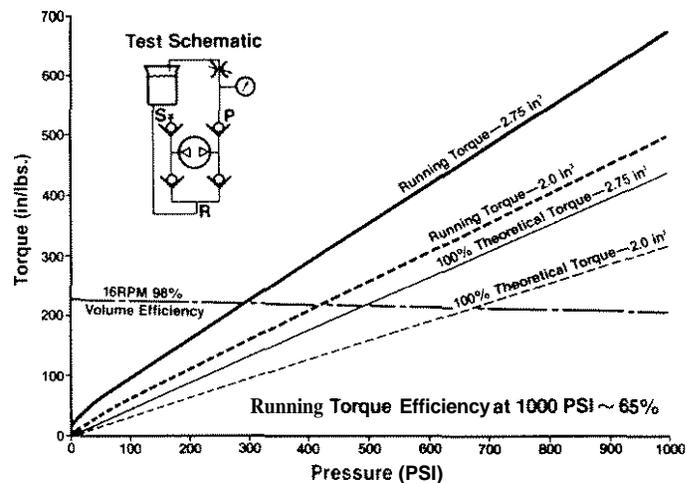
Service pressure is 1000 psi maximum with proof pressure established at 2000 psi. Maximum speed is 120 rpm.

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:



Construction

Exterior is corrosion resistant aluminum and stainless steel. Internal components — ferrous metal porting block and cylinder barrel with ground mating surfaces, hardened and ground steel pistons, drive keys, needle thrust bearings, Buna "N" seals. TFE

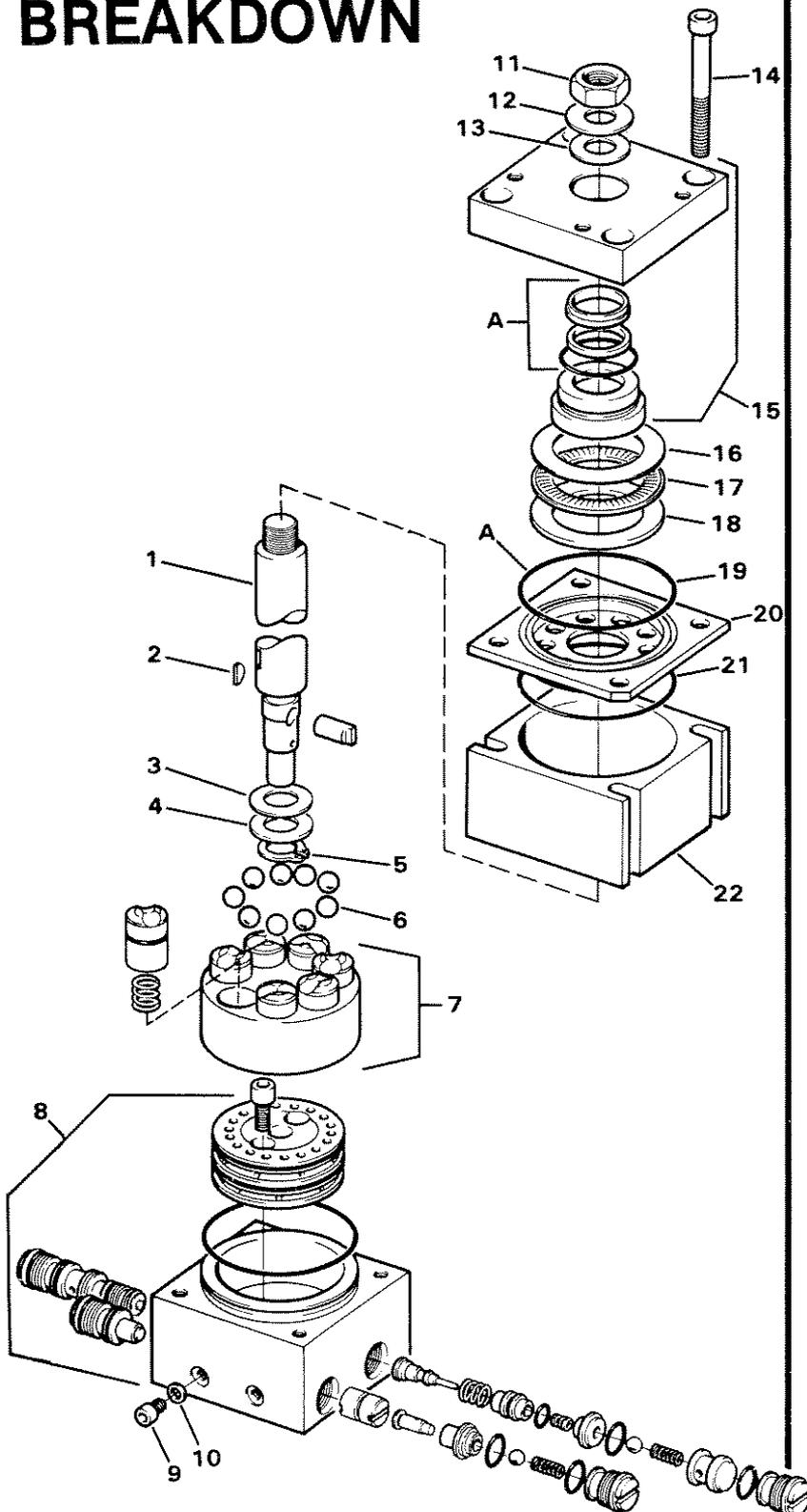
OTHER SHAFT CONFIGURATIONS ARE AVAILABLE UPON REQUEST

Alignment Notch (on ball cage)

4 Mounting Holes 3/8-16 Thd. 1/2 Dp.

Helm Unit	H 21	H 22	H 23	H 25	H 26
1" Straight	x	x			
Morse Taper			x		
Teleflex Taper				x	x
2.0 Cu. In./Rev.		x			x
2.75 Cu. In./Rev.	x		x	x	

ILLUSTRATED PARTS BREAKDOWN



WARNING
These Helm Units are manufactured under strict controls and testing procedures. Disassembly of item NO. 8 will void any existing warranty.

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

Parts Description

Item	Description	Helm Models	Part No.	Qty.
1.	Shaft	H-21, 22	400057	1
		H-23	400117	1
		H-25	400167	1
		H-26	400167	1
2.	Key	H-21, 22	650047	1
		H-23	650027	1
		H-25	650027	1
		H-26	650027	1
3.	Washer	ALL	740078	1
4.	Bearing Race	ALL	190012	1
5.	Retaining Ring	ALL	300046	1
6.	Ball	ALL	234066	9
7.	Cyl. Barrel Assy	H-21	510080	1
		H-23	510080	1
		H-25	510080	1
		H-22, 26	510070	1
		ALL	900220	1
8.	Valve Body Assy	ALL	900220	1
9.	Screw	ALL	240317	2
10.	Gasket	ALL	390028	2
11.	Nut	H-21, 22	340041	1
		H-23	270071	1
		H-25	270037	1
		H-26	270037	1
12.	Washer	H-21, 22	740011	1
13.	Washer	H-21, 22	740037	1
14.	Soc. Hd. Cap Screw	ALL	240367	4
15.	Body Assy-Front Cover	ALL	900300	1
16.	Bearing Race- thin	ALL	190004	1
17.	Bearing- thrust	ALL	190001	1
18.	Bearing Race-thick	ALL	190003	1
19.	O-Ring	ALL	21104C	1
20.	Bail Cage	ALL	620018	1
21.	O-Ring	ALL	211039	2
22.	Body Spacer	ALL	900264	1
A	Seal Kit (with spare O-Rings)	ALL	HS-02	

†Note: The valve assembly is tested at Hynautic. Replacement of individual valve parts may produce valve leakage or failure.

CAUTION

If you disassemble the entire unit, the ball cage (No. 20) must be properly aligned with the body spacer (No. 22) and valve body assembly (No. 8). Failure to do so will result in poor pump performance. To insure proper timing: Align the notched corner of the ball cage as illustrated with the corners of the body spacer (No. 22) and valve assembly (No. 8), using as a reference the two protruding bleed screws (No. 9).

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Hynautic, inc.
Marine Hydraulic Systems and Products

P.O. Box 908 Osprey, Florida 34229 Telephone 813-966-2151

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 electromechanical 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 electromechanical 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 chained to a 10 tooth sprocket, or a 30 tooth to a 15 tooth, etc.

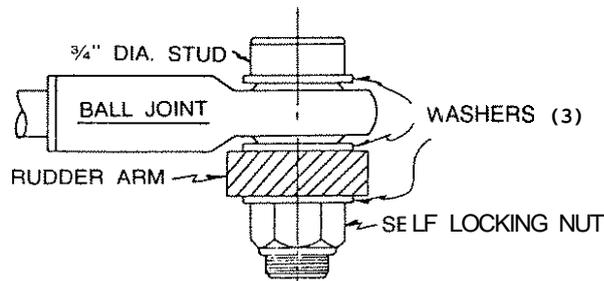
6. Most autopilots have a feedback system that makes rudder correction proportional to the heading error. With Hynautic steering systems, this autopilot feedback device must be connected to the rudder (or cylinder). The steering wheel will not accurately indicate rudder position.

CYLINDER NO.	BORE & STROKE (IN.)	DISPL'T (CU. IN.)
K-24	1-1/2 x 5	6.6
K-18	1-1/4 x 7	7.0
K-12	1-1/4 x 7	8.6
K-14'	1-1/4 x 7	8.6
K-10	1-1/4 x 9-1/2	7.5
K-19	1-1/4 x 9	9.0
K-13*	1-1/4 x 9	11.0
K-11*	1-1/4 x 9	*11.0
K-16'	1-1/4 x 9	*11.0
K-1	1-1/2 x 9	12.1
K-22	1-1/2 x 10	13.3
K-25	1-1/2 x 10	13.3
K-27	1-1/2 x 10	13.3
K-26	1-1/2 x 12	16.0
K-28	1-1/2 x 12	16.0
K-29	1-1/2 x 12	16.0
K-2	1-3/4 x 9	17.6
K-32	2 x 8	20.0
K-3	2 x 9	23.1
K-31	2 x 10	25.5
K-4	2 x 12	30.5

'DISPLACEMENT WHEN PRESSURIZING
THE HEAD END OF CYLINDER

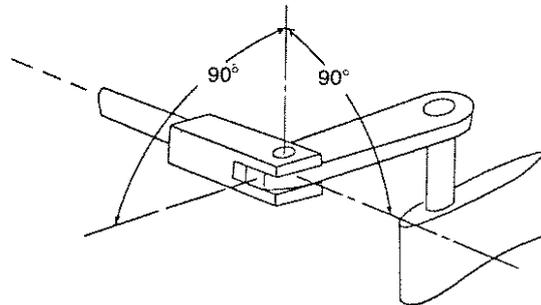
INSTALLATION INSTRUCTIONS: MOUNTING THE K-1, K-2, K-3 AND K-4 CYLINDERS

1. Cylinder layout and dimensions are shown in Figure 5.
2. The cylinder can be mounted in either a Crosswise (abeam) direction or a lengthwise (fore and aft) direction to the boat.
3. Select the diagram and dimensional data that best describes your particular installation, see Figures 1 thru 4. The approximate rudder arc for each of the indicated installations is 70 degrees.
4. The cylinder should be located in a position to insure an unobstructed pathway for flexible hose to go from the relief valve to the cylinder ports.
5. The rudder arm, or arms, must have an unobstructed arc of travel, with the rudder post packing allowing a free movement of the rudder arm and rudder.
6. It is most desirable to have a close fitting, but free, reamed ($\frac{3}{4}$ " dia.) clevis pin hole in the rudder arm. This will assure long pin life.
7. The rudder arm is connected directly to the ball joint on the end of the cylinder rod using a $\frac{3}{4}$ " dia. pin (available from Hynautic or fabricated by the installer). Suggested attachment method is shown below.



8. OPTIONAL CLEVIS INSTALLATION

The use of a clevis on the cylinder's rod end is an option offered by Hynautic. If a clevis is used, there is no allowance for installation misalignment. The cylinder and rudder arm must swing together in the same plane. There should be no binding and the clevis pin must be easily removed at any point throughout the rudder arm's travel. If clevis option is used all cylinder length dimensions will increase by $\frac{1}{2}$ inch.



9. CAUTION

Careshould betakennottoknickorscratchthecylinderrodorleakagewillresult.

10. With the cylinder attached to the rudder arm, position the rudder arm in the midships position and the cylinder in its' centered position. Now position the mounting bracket along the centerline as indicated in the installation figure you have selected.
11. The mounting bracket should be thru-bolted to a substantial member, since it will have to withstand forces up to 2400 lbs.

12. CAUTION

Dirt and foreign matter in the hydraulic system causes damage and malfunction. Use extra care when installing fittings and attaching hoses. Thread sealants may be used with due care.

13. Cylinder ports are tapped with $\frac{1}{4}$ -18 NPTF threads, $\frac{3}{8}$ " or $\frac{1}{2}$ " flare fittings should be used depending on the system being installed.
14. Flexible hose must be used to connect the cylinder into the system. Flexible hose must meet the **SAE 100R** specification and have a 1000psi. working pressure.

INSTALLATION INSTRUCTIONS: TUBING

1. COPPER TUBING - .032" wall thickness. Copper tubing can be used on high pressure applications. P & S lines require 3/8" or 1/2" compression or flare fittings, R lines require 1/4" compression or flare fittings.

CAUTION

Coppertubing should not be connected directly to the cylinder.

2. HOSE - High pressure hose may be used throughout your system. Use either Hynautic supplied hose or the equivalent of Aeroquip 2651 (SAE 100R with 1000psi working pressure). P & S lines require 3/8" or 1/2" lines, R lines require 1/4".

INSTALLATION INSTRUCTION: FLUIDS

1. Use MIL-0-5606 Aircraft Hydraulic Fluid, Texaco #15, Shell Tellus 15 (SO-Tellus 10) or Chevron EP-Machine Oil 10. LIGHT VISCOSITY OILS ARE RECOMMENDED, HEAVIER OILS WILL CAUSE SYSTEM STIFFNESS.

INSTALLATION INSTRUCTION: HELM TURNS

HELM TURNS HARDOVER TO HARDOVER					
CYLINDER NO.		K-1	K-2	K-3	K-4
HELM NO.	H-21	4.4	6.5	8.4	11.1
	H-25	4.4	6.5	8.4	11.1
	H-29	4.4	6.5	8.4	11.1
	H-42	3.0	4.5	5.8	7.6
	H-41	2.2	3.3	4.2	5.5

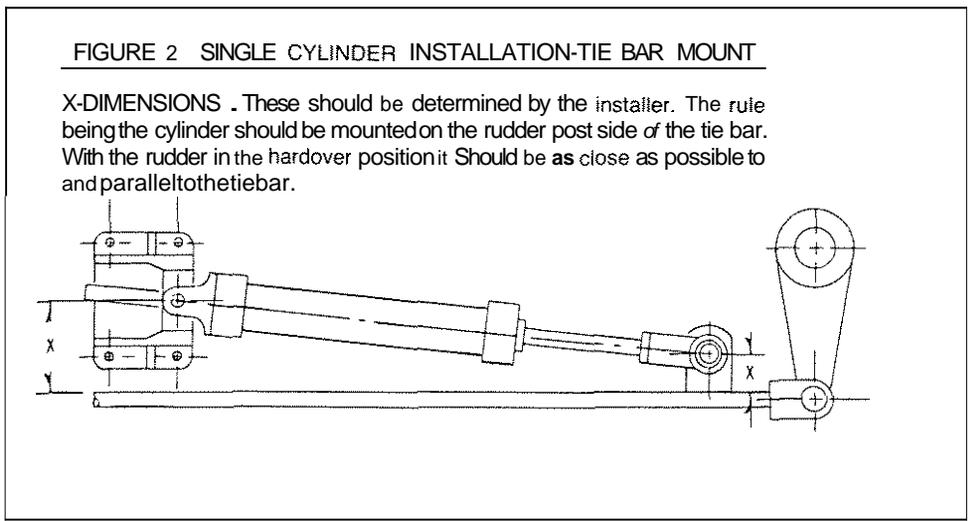
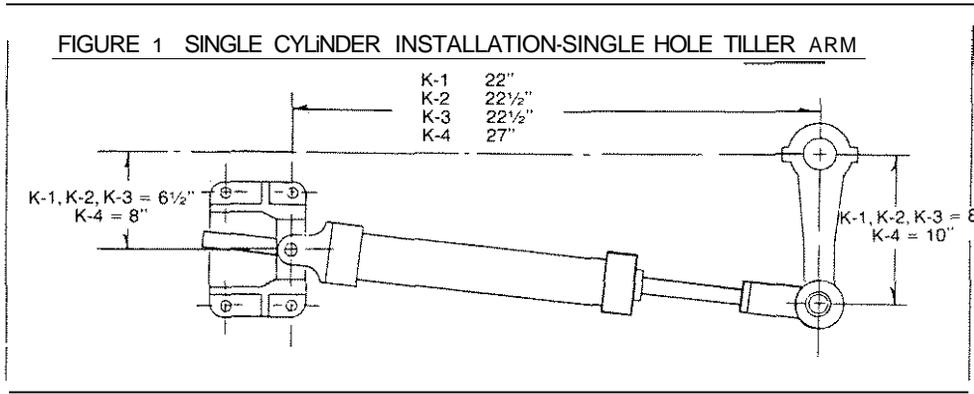


FIGURE 3 DUAL CYLINDER INSTALLATION - PARALLEL MOUNT

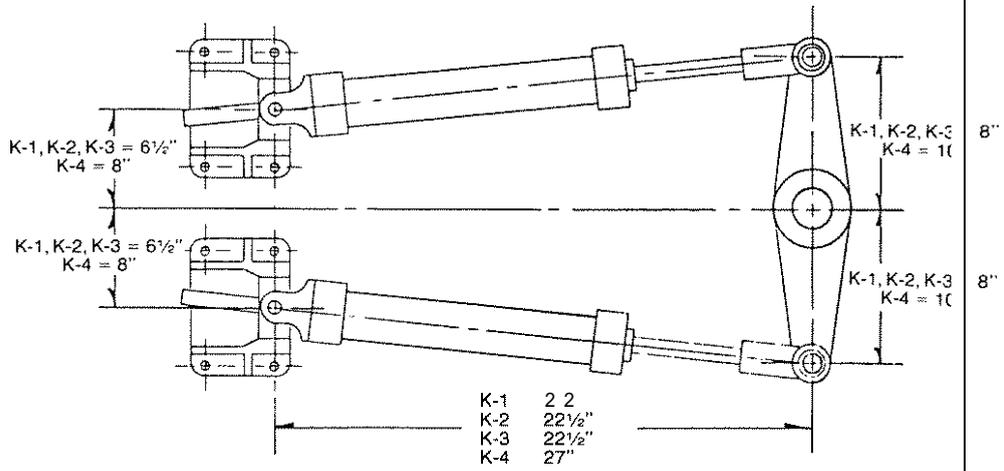


FIGURE 4 DUAL CYLINDER INSTALLATION - IN LINE MOUNTING

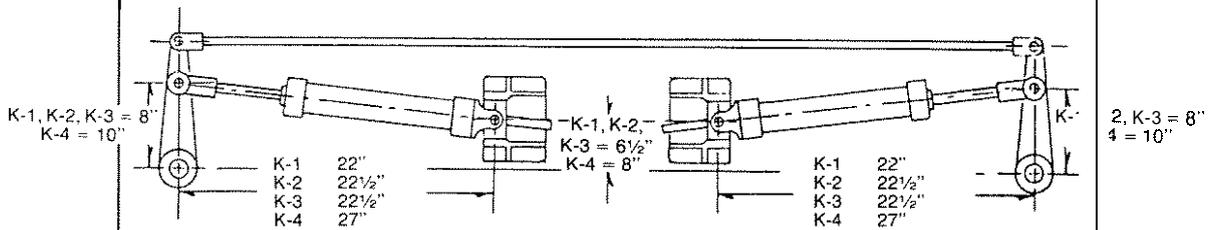
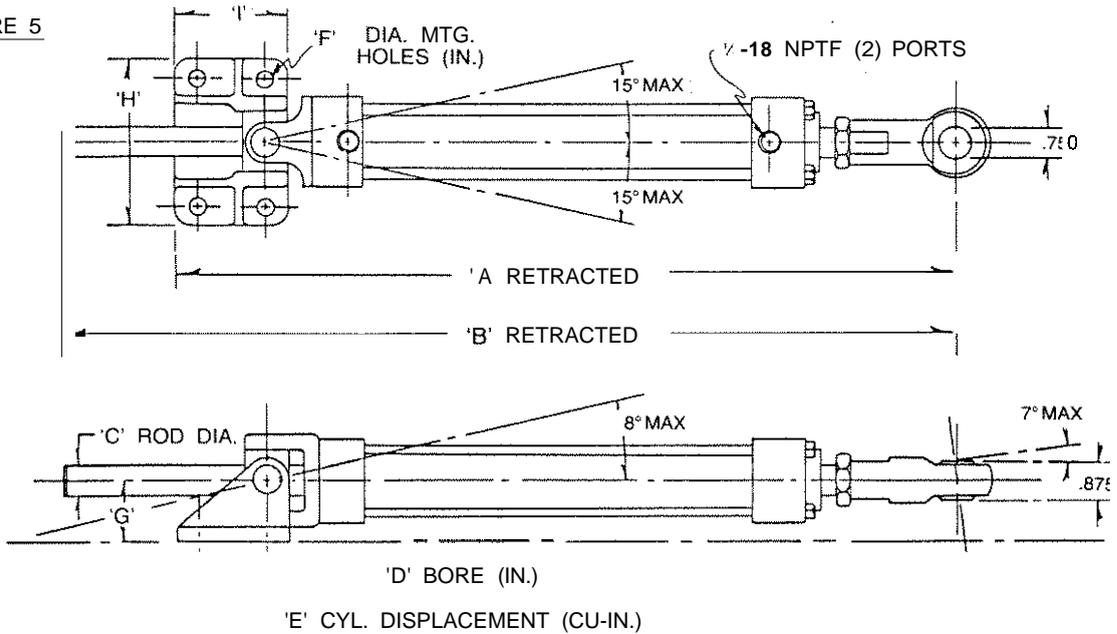


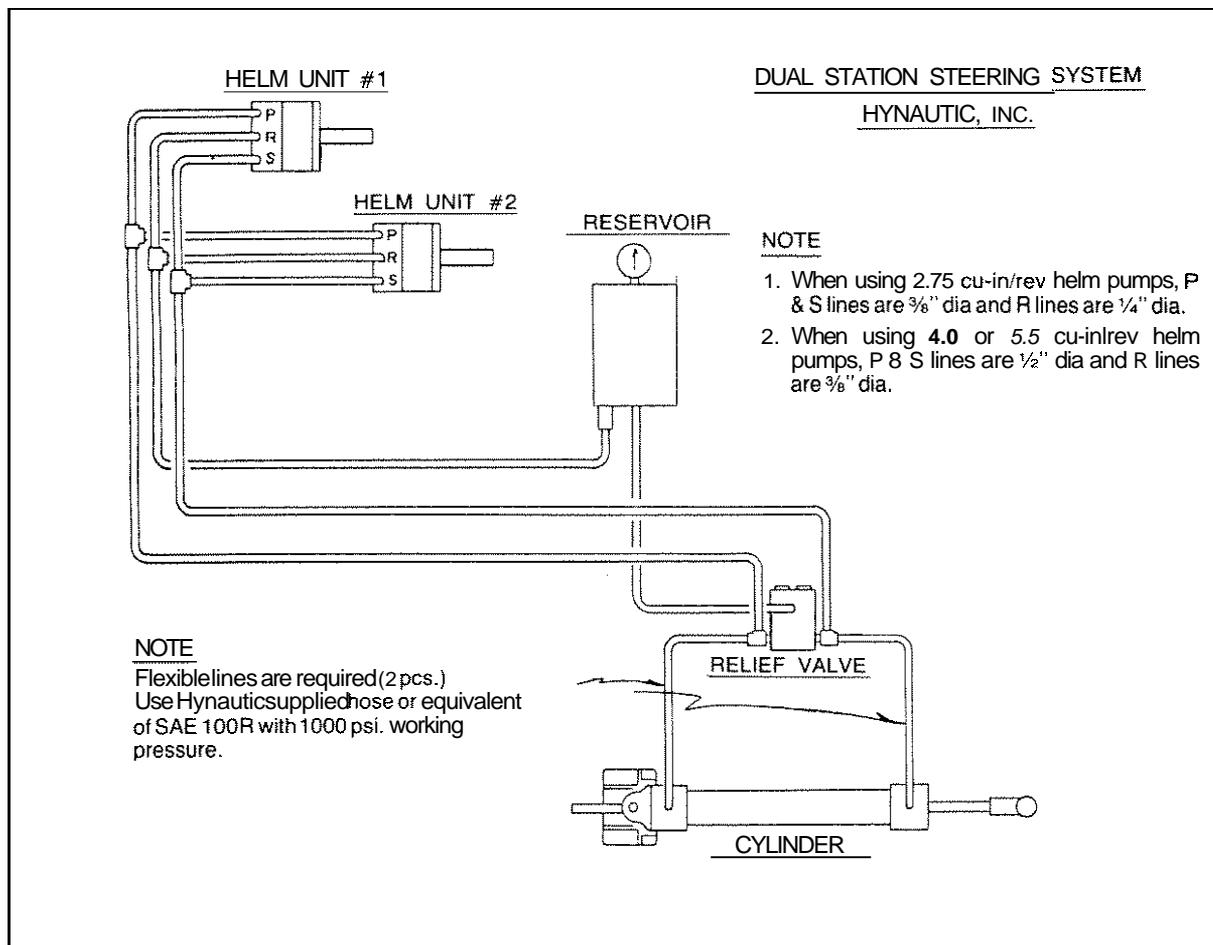
FIGURE 5



CYL. NO.	A	B	C	D	E	F	G	H	I
K-1	19.88	25.88	.750	1.50	11.9	.40	1.62	4.50	2.75
K-2	21.44	26.18	.750	1.75	17.7	.56	2.12	5.75	4.00
K-3	21.44	26.18	.875	2.00	22.9	.56	2.12	5.75	4.00
K-4	24.44	32.18	.875	2.00	30.5	.56	2.12	5.75	4.00

K-1, K-2, K-3 CYLINDER STROKE = 9.0 IN.

K-4 CYLINDER STROKE = 12.0 IN.



INSTALLATION INSTRUCTION: SYSTEM PURGING

1. Fill the reservoir to within 2" of the top. Pressurize to 40-50 psi.
2. Loosen valve screws on the relief valve.
3. Bleed both ends of the cylinder until solid oil appears. This is accomplished by loosening the hose connections at the cylinder and retightening it when solid fluid is evident. Single rod end cylinders bleed rod end first.
4. Go to highest helm and turn slowly 60-70 turns in one direction. Repeat at successively lower stations.
5. Again bleed at cylinder as in Step 3.
6. Go to top station and turn slowly 60-70 turns in the opposite direction. Repeat at successively lower Stations.
7. Again bleed at cylinder as in Step 3.
8. Purging should be complete at this time.
9. Close valve screws on relief valve, check turns H.O to H.O.
10. Leave system pressurize - at 25-35 psi, and reservoir half full.

HYNAUTIC, INC.

P.O. Box 908 Osprey, Florida 34229 Telephone 813-966-2151

INSTALLATION INSTRUCTIONS: 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. Reservoirs, and reservoir valves, have been pressure tested for leakage over a set period of time. Relief valves have been checked for leakage and factory set at the designated relief pressure. Cylinders have been tested for leakage and operation at 1000 psi.

Another factor that should be remembered is, that Hynautic manufactures Manual Hydraulic Steering not power steering (unless special ordered), so the effort required to turn the wheel will increase as the system is called on to exert more force on the rudder or outdrive. At no time should one expect this system to 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 not a malfunction, but is the general nature of the Hynautic pump, due to its basic design. At times when coming off the hardover position, a resistance is felt followed by a distinct audible sound. This should not be mistaken as a malfunction, but is a normal situation caused by the releasing of the pilot check valve.

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

PROBLEM: STEERING IS STIFF BOTH AT THE WCK AND UNDERWAY

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 follows:

<u>HELM DISPLACEMENT</u>	<u>TORQUE LIMITS</u>
1.65 cu-in.	22-30 in-lbs.
2.00 cu-in.	25-35 in-lbs.
2.75 cu-in.	35-45 in-lbs.
4.00 cu-in.	50-65 in-lbs.
5.50 cu-in.	70-90 in-lbs.

When you rotate the ship's wheel, if the torque is within, or below, the indicated limits, then Hynautic would consider 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.

CAUSE: High viscosity oil used in the system.

SOLUTION: Drain fluid from system and replace with low viscosity petroleum based fluid. Use MIL-0-5606 Aircraft Hydraulic Fluid, Texaco #15, Shell Tellus 15 or an equivalent fluid.

CAUSE: Restriction in the P or S lines' tubing or fittings.

SOLUTION: Find restriction and correct. When tubing is bent it can become kinked, such a restriction can cause stiff steering.

CAUSE: P and S line size too small

SOLUTION: 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.

CAUSE: Helm shaft binding on panel.

SOLUTION: Adequate shaft clearance must be maintained for the helm shaft to pass thru the control panel

CAUSE: Cylinder is misaligned or improperly mounted, causing internal binding

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

CAUSE: Fittings in cylinder have been overtightened, this is a common problem on aluminum cylinders. This causes two things to happen. First the fitting begins to bear down on the internal bearing distorting the bearing, secondly it causes a fluid flow restriction.

SOLUTION: Remove fitting and inspect bearing. If a definite circular mark is evident, the fitting has been overtightened. Using a new fitting replace the fitting in question, 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.

PROBLEM: STEERING IS SATISFACTORY UNTIL IT IS ATTACHED TO THE RUDDER OR OUTDRIVE SYSTEY, THE IT BECOMES STIFF.

CAUSE: Rudder post gland rings are to tight. or rudder post is bent. Steering linkages or outrives could also be mechanically binding.

SOLUTION: Correct problem as required

CAUSE: Outdrive or outboard swivel bracket requires lubrication

SOLUTION: Lubricate per maintenance manual.

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

SOLUTION: Tilt and guide tuber 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.

PROBLEM: STEERING IS EASY AT DOCK BUT BECOMES STIFFER AS BOAT IS UNDERWAY,

CAUSE: System is inadequate to handle the boat

SOLUTION: Contact Hynautic with data on the vessel's **rudder** dimensions and bolt speed. System may require replacement of the cylinder with a larger unit or a second unit in parallel with the initial cylinder.

CAUSE: Steering wheel may be too small.

SOLUTION: 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 below:

<u>HELM DISPLACEMENT</u>	<u>MIN. REC. WHEEL DIA.</u>
1.65 cu-in.	15 in.
2.00 cu-in.	15 in.
2.75 cu-in.	18 in.
4.00 cu-in.	28 in.
5.50 cu-in.	32 in.

PROBLEM: COMPONENT LEAKING FLUID FROY PARTING LINE, ROD OR SHAFT

CAUSE: Worn rod or shift seal.

SOLUTION: Return unit to Hynautic for repair. Unit **should** be returned for **repair** as quickly as possible. Rod and shaft leaks will only **get worse** and will not self correct.

CAUSE: Pinched or cut parting line o'ring.

SOLUTION: Return unit to Hynautic for repair,

PROBLEM: TURN WHEEL ON ONE HELM UNIT AND THE WHEEL ON ANOTHER STATION ALSO THURNS,

CAUSE: Dirt in pilot check valve assembly of free wheeling helm.

SOLUTION: Return unit to Hynautic for repair.

PROBLEM: HELM PUMPS IN ONE DIRECTION BUT NOT IN THE OTHER.

CAUSE: Dirt in the **makeup** check valve, these valves **are** located internally in the helm unit.

SOLUTION: Return helm to Hynautic for repair. Repair requires complete unit tear **down**, which Hynautic does not recommend except by factory trained **personnel**.

CAUSE: Air still in system.

SOLUTION: Re-purge system **per** the installation instructions.

PROBLEM: HELM UNIT SHOWS NO DEFINITE STOP IN EITHER DIRECTIONS.

It should be noted that, after the **operator** has reached hardover that **if** a constant pressure is maintained on the wheel that it will continue to rotate past the hardover position. This is normal, since a 100% efficient unit is most difficult to find. The degree and speed of wheel movement is determined by the unit's efficiency. However, **if** the **wheel** is easily rotated then a problem could exist

CAUSE: Valve screws on the relief **valve**. or reservlave, have been left open

SOLUTION: Close the **valve** screws

CAUSE: Excessive air in the System.

SOLUTION: Re-purge the system per the installation instructions.

PROBLEM: HELM TAKES EXCESSIVE TURNS GOING FROM HARDOVER TO HARDOVER,

CAUSE: Air in system.

SOLUTION: Re-purge system per the installation instructions

CAUSE: Incorrect helm displacement.

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

PROBLEM: SYSTEM SEEMS NOT TO BE PURGED WHEN IT HAD JUST BEEN PURGED THE DAY BEFORE.

CAUSE: Air Saturation into the oil or air foaming during the purging process

SOLUTION: Re-purge the system using just 20-30 psi.

PROBLEM: ONE HELM UNIT TURNS THE RUDDER IN ONE DIRECTION WHILE OTHER STATION(S) TURN IT IN THE OTHER DIRECTION.

CAUSE: Hydraulic lines P and S hooked up backwards at helm station

SOLUTION: Reverse lines going to P and S on Station in error.

PROBLEM: RUDDER DRIFTS EXCESSIVELY (MUST CONTINUALLY CORRECT STEERING IN ONE DIRECTION WHEN UNDERWAY.

CAUSE: Valve screws on relief valve or reserve valve are not tightened down.

SOLUTION: Tighten valve screws down.

CAUSE: Internal leakage of the relief valve or reserve valve.

SOLUTION: Return unit to Hynautic for repair.

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

SOLUTION: Isolate the secondary relief and see if problem persists.

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

SOLUTION: Return cylinder to Hynautic for repair.

PROBLEM: LOSS OF FLUID AND PRESSURE IN THE RESERVOIR OR RESERVE VALVE

CAUSE: Fluid leak in system.

SOLUTION: Check all components and fittings in the System and repair as required

PROBLEM: LOSS OF PRESSURE BUT NO LOSS OF FLUID IN THE RESERVOIR OR RESERVE VALVE,

CAUSE: Air leak in upper area of the reservoir or reserve valve

SOLUTION: If loss is over a long period of time just re-pressurize the reservoir or reserve valve to 20-30 psi. If the loss is over a short time period, check for air leakage using WD-40, CRC or a soapy solution. Repair as required and re-pressurize to 20-30 psi.

PROBLEM: DAMAGED HYNAUTIC NYLON TUBING, CAUSING FLUID LEAKAGE.

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

SOLUTION: If tubing is readily available, and the installation lends itself, just run a new length of tubing. However, in most cases the tubing must be spliced together. First cut the tubing at the 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" OD. If tubing is 3/8" OD, use Hyn# 690951 Union Adaptor.

REPLACEMENT PARTS

PART NUMBER	DESCRIPTION
160012	Pressure Gauge 0-60 psi., Bottom Mount
160041	Reservoir Air Valve
160042	Pressure Gauge 0-60 psi., Back Mount
160103	Filter Element
170001	Rubber Boot
211010	O'Ring for 5/16" Nylon Tubing
270037	Nut for 3/4" Taper Helm Shaft, 1/2-20 Thds.
340041	Chrome Acorn Nut, Helm Shaft
340051	Chrome Acorn Nut, Trim Plate
380010	Reservoir Filter Plug Assy, R-06 & RV-60
380020	Reservoir Fill Plug Assy, Complete with Air Valve
380030	Reservoir Filter Plug Assy for Nylon Tubing Return
530015	Nut 5/16" Nylon Tube
530025	Lock Ring 5/16" Nylon Tube
530045	Insert 5/16" Nylon Tube
530115	Union 5/16" Nylon Tube
650027	Woodruff Key for 3/4" Taper Helm Shaft
650036	Square Key for 1" Straight Helm Shaft
670030	Ball Joint for K-22 thru K-29 Cylinders
670060	Ball Joint for K-16 and K-17 Cylinders
670220	Ball Joint for K-1 thru K-5 Cylinders
670230	Ball Joint for K-11, 12, 18 & 19 Cylinders
670240	Ball Joint for K-11 & K-12 Cylinders (Mount End)
740011	Chrome Washer, 1" Straight Helm Shaft
740037	Spacer, 1" Straight Helm Shaft
860022	Air Pump, R-07 Reservoir

MISCELLANEOUS KITS

HS-01	Helm Seal Kit (Units with External Shaft Seal)
HS-02	Helm Seal Kit (Units with Internal Shaft Seal)
HS-03	Helm Seal Kit (H-41 & 42 with External Seal)
HS-04	Helm Seal Kit (H-41 & 42 with Internal Seal)
HS-05	Helm Seal Kit (For H-50, 51 & 52 Helm Units)
KS-01	Cylinder Seal Kit (For K-11 thru K-17 Old Style)
KS-02	Cylinder Seal Kit (For K-18 thru 20)
KS-03	Cylinder Seal Kit (For K-02 and H-1010)
KS-04	Cylinder Seal Kit (For K-22 thru K-29) to Aug 83
KS-05	Cylinder Seal Kit (For K-31 thru K-33)
KS-06	Cylinder Seal Kit (For K-22 thru K-29) after Aug 83
KS-07	Cylinder Seal Kit (For K-10)
KS-11	Cylinder Seal Kit for K-1
KS-12	Cylinder Seal Kit for K-2
KS-13	Cylinder Seal Kit for K-3
KS-15	Cylinder Seal Kit for K-5
MCO-01	One Quart MIL—0-5606 Aircraft Hydraulic Fluid
MCO-02	One Gallon MIL-0-5606 Aircraft Hydraulic Fluid
MCT-01	Nylon Tubing, 5/16" Dia., 50 Ft. Roll
MCT-02	Nylon Tubing, 5/16" Dia., 100 Ft. Roll