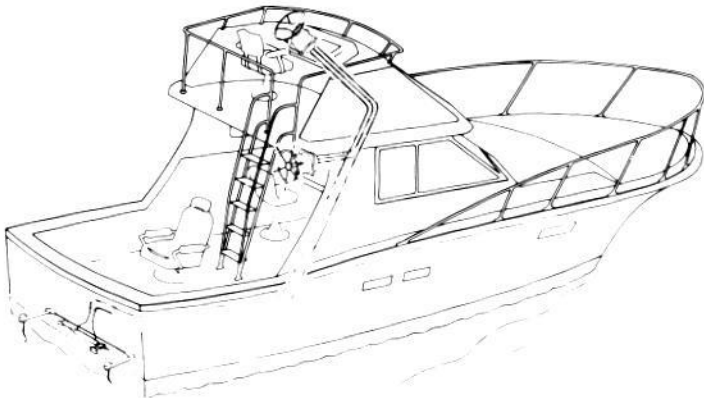


TeleflexTM

SeaStar I,II HYDRAULIC STEERING



THE SeaStar I, II HYDRAULIC SYSTEM



High-horsepower / high-speed boating is here. Many steering systems must perform at maximum capacity. The new SeaStar Hydraulic Steering System is designed to provide that extra margin of muscle when needed. SeaStar's helm pump, the heart of the system, easily handles OB, I/O, and Inboard engines in boats up to the 40 foot range.

System selection, installation and service is substantially simplified with just two components – helm and cylinder. Three types of cylinders are available to handle the variables in OB, I/O and Inboard power suitable for power pleasure and commercial boats. Extra steering stations and/or an auto-pilot are easily added.

SeaStar hydraulic steering is a total commitment to quality, performance and simplicity.

SeaStar, the hydraulic steering system that is . . .

- **Easy to install . . .**
 - Only two components; helm and cylinder.
 - Simple tube/hose fitting connections.
 - Clear, complete installation instructions.
- **Easy to fill and purge . . .**
 - Engineered bleed fittings on cylinder.
 - A helm and lock valve design that enhances air removal.
 - A no-mess filler device.
 - A filling and purging time of normally less than 30 minutes.
- **Easy to check for proper installation . . .**
 - Easy purging check via filler device.
 - Easy system check.
 - No searching for difficult to find air leaks.
- **Easy to turn . . .**
 - Heavy duty wheel shaft ball bearing.
 - Ball bearing piston race.
 - Anti-friction piston points.
- **Designed to provide many years of service . . .**
 - Precision built.
 - Heavy-duty bearings instead of bushings.
 - All metal construction.
 - No corrosive materials exposed to marine environment.
 - Field replaceable helm and cylinder shaft seals.
 - A no hassle 2 year user warranty.

SEASTAR! **SIMPLY THE BEST.**

THE SeaStar I, II HELM PUMP

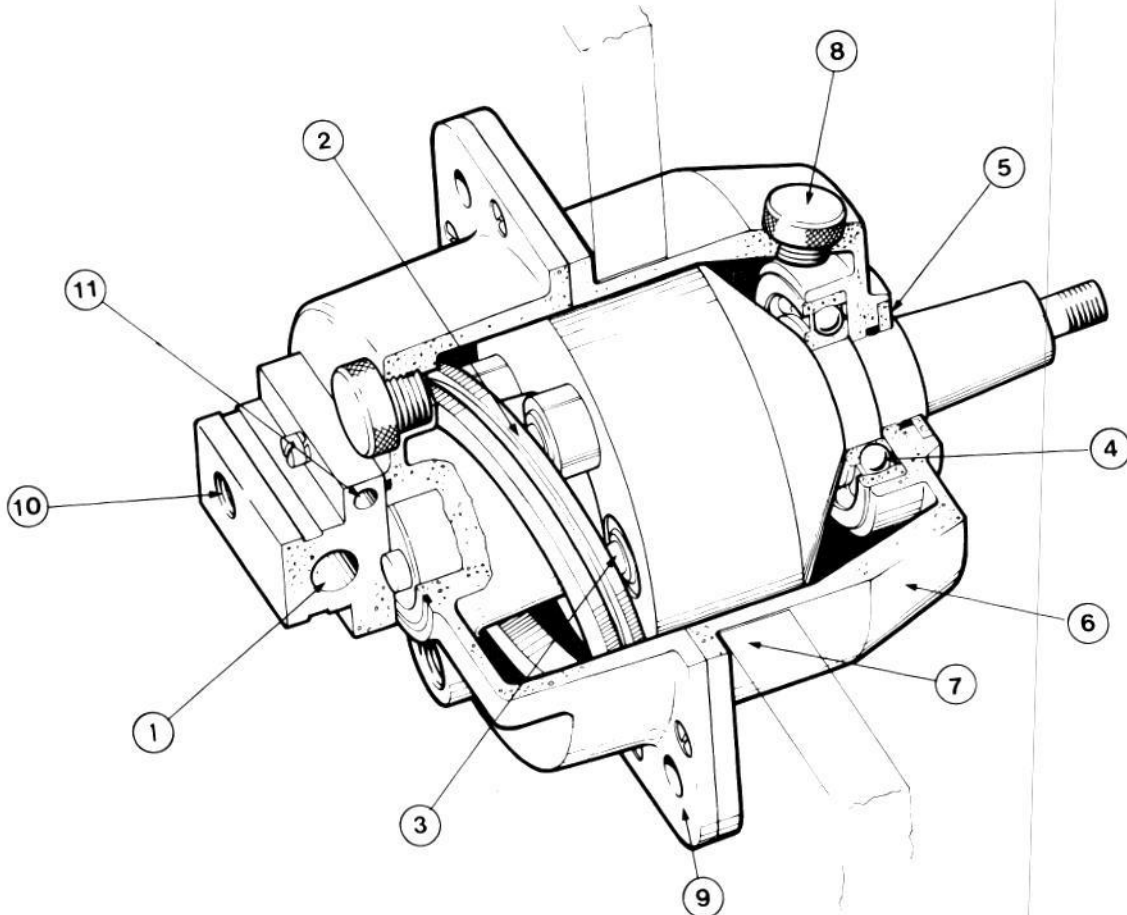
The SeaStar helm pump is the product of many years of research and experience by the world's foremost builder of manual hydraulic steering systems.

Our efforts have culminated in a design which represents the ultimate in efficiency, safety and



reliability, yet easy to install and maintain.

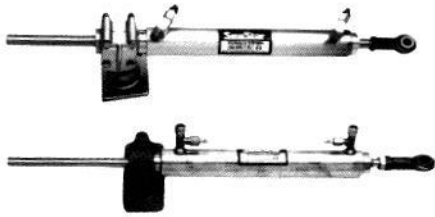
Our superior design, teamed with the finest materials, precision manufacturing and rigid quality control all adds up to an outstanding product which is certain to set the industry standard for many years to come.



SEASTAR FEATURES

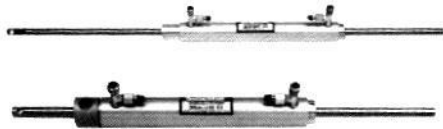
- | | |
|--|--|
| <ul style="list-style-type: none"> 1. Lock valve for positive rudder lock 2. Ball bearing piston race 3. Anti friction piston point <small>PAT. PEND.</small> 4. Heavy duty rotor bearing support for smoother feel and longer life 5. Field replaceable shaft seal | <ul style="list-style-type: none"> 6. All metal construction 7. Simple cut out for mounting 8. Front of dash fill 9. Behind dash mount (or front) 10. 1/4 NPT fitting ports, for standard available fittings 11. Pressure relief valve |
|--|--|

SEASTAR CYLINDERS



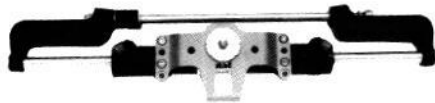
INBOARD CYLINDERS

These cylinders feature stainless steel ball joints and two axis articulation, simplifying installation. Five models are available.



STERNDRIVE CYLINDERS

These cylinders attach directly to the sterndrive unit. Four models are available to handle most applications.



OUTBOARD ENGINE CYLINDERS

Two models are available. Front of engine mount and side of engine mount.

FRONT MOUNT CYLINDER FEATURES

- Balanced, even number of steering wheel turns from midship to hard over
- Fits most big new outboard engines (except power assist models)
- Suitable for autopilot interface
- Subject to splashwell/bracket depth clearance. (Refer to "Minimum Motor Well Dimension Section")



SIDE MOUNT CYLINDER FEATURES

- Alternative to front mount type if motor well space too restrictive.
- Unbalanced, uneven number of wheel turns from midship to hard over left and right
- Suitable for outboard engines with power steering
- Not suitable for autopilot interface (Single Cylinder Only)
- Subject to adequate splashwell width clearance. (Refer to "Minimum Motor Well Dimension Section")

SeaStar TUBING

This flexible $\frac{3}{8}$ " nylon tubing is used for all SeaStar I Inboard, Sterndrive and Seadrive installations. Maximum recommended total tube run is 100 feet (30 m).

COPPER TUBING

$\frac{3}{8}$ " soft refrigeration copper tube (or SeaStar I, II, hose) must be used with all SeaStar II Inboard and Sterndrive installations. $\frac{3}{8}$ " copper tube should also be used with SeaStar I Inboard, Sterndrive and Seadrive installations when total tube run will exceed 100 feet (30 m).

Cylinder hose kits are required for all SeaStar Steering Systems installed with copper tube. (Except OMC Seadrives) This kit, made up of two short pieces of flexible tube or hose, and union coupling fittings will accommodate cylinder movement.

SeaStar HOSE KITS

Special high burst strength flexible hose is required for most outboard installations. This hose is designed for splashwell and transom bracket environments, hoses are precut to various length and are supplied with factory installed brass fittings.

Hoses are sold in pairs in length from 2 feet to 30 feet (.6 m to 9 m) in 2 feet (.6 m) increments.

PLAN AHEAD

To facilitate an extra steering station, autopilot or bulkhead fittings, order two pairs of shorter hose kits. For future installation of extra steering station or autopilot, connect hoses with a union coupling fitting, Part No. HF5527. Tee fittings can now be installed with ease at a later date.

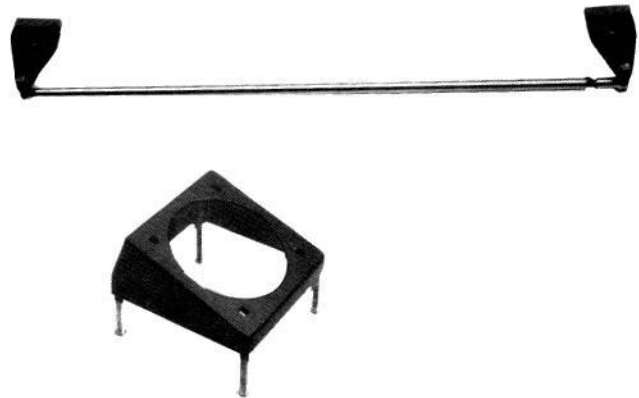
ACCESSORIES/OPTIONS

TIE BAR KIT

Required for twin outboard engines. These non-corrosive kits permit full independent engine tilt.

See Application Guide.

20° mount for SeaStar I, II Helms, Part No. HA5429. May be used on horizontal and vertical surfaces.



ADDITIONAL STATION/AUTOPILOT FITTING KIT

Contains all necessary fittings for an additional steering station or autopilot.

All necessary fittings are supplied with components for single steering station systems.

See Application Guide.

BULKHEAD FITTING KITS

These fittings provide a water tight routing of tubing and hose through bulkheads (i.e.: splashwell/transoms).

Two lengths are available . . .

SINGLE OUTBOARD CYLINDER SYSTEMS

HF5512, for splashwells up to ¾" (19 mm)

HF5513, for transoms up to 3" (76 mm)

TWIN OUTBOARD CYLINDER SYSTEMS

HF5514, for splashwells up to ¾" (19 mm)

HF5515, for transoms up to 3" (76 mm)

NOTE: Refer to "How to Measure Outboard Hose" Section of Catalogue for specific number of hose kits required for various applications.

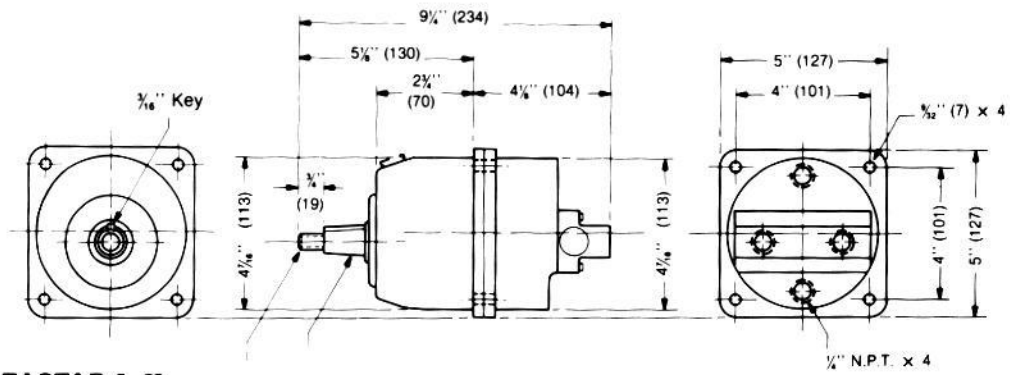
SeaStar OIL

This special high quality mill. spec. oil is required to ensure reliable performance of your SeaStar Steering System.

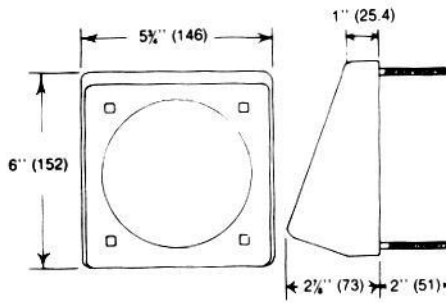
Oil is sold in one (1) liter/33.8 U.S. fluid ounces.

See Application/Order Guide.

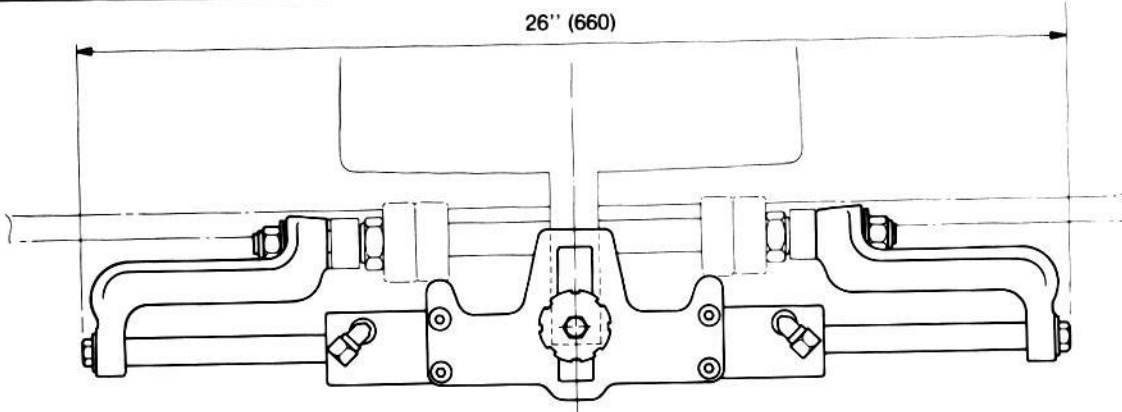
GENERAL DIMENSIONS



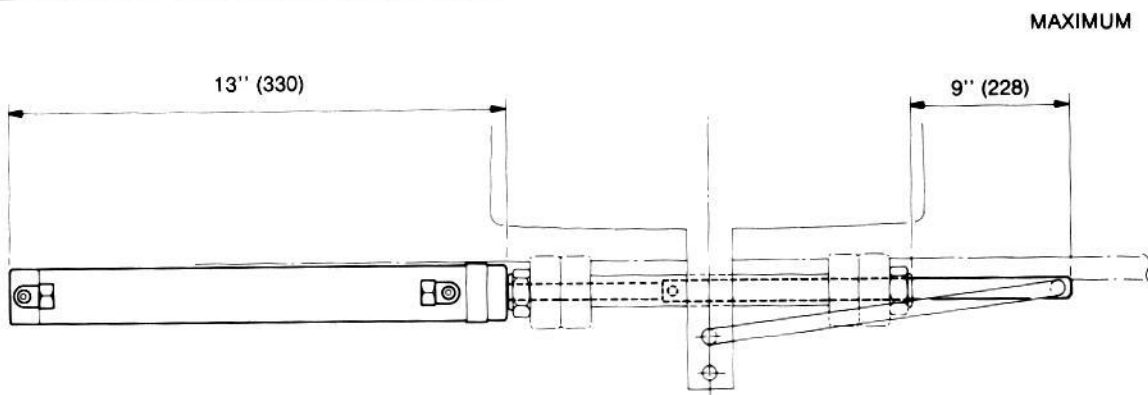
**HELM PUMP, SEASTAR I, II
HH5201, HH5202**



20° MOUNT HA5429

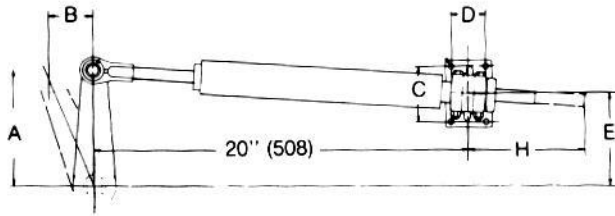


OUTBOARD CYLINDER, FRONT MOUNT TYPE HC5340



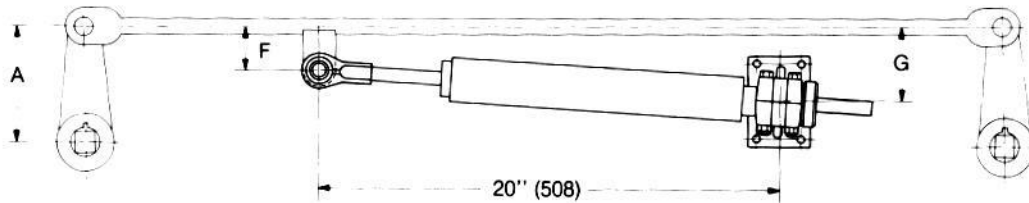
OUTBOARD CYLINDER, SIDE MOUNT TYPE HC5370

GENERAL DIMENSIONS

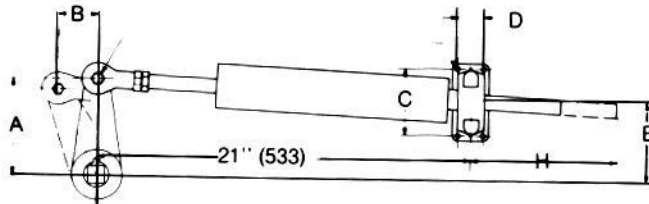


NOTE: For tie bar systems, cylinder may be mounted directly to the tie bar as shown, or to one of the two tiller arms, as long as dimensional data is adhered to.

- A = 6" — 152 mm
- B = 3½" — 89 mm
- C = 2½" — 63 mm
- D = 1½" — 49 mm
- E = 4¾" — 120 mm
- F = 2" — 50 mm
- G = 3¾" — 95 mm
- H = 6¼" — 148 mm

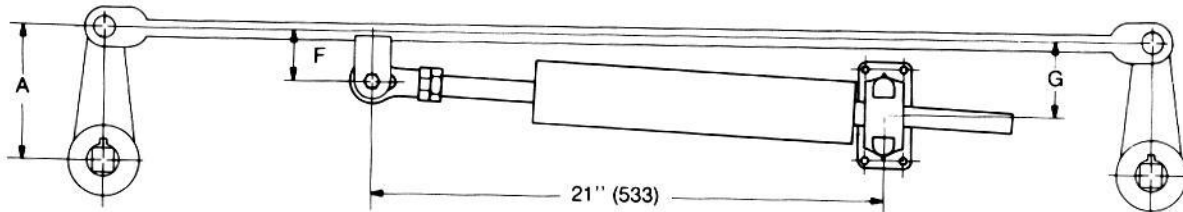


INBOARD CYLINDER, BJ MODELS HC5315-16-17

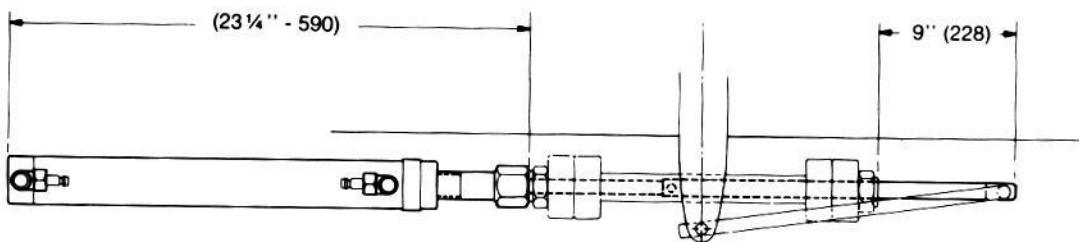


NOTE: For tie bar systems, cylinder may be mounted directly to the tie bar as shown, or to one of the two tiller arms, as long as dimensional data is adhered to.

- A = 6" — 152 mm
- B = 3½" — 89 mm
- C = 4" — 101 mm
- D = 1⅞" — 40 mm
- E = 4¾" — 120 mm
- F = 3" — 76 mm
- G = 4¾" — 108 mm
- H = 8" — 203 mm

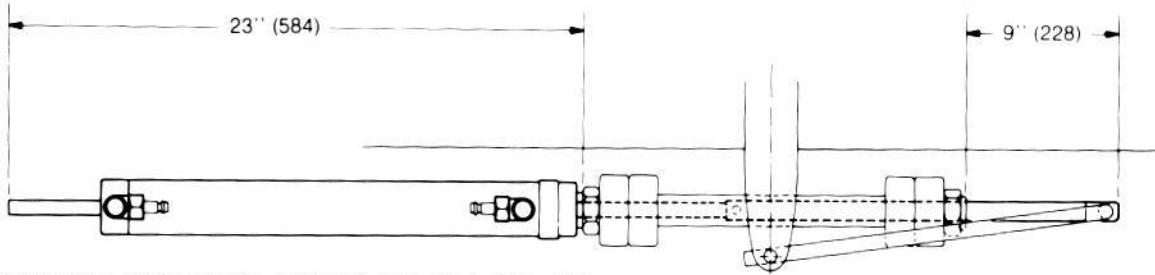


INBOARD CYLINDER, TM MODELS HC5318-19

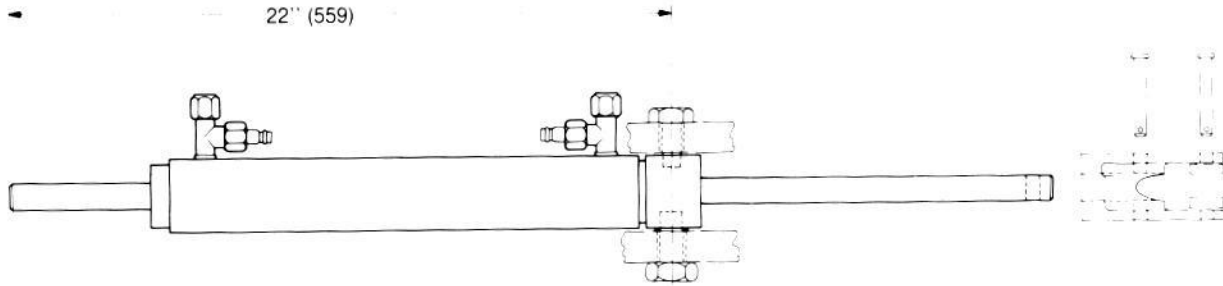


STERNDRIVE CYLINDERS, MODELS 125-8EM HC5328 (HC5329)

GENERAL DIMENSIONS



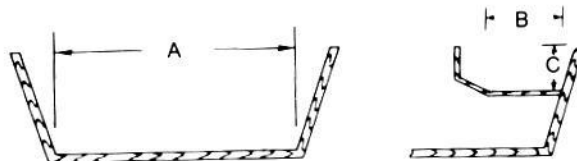
STERNDRIVE CYLINDER, MODEL BA135-8 EM HC5327



STERNDRIVE CYLINDER, MODEL BA150-7 EM HC5326

MINIMUM MOTOR WELL DIMENSIONS FOR OUTBOARD STEERING SYSTEMS

• FRONT MOUNT CYLINDER(S)



- One Engine A = 26" (660) B = 9" (230) C = 5½" (140)
- Two Engines A = 52" (1320) B = 9" (230) C = 6½" (165)

NOTE: Dimensional restrictions also apply to external motor mount brackets.

- Minimum engine centers for two engines is 26" (660).

• SIDE MOUNT CYLINDER(S)

Side mount cylinders require a minimum clearance of 13" (330) from end of tilt tube towards motor well wall or gunnel, and a minimum clearance of 14" (355) for installing.

- Minimum engine centers for two engines is 26" (660).

HOW TO MEASURE FOR OUTBOARD HOSE LENGTH

NOTE: The use of bulkhead fittings through splashwells or transoms is optional.

WARNING:

Hose length must provide adequate slack to permit unrestricted steering and tilt movement of cylinder(s).

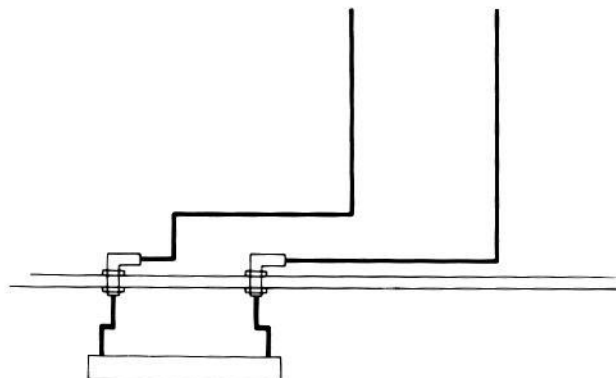
- **SINGLE CYLINDER INSTALLATIONS — NO BULKHEAD FITTINGS.**

Measure along intended hose path from the rear of helm location to the front center of outboard engine. Round up to the next even foot digit and add 2 feet/.6 m.

- **SINGLE CYLINDER INSTALLATION — WITH BULKHEAD FITTINGS.**

Measure along intended hose path from the rear of helm location to the proposed location of bulkhead fittings. Round up to the next even foot digit for hose kit number one.

Measure along path from bulkhead fittings to the front center of outboard engine. Round up to the next even foot digit and add 2 feet/.6 m for hose kit number two.

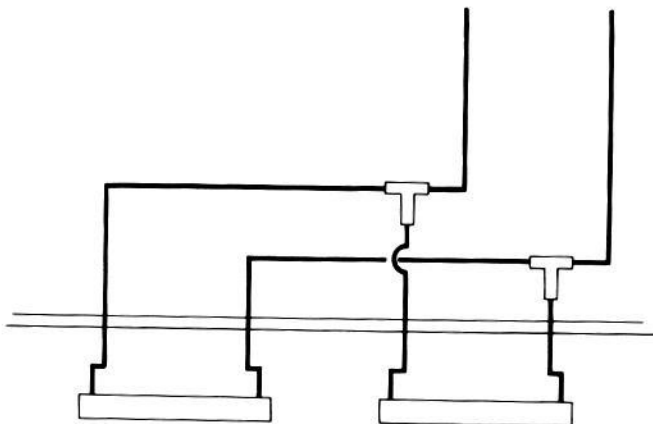


- **TWIN CYLINDER INSTALLATION — NO BULKHEAD FITTINGS.**

Measure along intended hose path from the rear of the helm location to a suitable tee fitting location near the splashwell or transom. Round up to the next even foot digit for hose kit number one.

Measure from tee fitting location to the front center of the starboard (right) outboard engine. Round up to the next even foot digit, and add 2 feet/.6 m for hose kit number two.

Measure from the tee fitting location to the front center of the port (left) outboard engine. Round up to the next even foot digit and add 2 feet/.6 m for hose kit number three.



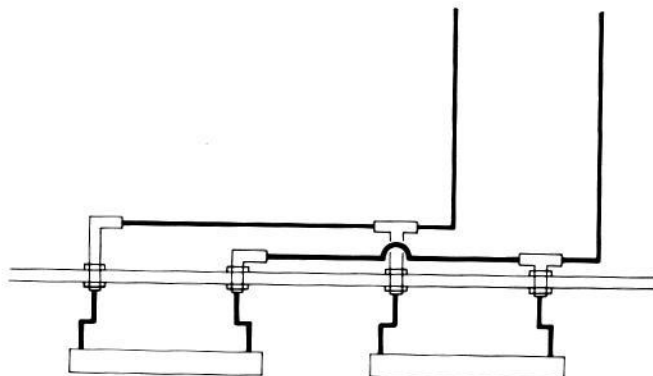
- **TWIN CYLINDER INSTALLATION — WITH BULKHEAD FITTINGS**

Measure along intended hose path from the rear of helm location to the proposed starboard location of bulkhead fittings. Round up to the next even foot digit for hose kit number one.

Measure along path from the starboard bulkhead fitting location to the port (left) bulkhead fitting location and round up to the next even foot digit for hose kit number two.

Measure along path from starboard (right) bulkhead fittings to the front center of the starboard engine. Round up to the next even foot digit and add 2 feet/.6 m for hose kit number three.

Measure along path from port (left) bulkhead fittings to the front center of the port engine. Round up to the next even foot digit and add 2 feet/.6 m for hose kit number four.



HOW TO ORDER SEASTAR HOSE KITS

Hose kits, one pair of equal length hoses, are available in length from 2 feet to 30 feet/.6 m to 9.1 m in increments of 2 feet/.6 m.

Part numbers range from HO5102 to HO5130. The last two digits of the part number are used to indicate the desired length.

Example: One each HO5118 is two hoses, 18 feet/5.48 m long.

HOW TO ORDER SEASTAR TUBING

CAUTION: This flexible tube is recommended for SeaStar I Sterndrive, Seadrive and Inboard Systems only.

Tubing is available in the following lengths:

- 25 feet/ 7.6 m = Part Number HT5092
- 50 feet/ 15.2 m = Part Number HT5095
- 75 feet/ 22.8 m = Part Number HT5097
- 100 feet/ 30.5 m = Part Number HT5100
- 1000 feet/305 m = Part Number HT5101

CAUTION

SeaStar nylon tubing is not recommended for:

- SeaStar II Systems
- SeaStar I Systems that require more than (approximately) 100 feet/30.5 m of tube run (total).
Use $\frac{3}{8}$ " O.D. soft copper tube or SeaStar hose. Copper tube is a good alternative for SeaStar nylon tube or SeaStar hose. Optimum system performance is obtained with copper tube due to the rigidity and larger inside diameter. $\frac{3}{8}$ " copper works with standard SeaStar fittings. A cylinder hose kit is required.

FOR SYSTEMS INSTALLED WITH COPPER TUBE (EXCEPT OMC SEADRIVES)

- For SeaStar I Systems use one each . . . HF5507, two each 2 feet/.6 m nylon tube and fittings.
- For SeaStar II Systems use one each . . . HF5508, two each 2 feet/.6 m hoses and fittings.

NOTE: Single steering station systems require two lines from the helm to the cylinder. Additional steering stations or autopilots require three lines between stations or autopilot pumpset.

TECHNICAL INFORMATION

HELM PUMP

	DISPLACEMENT	RELIEF VALVE	PORTS
SeaStar I	1.7 cu. in. - 27.8 cc	1000 PSI - 70 Bar	¼" NPT
SeaStar II	2.4 cu. in. - 39.3 cc	1000 PSI - 70 Bar	¼" NPT

HELM PUMP SHAFT

SeaStar I	¼" Standard Taper, 1" Per Ft.	⅜" NC Threads, ⅜" Key
SeaStar II	¼" Standard Taper, 1" Per Ft.	½" NF Threads, ⅜" Key

CYLINDERS — INBOARD AND STERNDRIVE MODELS

	INSIDE DIAMETER	STROKE
BA125-7BJ	1.250 - 31.7 mm	7" - 178 mm
BA135-7BJ	1.375 - 34.9 mm	7" - 178 mm
BA150-7BJ/TM	1.500 - 38.1 mm	7" - 178 mm
BA175-7TM	1.750 - 44.4 mm	7" - 178 mm
125-8EM	1.250 - 31.7 mm	8" - 203 mm
BA135-8EM	1.350 - 34.9 mm	8" - 203 mm
BA150-7EM	1.500 - 38.1 mm	7" - 178 mm

	VOLUME	TORQUE @ 1000 PSI - 70 Bar - 350
BA125-7BJ	7.2 cu. in. - 118.2 cc	5024 in/lbs
BA135-7BJ	8.2 cu. in. - 135.1 cc	5741 in/lbs
BA150-7BJ/TM	10.2 cu. in. - 167.5 cc	7117 in/lbs
BA175-7TM	13.7 cu. in. - 225.2 cc	9569 in/lbs
125-8EM	8.25/9.8 cu. in. - 135.1/160.8 cc	7142 - 8502 in/lbs ..
BA135-8EM	9.4 cu. in. - 154.4 cc	8162 in/lbs
BA150-7EM	10.2 cu. in. - 167.5 cc	8853 in/lbs

CYLINDERS — OUTBOARD MODELS

	INSIDE DIAMETER	STROKE
Front Mount	1.282 - 32.56 mm	10" - 254 mm
Side Mount	1.250 - 31.7 mm	8" - 203 mm

	VOLUME	TORQUE @ 1000 PSI - 70 BAR - H.O.
Front Mount	8.5 cu. in. - 139.2 cc	N/A
Side Mount	8.25/9.8 cu. in. - 135.1/160.8 cc	7142/8502 in/lbs - 82.1/97.7 K gm

FITTINGS

SeaStar cylinder and all other fittings are ⅜" compression type fittings. Threads are ⅜" x 24 extra fine. A brochure on all SeaStar fittings is available from Teleflex/Flexatrol.

SEASTAR I, II HOSE..... Inside diameter - 5/16" (8).



OUTBOARD HYDRAULIC STEERING

CHOOSE YOUR SYSTEM

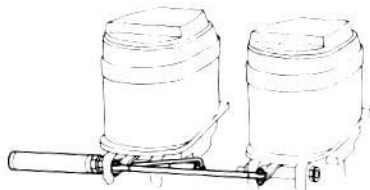
CONFIRM YOUR APPLICATION

A



- All threaded tilt tube models max. 300 HP.

B



- All threaded tilt tube models max 300 HP total.

C



- All threaded tilt tube models over 300 HP total.

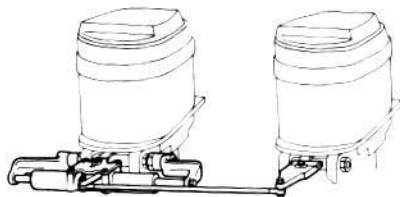
D



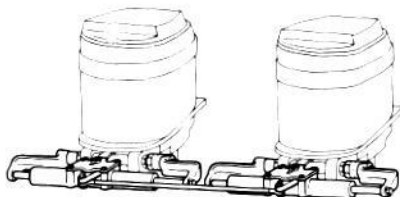
D, E, F suitable only for:

- Johnson-Evinrude, 90-300 HP. Except power steering models. 1977 to date.
Use tie bar number HO5001 for twin engines.
- Suzuki, 150-200 HP, 1986 to date.
Use tie bar number HO5001 for twin engines.
- Mercury-Mariner, V-6 Eng., 1984 only.
Use tie bar number HO5002 for twin engines.
- Mercury-Mariner, 90-115 HP, 1984 to date.
135-200 HP, 1985 to date.
Use tie bar number HO5003 for twin engines.
- Yamaha, 115-220 HP, 1986 to date.
Use tie bar number HO5004.
- Yamaha, 115-220 HP, 1984 to 1985.
Use tie bar number HO5005 for twin engines.

E



F



See Page 3 & 5 for Cylinder details.

OPTIONS

- 20° Mounting Wedge HA5429. For SeaStar I and II helms
- Fitting kit for Autopilot HF5501. Suitable for hose and tube

WHEEL TURNS

- System A, B, to the right 5.7, to the left 4.8
- System C, 7.5 turns
- System D, E, 5 turns
- System F, 7 turns

WARNING

Not recommended for racing type installations with surfacing, chopper or cleaver propellers, and highly-jacked engines, or where engine trim tabs are removed.

OUTBOARD HYDRAULIC STEERING

ORDER

A

- 1 ea. Helm HH5201
- 1 ea. Cylinder HC5370
- 1 ea. Hose Kit HO51 ____ Refer to Page 8 "How to Measure Outboard Hose"
- 2 ea. Oil HA5430
- 1 ea. Steering Wheel

B

- 1 ea. Helm HH5201
- 1 ea. Cylinder HC5370
- 1 ea. Hose Kit HO51 ____ Refer to Page 8 "How to Measure Outboard Hose"
- 2 ea. Oil HA5430
- 1 ea. Tie Bar HO5009
- 1 ea. Steering Wheel

C

- 1 ea. Helm HH5202 1 ea. Steering Wheel
- 2 ea. Cylinders HC5370
- 3 ea. Hose Kit HO51 ____ Refer to Page 8 "How to Measure Outboard Hose"
- 2 ea. Tee Fitting HF5530 See also Page 4 Bulkhead Fitting Section
- 1 ea. Tie Bar HO5009
- 2 ea. Oil HA5430

D

- 1 ea. Helm 5201
- 1 ea. Cylinder HC5340
- 1 ea. Hose Kit HO51 ____ Refer to Page 8 "How to Measure Outboard Hose"
- 2 ea. Oil HA5430
- 1 ea. Steering Wheel

E

- 1 ea. Helm HH5201
- 1 ea. Cylinder HC5340
- 1 ea. Hose Kit HO51 ____ Refer to Page 8 "How to Measure Outboard Hose"
- 1 ea. Tie Bar HO500__ Select No. 1, 2, 3, 4 or 5 for last digit
- 3 ea. HA5430
- 1 ea. Steering Wheel

F

- 1 ea. Helm HH5202 1 ea. Steering Wheel
- 2 ea. Cylinders HC5340
- 3 ea. Hose Kit HO51 ____ Refer to Page 8 "How to Measure Outboard Hose"
- 2 ea. Tee Fitting HF5530 See also Page 4 Bulkhead Fitting Section
- 1 ea. Tie Bar HO500__ Select No. 1, 2, 3, 4 or 5 for last digit
- 3 ea. Oil HA5430

See Page 3, 4 & 8 for Tube, Hose Kit details.

For Extra Steering Station for all above systems add:

- 1 ea. Helm HH5201 or HH5202, as applicable
- 1 ea. Fitting Kit HF5501
- 1 ea. Hose Kit HO51 ____ Refer to Page 8 "How to Measure Outboard Hose"
- 1 ea. Oil HA5430
- 1 ea. Steering Wheel



STERNDRIVE HYDRAULIC STEERING

SELECT APPLICATION WITHOUT POWER ASSIST STEERING

- Mercruiser 1984 to date }
- OMC Cobra 1986 to date }
- Cylinder BA150-7EM HC5326

- Mercruiser - Pre 1984 }
- Volvo }
- BMW }
- Cylinder BA135-8EM HC5327

SELECT APPLICATION WITH POWER ASSIST STEERING

- Mercruiser }
- OMC Cobra }
- BMW }
- Volvo (not Inline Diesel) }
- Cylinder 125-8EM HC5328

- Volvo Inline Diesel Cylinder 125-8VEM HC5329

ORDER

- 1 ea. Helm HH5201
- 1 ea. Cylinder - Select from above _____
- 2 ea. Oil HA5430
- SeaStar Nylon Tubing HT5_____*

OR

- 3/8" Copper Tubing — Requires 1 ea. Cylinder Hose Kit HF5507

For Extra Steering Station add:

- 1 ea. Helm HH5201
- 1 ea. Fitting Kit HF5502
- 1 ea. Oil HA5430
- Extra Tubing

OPTIONS

- 20° Mounting Wedge HA5429
- Autopilot Fitting Kit HF5502

*See Page 3, 4 for tube and Hose details. See Page 3, 6 & 7 for Cylinder details.

WARNING:

These recommendations apply to factory installed stock stern drives only. Modified installations may require a higher capacity steering system. If in doubt, contact our technical service for assistance.

OMC SEADRIVE® HYDRAULIC STEERING

NOTE: THE HYDRAULIC CYLINDER IS FURNISHED BY OMC WITH SEADRIVE ENGINE

SELECT

1. ONE SEADRIVE ENGINE



ORDER

- 1 ea. Helm HH5201
- 1 ea. Fitting Kit HF5503
- 2 ea. Oil HA5430
- SeaStar Nylon Tubing, or
- $\frac{3}{8}$ Copper Tubing
- 1 ea. Steering Wheel

For Extra Steering Station add:

- 1 ea. Helm HH5201
- 1 ea. Oil HA5430
- 1 ea. Fitting Kit HF5502
- Extra Tubing
- 1 ea. Steering Wheel

2. TWO SEADRIVE ENGINES



- 1 ea. Helm HH5201
- 1 ea. Fitting Kit HF5504
- 3 ea. Oil HA5430
- SeaStar Nylon Tubing, or
- $\frac{3}{8}$ Copper Tubing
- 1 ea. Steering Wheel
- 1 ea. OMC Sync. Valve, from OMC

For Extra Steering Station add:

- 1 ea. Helm HH5201
- 1 ea. Fitting Kit HF5502
- 1 ea. Oil HA5430
- Extra Tubing
- 1 ea. Steering Wheel

OPTIONS:

- 20° Helm Mounting Wedge HA5429
- Autopilot Fitting Kit HF5502

Refer to Page 3 & 4 for Tubing and Hose details.





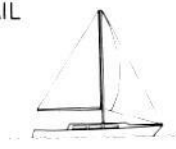


INBOARD HYDRAULIC STEERING

SELECT

1. SELECT BOAT TYPE

2. FIND SYSTEM NO. UNDER BOAT LENGTH

BOAT LENGTH UP TO		26 ft 8 m	32 ft 10 m	38 ft 11.5 m	44 ft 13.5 m	50 ft 15 m
PLANING HULL  SINGLE ENGINE	PLEASURE	1	2	3	5	
	WORK	4		5		
PLANING HULL  TWIN ENGINES	PLEASURE	1		2	3	5
	WORK	4		5		
DISPLACEMENT HULL  SINGLE ENGINE	PLEASURE	2	3	5		
	WORK	4		5		
DISPLACEMENT HULL  TWIN ENGINE	PLEASURE	2	3		5	
	WORK	4		5		
SAIL 	BALANCED RUDDER		4		5	
	UN-BALANCED RUDDER	4		5		

- Steering Wheel Turns
System 1 = 4 turns. 2 = 5 turns. 3 = 6 turns. 4 = 4 1/4 turns. 5 = 5 1/2 turns.
- Refer to Page 3 for Tube and Hose details
- Refer to Page 3, 6 for Cylinder details

OPTIONS

- 20° Mounting Wedge HA5429 for SeaStar I and II Helms
- Autopilot Fitting Kit HF5502

NOTE:

Planing Hulls: Maximum Speed normally exceeds 15 - 18 knots.
Displacement Hulls normally do not exceed 15 - 18 knots.

WARNING:

Many factors influence steering loads. These recommendations are provided only as a general guideline. Actual cylinder size requirement is dictated by the maximum torque your vessel's rudder can generate. Cylinder must provide a 20% torque safety factor. Refer to technical info. section for cylinder torque figures. If in doubt, contact our Technical Service Department.

INBOARD HYDRAULIC STEERING

ORDER FROM SYSTEM NUMBER

- 1 ea. Helm HH5201
- 1 ea. Cylinder HC5315
- 3 ea. Oil HA5430
- SeaStar Nylon Tubing or
- 1 ea. Cylinder Hose Kit HF5507
For Copper Tubing

For Extra Steering Station add:

- 1 ea. Helm HH5201
- 1 ea. Fitting Kit HF5502
- 1 ea. Oil HA5430
- Extra Tubing

- 1 ea. Helm HH5201
- 1 ea. Cylinder HC5316
- 3 ea. Oil HA5430
- SeaStar Nylon Tubing or
- 1 ea. Cylinder Hose Kit HF5507
For Copper Tubing

For Extra Steering Station add:

- 1 ea. Helm HH5201
- 1 ea Fitting Kit HF5502
- 1 ea. Oil HA5430
- Extra Tubing

- 1 ea. Helm HH5201
- 1 ea. Cylinder HC5317
- 3 ea. Oil HA5430
- SeaStar Nylon Tubing or
- 1 ea. Cylinder Hose Kit HF5507
For $\frac{3}{8}$ Copper Tube

For Extra Steering Station add:

- 1 ea. Helm HH5201
- 1 ea. Fitting Kit HF5502
- 1 ea. Oil HA5430
- Extra Tubing

- 1 ea. Helm HH5202
- 1 ea. Cylinder HC5318
- 3 ea. Oil HA5430
- SeaStar Hose Kit HO51 ____ or
- 1 ea. Cylinder Hose Kit HF5508
For $\frac{3}{8}$ Copper Tube

For Extra Steering Station add:

- 1 ea. Helm HH5202
- 1 ea Fitting Kit HF5502
- 1 ea. Oil HA5430
- Extra Hose or Tube

- 1 ea. Helm HH5202
- 1 ea. Cylinder HC5319
- 3 ea. Oil HA5430
- SeaStar Hose Kit HO51 ____ or
- 1 ea. Cylinder Hose Kit HF5508
For $\frac{3}{8}$ Copper Tube

For Extra Steering Station add:

- 1 ea. Helm HH5202
- 1 ea. Fitting Kit HF5502
- 2 ea. Oil HA5430
- Extra Hose or C. Tube

WARNING:

Many factors influence steering loads. These recommendations are provided only as a general guideline. SeaStar may be used on any size vessel as long as steering system working pressures do not exceed 500-600 psi/35-40 bar, and periodic maximum peak pressures do not exceed 800 psi - 56 bar. If in doubt, contact our Technical Service Department.

MANUFACTURED BY

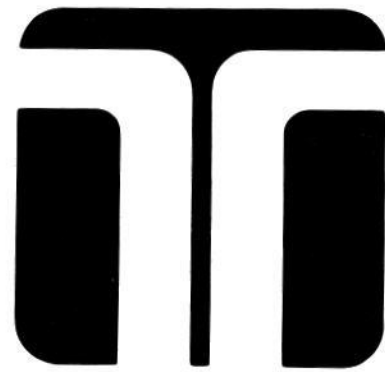


1650 W. 2nd AVE.. VANCOUVER, B.C., CANADA V6J 1H4 • (604) 736-2831 • TELEX 04-508802

REV/FORM A/1M/9/86

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INSTALLATION INSTRUCTIONS



SeaStar

HYDRAULIC OUTBOARD STEERING

For Outboard
Powered Vessels



capilano

and

SeaStar

ARE MANUFACTURED BY

Teleflex

Canada Ltd.

AND EXPORTED UNDER THE

flexatrol

TRADE NAME

*Before you do it your way,
please try it our way.*

The SEASTAR OUTBOARD STEERER has been designed for normal pleasure and fishing craft where standard engine mountings and propellers are utilized. For racing-type installations with surfacing, chopper, or cleaver propellers, and for highly-jacked engines, or where engine trim tabs are removed, consult the factory for information on the recommended systems.

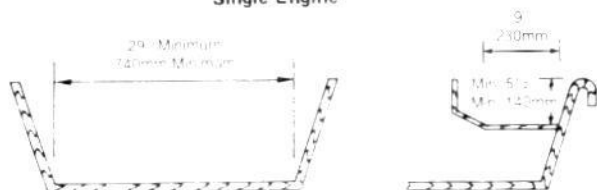
Before proceeding with the installation, read these instructions thoroughly. Teleflex cannot accept responsibility for installations where instructions have not been followed, where substitute parts have been used, or where modifications have been made to our products.

Before attempting installation, ensure that the splashwell of your boat has the following minimum motor well dimensions.



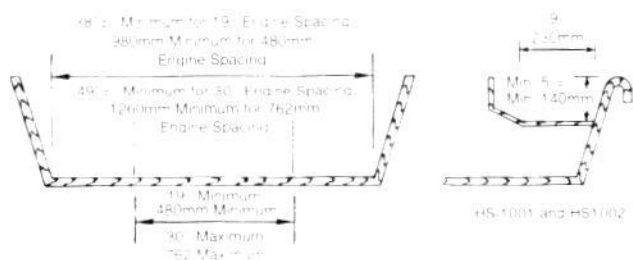
MINIMUM MOTOR WELL DIMENSIONS

Single-Engine



9" (230)

Twin-Engine



HS-1001 and HS1002

NOTE: TRANSOM WALL THICKNESS MUST NOT EXCEED 2 3/8"

CAUTIONS:

Use only SEASTAR hydraulic hose supplied in kit form. Hoses are ordered to length for your particular installation. Substitute hoses or tubing will affect safety and performance.

Use only SEASTAR outboard hydraulic fluid or Texaco aircraft oil HO-15.

Lightly lubricate all bolts, nuts, and threaded parts prior to usage.

Also, lubricate all moving parts with good quality marine grease.

Do not remove protective caps from helm pump, cylinder, and hose fittings until connection of hose to helm pump and cylinder is called for in the instructions. Contamination introduced into the steering system may cause steering malfunction. Cleanliness is of utmost importance.

For twin-engine applications, a SEASTAR Outboard tie-bar kit is required. Do not attempt to substitute other tie bars.

Then follow the illustrated installation steps **in order**.

STEP 1/MOUNTING THE HELM PUMP

- Mount the helm pump with the filler hole in its uppermost position.
- Determine desired mounting position for helm pump on dashboard. Ensure that steering wheel will not later interfere with other functional equipment. Use the cover bezel as a template and mark the holes. Cut a 4½" hole for the pump and drill the mounting holes with a ⅜" drill then mount the helm with the bolts provided.

NOTE:

- Before proceeding with Step 2, install elbow fittings to helm pump. Elbow fittings are supplied with helm straight fittings are available, part no. HF5528, always use a quality soft pipe sealant such as Loctite P.S.T. or equivalent on pipe threads. Do not use tape sealers.



STEP 2/INSTALLING HYDRAULIC HOSE

- Make certain that protective caps are on hose fittings.
- Route hydraulic hose from behind dashboard area, along side of gunnel or builder-installed tube, to splashwell area. Use shortest convenient path, ensuring that minimum bend radius of 2 inches is not exceeded.

NOTE: IN REPLACEMENT INSTALLATIONS, YOU MAY FIND IT EASIER TO ATTACH HYDRAULIC HOSES TO MECHANICAL CABLES OR EXISTING HOSES WITH BLACK TAPE — THEN PULLING NEW HOSE THROUGH WITH OLD CABLE OR HOSE.

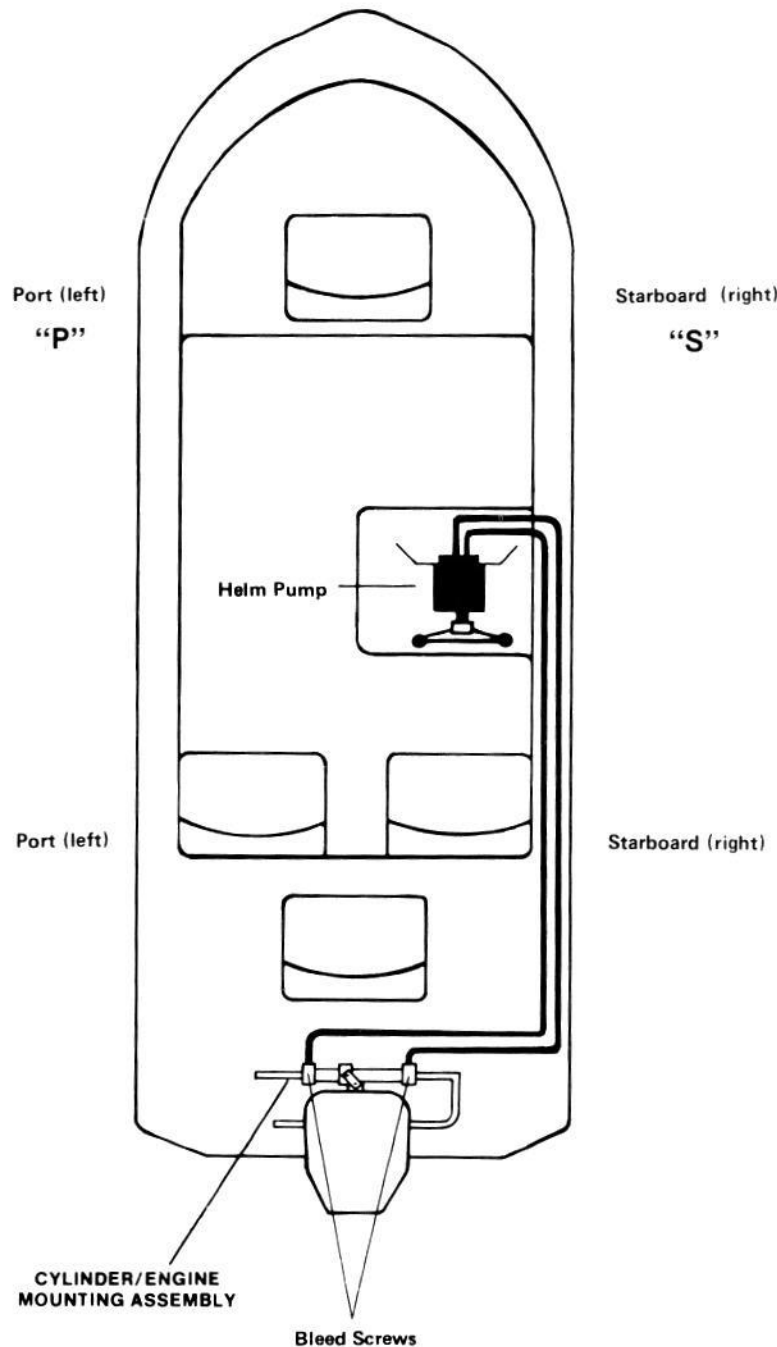
- Ensure that hydraulic hose is protected against chafing and is secured wherever possible. Do not allow hydraulic hose to hang free in an area where it could constitute a safety hazard.

WARNING:

This steering system is not recommended for use on boats where horsepower exceeds U.S. or other coast guard ratings. This cylinder is suitable for certain engines only. Install and maintain in accordance with Teleflex instructions. Use approved oils only. Do not use brake fluid. Failure to comply with the above may result in loss of steering, causing property damage and/or personal injury.

STEP 3/HYDRAULIC HOSE CONNECTION

- Note from diagram below that starboard (right) helm pump fitting connects via hydraulic hose to port (left) cylinder fitting, and port (left) helm pump fitting connects via hydraulic hose to starboard (right) cylinder fitting.
- Swivel nuts on hydraulic hose fittings are color-coded to ensure correct connection. Fittings on one hose are gold; fittings on second hose are silver.
- Remove protective caps from fittings so you can see color codes, and connect hoses to helm pump and cylinder — starboard to port, and port to starboard.
- Start hose nuts by hand. After several turns, firmly tighten with ⅝" wrench. Do not overtighten (maximum 140 inch/pounds if you are using a torque wrench).



STEP 4/ FILLING AND BLEEDING THE SYSTEM.

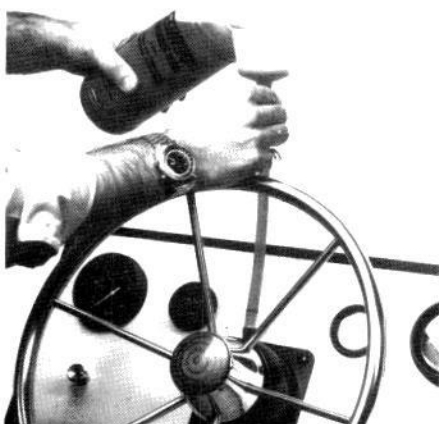
- This procedure requires two people. Do not attempt filling and bleeding alone, since it would be difficult for one person to remove all the air from the system. Failure to remove all the air will result in spongy, unresponsive steering.

NOTE: Using the funnel only, fill the helm pump with SEASTAR outboard hydraulic fluid. When the helm pump is full of oil, screw the threaded end of filler tube into the filler hole and insert the funnel into opposite end of filler tube.

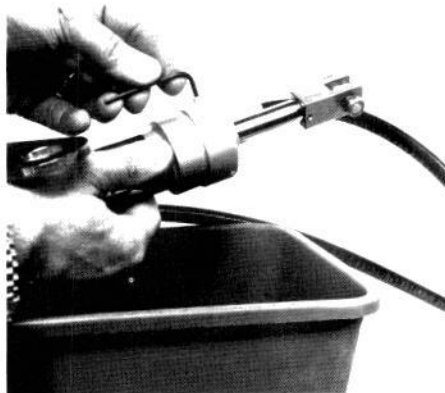


CAUTION: During the entire bleeding procedure, oil must always be visible in funnel or filler tube. Do not allow the oil level to disappear into the helm pump as this may introduce more air into the system, wasting fluid and making bleeding more difficult.

- The second person is now required at the splashwell area, equipped with a clean rag, pan, and the Allen wrench.



- Carefully fill the funnel with oil.



- Turn steering wheel slowly to port (left) side (1 turn per 15 seconds — turning the steering wheel fast will cause air and oil to mix, requiring several hours of separation).
- When air-free oil appears from bleed screws, close bleed screw.

CAUTION:

Ensure that the steering wheel is securely mounted to helm with washer and nut, before attempting wheel turning. Tighten nut to 150 IN/LBS (17 Nm). Do not exceed 200 IN/LBS (22 Nm).

- Tilt the cylinder so that the bleed screw on the starboard (right) side is higher than the port (left) side and open starboard (right) bleed screw (approximately 5 turns).



- Tilt cylinder so that the bleed screw on the port (left) side is higher than the starboard (right) side and open port (left) bleed screw (approximately 5 turns).
- Turn steering wheel slowly to starboard (right) side (1 turn per 15 seconds).
- When air-free oil appears from bleed screw, close bleed screw.
- Turn the steering wheel back and forth slowly. Do not apply pressure when resistance is felt at each hard-over position. Stop the back and forth movement by turning steering wheel all the way to port (left).

- Repeat bleeding the system as above. Starboard side first — followed by port side. Only a slight amount of air should appear this time.

The following step calls for removal of excess oil in funnel and filter tube. Do not add more oil to funnel than necessary.

- Open port (left) bleed screw.
- Turn steering wheel to starboard (right) side until oil just disappears from sight in filler tube.
- Close port (left) bleed screw.

A slight movement of the steering wheel should now cause movement of the cylinder rod, indicating that the steering system is properly bled. If at this time, or anytime in the future, the response from steering wheel to cylinder rod is not immediate, re-bleed the system.

- Remove funnel and filler tube from helm pump, and screw vent cap onto filler hole.
- Ensure at all times that fluid level in helm pump is at its correct level. If any metal is visible through the filler hole, add SEASTAR hydraulic fluid. Use only SEASTAR outboard hydraulic fluid or Texaco aircraft oil HO-15.

WARNING:

Check for leaks. Unchecked leaks will lower the fluid level in the helm pump to such a point that spongy, unresponsive steering will result, and in time could cause total loss of steering.

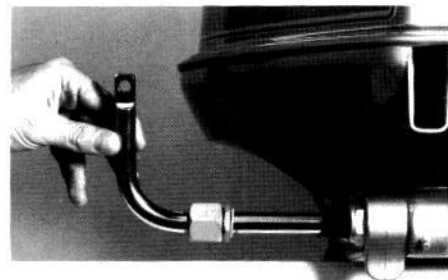
STEP 5/CYLINDER CONNECTION



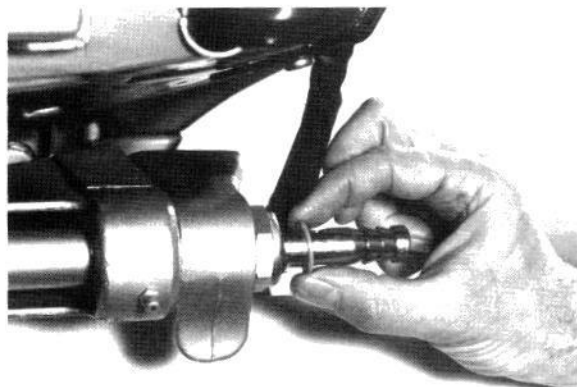
Place the nylon washer on the support rod. For Mercury/Mariner inline engines (80 through 140 HP) place the one inch spacer bushing on the rod before putting on the washer.



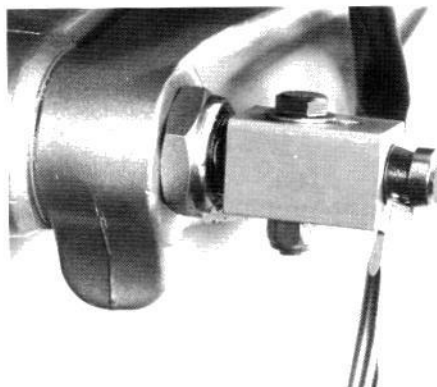
VERY IMPORTANT. Grease the support rod thoroughly with a good waterproof and anti-corrosive grease such as OMC triple guard or equivalent.



Insert the support rod into the tilt tube, from starboard side.



Place a nylon washer on the protruding end of the support rod then bolt on the support rod collar and tighten loosely.



Remove free play in the support rod by prying the end with a screwdriver while tightening the nut and bolt firmly. A helper is needed for this step. For dual engine installations refer at this point to instructions included with tie-bar kit.

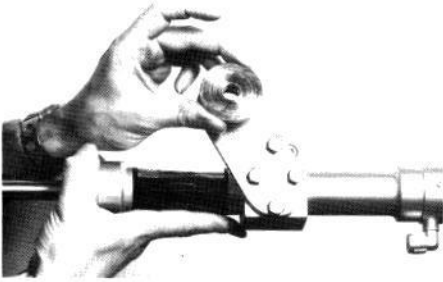
CONNECT THIS CYLINDER KIT ONLY TO OUTBOARD MOTORS LISTED ON THE FOLLOWING ENGINE APPLICATION GUIDE.

OUTBOARDS

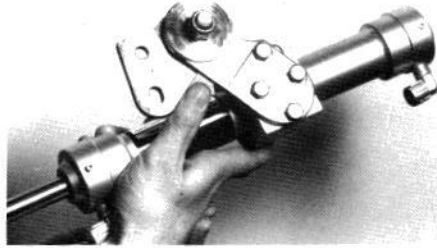
ENGINE MFG.	MODEL YEAR	HORSE POWER	CYLINDER P/N	TIE BAR KIT
Chrysler	1983 - To Date	85 and up	HC 5301	HO 5013
Johnson-Evinrude	1977 - To Date	70 and up	HC 5301	HO 5013
Mercury	1978 - 1979	150 and up	HC 5302	N/A
Mercury/Mariner	1980 - 1981	V-6 Eng. only	HC 5301	HO 5011
Mercury/Mariner	1982 - 1984	V-6 Eng. only	HC 5301	HO 5012
Mercury/Mariner	1980 - 1983	In-Line Eng. Only	HC 5301	HO 5013
Mercury/Mariner	1984 - To Date	90 - 115	HC 5303	HO 5014
Mercury/Mariner	1985 - To Date	V-6 Eng.(exc. 3.4)	HC 5303	HO 5014
Yamaha	1983 - To Date	115 and up	HC 5301	HO 5012
OMC Seadrive	Refer to order guide			

STEP 6/MOUNTING THE CYLINDER ASSEMBLY

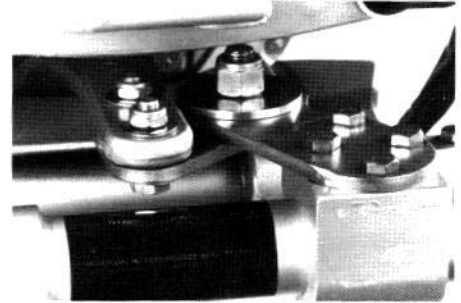
FOR ALL ENGINES EXCEPT MERCURY/MARINER V6



For all engines except Mercury/Mariner V6 insert the brass washer bushing on top of the pre-assembled cylinder plate.



Bolt the connecting plate to the underside of the cylinder plate. Note the instructions on the connecting plate to ensure correct orientation. Tighten securely.



Bolt the connecting plate to the bottom of the tiller arm using washers top and bottom. Seat the bolts completely and tighten the nuts securely.

FOR MERCURY/MARINER V6 ENGINES (EXCEPT 300 HP)



For all Mercury/Mariner V6 engines insert the brass washer bushing on the underside of the cylinder plate.



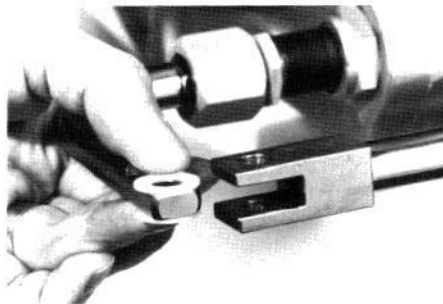
Bolt the connecting plate to the top of the cylinder plate.

Bolt the connecting plate to the top of the tiller arm. Use both washers on the top-side to provide maximum clearance below.



Seat the bolts completely and tighten the nuts securely. It may be necessary to take this in two steps because of clearance. In each case run the bolt through the tiller arm first, then tighten the nut. Keep a wrench on the bolt head to prevent it from backing off.

STEP 7/CONNECTING THE CYLINDER TO THE SUPPORT ROD.



Make sure to include the nylon spacers as shown. Tighten the nut and bolt securely but do not overtighten.

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[Canada] Ltd.

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INSTALLATION INSTRUCTIONS AND OWNERS MANUAL

1S



HYDRAULIC STEERING FOR OUTBOARD POWERED VESSELS



capilano

and

SeaStar

ARE MANUFACTURED BY

Teleflex
■ ■ (Canada) Ltd. ■ ■

AND EXPORTED UNDER THE

flexatrol.

TRADE NAME

*Before you do it your way,
please try it our way.*



The Sea Ray/SeaStar outboard cylinder is designed for exclusive use on Sea Ray outboard engines. Do not attempt to install on any other engine brands.

These instructions cover:

- **Mounting connection of cylinder to outboard engine**
 - single engine,
 - twin engines.
- **Field replacement of steering system components.**
- **Filling and purging.**
- **Oil level and system check.**
- **Maintenance.**

THE SEASTAR OUTBOARD STEERER has been designed for normal pleasure and fishing craft where standard engine mountings and propellers are utilized. For racing-type installations with surfacing, chopper, or cleaver propellers, and for highly-jacked engines, or where engine trim tabs are removed, consult the factory for information on the recommended system.

Before proceeding with the installation, read these instructions thoroughly. Teleflex cannot accept responsibility for installations where instructions have not been followed, where substitute parts have been used, or where modifications have been made to our products.

Before attempting installation, ensure that the splashwell of your boat has the following minimum motor well dimensions.

FIG. 1 HOSE ROUTING, SINGLE ENGINE-CYLINDER.

NOTE: STARBOARD HOSE IS ROUTED AROUND BACK OF CYLINDER AND RUNS FORWARD ON STARBOARD (RIGHT) SIDE OF PORT (LEFT) CYLINDER FITTING. SECURE STARBOARD HOSE WITH HOSE CLAMP AS SHOWN BELOW.

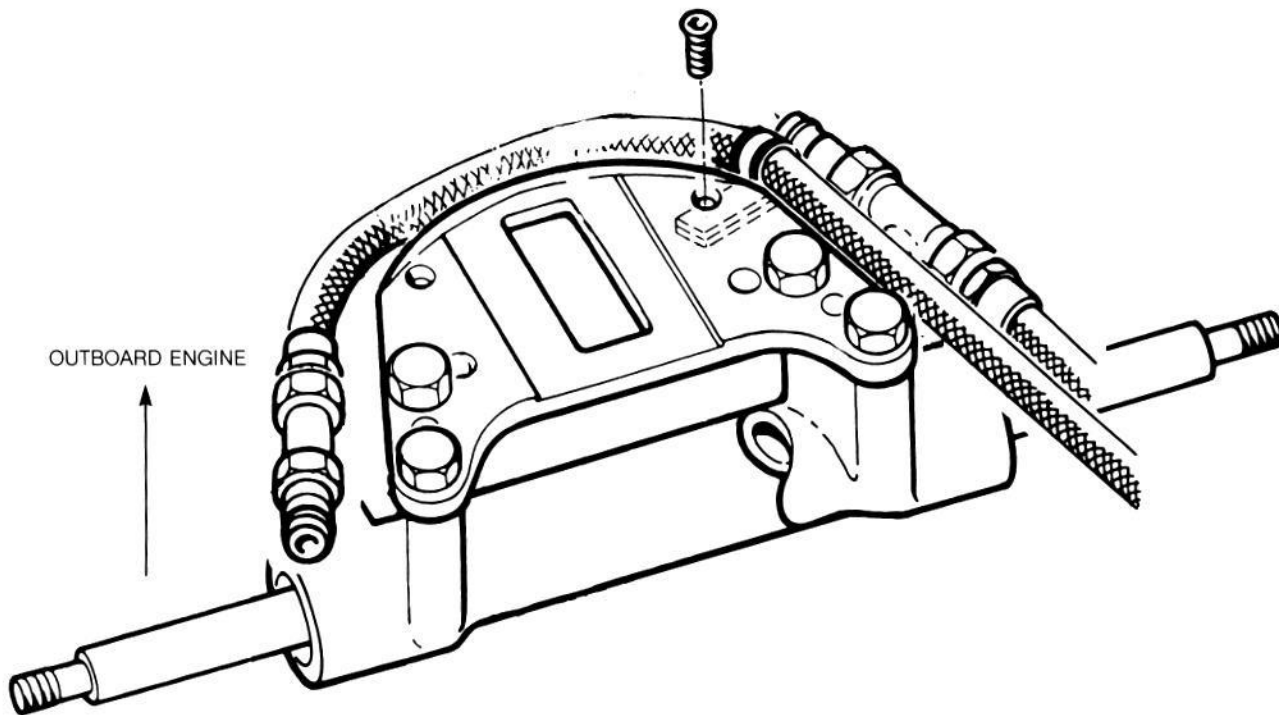


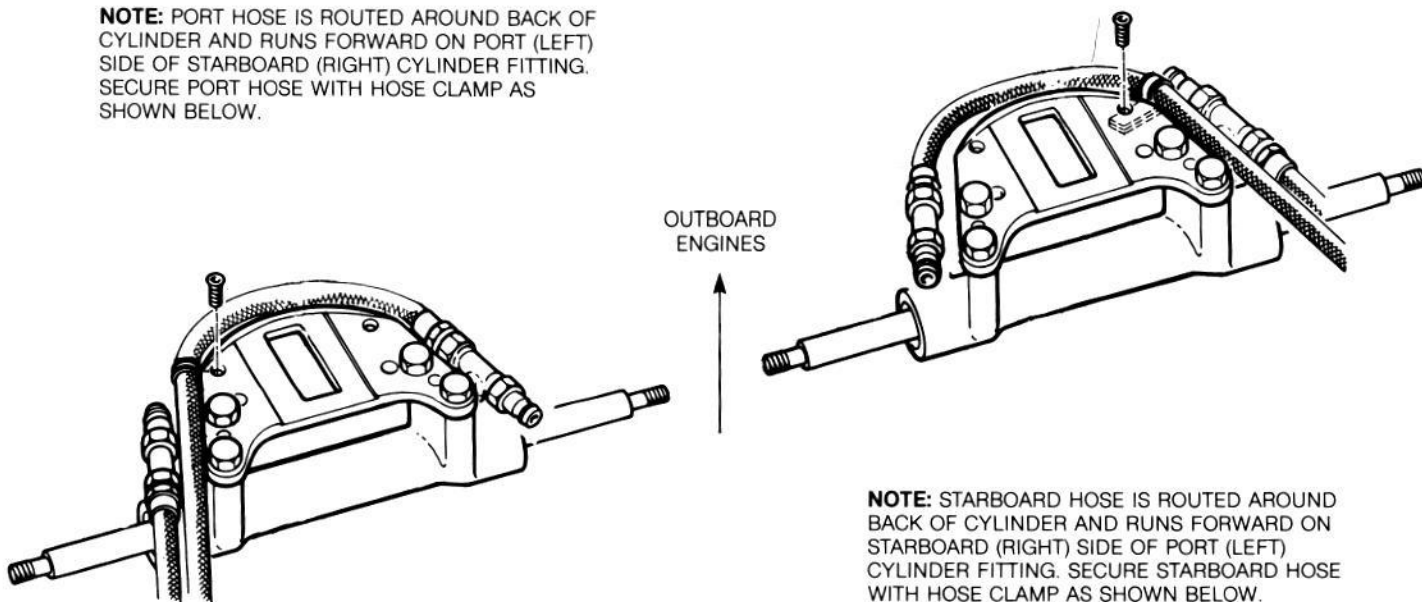
FIG. 2 HOSE ROUTING, TWIN ENGINE-CYLINDER

STARBOARD CYLINDER (RIGHT)

PORT CYLINDER (LEFT)

NOTE: PORT HOSE IS ROUTED AROUND BACK OF CYLINDER AND RUNS FORWARD ON PORT (LEFT) SIDE OF STARBOARD (RIGHT) CYLINDER FITTING. SECURE PORT HOSE WITH HOSE CLAMP AS SHOWN BELOW.

OUTBOARD ENGINES



NOTE: STARBOARD HOSE IS ROUTED AROUND BACK OF CYLINDER AND RUNS FORWARD ON STARBOARD (RIGHT) SIDE OF PORT (LEFT) CYLINDER FITTING. SECURE STARBOARD HOSE WITH HOSE CLAMP AS SHOWN BELOW.

CYLINDER MOUNTING

SINGLE CYLINDER/ENGINE

Refer to drawing No. 1 and study carefully. See Fig. 1 for Hose Orientation/Routing.

NOTE: Engine cowling must be opened.

▲ **WARNING**

The slider plate and slider assembly must be well greased with a quality marine grease such as Quicksilver 2-4-C, OMC Tripleguard or equivalent.

Grease the slider plate slot edges and the top and bottom slider surfaces.

STEP 1

Assemble items no. 6, 3 and 5 to the bottom of the slider plate. Grease will help to hold the parts to the slider plate while placing the cylinder slider plate assembly over the tiller arm.

ie.: Item no. 5 inside slider plate slot.

Item no. 3 and 6 below slider plate.

CAUTION: Do not pinch washers (item no. 3) and slider (item no. 5) on washer bushing (item no. 6).

STEP 2

Line up the slider assembly with the **rear tiller arm hole**.

Place item no. 3 and 2 placed on the $\frac{3}{8}$ NF x 1 1/2" bolt (item no. 1) as illustrated on drawing no. 1, insert the bolt with item no. 3 and 2 through the slider assembly and then thread through the tiller arm hole.

Tighten the bolt (item no. 1) firmly, and while holding the bolt in place with a wrench, thread on the nut (item no. 7) and tighten firmly.

STEP 3

Check the slider assembly! The cylinder slider plate must now move freely back and forth on the slider assembly.

STEP 4

Slide well greased support rod (item no. 9) into the thoroughly cleaned and rust free engine tilt tube.

STEP 5

Mount the spacer, washers, item no. 10 and 11 onto port (left) side of the support rod.

Mount the adjusting ring nut (item no. 8) onto starboard (right) side of support rod.

STEP 6

Attach and connect support brackets (item no. 12) to the support rod (item no. 9) and the cylinder rod, using the washers and nuts (item no. 13, 14, 15 and 16) as illustrated on drawing no. 1.

CAUTION: All threaded fasteners should be lightly lubricated to prevent galling.

STEP 7

Eliminate support rod free play by turning the adjusting ring out (item no. 8) counter clockwise. Do not use a wrench of any type on the adjusting ring nut. Turn by hand only. Lock the ring nut in place by securely tightening the set screw.

STEP 8

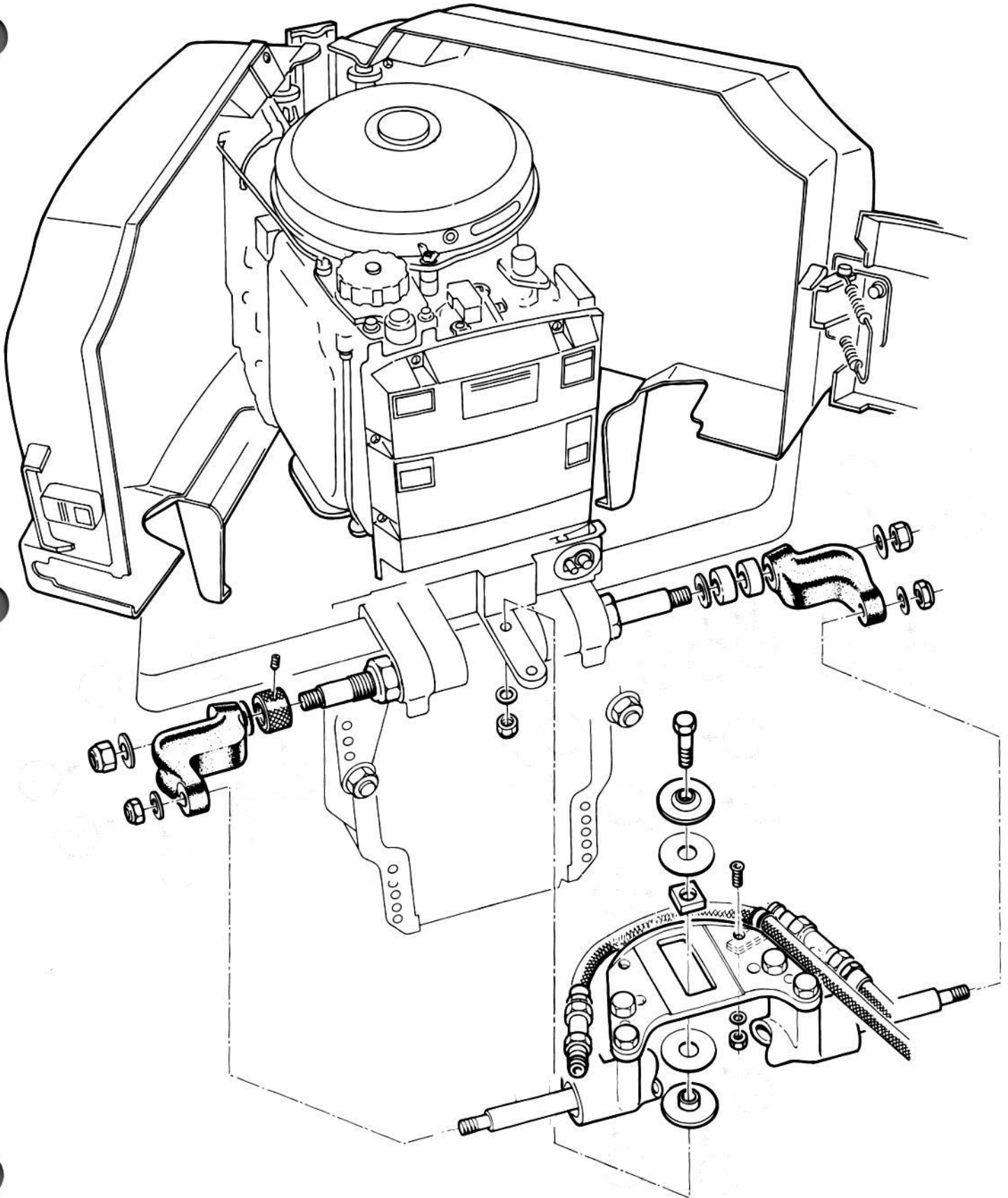
Check the cylinder assembly for smooth operation, making certain that no binding or interference is present. Check cylinder assembly by turning a steering wheel from stop to stop.

- ▲ **WARNING:** Tilt engine(s) fully and down to ensure that no parts of the cylinder assembly contacts any part of the splashwell surfaces or engine-transom mounting bolts. If the cylinder does contact the engine mounting bolts, try turning the engine mounting bolts around by placing mounting bolt head inside the transom. If interference is still obvious, lower or raise engine as required, or use the SeaStar sidemount cylinder.

FAILING TO CHECK FOR INTERFERENCE MAY RESULT IN CYLINDER AND/OR SPLASHWELL, AND/OR ENGINE DAMAGE.

90-100 HP SW6C

DRAWING NO. 1



TWIN CYLINDER/ENGINES

Refer to drawing No. 2 and study carefully. See Fig. 2 for Hose Orientation/Routing.

- ▲ **WARNING:** The slider plate and slider assembly must be well greased with a quality marine grease such as Quicksilver 2-4-C, OMC Tripleguard or equivalent.

Grease the slider plate slot edges and the top and bottom slider surfaces.

STEP 1

Assembly items no. 6, 3, 5, 3 and 17 on the slider plate.

Grease will help to hold the parts to the slider plate while placing the cylinder slider plate assembly over the tiller arm.

ie.: Item no. 6 and 3 on top of the slider plate.

Item no. 5 inside slider plate slot.

Item no. 3 and 17 below the slider plate.

CAUTION: Do not pinch slide washers (item no. 3) and slider (item no. 5) on washer bushing (item no. 6).

NOTE: Ensure that the tie bar extension plate is oriented correctly.

STEP 2

Line up the slider assembly with the **rear tiller arm hole** and insert item no. 1 ($\frac{3}{8}$ NF x 1 1/2" bolt) through slider assembly and then thread through the tiller arm hole.

NOTE: The $\frac{3}{8}$ " NF x 1 1/2" bolt is installed through cut out in front section of cowling.

Tighten the bolt (item no. 1) firmly, and while holding the bolt head in place with a socket wrench, to prevent bolt from backing off, thread on the self-locking nut (item no. 7) and tighten firmly.

CAUTION: All threaded fasteners should be lightly lubricated to prevent galling.

STEP 3

Check the slider assembly! The cylinder slider plate must now move freely back and forth on the slider assembly.

STEP 4

Repeat steps 1 through 4 on the other engine.

STEP 5

Install item no. 18 and 7 to port (left) and starboard (right) tiller arm-extension plate.

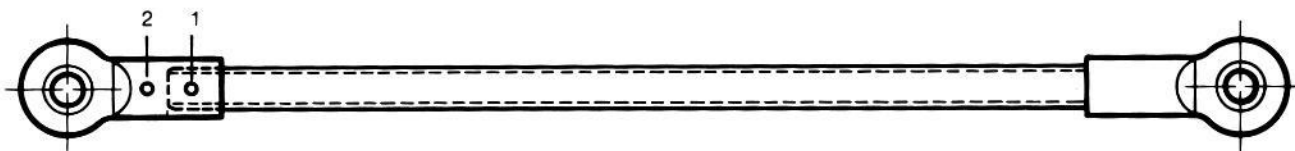
STEP 6

Connect tie bar to outer hole of extension plates as illustrated on drawing No. 2.

CAUTION: Do not mix up orientation (placement) of item no. 21 and 20.

- ▲ **WARNING**

At the time of installation and any time thereafter, the threaded rod must always fully cover inspection hole 1, but never inspection hole No. 2. Failing to observe this warning may result in one engine becoming separated from the steering system and result in property and/or personal injury.



STEP 7

Eliminate support rod free lay by turning the adjusting ring nut (item no. 8) counter clockwise. Do not use a wrench of any type on the adjusting ring out. Turn by hand only. Lock the ring nut in place by securing tightening the set screw.

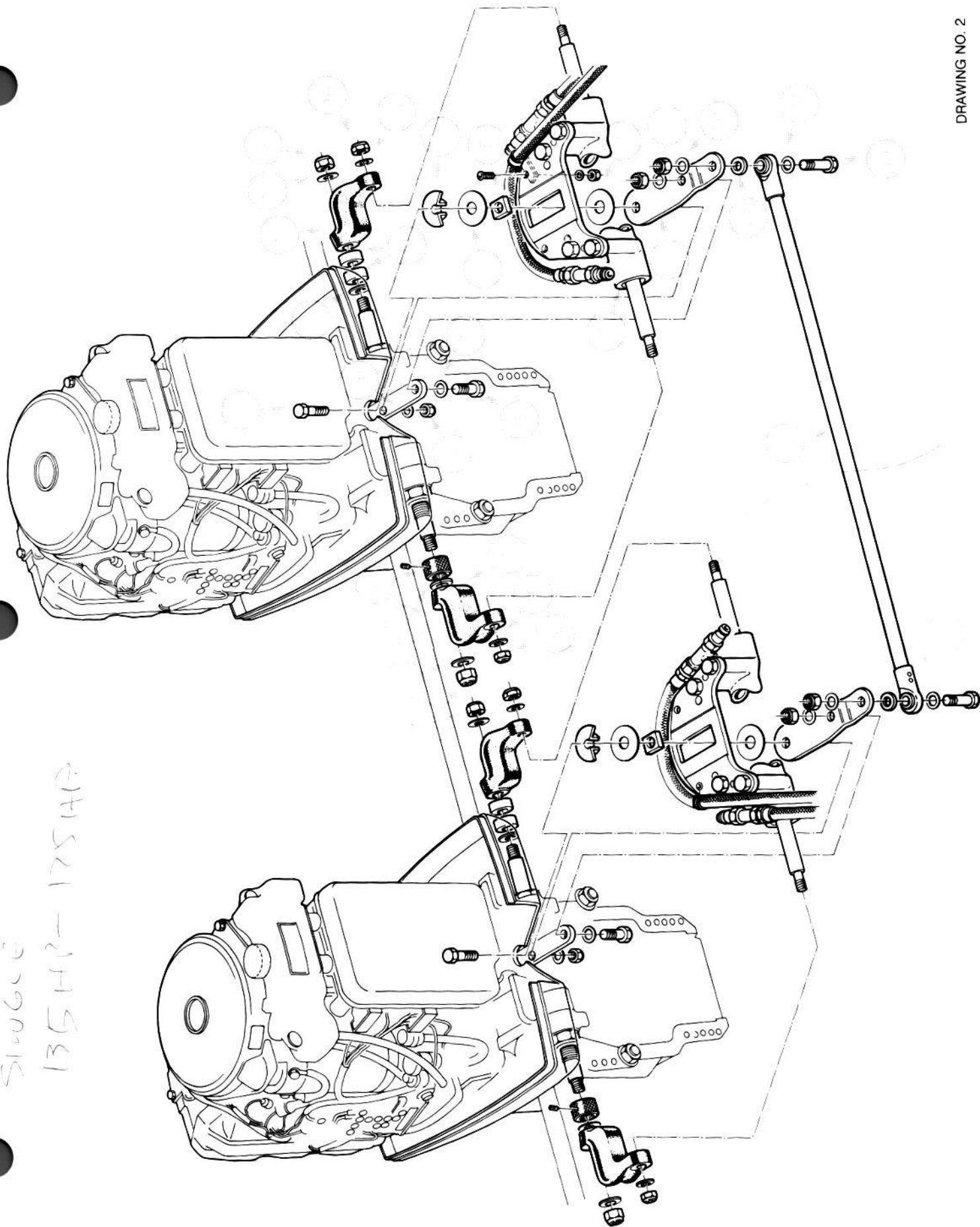
STEP 8

Check the cylinder assembly for smooth operation, making certain that no binding or interference is present. For cylinders not yet connected to hydraulic hoses, etc., check cylinder assembly by moving engine from engine to engine stop. For cylinders already connected to hydraulic hoses, etc., check cylinder assembly by turning a steering wheel from stop to stop.

- ▲ **WARNING:** Tilt engine(s) fully and down to ensure that no parts of the cylinder assembly contacts any part of the splashwell surfaces or engine-transom mounting bolts. If the cylinder does contact the engine mounting bolts, try turning the engine mounting bolts around by placing mounting bolt head inside the transom. If interference is still obvious, lower or raise engine as required, or use the SeaStar sidemount cylinder.

FAILING TO CHECK FOR INTERFERENCE MAY RESULT IN CYLINDER AND/OR SPLASHWELL, AND/OR ENGINE DAMAGE.

SINGLE
135HP-175HP



GENERAL SERVICE INSTRUCTIONS

▲ WARNING:

In the event that the helm pump and/or the cylinder must be removed from the boat for servicing, the following points must be adhered to:

- Use self-locking type fasteners only; substituting non-self locking fasteners can result in loosening or separation of equipment and loss of steering control.
- Do not exceed 110 in./lbs. (12Nm) on helm nuts and bolts.
- If hydraulic cylinder is removed for service, refer to cylinder mounting instructions when re-installing.

Once a helm pump or cylinder has been re-installed after servicing, or as replacement, the steering system must be refilled with oil.

HOSE CONNECTION

Refer to illustrations below for the correct connection of hoses from helm pump to cylinder.

NOTE:

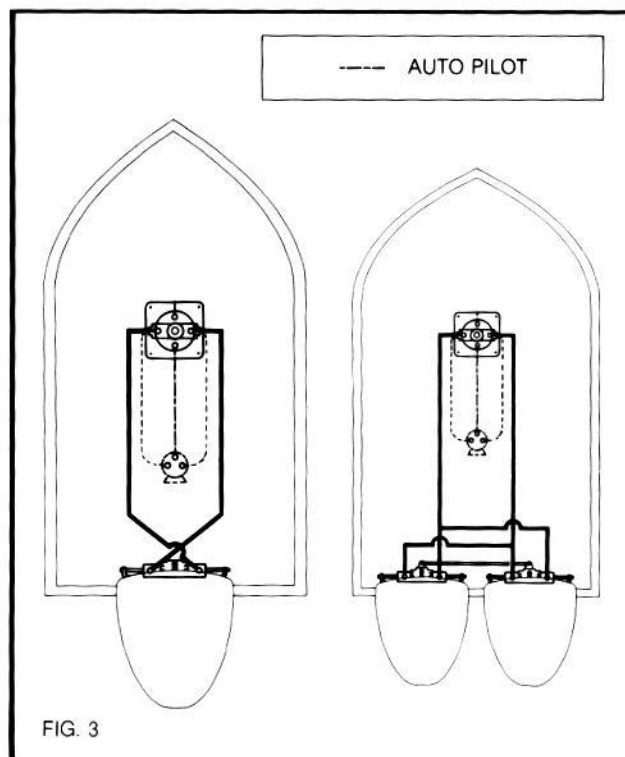
Helms in illustrations are viewed from the steering wheel side.

CAUTION

Start hose nut by hand. After a few turns, firmly tighten the tube nut with a $\frac{3}{4}$ " wrench. Do not over tighten. Maximum 140 in./lbs.

CAUTION

Operate the steering system from engine stop to engine stop with engine(s) in its (their) normal and tilt position to confirm that no binding or hang up of hoses occurs.



HYDRAULIC FLUID

Acceptable and recommended oils for your steering system are:

- SeaStar Hydraulic Fluid, part no. HA5430
- Texaco HO15
- Shell Aero 4
- Esso Univis N15
- Chevron Aviation Fluid A
- Mobil Aero HFA
- Fluids meeting Mil H5606C specifications.

NOTE:

Automatic transmission fluid Dexron II may be used in case of emergency.

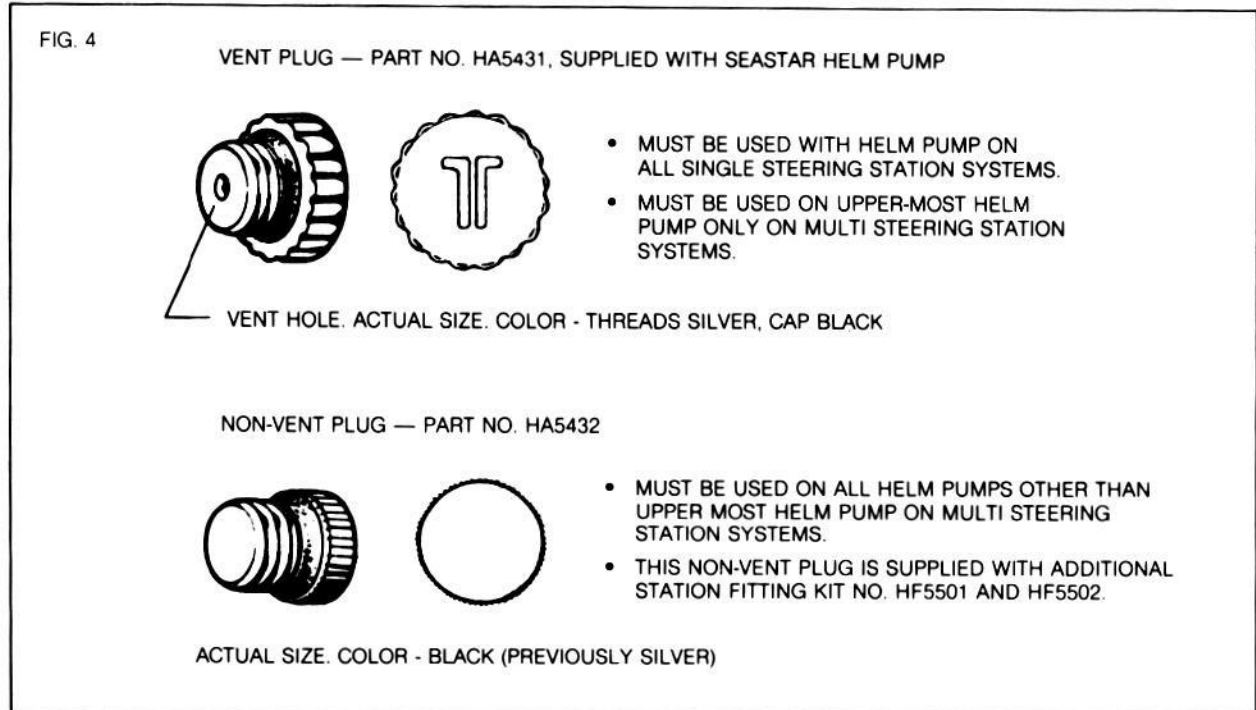
▲ WARNING:

Never use brake fluid. Any non-approved fluid may cause irreparable damage, loss of steering, and cancellation of warranty.

NOTE:

In case of extreme emergency any non-toxic, non-flammable fluid may provide temporary steering.

FILL PLUGS FOR SEASTAR HELMS



FILLING AND PURGING THE SYSTEM

CAUTION

- This procedure requires two people. One person may not be able to remove all the air from the system which will result in spongy, unresponsive steering.

HYDRAULIC OIL REQUIREMENTS

- 2 bottles (2 quarts or liters) for single station and single cylinder systems.
- 1 additional bottle for each additional helm, cylinder, or auto pilot.

CAUTION

- During the entire filling procedure, oil must always be visible in the filler tube. Do not allow the oil level to disappear into the helm pump, as this may introduce more air into the system and increase your filling time.

SINGLE CYLINDER SYSTEM

1. Screw the threaded end of the filler tube into the helm filler hole.
2. Remove the bottle cap from the oil bottle and while holding the oil bottle upright, screw the oil bottle into the filler tube bottle cap.
3. Now turn the oil bottle upside down, and with the push pin (supplied with the filler kit) make one hole in the bottle above the oil level.
4. Now turn the steering wheel from hard over to hard over (wherever hard over may be initially) until the bottle is empty.
5. Attach the next oil bottle to the filler tube as described above and continue turning the steering wheel until the oil level in the oil bottle stops dropping.

NOTE:

If an auto pilot is installed, it must now be turned on, and the cylinder(s) must be moved back and forth by the pilot for 5 - 10 minutes, or until the oil level in the oil bottle stops dropping again.

6. Turn the steering wheel to the hard over starboard position. Back steering wheel off slightly to port to eliminate any pressure build up which would cause oil to squirt out under pressure at bleed nipple. The second person must now open port (left) side bleeder nut on the cylinder. See Fig. 5, Page 11.

CAUTION

Do not unscrew the bleeder nut completely, just one or two full turns only. Oil will come out of the bleed nipple. Have a small container and cloth ready to catch the oil. Oil that has been purged through the system must not be reused.

7. Now continue turning the wheel to starboard (right) until one-half of the remaining oil in the bottle is gone. Close the bleed nut firmly.
8. Now open the other bleed nut and turn the wheel to port (left) until the remaining oil begins to disappear from sight in the fill tube. Close the bleed nut firmly.
9. If wheel turns are within 4 - 4 ¼ turns the system is correctly purged. Repeat purging procedure if wheel turns are more than 4 ½ turns from hard over to hard over.
10. Remove the fill tube from the helm and screw the vent plug back into the helm.

TWIN CYLINDER SYSTEM

1. Screw the threaded end of the filler tube into the helm filler hole.
2. Remove the bottle cap from the oil bottle and while holding the oil bottle upright, screw the oil bottle into the filler tube bottle cap.
3. Now turn the oil bottle upside down, and with the push pin (supplied with the filler kit) make one hole in the bottle above the oil level.
4. Now turn the steering wheel from hard over to hard over (wherever hard over may be initially) until the bottle is empty.
5. Attach the next oil bottle to the filler tube as described above and continue turning the steering wheel until the oil level in the oil bottle stops dropping.

NOTE:

If an auto pilot is installed, it must now be turned on, and the cylinder(s) must be moved back and forth by the pilot for 5 - 10 minutes, or until the oil level in the oil bottle stops dropping again.

6. Turn the steering wheel to the hard over starboard position. Back steering wheel off slightly to port to eliminate any pressure build up which would cause oil to squirt out under pressure at bleed nipple. The second person must now open port (left) side bleeder nut on both cylinders.
7. Now continue turning the wheel to starboard (right) until one-half of the remaining oil in the bottle is gone, or until solid air free oil comes out of both bleed nipples. Now close bleed nuts firmly.
8. Now open the starboard side bleeder nipple nut on both cylinders, and turn the steering wheel to port until solid air free oil comes out of both bleed nipples. Continue turning until the remaining oil begins to disappear from sight in the fill tube. Now close bleed nuts firmly.
9. If steering wheel turns are within 5.7 to 6 turns, the system is correctly purged. If turns are more than 6 - 6½ turns, repeat purging procedure.
10. Remove the fill tube from the helm and screw the vent plug back into the helm.

OIL LEVEL AND SYSTEM CHECK

- Helm mounted with wheel shaft completely horizontal must be filled to bottom of filler hole at all times. Do not allow oil level to drop more than ¼" (6.3).
- Helms mounted on a 20° angle or with wheel shaft vertical, oil level should be within ½" (12.7) of fill hole at all times. Check oil level periodically. Best time for periodic oil level check is **before** departing from your dock or berth.
- At this time the steering system should be checked for proper connections of hose, tube and fittings, possible leaks, and air removal. To do so, turn steering wheel (any one on multi-steering station system) and pressurize very hard to port. Apply enough force to the wheel to exceed pressure relief valve pressure. You will not harm the helm or system. While pressure is maintained on steering wheel, check all port (left) fittings and line connections.

Repeat procedure by turning wheel to starboard. Watch the oil level in the helm pump when pressurizing the steering wheel in either hard over positions. If there is no obvious drop in oil level air has been removed. If there is an obvious drop in oil level, you are compressing air and further fill and purging is required. Repeats Steps 1 through 9.

If no leaks are obvious your steering system is ready for use. If leaks are found, correct before using. Failure to correct a leak can lower oil level in system and result in loss of steering.

MAINTENANCE

Maintenance requirements will vary with usage and climate.

Inspection of the following items is required:

- At the first sign or indication that the steering system is not operating normally or correctly.
 - A minimum of two times a year.
 - By a qualified marine mechanic.
1. Check oil level in helm pump. Oil level should always be within ½" of the bottom of the filler hole. Refer to the hydraulic fluid section in the manual for oil type recommendations. Page 8.
 2. Check the outboard engine tilt tube for salt deposits and corrosion. Clean and regrease as required.
 3. Clean and grease the cylinder slider assembly. Use a quality marine grease such as Quicksilver 2-4-C or equivalent.

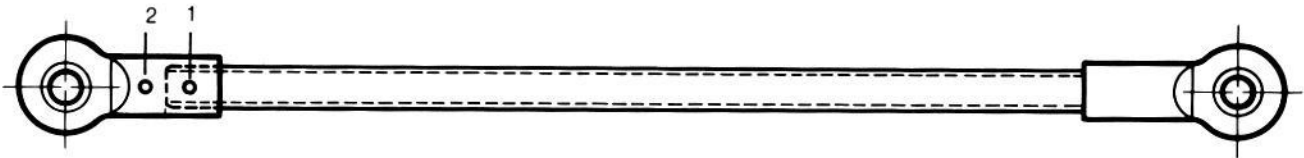
▲ WARNING

Slider assembly must be greased at all times. Do not operate boat if slider assembly is dry and free of grease. See Fig. 6, Page 12.

4. Check mechanical linkages and connections. Tighten loose parts, and replace badly worn parts.
5. Check for leaks. Refer to end of filling and purging section for how to check for leaks.
6. Check hoses for chafing/rubbing marks and replace if required.

▲ WARNING

At the time of installation and any time thereafter, the threaded rod must always fully cover inspection hole 1, but never inspection hole No. 2. Failing to observe this warning may result in one engine becoming separated from the steering system and result in property damage and/or personal injury.

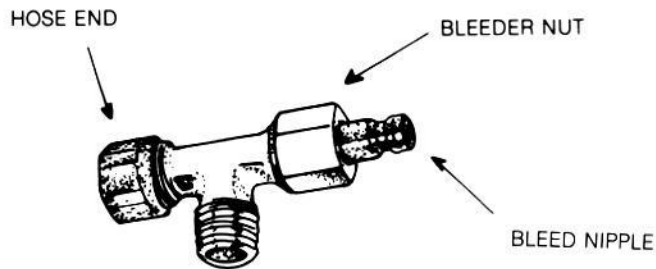


▲ WARNING

FAILURE TO COMPLY WITH MAINTENANCE CHECKS MAY RESULT IN LOSS OF STEERING, CAUSING PROPERTY DAMAGE AND/OR PERSONAL INJURY.

BLEEDER FITTING

FIG. 5

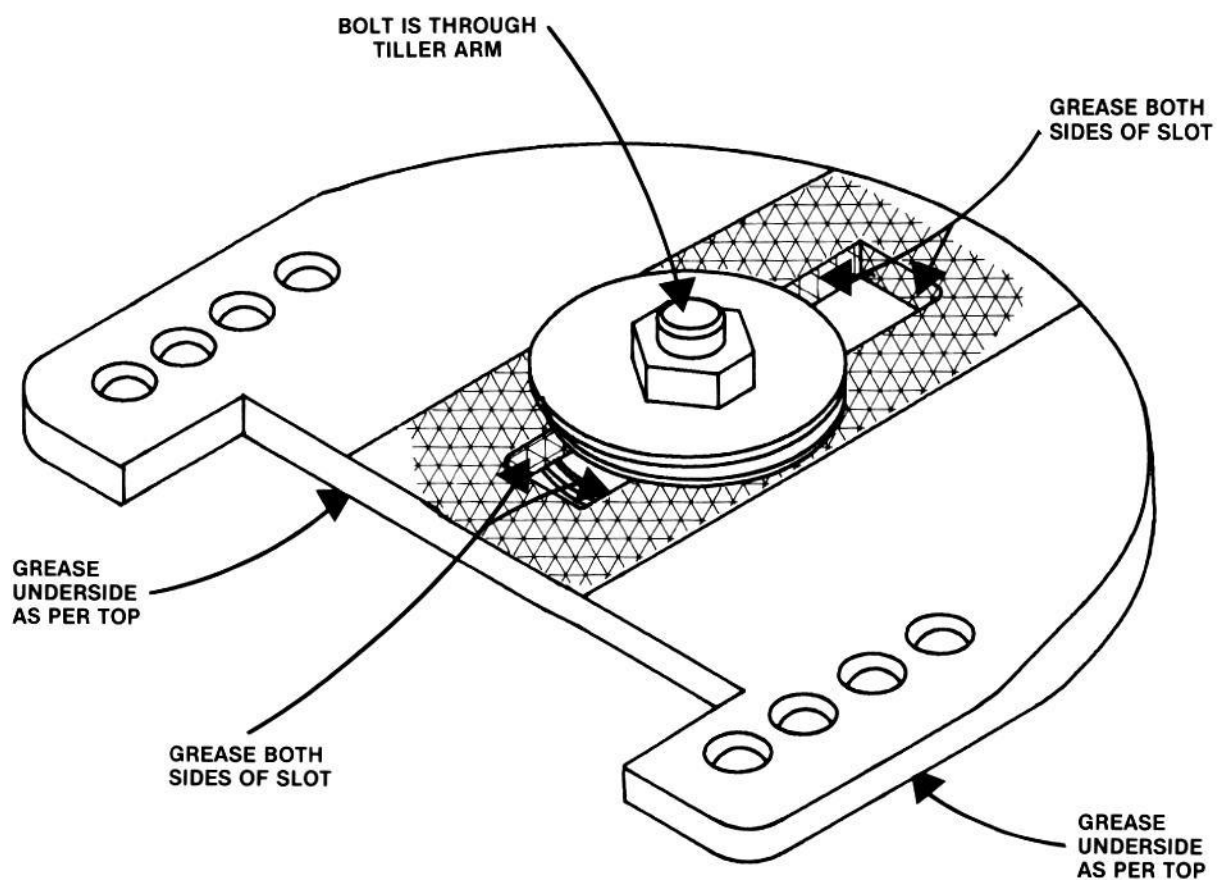


TO OPEN BLEEDER, TURN BLEEDER NUT ONE (1) FULL TURN ANTI CLOCKWISE. TO CLOSE, TURN CLOCKWISE UNTIL TIGHT.

SLIDER PLATE GREASING INSTRUCTIONS

THE SLIDER ASSEMBLY SHOWN IS ATTACHED TO THE TILLER ARM OF YOUR OUTBOARD ENGINE.

APPLY PLENTY OF GREASE TO SLIDER PLATE SURFACES AS INDICATED BY SHADED AREAS AND ARROWS ON SKETCH BELOW.



NOTE:
CYCLE CYLINDER BACK AND FORTH BY TURNING STEERING WHEEL FROM HARD OVER TO HARD OVER TO ENSURE COMPLETE GREASE COVERAGE. REGREASE ANY DRY AREAS.

FIG. 6

PARTS LIST Refer to Page 4 and 6 for Items 1 - 23.

ITEM NO.	DESCRIPTION	QUAT.	SINGLE ENG.	TWIN ENG.	PART NO.
1.	3/8 - 24 x 1 1/2 Hex HD		1	2	113529
2.	Top washer		1	—	731325
3.	Slide washer		2	4	721323
4.	Cylinder ass'y - port/starboard		1	2	
5.	Slide follower		1	2	729221
6.	Bushed washer		1	2	731221
7.	3/8 - 24 Nylock nut - thin		1	2	113529
8.	Adjusting nut		1	2	721521
9.	Support rod		1	2	730229
10.	Washer 3/8 flat		2	4	020212
11.	Spacer		2	4	728924
12.	Support bracket		2	4	730426
13.	Flat washer 1/2 o		2	4	202027
14.	Nut 1/2 - 20 nylock		2	4	113425
15.	Flat washer 1/16 o		2	4	731625
16.	Nut 1/16 - 20 NF nylock - thin		2	4	731720
17.	Extension plate		—	2	730924
18.	3/8 - 24 x 1 1/4 Hex HD cap		—	2	113321
19.	3/8 - 24 x 1 3/4 Hex HD cap		—	2	726825
20.	Washer 3/8 flat		—	10	113622
21.	Stand off		—	2	731128
22.	Tie rod S' ass'y (includes 1 rod end)		—	1	732826
23.	Rod end special, c/w inspection holes		—	1	116527
24.	Seastar I helm		✓		HH5201
25.	Seastar II helm			✓	HH5202
26.	Seastar oil (32 fl. oz. - 1 L)		✓	✓	HA5430
27.	Filler kit		✓	✓	HA5438

MANUFACTURED BY



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INSTALLATION INSTRUCTIONS

2



HYDRAULIC STEERING FOR
STERN DRIVES & INBOARD,
POWERED VESSELS



capilano

and

SeaStar

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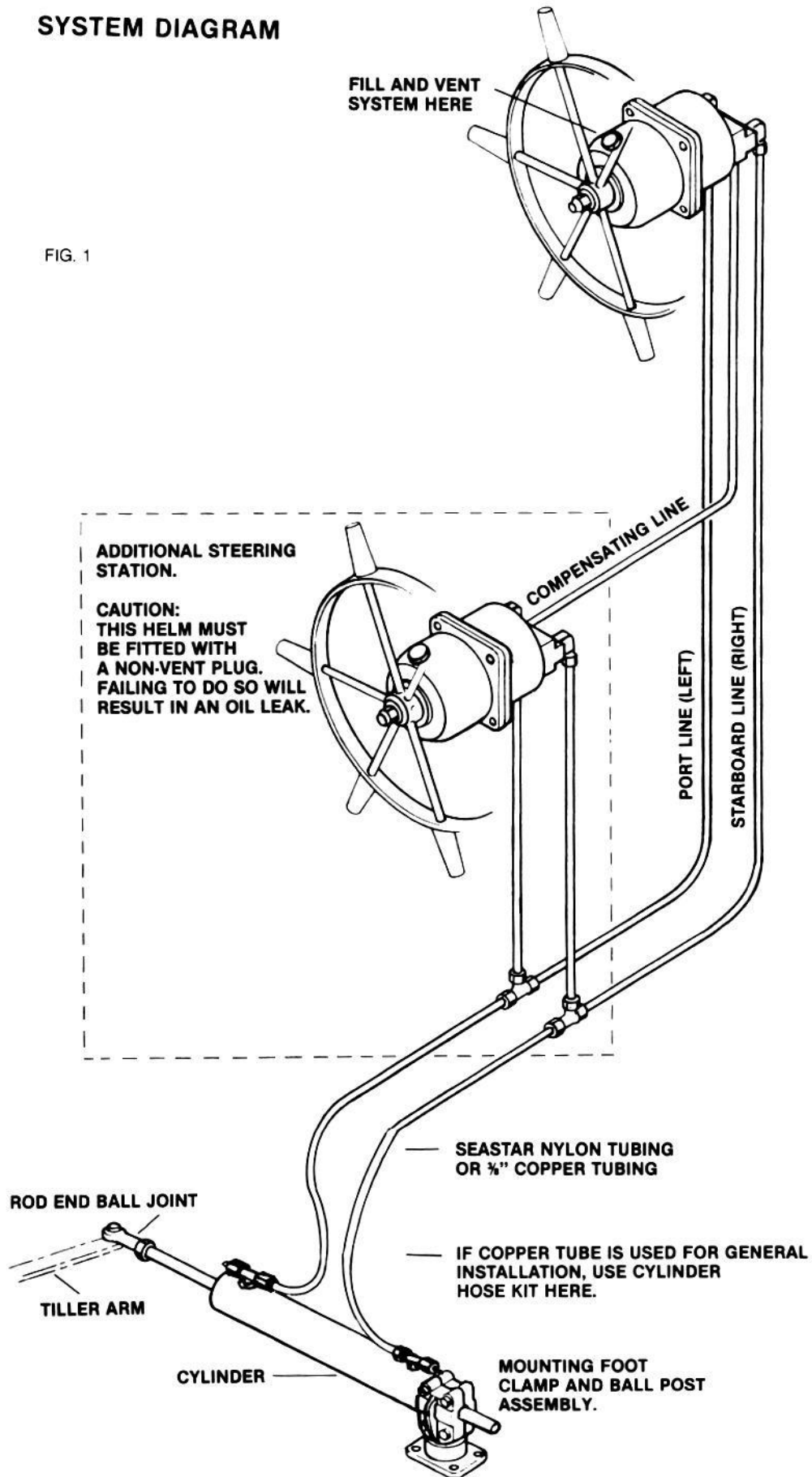
TRADE NAME

*Before you do it your way,
please try it our way.*

SYSTEM DIAGRAM

FILL AND VENT SYSTEM HERE

FIG. 1



SEASTAR HYDRAULIC STEERING

The SeaStar Steering System has been designed for pleasure and commercial vessels.

Please read these instructions thoroughly before you start the installation. Teleflex cannot accept responsibility for installations where instructions have not been followed, where substitute parts have been used, or where modifications have been made to our products.

TOOLS

You will need the following tools for installing your steering system.

HELM

- 4½" (115) diameter Hole Saw or Key Hole Saw and a ⅝" (8) dia. Drill.
- ⅞", ⅝" and ⅜" Open End Type Wrenches/Spanners, ⅞" for SeaStar II.

20° MOUNT

- Key Hole Type Saw, and a ⅝" (10) dia. Drill
- ½" Wrench/Spanner, Box or Open End type and ⅞" Socket and Drive

CYLINDER — MODEL 125-8EM

- 1⅞" Wrench/Spanner (34 mm).

CYLINDER EM MODELS OTHER THAN 125-8EM

- No special tools required.

CYLINDER — BJ - TM MODELS

- ¾" Wrench/Spanner, 2 required.

CAUTION: A high quality Teflon base pipe thread sealant must be used on all pipe threads. Use Loctite P.S.T. (Pipe Sealant with Teflon) or equivalent.

TUBING

SEASTAR I SYSTEMS

Use only SeaStar ⅜" Nylon Tubing or ⅜" Copper Tubing. Cylinder Hose Kit, Part No. HF5507 is required for systems installed with Copper Tube.

SEASTAR II SYSTEMS

Use only ⅜" Copper Tube or SeaStar I-II Outboard Hose. Cylinder Hose Kit, Part No. HF5508 is required for systems installed with Copper Tube.

NOTE: Cylinder Hose Kit, Part No. HF5508 may also be used with SeaStar I Systems. Cylinder Hose Kit Part No. HF5507 should not be used with SeaStar II Systems.

SeaStar Nylon Tubing is available in the following length:

25 Ft. - 7.6 m	Part No. HT5092
50 Ft. - 15.2 m	Part No. HT5095
75 Ft. - 22.8 m	Part No. HT5097
100 Ft. - 30.4 m	Part No. HT5100
1000 Ft. - 303 m	Part No. HT5101

FITTINGS

All necessary fittings are supplied with a single steering station system. Fitting Kit, Part No. HF5502 is required for each additional steering station and or auto pilot interface.

SeaStar Fittings are available as follows:

Connector, Tube to ¼" Male Pipe	Part No. HF5528
Union Coupler, Tube to Tube	Part No. HF5527
Tube Nut, c/w sleeve	Part No. HF5526
Elbow, Tube to ¼" Male Pipe	Part No. HF5529
Tee, three times tube	Part No. HF5530
Connector, Tube to ⅝" Male Pipe	Part No. HF5532

NOTE: A SeaStar Fitting Booklet is available for a complete list of SeaStar Fittings.

MOUNTING THE HELM

- The SeaStar helm may be mounted behind or in front of the dashboard. Photo shows front of dash mount.
- The helm may be mounted with the helm shaft horizontal, vertical or any angle in between.
- The filler plug must always be be in the uppermost position.

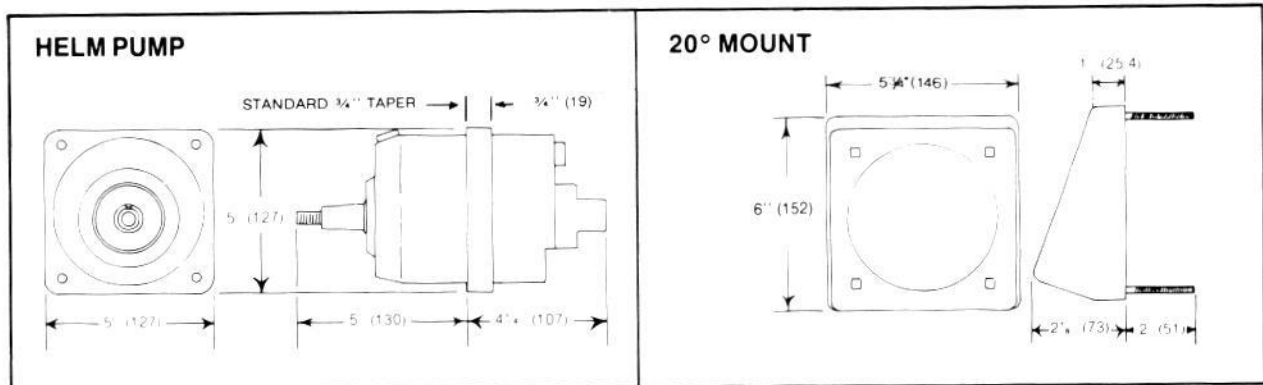
CAUTION: If more than one steering station is installed the fill-vent plug on all but the uppermost helm must be replaced with a non-vent plug which is included in a dual station fitting kit.

- Determine desired mounting position. Ensure that the steering wheel will not interfere with other functional equipment. Check for adequate space behind dash for fitting and line connections.
- Use the helm mounting template or helm bezel to drill or cut out one 4½" dia. hole (11.5 cm) and four ⅝" mounting holes (8 mm).

CAUTION: If a 20° mounting wedge is used, cut out dash as per mounting wedge template and mount the helm directly to the 20° wedge.

WARNING: Use self-locking type fasteners only; substituting non-self locking fasteners can result in loosening or separation of equipment and loss of steering control.

WARNING: Do not exceed 110 in./lbs. (12 Nm) torque on helm and wedge nuts and bolts.



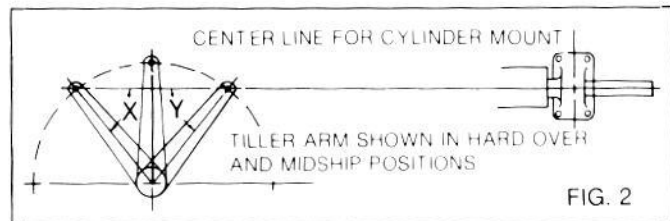
CYLINDER INSTALLATION

GENERAL NOTES

- Proper cylinder installation is the key to the successful operation of the hydraulic steering system. An incorrect installed cylinder is subject to rapid seal and bearing wear and nonrepairable damage.
- Minimum side loading of cylinder rod and maximum cylinder performance of BJ & TM Models can be achieved by observing sketch no. 2.

An imaginary line drawn through the tiller arm hole at both hard over positions will create the cylinder centre line.

With tiller arm at hard over positions, angle X and Y should be the same.



- Select the diagram and dimensional data that corresponds with your cylinder model. Note, not all possible cylinder mounting configurations are shown, however, all necessary dimensions are shown regardless of mounting configurations.

CAUTION:

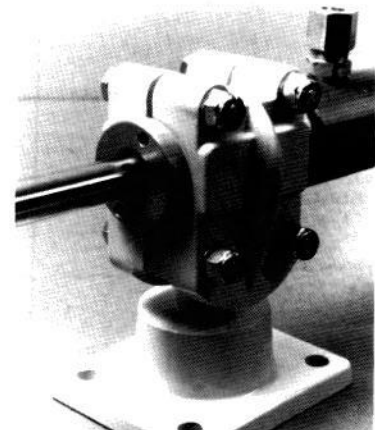
Cylinders should always be secured with thru bolts, not with lag screws. (Where applicable).

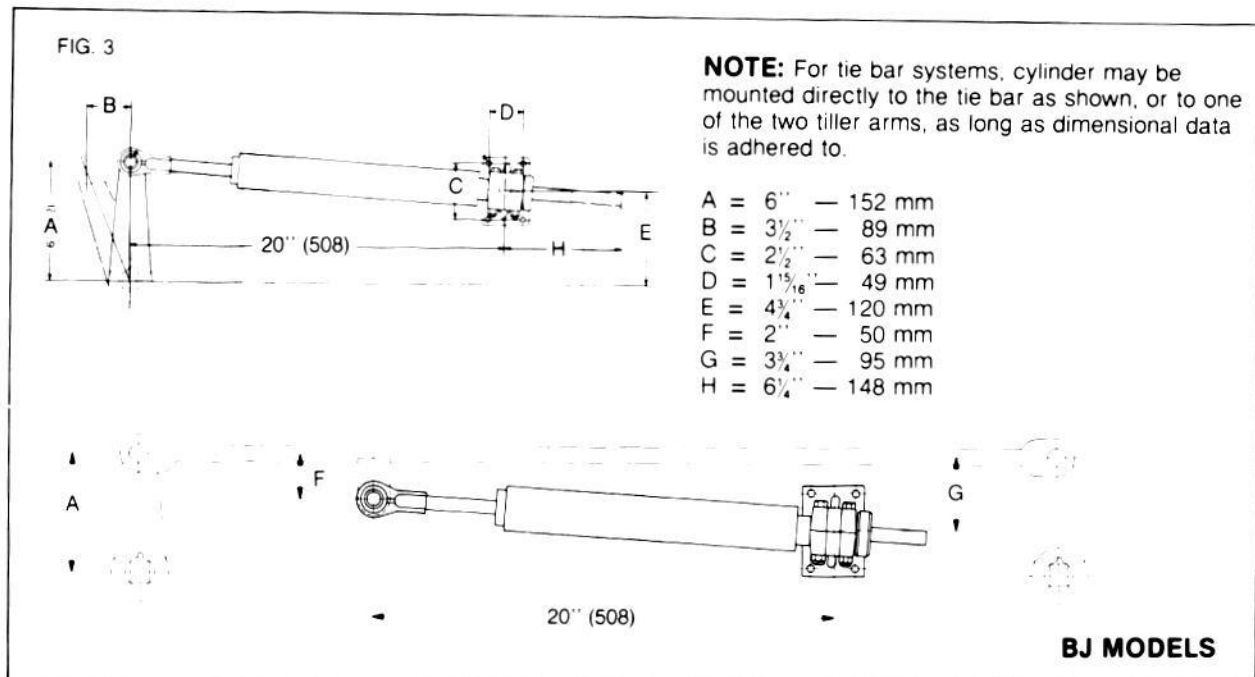
Cylinder ports for hose connection should always be in the uppermost position. If this is absolutely not possible, cylinder should be left disconnected until the steering system is filled and purged free of air, while leaving cylinder ports in an uppermost position to assist air removal from the cylinder(s), then reconnect.

- Protect cylinder rods from nicks and scratches, which can cause cylinder to leak, and result in loss of steering.
- All parts used are corrosion resistant, however with extended operation under extremely corrosive conditions, corrosion may occur and affected parts should be replaced.
- In order to avoid excess steering loads and optimize steering characteristics, outdrive trim tabs must be adjusted in accordance with engine manufacturer's instructions for specific motor/boat combination. Failure to do so can affect boat performance and safety of operation.

INBOARD CYLINDERS, MODEL BA125-7BJ, BA135-7BJ, BA150-7BJ

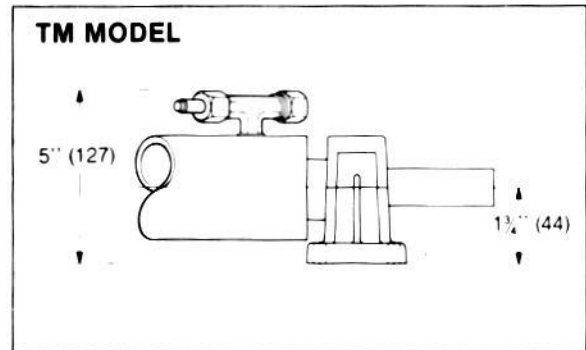
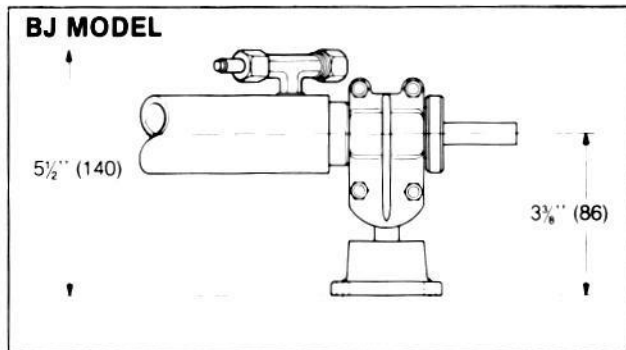
- Assemble and attach mounting foot-clamp assembly to cylinder mounting gland as per photo. Do not fully tighten nuts and bolts (4) at this time.
- With rudder(s) in the fore and aft position, attach rod end ball joint to the tiller arm or tie bar.
- Loosen tube nuts on cylinder fittings. Extend cylinder rod to arrive at 20" (508) from center of rod end ball joint hole to the center of the mounting foot, or at a distance of 6 $\frac{1}{16}$ " (164) center of rod end ball joint hole to cylinder face as shown in Fig. 3.





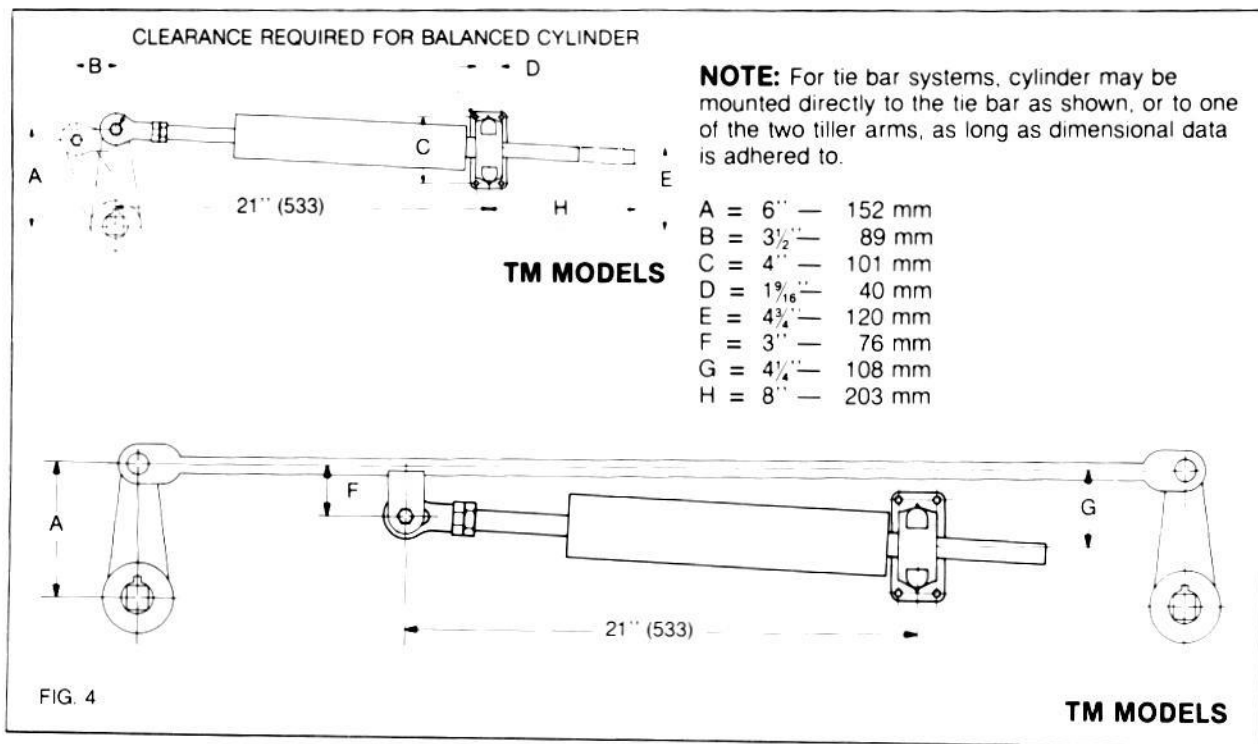
CAUTION: There is no adjustment for centering cylinder after installation. Correct mounting at this time is very important. Total cylinder rod travel is 7" (178).

- With cylinder fittings in the uppermost position, securely tighten the four bolts on cylinder clamp.
- Secure mounting foot to transom or mounting bracket, using four ⅝" (8) Grade 5 bolts (corrosion resistant) and self-locking nuts.
- In order to obtain a correct push and pull angle between the tiller arm and cylinder, or tie bar and cylinder, the cylinder should be parallel to transom, or tie bar, or the keel line, depending on mounting configuration, when cylinder rod is fully extended (out) or fully retracted (in).
- Swing rudder(s) back and forth at this time, to ensure free movement of cylinder. Ensure that there is no binding of ball joint.



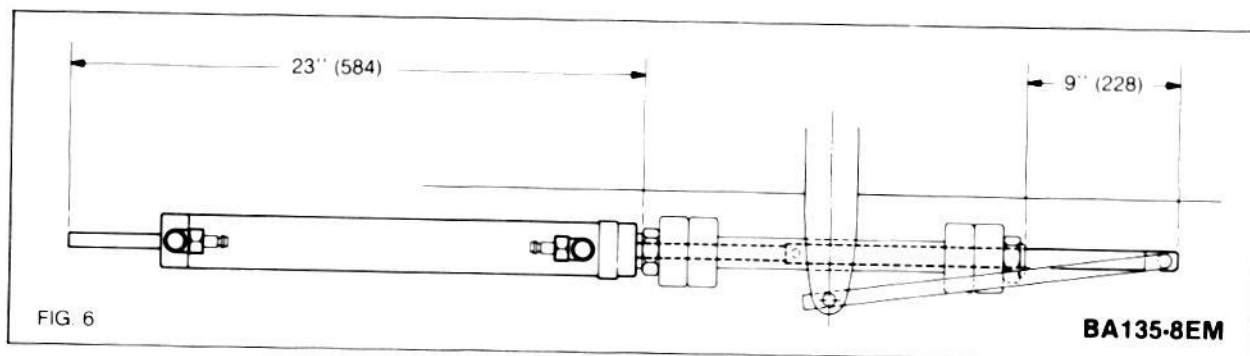
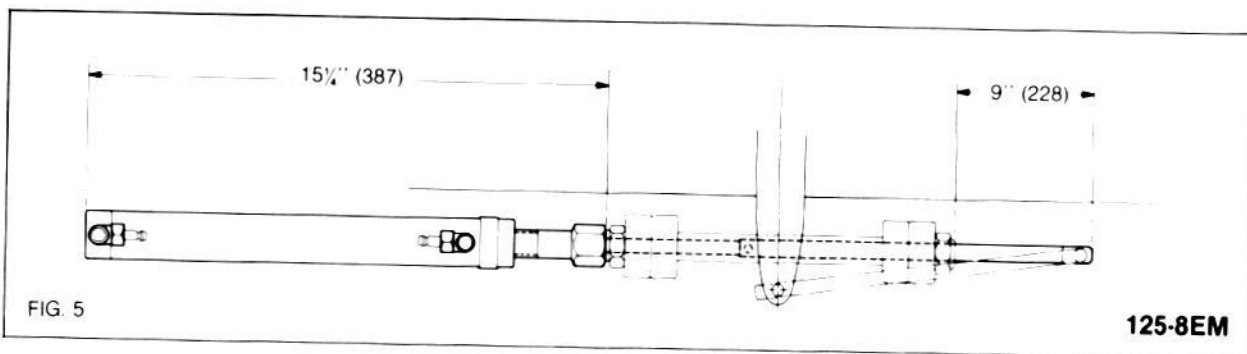
MODEL BA150-7TM, BA175-7TM

- With rudder(s) in the fore and aft position, attach rod end ball joint to the tiller arm or tie bar.
- Extend the cylinder rod to arrive at 21" (533) from center of rod end ball joint to the center of the mounting foot. See Fig. 4.
- Position the mounting foot in accordance to dimensional figures on Fig. 4 and secure to mounting bracket or surface using four ⅝" (10) Grade 5 bolts and self-locking nuts.
- In order to obtain a correct push and pull angle between tiller arm and cylinder, or tie bar and cylinder, the cylinder should be parallel to transom, or tie bar, or the keel line, depending on mounting configuration, when cylinder rod is fully extended (out) or fully retracted (in).
- Swing rudder(s) back and forth at this time, to ensure free movement of cylinder. Ensure that there is no binding of ball joint.



ENGINE MOUNTED CYLINDER, MODEL BA135-8EM, 125-8EM

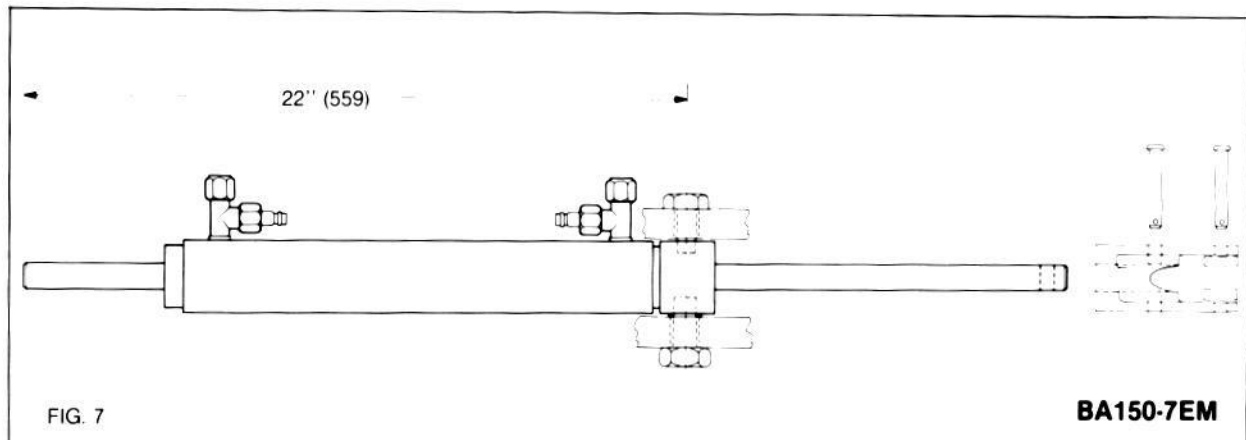
- A support tube provided by the engine manufacturer, must be used for these two cylinder models. These cylinders are mounted to the sterndrive's support or guide tube in the same manner as a steering cable.
- Thoroughly lubricate support tube and cylinder rod with a high quality anti-corrosive type marine grease such as OMC Triple Guard or equivalent, before mounting cylinder to support tube.
- Slide well greased cylinder rod into and through well greased support tube and thread cylinder fully onto support tube as shown in Fig. 5 and 6.



MODEL BA150-7EM

This cylinder is designed for use with 1984 to date Mercruiser, and OMC Cobra non power assisted steering sterndrives. Sterndrives equipped with optional power assist steering require Cylinder Model 125-8EM.

NOTE: Quicksilver Clevis Adaptor Kit, Part No. B98735A1 is required to complete cylinder connection to both sterndrives. This part is supplied with the Quicksilver Tie Bar Kit for twin sterndrives.



CAUTION:

- When connecting the cylinder to a Mercruiser the two washer spacers must be installed between the cylinder and mounting bracket.
- When connecting the cylinder to an OMC Cobra, the two bushings must be inserted to the cylinder mounting holes.

STEP 3

TUBING INSTALLATION

- The following recommendations refer to $\frac{3}{8}$ " soft copper tubing and SeaStar $\frac{3}{8}$ " nylon tubing.
- Route the tubing so that it will not interfere with hatchways or other type of functional equipment.
- Do not allow tubing to kink or collapse while routing through vessel. Any piece of tubing that has collapsed, must be replaced or spliced with a union coupling fitting.
- Tie down tubing at regular intervals, using non-metallic type tie downs.
- Do not allow the tubing to rest or chafe against a sharp or abrasive surface.

WARNING: Do not allow nylon tubing to contact, or come too close to hot engine. Extreme heat will lower burst pressure or melt nylon tubing. In either case instant loss of steering may occur.

CAUTION: Teleflex will not be responsible for any consequence resulting from the use of a substitute tube or hose.

AUTOPILOT

- An autopilot designed for use with hydraulic steering may be teed into your SeaStar steering system at any convenient point in the system.
- Installing shut-off valves in hydraulic lines running from autopilot pump set to steering system lines will simplify trouble shooting and servicing at a later time if necessary.
- Autopilot selection must be compatible with oil used in your SeaStar steering system.

STEP 4

SYSTEM CONNECTION

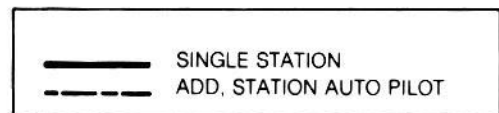
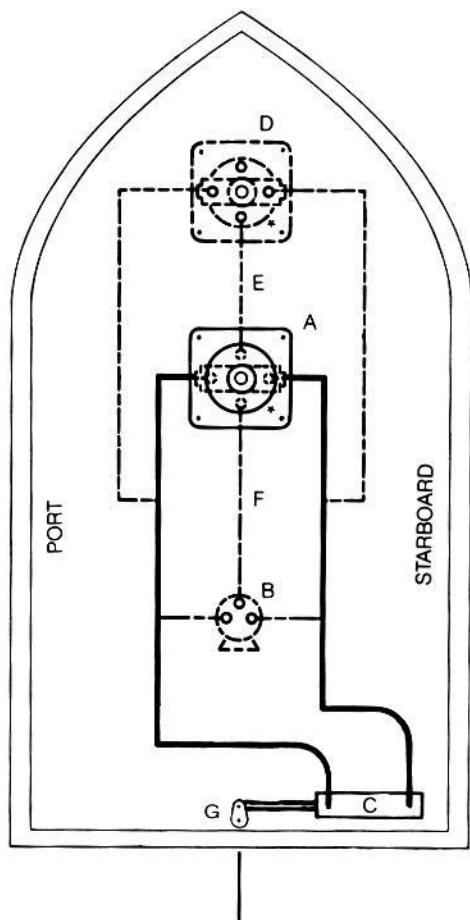
- This section covers the tube nut and tube connections ($\frac{3}{8}$ " copper and $\frac{3}{8}$ " nylon) to helm(s) and cylinder.
- Refer to system diagram for general system connection and for identification of components. See page 3.
- Tube nuts supplied with components and fitting kits are suitable for use with $\frac{3}{8}$ " OD copper tube and SeaStar $\frac{3}{8}$ " OD nylon tubing.
- A quality Teflon base thread sealer should be used on all pipe threads, such as Loctite P.S.T. or equivalent. Failing to use a thread sealant could result in leaks.

Do not use pipe sealant on tube nut portion of fitting. See Fig. 10.

- Screw elbow fittings into helm ports marked S and P.
- Ensure that elbow fittings are finally oriented in desired position, for connection to tubing.
- In a multi-steering station system a compensating line must run from port R to helm port R. The compensating line must always be connected to the bottom R port on the highest helm, and the top R port on the lowest helm. Refer to Fig. 8.

WARNING: Never attach copper tubing or any rigid tube or pipe directly to cylinder(s). Cylinders articulate during the hard over to hard over movement and require a flexible hose to compensate for the articulation.

FIG. 8



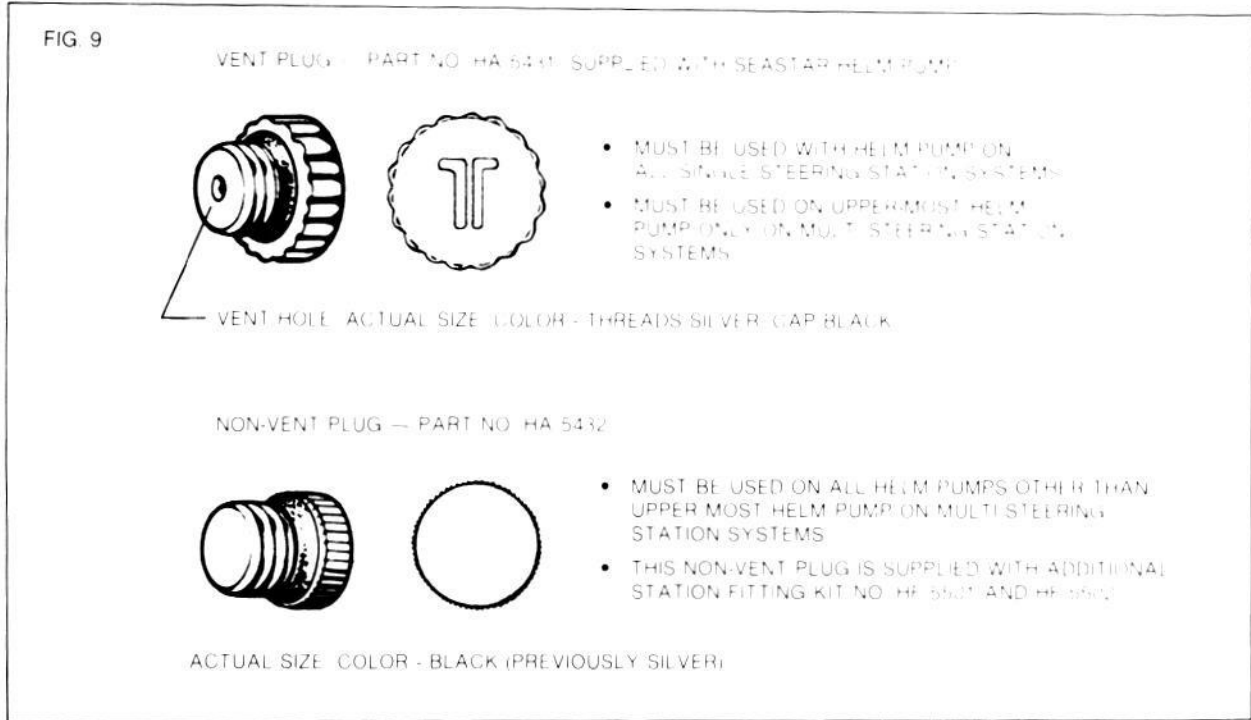
HELMS ARE VIEWED FROM STEERING WHEEL SIDE

- A = STEERING HELM
- B = OPTIONAL AUTO PILOT
- C = CYLINDER
- D = OPTIONAL ADDITIONAL HELM
- E = HELM COMPENSATING LINE
- F = AUTO PILOT COMPENSATING LINE
- G = TILLER ARM

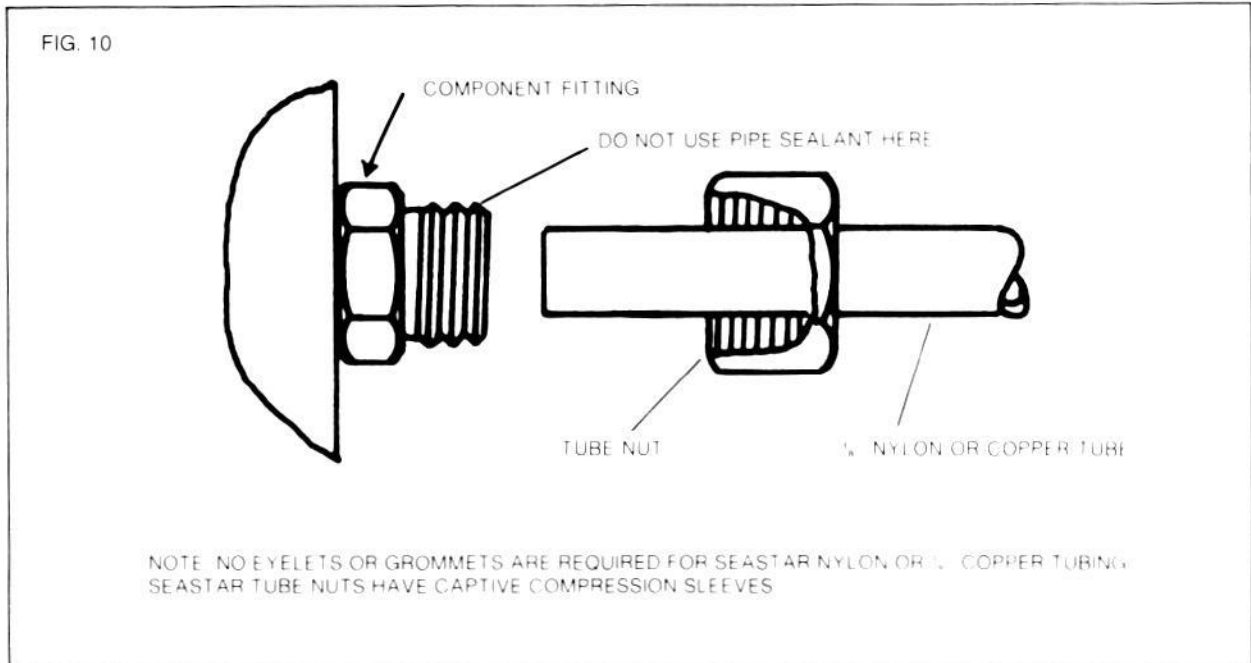
* This fitting port will not accept an elbow fitting, use the straight connector fitting supplied in fitting kit, when applicable. A $\frac{1}{4}$ " NPT male-female adaptor will allow the use of an elbow fitting.

- An autopilot compensating line may be teed into an existing compensating line between two helms or directly into a bottom R port on the SeaStar helm. Connector fittings for compensating line are supplied on fitting kit HF5502.
- Fitting kit, part no. HF5502 is required for additional steering helm(s) or for an autopilot connection.

CAUTION: Fitting kit, part no. HF5502 also contains a solid non-vent plug, which must be used on all helms other than the highest helm in a steering system. See Fig. 9.



- To attach tubing to elbow, tee and/or connector fittings on helms and cylinder, refer to Fig. 9



- Slide tube nut over tubing
- Push tubing into bottom of component fittings
- Hand tighten tube nut, ensuring that tube is bottomed against fitting, while tightening tube nut
- After hand tightening tube nut, tighten nut an additional 1 - 1 1/2 turns with a 3/8" wrench

HYDRAULIC FLUID

Acceptable and recommended oils for your steering system are:

- SeaStar Hydraulic Fluid, part no. HA5430
- Texaco HO15
- Shell Aero 4
- Esso Univis N15
- Chevron Aviation Fluid A
- Mobil Aero HFA
- Fluids meeting Mil H5606C specifications.

NOTE: Automatic transmission fluid Dexron II may be used in case of emergency.

WARNING: Never use brake fluid. Any non-approved fluid may cause irreparable damage, loss of steering, and cancellation of warranty.

NOTE: In case of extreme emergency any non-toxic, non-flammable fluid may provide temporary steering.

FILLING AND PURGING THE SYSTEM

CAUTION

- This procedure requires two people. One person may not be able to remove all the air from the system which will result in spongy, unresponsive steering.

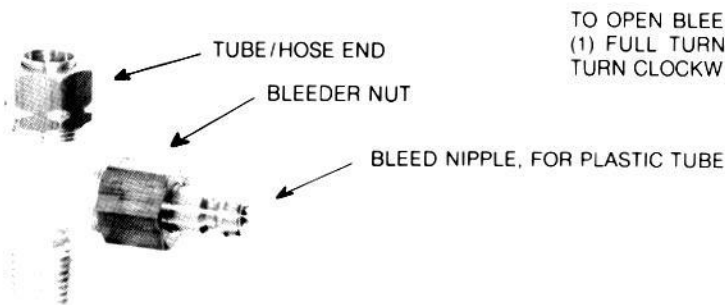
HYDRAULIC OIL REQUIREMENTS

- 2 - 3 bottles (2 - 3 quarts or liters) for single station and single cylinder systems.
- 1 additional bottle for each additional helm, cylinder, or auto pilot.

CAUTION

- During the entire filling procedure, oil must always be visible in the filler tube. Do not allow the oil level to disappear into the helm pump, as this may introduce more air into the system and increase your filling time.

BLEEDER FITTING



TO OPEN BLEEDER, TURN BLEEDER NUT ONE (1) FULL TURN ANTI CLOCKWISE. TO CLOSE, TURN CLOCKWISE UNTIL TIGHT.

ONE STEERING STATION

1. Screw the threaded end of the filler tube into the helm filler hole.
2. Remove the bottle cap from the oil bottle and while holding the oil bottle upright, screw the oil bottle into the filler tube bottle cap.
3. Now turn the oil bottle upside down, and with the push pin (supplied with the filler kit) make one hole in the bottle above the oil level.
4. Now turn the steering wheel from hard over to hard over (wherever hard over may be initially) until the bottle is empty.
5. Attach the next oil bottle to the filler tube as described above and continue turning the steering wheel until the oil level in the oil bottle stops dropping.

NOTE:

If an auto pilot is installed, it must now be turned on, and the cylinder(s) must be moved back and forth by the pilot for 5-10 minutes, or until the oil level in the oil bottle stops dropping again.

6. The other person must now attach the bleed tube to the starboard (right) bleeder fitting and open the bleeder nut one full turn. See Fig. A-17.

CAUTION: Have a small container handy to catch the oil coming out from the other end of the bleed tube.

7. Now continue to turn the wheel to starboard (right) until half of the remaining oil in the bottle is gone. Close the bleeder nut firmly.
8. Now attach the bleed tube to the other bleeder fitting and open the bleeder nut one full turn. Turn the wheel to port (left) until the remaining oil begins to disappear from sight in the fill tube.

CAUTION:

Power assisted stern drive cylinders are unbalanced. The oil level in the helm must be set with the cylinder rod fully retracted. Failing to observe this caution will result in an oil spill at the helm. Turning the wheel to port (left) will retract the cylinder rod.

9. Remove the fill tube from the helm and screw the vent plug back into the helm.

TWO STEERING STATIONS

Beginning at the lower helm, perform steps 1 to 4 as described in the single station instructions. Then, perform steps 1 to 9 at the upper station.

CAUTION:

Lower station helms must be fitted with non-vent plugs, which are supplied in an additional station fitting kit No. HF5502. See Fig. No.

THREE STEERING STATIONS

Beginning at the lowest helm, perform steps 1 to 4 as described in the single station instructions. Repeat steps 1 to 4 at the next highest helm, then perform steps 1 to 9 at the upper station.

OIL LEVEL AND SYSTEM CHECK

- Helm mounted with wheel shaft completely horizontal must be filled to bottom of filler hole at all times. Do not allow oil level to drop more than $\frac{1}{4}$ " (6.3).
- Helms mounted on a 20° angle or with wheel shaft vertical, oil level should be within $\frac{1}{2}$ " (12.7) of fill hole at all times. Check oil level periodically. Best time for periodic oil level check is **before** departing from your dock or berth.
- At this time the steering system should be checked for proper connections of hose, tube and fittings, and possible leaks. To do so, turn steering wheel (any one on multi-steering station system) and pressurized very hard to port. Apply enough force to the wheel to exceed pressure relief valve pressure. You will not harm the helm or system. While pressure is maintained on steering wheel, check all port (left) fittings and line connections. Repeat procedure by turning wheel to starboard.

If not leaks are obvious your steering system is ready for use. If leaks are found, correct before using. Failure to correct a leak can lower oil level in system and result in loss of steering.

NOTE

- Air compresses very easily. Oil does not. Watch the oil level in your helm when pressurizing the steering wheel at either hard over positions. If there is no noticeable drop in the oil level, air has been removed. If the oil level does drop, and then rises again when the pressure is released, air is still present in the system and further purging is required.

MAINTENANCE

Inspection of the following items is required a minimum of two times a year, by a qualified hydraulic marine mechanic.

- Check the oil level in the upper most helm.

CAUTION

The special hydraulic oil is not available from your local gas station. Order a spare bottle (HA5430) from your Teleflex/Flexatrol dealer.

- Check mechanical linkages and connections. Tighten loose parts and replace badly worn parts.
- Check for leaks.
- Check hoses/tubing for chafing/rubbing marks, and replace if required.

TECHNICAL INFORMATION

HELM PUMP

	DISPLACEMENT	RELIEF VALVE	PORTS
SeaStar I	1.7 cu. in. - 27.8 cc.	1000 PSI - 70 Bar	¼" NPT
SeaStar II	2.4 cu. in. - 39.3 cc.	1000 PSI - 70 Bar	¼" NPT

HELM PUMP SHAFT

SeaStar I	¾" Standard Taper, 1" Per Ft.	⅜" NC Threads, ⅜" Key
SeaStar II	¾" Standard Taper, 1" Per Ft.	½" NF Threads, ⅜" Key

CYLINDERS

	INSIDE DIAMETER	STROKE
BA125-7BJ	1.250 - 31.7 mm	7" - 178 mm
BA135-7BJ	1.375 - 34.9 mm	7" - 178 mm
BA150-7BJ/TM	1.500 - 38.1 mm	7" - 178 mm
BA175-7TM	1.750 - 44.4 mm	7" - 178 mm
125-8EM	1.250 - 31.7 mm	8" - 203 mm
BA135-8EM	1.350 - 34.9 mm	8" - 203 mm
BA150-7EM	1.500 - 38.1 mm	7" - 178 mm

	VOLUME	TORQUE @ 100 PSI - 70 Bar - 350
BA125-7BJ	7.2 cu. in. - 118.2 cc.	5024 in/lbs. .57.7 K gm
BA135-7BJ	8.2 cu. in. - 135.1 cc.	5741 in/lbs. .65.7 K gm
BA150-7BJ/TM	10.2 cu. in. - 167.5 cc.	7117 in/lbs. .81.8 K gm
BA175-7TM	13.7 cu. in. - 225.2 cc.	9569 in/lbs. .110.0 K gm
125-8EM	8.25/9.8 cu. in. - 135.1/160.8 cc.	7142 - 8502 in/lbs. .82.1 - 97.7 K gm
BA135-8EM	9.4 cu. in. - 154.4 cc.	8162 in/lbs. .93.8 K gm
BA150-7EM	10.2 cu. in. - 167.5 cc.	8853 in/lbs. .101.8 K gm

FITTINGS

SeaStar cylinder and all other fittings are ⅜" compression type fittings. Threads are ⅜" x 24 extra fine. A brochure on all SeaStar fittings is available from Teleflex/Flexatrol.

TROUBLE SHOOTING GUIDE

- SeaStar hydraulic steering will provide years of safe reliable performance with a minimum of service if properly installed with correct cylinder.
- SeaStar steering systems have been designed with protection against over-pressure situations, by a pressure relief valve, and against the effects of contamination to minimize the possibility of total loss of steering.
- Most faults occur when the installation instructions are not followed and usually show up immediately upon filling the system. Provided below, are the most common faults encountered and their likely cause and solution. The term "Rudder" also applies to stern drives, when applicable.
- Sometimes when returning the wheel from a hard-over position, a slight resistance may be felt and a clicking noise may be heard. This should not be mistaken as a fault, as it is a completely normal situation caused by the releasing of the lockspool in the system.

WARNING CAUTION

Whenever in the following text, a solution calls for removal from vessel and/or dismantling of steering system components, such work must only be carried out by a qualified marine hydraulic mechanic. Teleflex offers the following as a guide only and is not responsible for any consequences resulting from incorrect dismantling and repairs.

- 1. FAULT** • DURING FILLING, THE HELM BECOMES COMPLETELY JAMMED.
 - Cause • blockage in the line between the helms and the cylinder(s).
 - Solution • Make certain that tubing has not collapsed during installation. If so, the collapsed section must be removed and re-fitted with a new piece with the aid of tube connectors. Check fittings for incomplete holes. Fittings with incomplete holes, however, are not common.
 - Cause • Lines not installed correctly.
 - Solution • check runs of lines; refer to installation diagram. Make certain that all port lines are hooked up to the port connections on helms and cylinder(s), and all starboard lines are connected to the starboard connections on helms and cylinder(s). If the compensating line is identical to the delivery lines, it could have been mistaken as either a port or starboard line.

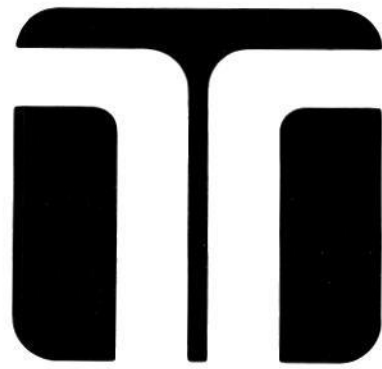
2. **FAULT** • SYSTEM IS VERY DIFFICULT TO FILL. AIR KEEPS BURPING OUT TOP OF HELM EVEN AFTER SYSTEM APPEARS FULL.
- Cause • cylinder(s) has been mounted upside down. This causes air to be trapped in the cylinder(s).
- Solution • mount cylinder(s) correctly, according to cylinder installation instructions. Ports should always be kept in uppermost position.
- Cause • air in system.
- Solution • review filling instructions.
3. **FAULT** • STEERING IS STIFF AND HARD TO TURN, EVEN WHEN THE VESSEL IS NOT MOVING.
- Cause • rudder post glands are too tight or rudder post is bent, causing mechanical binding. The same applies to tiller arm and linkage on outdrives.
- Solution • to test, disconnect cylinder(s) from the tiller arm and turn the steering wheel. If it turns easily, correct above-mentioned problems. Please note that excessively loose connections to tiller arm or tie-bar can also cause mechanical binding.
- Cause • restrictions in hose, copper tubing, piping or fittings.
- Solution • find restriction and correct.
- NOTE: Collapsing of copper tubing during bending is enough to cause restrictions.
- Cause • air in oil.
- Solution • see filling instructions supplied with helm units.
- Cause • wrong oil has been used to fill steering system, like A.T.F. (automatic transmission fluid, or any other oil with a high viscosity factor).
- Solution • drain system and fill with recommended oils.
4. **FAULT** • STEERING IS EASY TO TURN AT THE DOCK, BUT BECOMES HARD TO TURN WHEN VESSEL IS UNDERWAY.
- Cause • steering wheel is too small.
- Solution • fit larger wheel if possible, see installation instructions. If the problem cannot be rectified by the above mentioned solution, proceed with next cause and solution or consult factory.
- Cause • cylinder(s) too small.
- Solution • replace with larger cylinder(s).
- Cause • incorrect setting of trim tab on stern drive.
- Solution • adjust tab(s).
- Cause • incorrectly designed or adjusted rudders, causing binding on rudder post and/or tie bar at cruising speeds.
- Solution • seek professional help. Have competent, qualified marine mechanic correct problem.
5. **FAULT** • RUDDER DRIFTS TO PORT OR STARBOARD WHILE VESSEL IS UNDERWAY, EVEN WHEN WHEEL IS NOT BEING TURNED.
- Cause • dirt in check valves.
- Solution • remove check valve plugs. These are the larger plugs on either side on rear of helm. Clean ball seats and balls and re-assemble. (See sketch overleaf)
- NOTE: Be prepared to lose a certain amount of oil during this procedure. Have a small can available. Refill system when check balls have been re-assembled.
6. **FAULT** • ONE HELM UNIT IN SYSTEM IS VERY BUMPY AND REQUIRES TOO MANY TURNS FROM HARD-OVER TO HARD-OVER.
- Cause • dirt in inlet check of helm pump.
- Solution • dismantle helm pump and remove contaminant from one or more piston inlet checks.
7. **FAULT** • TURNING ONE WHEEL CAUSES SECOND STEERING WHEEL TO ROTATE.
- Cause • See Fault No. 5
- Solution • See Fault No. 5
8. Worn Seals:
- seals will sometimes leak if steering system is not vented at uppermost helm.
 - the SeaStar helm has a field replaceable wheel shaft seal which can readily be replaced by removing steering wheel and seal cover held in place by three small bolts. O-ring no. 214 as found in SeaStar helm seal kit HS5151.
 - Seal kits are available for SeaStar cylinders, however, these must only be used by a qualified marine mechanic.

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INSTALLATION INSTRUCTIONS



capilano cylinders

capilano

and

SeaStar

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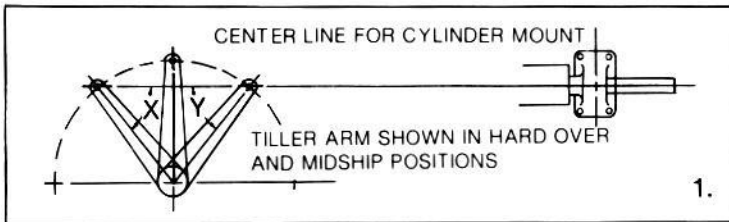
AND EXPORTED UNDER THE

flexatrol

TRADE NAME

*Before you do it your way,
please try it our way.*

- Capilano cylinders are engineered and manufactured for heavy duty marine usage and are suitable for commercial and pleasure boat applications. Capilano cylinders are also designed to meet A.B.S., Lloyds and D.N.V. specifications.
- Please read these instructions thoroughly before attempting installation. Teleflex (Canada) Ltd. cannot accept responsibility for installations where instructions have not been followed, where substitute parts are used or where modifications have been made to our product.
- Proper cylinder installation is the key to the successful operation of the hydraulic steering system. An incorrect installed cylinder is subject to rapid seal and bearing wear and nonrepairable damage.
- Minimum side loading of cylinder rod and maximum cylinder performance can be achieved by observing sketch no. 1.



An imaginary line drawn through the tiller arm hole at both hard over positions will create the cylinder centre line.

With tiller arm at hard over positions, angle X and Y should be the same.

- Select the diagram and dimensional data that corresponds with your cylinder model. Note, not all possible cylinder mounting configurations are shown, however, all necessary dimensions are shown regardless of mounting configurations.
- Mount the tiller arm(s) to rudder post(s). All slack or free play must be eliminated.
- Connect the cylinder ball joint or clevis to tiller arm. With tiller arm in midship position and with cylinder rod extended to its center position determine the anchoring position of cylinder mounting foot. A mounting bracket may be required.
- Swing rudder to ensure free movement of cylinder and tiller arm.
- Refer to System Instructions (supplied with helms) to complete the installation - and for recommended servicing.

CAUTION:

Cylinders should always be secured with thru bolts, not with lag screws.

Cylinder ports for hose connection should always be in the uppermost position. If this is absolutely not possible, cylinder should be left disconnected until the steering system is filled and purged free of air, while leaving cylinder ports in an uppermost position to assist air removal from the cylinder(s), then reconnect.

HOSE KIT CONNECTIONS

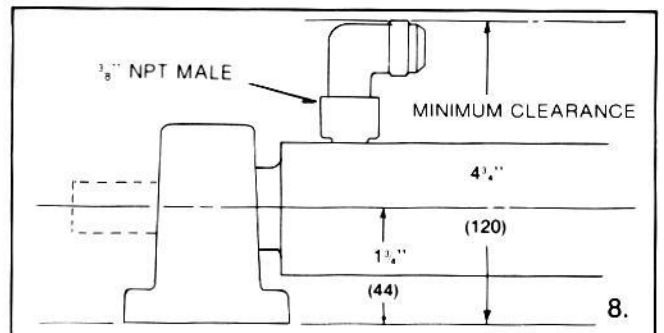
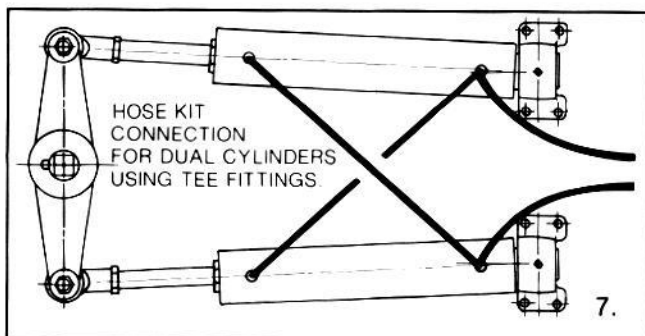
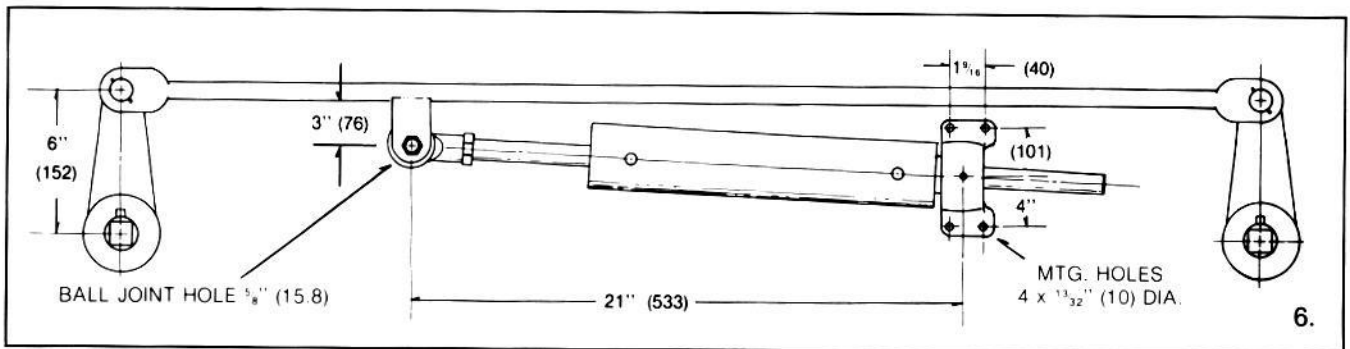
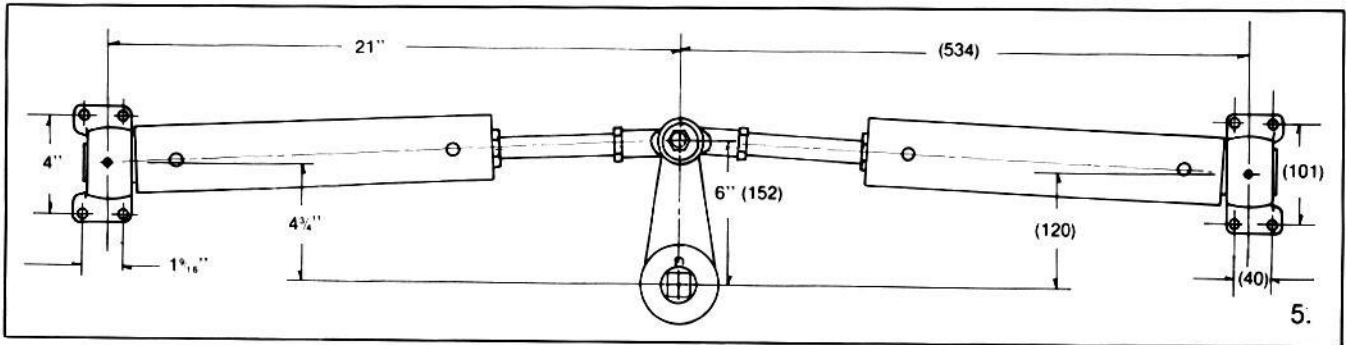
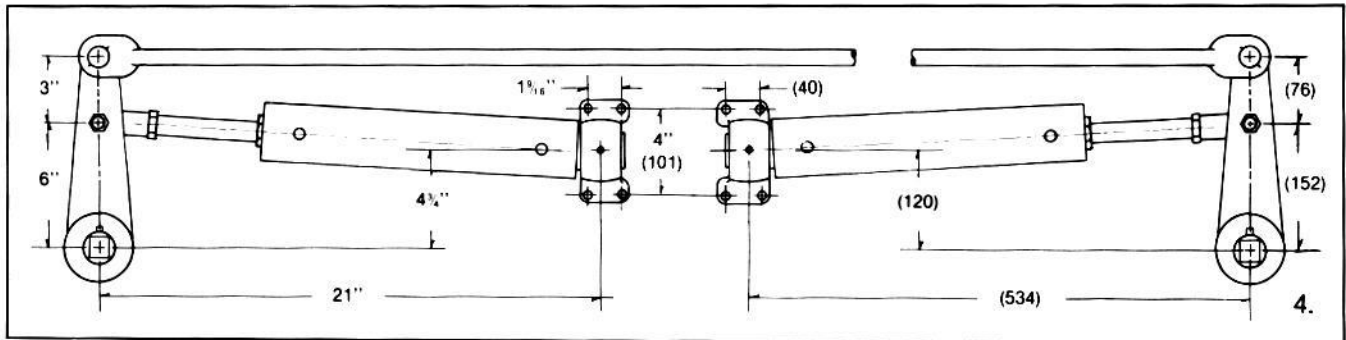
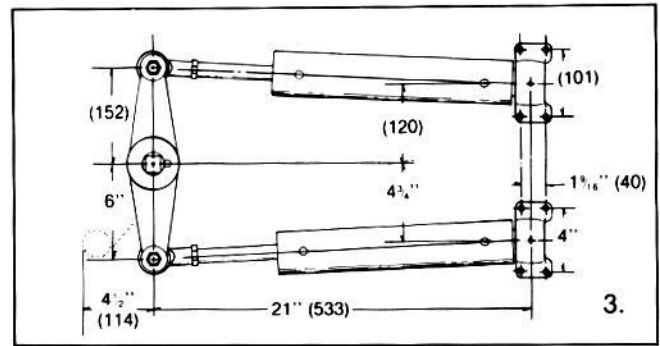
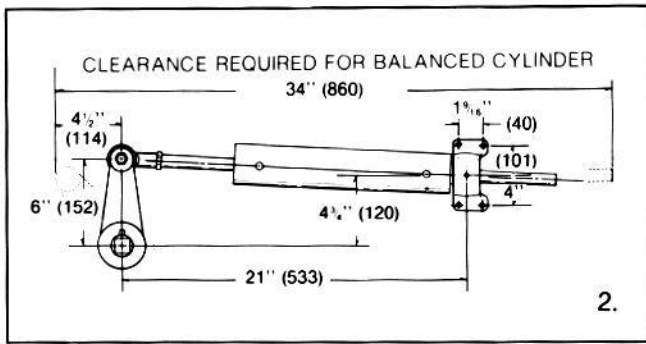
Never attach copper tubing or any rigid tube or pipe directly to cylinder(s). Cylinders articulate during the hard over to hard over movement and require a flexible hose to compensate for the articulation. Refer to sketch 7 and 11 for twin cylinder hose connection. The same connection procedure applies to cylinders mounted in-line.

CYLINDER MODEL INFORMATION

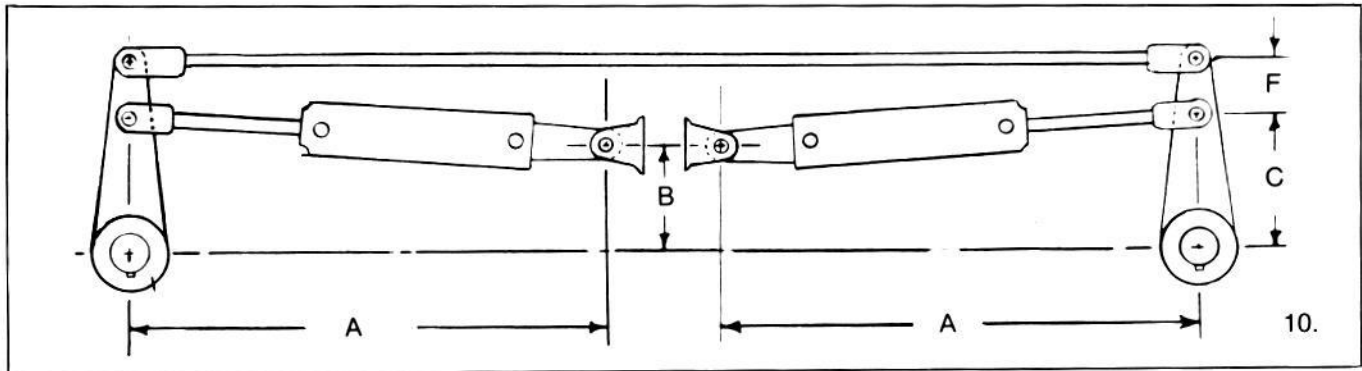
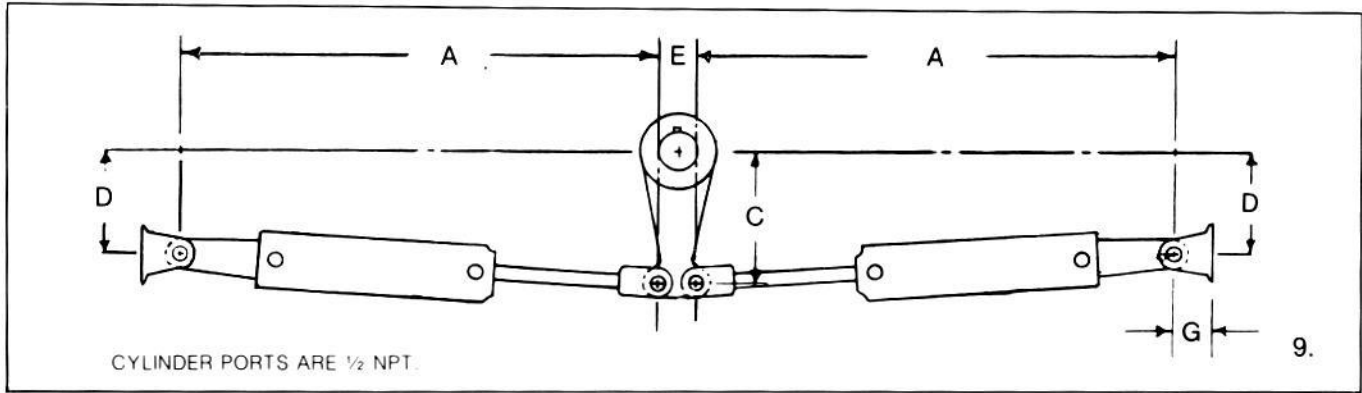
Cylinder models with letters BA are balanced and are normally used as a single unit. (If space permits, balanced cylinders may be used in pairs as an alternative to unbalanced cylinders). The absence of letters BA indicate that the cylinder is un-balanced, and must be used in pairs only. The letters TM indicate a trunion mount. This cylinder can articulate in two planes (axis) to a total of 16°. The absence of letters TM indicate that the cylinder is a clevis pin type with one plane (axis) articulation only.

CYL. MODEL	CYL. VOLUME	
BA 150 - 7 TM	— 10.2 cu. in	167 cu. cm
BA 175 - 7 TM	— 13.7	225
BA 200 - 7 TM	— 18.9	310
2 X 150 - 7 TM	— 23	377
2 X 175 - 7 TM	— 31	508
2 X 200 - 7 TM	— 41	672
2 X 175 - 11	— 45	738
2 X 200 - 11	— 61	1000
2 X 225 - 11	— 81	1328
2 X 250 - 11	— 98	1606
2 X 250 - 15	— 134	2196
2 X 300 - 15	— 194	3180
2 X 350 - 15	— 262	4294

TM MODELS 7'' (177mm) STROKE CYLINDERS NO.S IN BRACKETS DENOTE mm

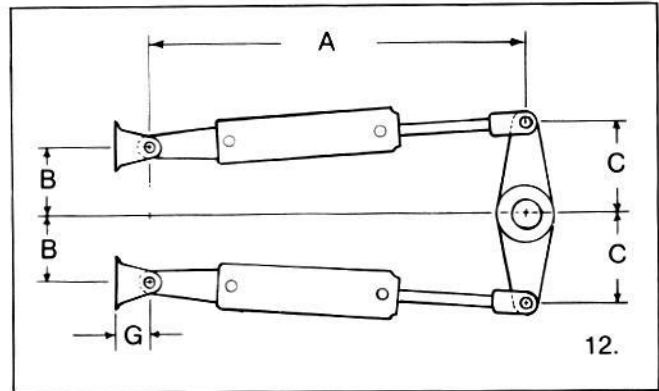
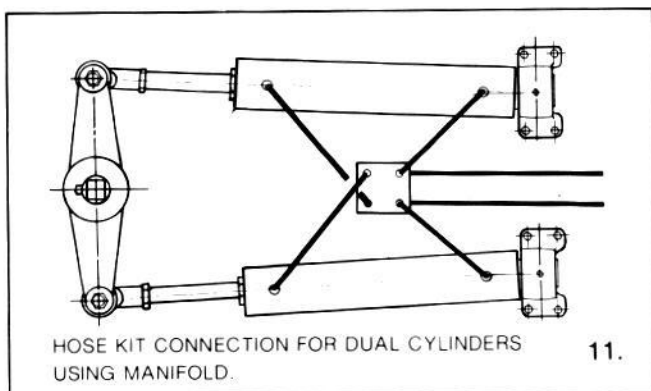


CLEVIS - PIN MODELS 11'' (279mm) AND 15'' (381mm) STROKE CYLINDERS



CYLINDER MODEL	A		B		C		D		E		F		G	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
175-11 *	30 1/4	768	7 1/8	181	9	228	3 1/8	79	2 1/2	64	4 1/2	115	2 3/8	60
200-11 *	30 1/4	768	7 1/8	181	9	228	3 1/8	79	2 1/2	64	4 1/2	115	2 3/8	60
225-11	30 1/4	768	7 1/8	181	9	228	3 1/8	79	2 1/2	64	4 1/2	115	2 1/2	64
250-11	30 1/4	768	7 1/8	181	9	228	3 1/8	79	2 1/2	64	4 1/2	115	2 1/2	64
250-15	37 1/4	946	9 1/2	241	12	304	3 1/2	89	4	101	6	152	2 1/2	64
300-15	37 1/4	946	9 1/2	241	12	304	3 1/2	89	4	101	6	152	2 1/2	64
350-15	37 1/4	946	9 1/2	241	12	304	3 1/2	89	4	101	6	152	2 1/2	64

*CLEVIS PIN DIA. FOR 175-11 & 200-11 IS 3/4" (19) CLEVIS PIN DIA. FOR OTHERS IS 1" (25.4)



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INSTALLATION GUIDE



seal kits

for
SYTEN, SEASTAR AND
TM CYLINDER

capilano

and

SeaStar

ARE MANUFACTURED BY

Teleflex
■ ■ (Canada) Ltd. ■ ■

AND EXPORTED UNDER THE

flexatrol

TRADE NAME

*Before you do it your way,
... please try it our way.*

IMPORTANT:

The following seal replacement guide apply to the following cylinder models only:

Syten and Seastar Cylinders:

BA125-7 BJ, BA135-7 BJ, BA150-7 BJ, BA125-7 MV, BA135-7 MV, BA150-7 MV, BA150-7 EM, BA135-8 EM and 125-8 EM.

Capilano Cylinders:

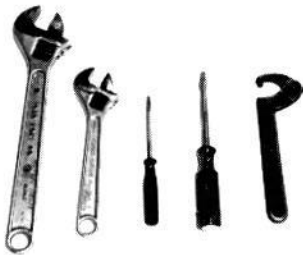
150-7 TM, 175-7 TM, 200-7 TM, BA150-7 TM, BA175-7 TM, and BA200-7 TM.

Due to the similarity of construction of the above mentioned cylinder models, the pictorial guide may or may not always indicate the exact cylinder model that you are repairing, however the recommendations and procedures still apply.

CAUTION:

- Do not attempt to overhaul cylinder without a proper bench vise that is equipped with proper "soft jaws" to prevent marking and scratching of the cylinder shaft and barrel. A small "nick" or scratch on the cylinder shaft will cause a seal to leak.
- When holding the cylinder barrel in a vise, use only sufficient pressure to prevent barrel from moving, over-tightening may cause collapsing of the barrel. If this does occur the barrel must be honed or replaced.
- Before proceeding, ensure that the cylinder is completely drained of hydraulic fluid. If cylinder shaft is pushed or pulled, with oil still in the cylinder, oil will "shoot" out of the fitting, and possibly spraying your face and clothes.

NOTE: DUE TO PERIODIC PRODUCT IMPROVEMENTS, SIMPLIFIED DISASSEMBLY METHODS AND THE USE OF COMMON TOOLS MAY BE POSSIBLE IN FUTURE.



TYPICAL TOOLS REQUIRED FOR T.M. CYLINDER SEAL OVERHAUL.



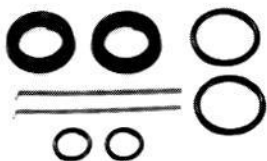
TYPICAL TOOLS REQUIRED FOR SYTEN & SEASTAR CYLINDER SEAL OVERHAUL.



ADJUSTABLE PIN SPANNER
PART NO. HA 3442

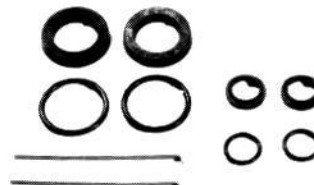


ADJUSTABLE FACE SPANNER
FOR SYTEN & SEASTAR CYL.
PART NO. HA 3440
FOR TM CYL.
PART NO. HA 3441



CONTENTS OF SYTEN & SEASTAR CYLINDER SEAL KIT.

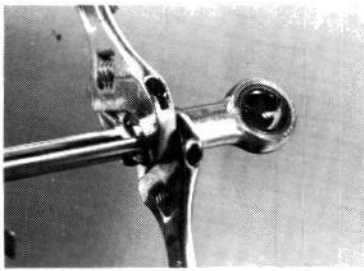
NOTE: CONTENTS OF SEAL KITS SUBJECT TO CHANGE WITHOUT NOTICE.



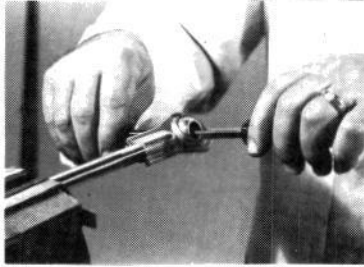
CONTENTS OF T.M. CYLINDER SEAL KIT.

NOTE: CONTENTS OF SEAL KITS SUBJECT TO CHANGE WITHOUT NOTICE.

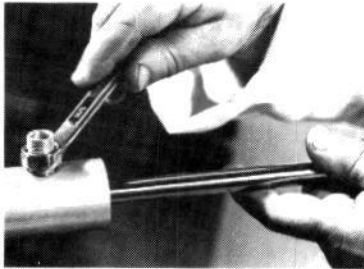
DISASSEMBLY GUIDE



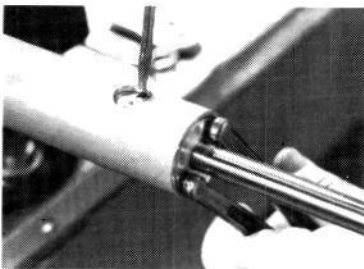
REMOVAL OR INSTALLATION OF BALL JOINTS.



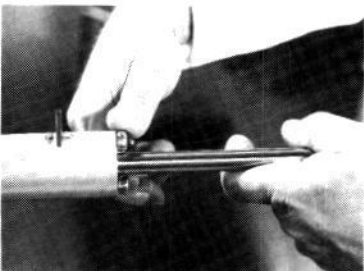
FOR SYTEN CYLINDERS, CYLINDER SHAFT MUST BE HELD IN A VICE USING "SOFT JAWS"



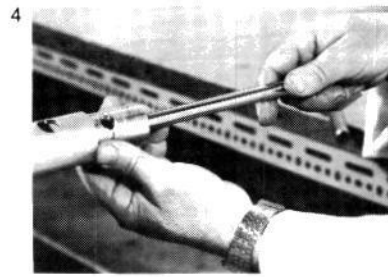
REMOVE CYLINDER FITTING FROM CYLINDER. THE USE OF A BOX TYPE WRENCH IS RECOMMENDED, TO PREVENT DAMAGE TO THE FITTING.



REMOVAL OF CYLINDER FITTING WILL EXPOSE RETAINING WIRE. THE RETAINING WIRE CAN BE FED OUT BY TURNING THE CYLINDER GLAND. USE A SMALL SCREWDRIVER OR SIMILAR DEVICE TO HELP LIFT UP RETAINING WIRE THROUGH THE CYLINDER BARREL FITTING HOLE.



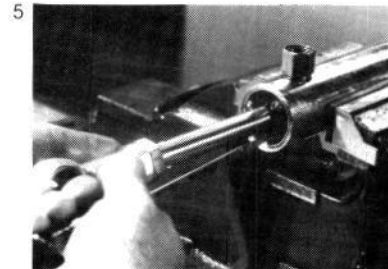
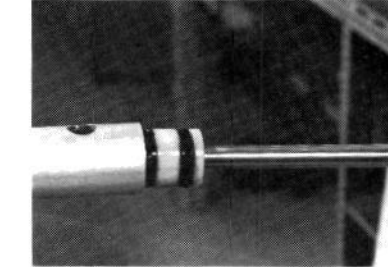
CAUTION: TURN THE CYLINDER GLAND IN THE DIRECTION SO THAT THE "BENT" OR "HOOKED" SECTION OF THE RETAINING WIRE COMES OUT LAST.



THE CYLINDER GLAND CAN NOW BE REMOVED BY A SUCCESSION OF SHORT-HARD PULLS OF THE CYLINDER ROD. GLAND SEALS CAN NOW BE REMOVED. THE CYLINDER ROD CAN NOW BE REMOVED IN A SIMILAR MANNER.

CAUTION: WHENEVER THE CYLINDER IS COMPLETELY DISASSEMBLED, CHANGE AND REPLACE ALL SEALS REGARDLESS OF CONDITION.

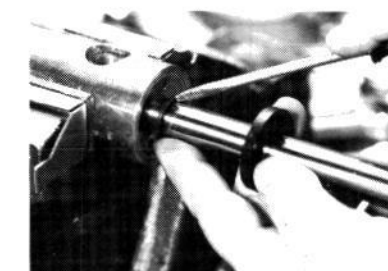
CAUTION: NOTE HOW "U" CUP SEALS ARE PLACED ON PISTON.



VARIATION:
THE BALL JOINT ROD END CYLINDER SHAFT SEAL ON T.M. CYLINDERS CAN BE REPLACED WITHOUT HAVING TO REMOVE THE CYLINDER GLAND.

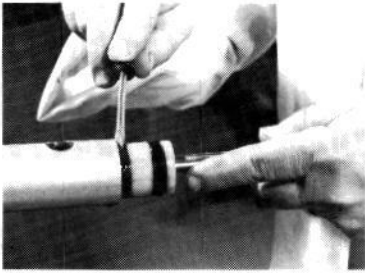
- REMOVE BALL JOINT
 - UNSCREW SEAL CAP SCREWS
 - REMOVE SEAL CAP
 - REMOVE DEFECTIVE OR WORN 'O' RING
- REVERSE PROCEDURE FOR ASSEMBLY.

CAUTION: REFER TO ASSEMBLY GUIDE SECTION FOR IMPORTANT NOTES:

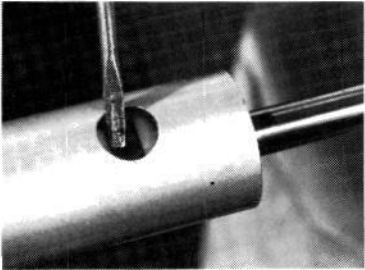


INSERTION OF NEW SHAFT SEAL INTO A T.M. CYLINDER MOUNTING GLAND.

ASSEMBLY GUIDE



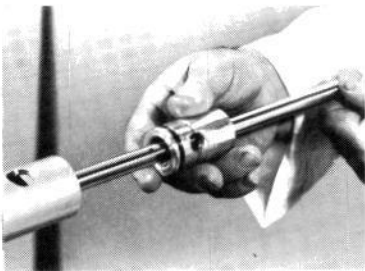
IMPORTANT:
LUBRICATE ALL SEALS AND PARTS THAT WILL COME IN CONTACT WITH SEALS PRIOR TO RE-ASSEMBLY. FAILURE TO DO SO CAN DAMAGE NEW SEALS DURING ASSEMBLY. THE USE OF A THICK OIL WITH SUPERIOR LUBRICATION IS RECOMMENDED.



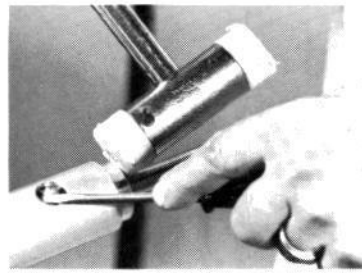
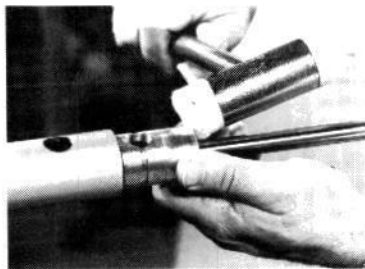
USE A SMALL BLUNT OBJECT TO GUIDE SEAL EDGES INTO BARREL AND THROUGH FITTING HOLE

BASIC ASSEMBLY STEPS:

- SLIDE PISTON-SHAFT INTO BARREL.
- SLIDE GLAND ONTO PISTON ROD AND TAP GENTLY INTO BARREL.

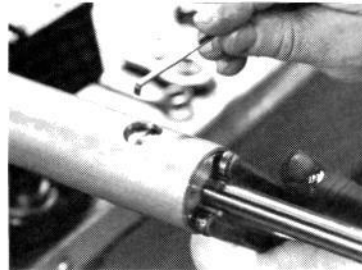


CAUTION: USE A "SOFT" MALLET OR HAMMER. ENSURE THAT PLENTY OF LUBRICANT IS USED ON SEAL AND SURFACES.

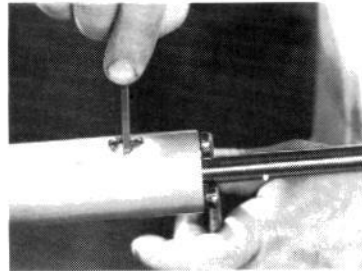


WHEN THE LARGE GLAND "O" RING HAS ENTERED THE CYLINDER BARREL. USE A BLUNT OBJECT TO GUIDE "O" RING THROUGH THE INSIDE BOTTOM EDGE OF THE FITTING HOLE.

TURN THE GLAND UNTIL THE RETAINING WIRE "HOOK" HOLE IS VISIBLE.

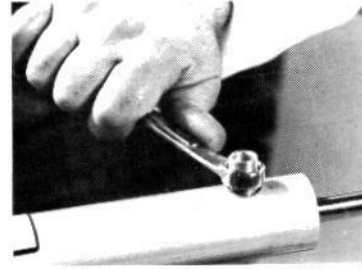


INSERT HOOK OF RETAINING WIRE IN THE HOLE AND TURN GLAND TO FEED RETAINING WIRE IN. STOP TURNING THE GLAND WHEN THE THREADED FITTING HOLE APPEARS AND IS ALIGNED WITH CYLINDER BARREL FITTING HOLE.



APPLY A GOOD QUALITY THREAD SEALER TO THE FITTING AND REINSTALL.

CAUTION: DO NOT OVERTIGHTEN. IF FITTING IS THREADED IN TOO DEEP, THE FITTING MAY JAM AGAINST CYLINDER ROD, PREVENTING MOVEMENT OF THE CYLINDER ROD.



CAUTION: THIS IS A GUIDE ONLY. TELEFLEX ASSUMES NO RESPONSIBILITY WHATSOEVER OF ANY CONSEQUENCES DUE TO OVERHAULING OR REPAIR TO OUR CYLINDERS.

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[Canada] Ltd.

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APPLICATION GUIDE

3



fittings

for
SEASTAR AND SYTEN
HYDRAULIC STEERING SYSTEMS

capilano

and

SeaStar

ARE MANUFACTURED BY

Teleflex
■ (Canada) Ltd. ■

AND EXPORTED UNDER THE

flexatrol

TRADE NAME

*Before you do it your way,
please try it our way.*

Fittings shown here are used in the installation of Teleflex-Flexatrol hydraulic steering systems.

The following code-guide indicates the system in which the fittings are most commonly used:

- SeaStar stern drive and inboard systems A
- SeaStar outboard systems B
- OMC Seadrive® C
- SeaStar brass inboard cylinders D
- SeaStar cylinder hose kits E
- Syten systems F

NOTE:

All tapered threads are 1/4" or 3/8" N.P.T. (National Pipe Threads). Tube connecting end of fitting, tube nuts and o/b hose swivel nut are 9/16" X 24 NEF (National Extra Fine).

All fittings are made of brass. In some cases brass fittings are plated.

SEASTAR FITTING KIT CONTENTS			
PART NO.	CONTENT	PART NO.	PHOTO NO.
HF 5501	1 ea. NON VENT PLUG	HA 5432	—
	2 ea. TEE	HF 5531	12
	4 ea. CONNECTOR	HF 5528	3
	4 ea. TUBE NUT	HF 5526	1
	1 ea. 25' SS TUBE	HT 5092	—
HF 5502	1 ea. NON VENT PLUG	HA 5432	—
	2 ea. TEE	HF 5530	11
	2 ea. ELBOW	HF 5529	4
	2 ea. CONNECTOR	HF 5528	3
	10 ea. TUBE NUT	HF 5526	1
HF 5503	2 ea. TUBE NUT	HF 5526	1
	2 ea. BLEED TEE	HF 5520	14
	2 ea. REDUCER FTG.	HF 5535	5
HF 5504	12 ea. TUBE NUT	HF 5526	1
	4 ea. ELBOW	HF 5534	8
	4 ea. BLEED TEE	HF 5520	14
	4 ea. REDUCER FTG.	HF 5535	5
	4 ea. CONNECTOR	HF 5532	7
HF 5507	2 ea. UNION COUPLING	HF 5527	2
	4 ea. TUBE NUT	HF 5526	1
	6 FT. SS NYLON TUBE	—	—
HF 5508	2 ea. UNION COUPLING	HF 5527	2
	2 ea. TUBE NUT	HF 5526	1
	1 ea. O/B HOSE KIT	HO 5102	—
HF 5512	2 ea. BULKHEAD FTG.	—	19
HF 5513	2 ea. BULKHEAD FTG.	—	21
HF 5514	2 ea. BULKHEAD FTG.	—	19
	2 ea. BULKHEAD FTG.	—	20
HF 5515	2 ea. BULKHEAD FTG.	—	21
	2 ea. BULKHEAD FTG.	—	22

CODE A, E

1



HF 5526 TUBE NUT $\frac{3}{8}$ " NYLON AND COPPER TUBE

CODE A, E

2



HF 5527 UNION COUPLING FTG. TUBE TO TUBE

CODE A, B

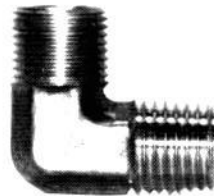
3



HF 5528 CONNECTOR FTG. TUBE X $\frac{1}{4}$ " NPT MALE

CODE A, B

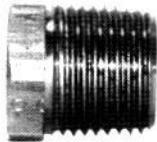
4



HF 5529 ELBOW FTG. TUBE X $\frac{1}{4}$ " NPT MALE

CODE C

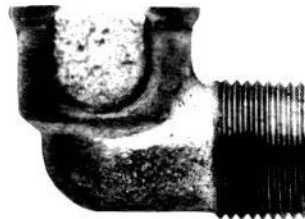
5



HF 5535 REDUCER FTG. $\frac{3}{8}$ " NPT MALE TO $\frac{1}{4}$ " NPT FEMALE

CODE A, B

6



HF 5538 ELBOW, TUBE TO $\frac{1}{4}$ " NPT FEMALE

CODE C

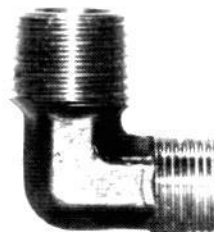
7



HF 5532 CONNECTOR TUBE TO $\frac{3}{8}$ " NPT MALE

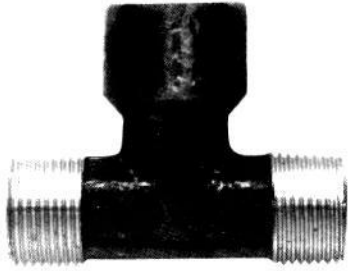
CODE C

8



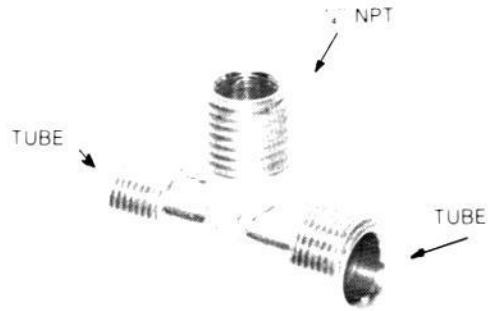
HF 5534 ELBOW FTG. TUBE TO $\frac{3}{8}$ " NPT MALE

9



HF 5533 TEE, ENDS TUBE, BRANCH 1/4" NPT FEMALE

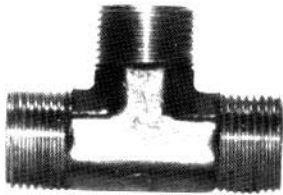
10



HF 5536 TEE FTG. ENDS TUBE, BRANCH 1/4" NPT MALE

CODE A

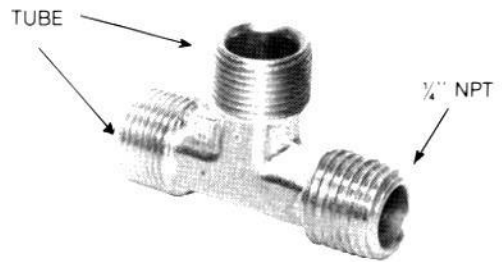
11



HF 5530 TEE FTG. 3 X TUBE

CODE B

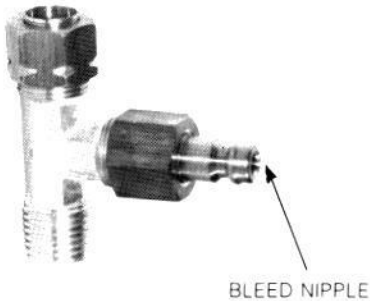
12



HF 5531 TEE FTG. ENDS = TUBE & 1/4" NPT MALE. BRANCH = TUBE

CODE A

13



HF 5521 BLEEDER TEE (EM CYLINDERS)

CODE A, C

14



HF 5520 BLEEDER TEE (BJ CYLINDER)

CODE F

15



HA 0027 TUBE NUT FOR 1/8" TUBE ONLY NYLON & COPPER

CODE F

16



HA 0162 EYELET FOR 1/8" NYLON TUBE ONLY

CODE F

17



HA 0292
GROMMET FOR 1/4" TUBE ONLY. NYLON & COPPER

CODE F

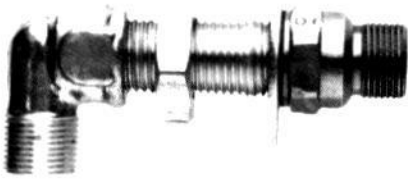
18



HA 3101 SHUTTLE TEE 3X TUBE

CODE B

19



CODE B

20



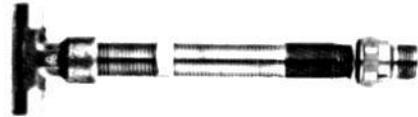
CODE B

21



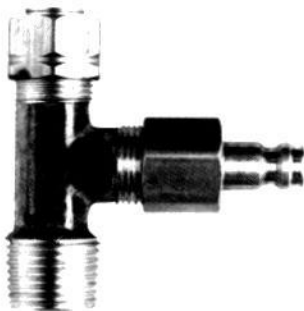
CODE B

22



CODE A

23



BLEEDER TEE, TM CYLINDER

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