KOBELT

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STEERING GEAR SELECTION

AND

INSTALLATION

"LEADERS IN QUALITY MARINE CONTROLS, STEERING GEAR AND DISC BRAKES"

CLASSIFICATION

Not all steering gear components need approval by classification. The ones that do, however, are manufactured by Kobelt and are Lloyds Type Approved. Lloyds Type Approval means that the product is designed and manufactured to be functional and seaworthy for its intended purpose. If a vessel is built to Lloyds rule but not certified, that means that all components can be readily used without any further paper work. If, however, a vessel is to be certified, all of the items required need special drawings which have to be prepared and sent for approval. There are several classification groups, such as Lloyds, ABS, NKK, BV and DNV ect. Their rules and specifications are very similar and once type approval is granted by one of the inspecting authorities, it is usually a foregone conclusion that the others will accept it as well. Certification, however, is a different matter. The components supplied by Kobelt, are Society approved and certified, this does not mean that the system once installed aboard a vessel is approved and certified. The installer or the shipbuilder then have to get the installation approved. Kobelt's certification provided by the Society only relates to the components supplied by us. Getting a system certified can sometimes be a lengthy process and also expensive. The closer the cooperation between the customer and Kobelt and the more information made readily available to us at the very beginning, the more the expense can be reduced, since any changes in the system will cost us $100.00 U.S. an hour by the inspection authorities.

STEERING GEAR SELECTION AND INSTALLATION

Selecting the proper steering gear for a marine vessel is extremely important. If the components that are selected prove to be inadequate, disastrous consequences could arise. Properly selected steering gear will make a tremendous difference in the feel and response of a vessel and will make an enormous difference as far as feeling confident without any major effort in the control of a ship or boat.

Kobelt Manufacturing highly recommends that any and all steering gear is sized in accordance with the ship's or boat's rudder, hull design and speed of the vessel. We feel that it is very important to get the proper steering gear components installed the first time around.

After the rudder torque is established, the proper steering cylinder combination can be established. In other words, the diameter of the cylinder and stroke of the cylinder that will be sufficient to operate the rudder safely. Once the cylinders have been established the volume of hydraulic fluid to turn the rudder from hardover to hardover is given in our tables. If for example a rudder torque is established with 35° rotation to either side, with a torque of 4,000 foot pounds a single cylinder model 7080 with 12" stroke can be installed. This cylinder requires 70.1cu. inches of oil. If for example a 7005 Helm pump is used at full volume, it will require 12 turns to move the cylinder from extreme to extreme. This may prove to be too many turns for some operators. If a 7012 pump is installed at full volume, this pump produces 12 cu. inches per turn, only six turns at the helm pump will be required to turn the rudder 35° to either side. If a single cylinder is used in a steering gear system, it is extremely important that the cylinder is of a balanced type since there is a limited reservoir in the helm pump. A single unbalanced cylinder will cause the oil to go low with the cylinder all the way extended and may cause the helm pump to overflow with the cylinder all the way contracted. An unbalanced cylinder will also cause unequal turns from side to side. A balanced cylinder has the piston rod coming out on both sides of the cylinder whereas in an unbalanced cylinder the rod only extends on the rod end side.

INSTALLATION INSTRUCTIONS
FOR
STEERING CYLINDERS

Before installing a steering cylinder, it is important that the proper cylinder is selected to provide enough force to turn the rudder hardover to hardover in extreme conditions and also is of sufficient stroke to provide the proper degrees of rotation for the rudder stock. A steering cylinder is a linear motion device and its function is to convert this linear motion into a rotary motion off the rudder stock.It is also of extreme importance to remember that the cylinder must be installed to provide equal travel in both directions. The information for all cylinder installations is given in Kobelt steering gear brochures. To arrive at the proper geometry, the tiller arm must be at 90° in mid-position in accordance with our installation instructions. If this is not accomplished, unequal travel from straight-ahead will result.

The following two sketches indicate: Figure No. 1 shows the proper angle and positioning of steering cylinders, rudder stock and related components. Figure No. 2 shows a wrong installation where it can clearly be seen that even though the rudder turns 35° in either direction, the stroke is unequal and therefore, the rudder would not be in mid-position. All indications and feedback signals, as well as the number of turns or fluid required to turn the rudder hardover to either side would not be the same.

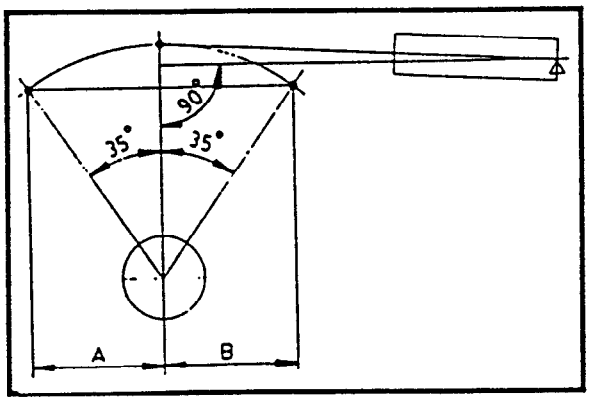


Figure No. 1 RIGHT
It can clearly be seen that A and B are of equal length.

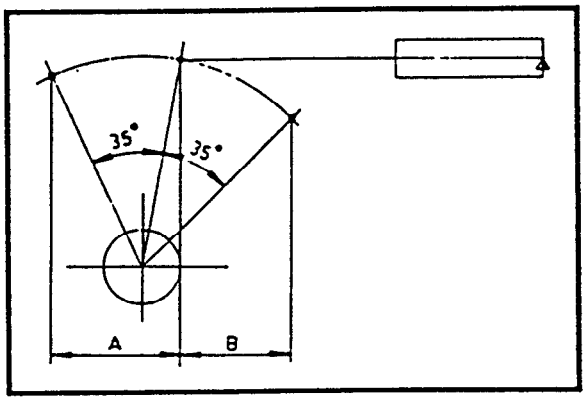


Figure No. 2 WRONG
With the wrong geometry, A and B are <u>not</u> equal.

The feedback linkage for rudder angle indicators and electronic steering devices must also be installed on the same mechanical principals since again, a rudder angle indicator could be reading more degrees of rotation to one side than the other if these steps are not followed. It is also important to remember that the piston rod on a balanced cylinder will protrude past the mounting foot when the cylinder is in its contracted position and during the installation, room must be allowed for the piston rod.

It must also be remembered that a piston rod goes through a slight arc as the cylinder is moved from hardover to hardover. Allowance must be made so that there is no mechanical interference with any other objects. Failing to do so could result in bending the piston rod.

Another very important fact to remember is that the piston rod itself is made of stainless steel, is ground, hard-chromed and polished and is therefore a relatively expensive item. The rod should be protected during installation from mechanical or welding damage. If the piston rod, in fact, is damaged, the hydraulic seals will also become damaged and external leakage is unavoidable. This would mean that the piston rod itself and the seals would have to be replaced.

On a multi-rudder vessel with mechanical tie bars, it is of extreme importance that all rudders are synchronized mechanically to obtain best vessel performance. Kobelt Manufacturing can provide rod ends and special adaptors to be welded on the tie bar pipes which makes it very convenient to the shipyard. Also special tiller arms can be ordered from Kobelt to accomplish all these special tasks. For catamaran vessels where a mechanical tie bar is not feasible, Kobelt can provide electronic rudder synchronization.

The cylinder must be installed on a flat and even surface to avoid stressing of the mounting pad. If this is not followed, the trunnion mount could be cracked. It is also important to remember that a flexible hose is required on the end of the piping to connect to the cylinder itself. Since the cylinder moves through an arc in operation, a solid pipe or tubing connection to the cylinder is not acceptable. A flexible hose must be installed. All piping and hosing must be of sufficient diameter and pressure rating to comply with the general system specifications. It is of extreme importance to keep all lines and hosing and hydraulic components spotlessly clean during the installation since any foreign matter inside the hydraulic components and transmission lines could cause damage to the hydraulic components. The tiller arm and mounting pad for the trunnion must be designed to absorb a minimum of double stress imposed by the hydraulic cylinder(s). All bolts and nuts should to be of superior quality and should be tightened securely.

If a pressure compensated pump is used in conjunction with a safety valve, it is of the utmost importance that the safety valve be set 10-15% (minimum 200 lbs.) higher than the maximum pump pressure. Failing to do this would cause the pump to operate at the safety valve pressure and maximum volume, dumping the oil back to the tank. This would create high oil temperature, excessive consumption of energy and unwanted wear and tear.

MOUNTING THE HELM PUMP

The helm pumps are supplied with a short shaft or with a long shaft. Either of these pumps can be mounted through the console or behind the console, although the short shaft version would normally be mounted in the thru-console mode.
As can be seen in our catalogue specifications, Kobelt Manufacturing produces 5 different helm pumps.
Model 7031 is available with either 2 cu.in. or 2.6 cu.in. per turn. This pump is not adjustable, it is a fixed displacement pump. Kobelt Manufacturing produces 3 pumps which are adjustable. Our model 7003 can be adjusted from 1 to 3 cu.in. per turn. Our model 7005 is adjustable between 2 and 6 cu.in. per turn and our model 7012 is adjustable from 4 to 12 cu.in. per turn. When installing these helm pumps one must allow sufficient space to install a steering wheel. The bigger the volume of the pump the bigger the steering wheel should also be. For our smaller pump model 7031 and 7003, we recommend the minimum wheel diameter of approximately 12 to 14 inches. Bigger wheels can be installed without causing any harm to the pump, with our model 7005, we recommend a 24" diameter wheel or bigger. On our Model 7012 a 30" - 36" diameter wheel or bigger should be installed. The reason for these large wheels is that a person must produce a torque on the helm pump sufficient to operate the rudder. With a small wheel it is very difficult to produce a lot of pressure. Kobelt Manufacturing does not recommend operating cylinders larger than our Model 7080 with a manual system since the human effort is just too much to operate big cylinders on a manual basis.
When deciding which way to mount the pump, attention must be paid to the method of filling the system. When mounted thru-console, the filler plus is accessible, but when behind the console, it is obscured. In the behind console mode, either arrange access to the filler plug or arrange some form of remote filling system. The remote filling system can either be a small tank or a tube run up from the pump to a position convenient for topping up with oil.

Kobelt helm pumps, model 7031, can be installed at any angle. Models 7003, 7005 and 7012 are best installed with the shaft on a horizontal plane.

Thru-console

A template is provided for the cut-out to allow the front half of the pump to protrude through the console with the flange butting up against the back or front face of the console. The pump should be secured to the console by four bolts through the bolt holes at the four corners of the pump flange. The mounting surface for the pump **must be flat,** an uneven surface could Distort the pump causing it to leak

Behind console

A template is provided for the cut-out to allow the pumpshaft through the console and for the drilling of four holes to secure the pump to the back face of the console. Four bolts and washers are required to screw into the tapped holes in the face of the pump. If the variable flow facility of the helm pump is to be used, cut the hole for access to the adjusting screw.

Installation with adaptor plate

An adaptor plate is optionally available to greatly simplify mounting of the pump. This plate can be installed on either side of the console. A template is provided to drill the necessary holes. Two bolts with washers are required in this case to secure the pump to the bulkhead.

All helm pumps have a lock valve mounted directly on the back. The ports are 7/16" O Ring fitting for Model **7003**, 9/16" O Ring. for Model **7005** and 1/2" N.P.T. for Model **7012**. In dual station installations, the vent line ports must also be used. These ports are 1/4" N.P.T. on all pumps.

Adjusting the output

INCREASING the output of the pump DECREASES the number of turns hardover to hardover. The lower the number of turns, the stiffer the steering will feel. Larger diameters of wheel may be necessary at full pump output, depending on cylinder size. Consult our distributor or dealer.

DECREASING the output of the pump INCREASES the number of turns hardover to hardover. The steering will become lighter with the increased number of turns and this should allow the use of small diameter wheels.

To increase output:	Turn the screw clockwise
To decrease output:	Turn the screw counterclockwise

Tubing

Dependingon the number of stations the length of runs and the size of the helm pump the piping must be chosen acordingly. We recommend the minimum diameter of 1/2" tubing, but on long runs, and larger pumps the 3/4" tubing is recommended.

Fittings

Pipe fittings should not be over-torqued since the tapered thread can cause splitting of the control components. The table below indicates the torque required for tightening tapered fittings.

1/8" N.P.T.	10 Ft lbs
1/4" N.P.T.	20 Ft lbs
3/8" N.P.T.	30 Ft lbs
1/2" N.P.T.	40 Ft lbs

BASIC SELECTION GUIDE FOR KOBELT HYDRAULIC STEERING

HYDRAULIC STEERING SYSTEMS ARE AVAILABLE WITH THE FOLLOWING OPTIONS

Please tick box

A. MANUAL HYDRAULIC STEERING OR POWER — M ☐ P ☑

B. MANUAL NUMBER OF TURNS REQUIRED H-O TO H-O (H-O, HARD OVER) ☐

C. NUMBER OF STEERING STATIONS (HYDRAULIC) ☐

D. HEADER TANK (KOBELT #7002) ☐

E. RUDDER ANGLE INDICATORS REQUIRED (KOBELT #7175) ☐

F. PANORAMIC RUDDER ANGLE INDICATOR (KOBELT #7178) ☐

G. AUTO-PILOT HYDRAULIC PUMP (KOBELT #7201) ☐

H. AUTO-PILOT INTERFACE ☐

IF "YES" INDICATE SPEED — SINGLE ☐ TWO ☐

I. NUMBER OF JOG LEVERS (KOBELT #7170) ☐

J. FULL POWER FOLLOW UP (FFUS) SERVO HYDRAULIC STEERING (KOBELT #7147 OR #7148) ☐

K. FULL POWER FOLLOW UP (FFU) ELECTRONIC STEERING (KOBELT #7173) ☐

L. ELECTRONIC TIE BAR (KOBELT #7173) ☐

M. STATION TRANSFER ☐

N. NUMBER OF STATIONS (ELECTRONIC) ☐

O. TILLER ARMS — SINGLE ☐ TWIN ☐

P. TYPE OF CONTROL ☐

7171 ☐

7171-SW ☐

7172 ☐

SPECIFY ☐

RUDDER INFORMATION REQUIRED

NUMBER OF RUDDERS — 1 ☐ 2 ☐ OTHER ☐

NUMBER OF CYLINDERS PER RUDDER ☐

TIE BAR FITTING REQUIRED ☐

DEGREE OF RUDDER ROTATION — 35 ☐ 45 ☐ OTHER ☐

RUDDER TORQUE (*IF AVAILABLE) ☐

SPEED H-O TO H-O (H-O, HARD OVER) IN SECONDS ☐

POWER INFORMATION REQUIRED

SPECIFY ELECTRICAL POWER AVAILABLE FOR POWER PACK — VOLTAGE ☐ PHASE ☐

SPECIFY ELECTRICAL POWER (DC) AVAILABLE FOR ELECTRONIC CONTROLS — 12V ☐ 24V ☐

ENGINE DRIVEN PUMPS ☐

* IF RUDDER TORQUE IS NOT AVAILABLE PLEASE COMPLETE HYDRAULIC STEERING TECHNICAL DATA SHEET

KOBELT

Hydraulic Steering Technical Data Sheet

To properly size the steering system required for your vessels please complete the following accurately.

Customer Name: _____ Date: _____

Address: _____ Phone: _____

_____ Fax: _____

Signature: _____

Vessel Name: _____

Vessel length: _____

Vessel type: _____ (Power, Sail, Workboat, etc.)

Hull type ☐ Planing ☐ Displacement ☐ Sail

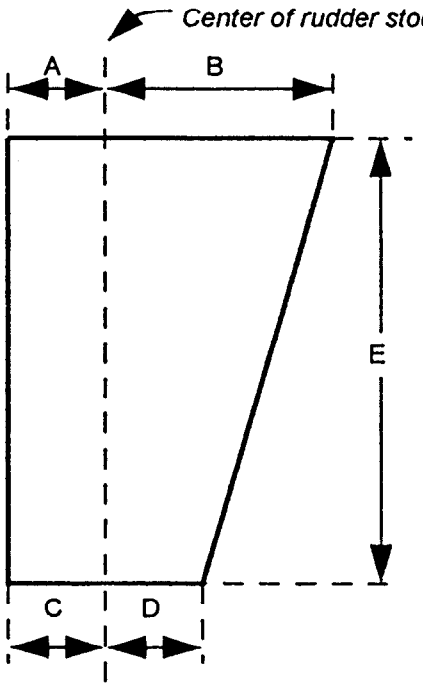
Maximum speed: _____

Number of rudders: _____

Degree of rudder angle 2 x _____

Please specify other details (Nozzle, Tunnel, etc.) _____

Dimensions and counter balance of rudder, provide sketch as per sample

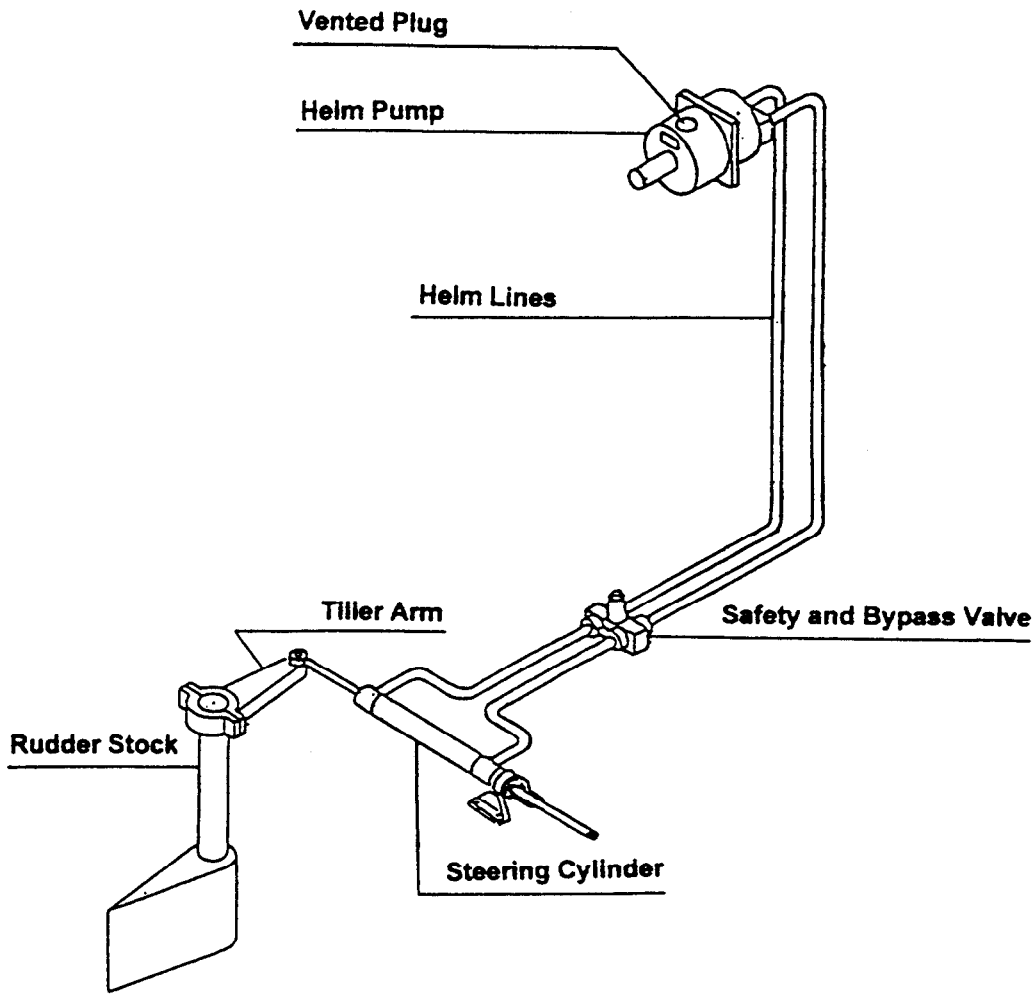


Unit of measure ☐ mm ☐ inches

INSTALLATION No. 1

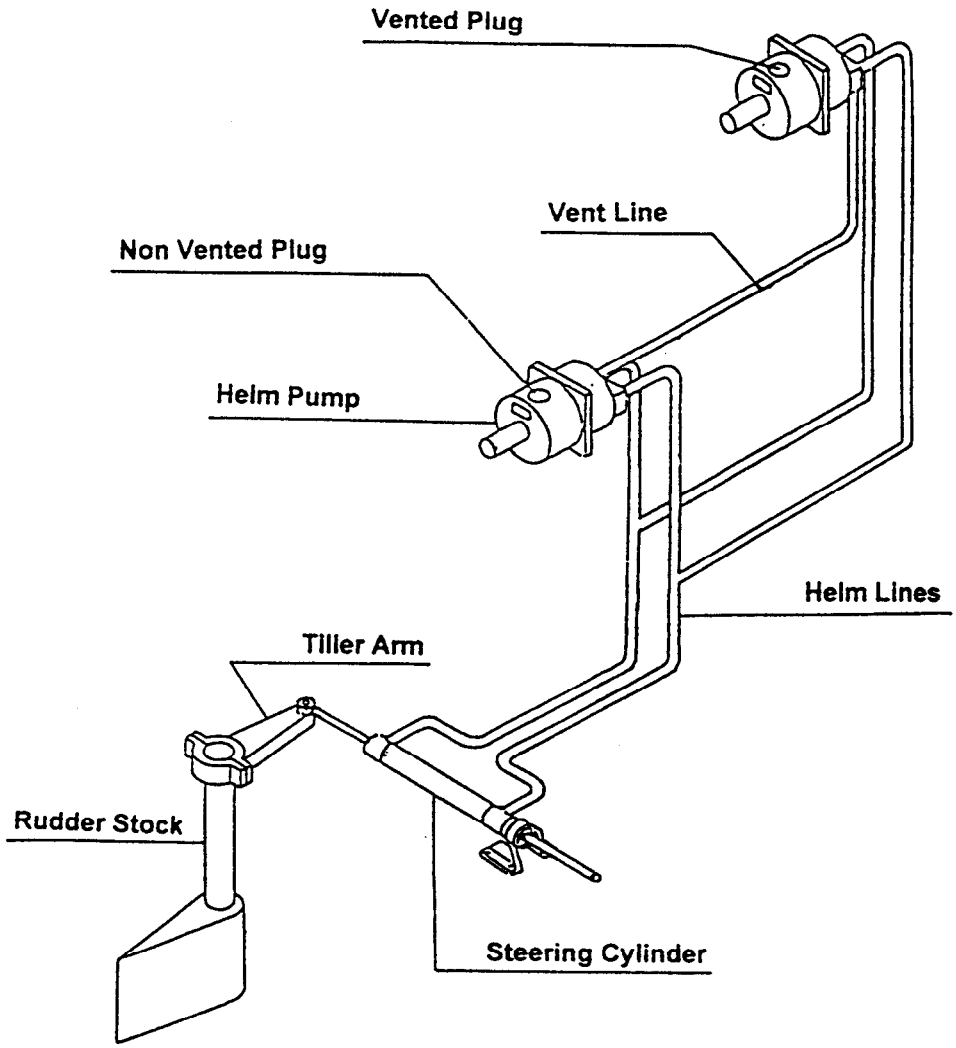
This illustrates a single balanced cylinder operating a single rudder with a one station manual helm pump. A 7020 safety and bypass valve is also installed. The purpose of this valve is to avoid breakage in the steering system, should the rudder bump into some solid object. If the pressure rises in the steering lines above 1400 psi, the oil will bypass in the 7020 valve from the high pressure side of the steering system into the low pressure side of this steering system and will therefore allow the rudder to yield. A screw with lock nut is provided in the middle of the bypass valve. By loosening the lock nut and turning the screws anti clockwise, will allow the rudder to be moved manually during dry docking. One must, however, remember to close the valve before going to sea.

The helm pump must have a filler vented plug. The system must be left open in order to allow for oil expansion and contraction. Failing to do so will cause damage to the helm pump shaft seal. Please note the size of helm's lines recommended for various pumps and length of the run required. In areas where the weather gets cold, it is recommended to go with the bigger lines since the hydraulic oil can become harder to move.



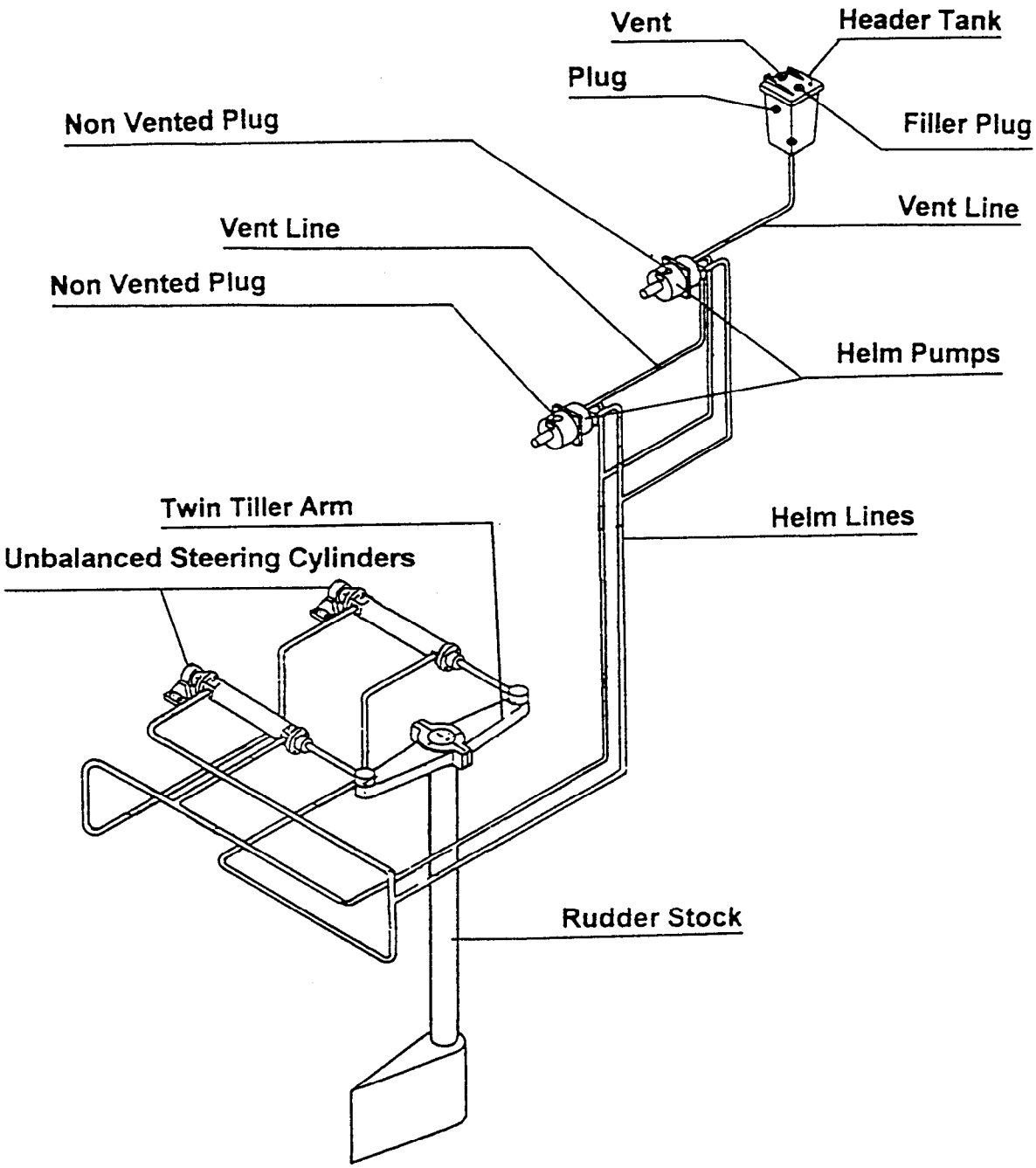
SYSTEM No. 2

This system illustrates a single rudder single cylinder two station manual helm pump . Please note that the lower station has a non vented filler plug and the upper station must have a vented plug. There is also a 3/8 vent line going from the lower helm pump to the upper helm pump. The purpose of this line is to vent air from the lower helm pump to the upper pump, where the air can escape into atmosphere during the filling process. When installing the tubing between the hydraulic components, it is extremely important to keep this tubing and fittings clean from foreign matter, especially sand. This can cause a tremendous amount of damage to the internal parts of the steering system and could cause the system to leak and fail. We recommend the use of liquid teflon for all pipe fittings.



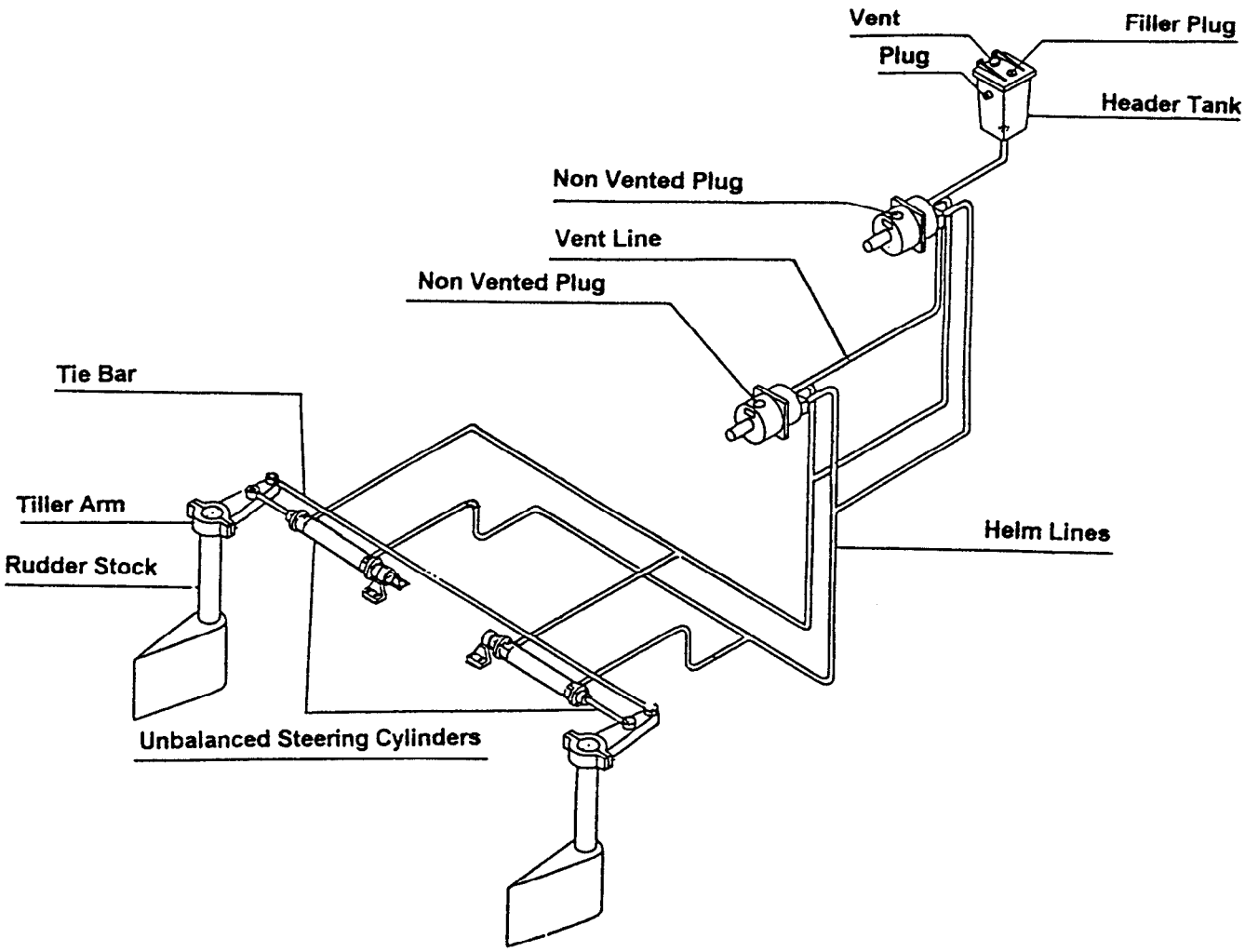
SYSTEM No. 3

System No. 3 illustrates a single rudder steering system with 2 cylinders attached on a double tiller arm. These cylinders can be of an unbalanced type. Please also note that the 2 helm pumps are not vented. Again, there is a vent line between the lower and upper helm pump and from the upper helm pump there is a vent line to the header tank. The header tank must have a vent and must be installed above the top helm pump. The extra reservoir in the header tank makes bleeding considerably easier. All Kobelt steering cylinders are also equipped with bleeder valves. The bleeder valves can be opened to let the air escape during the bleeding process.



SYSTEM No. 4

System No. 4 illustrates a twin rudder manual hydraulic steering. Again with the two unbalanced cylinders and a mechanical tie bar. This system is basically the same as system No. 3.

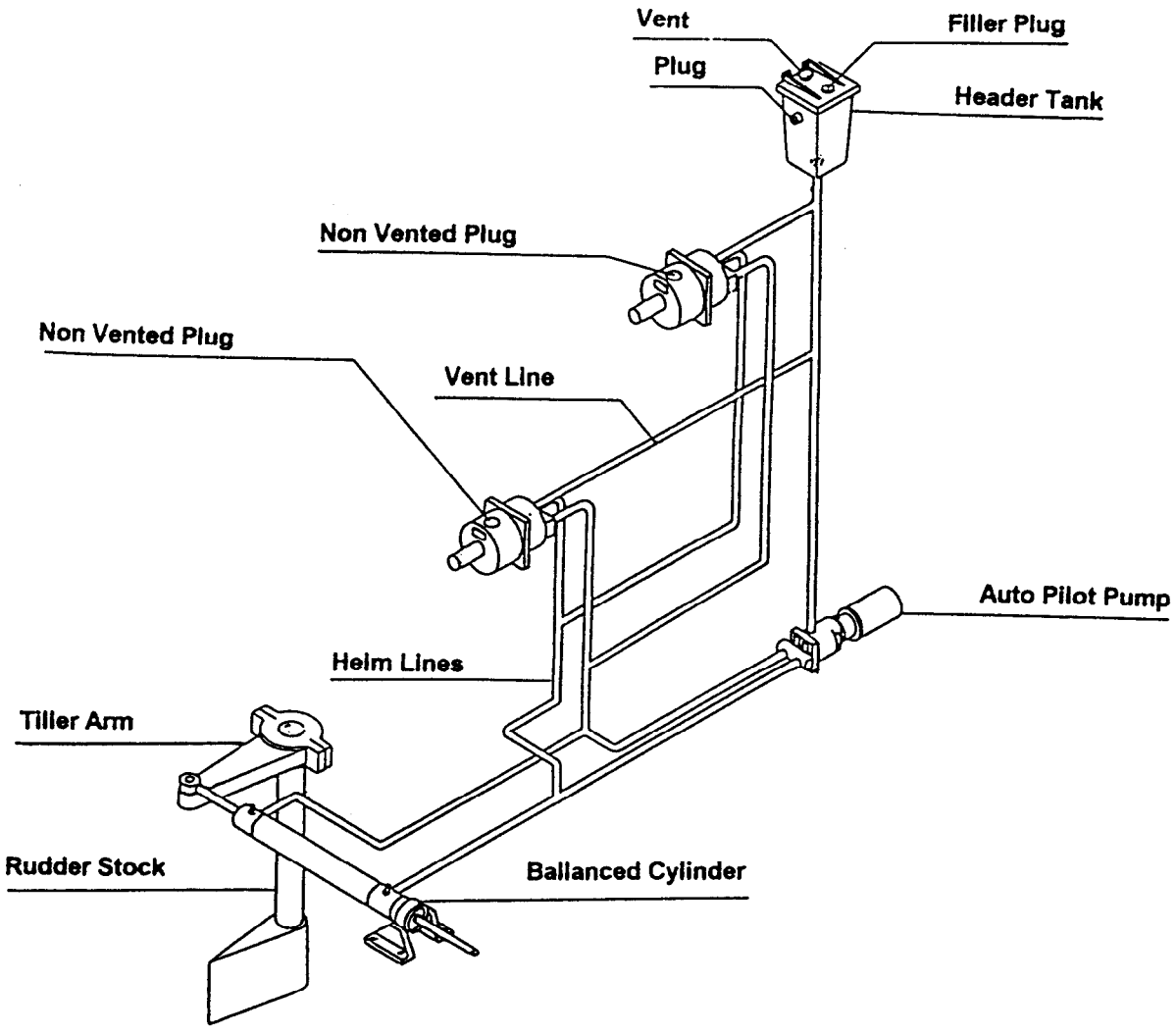


SYSTEM No. 5

System No. 5 illustrates a two station single rudder manual steering system with a battery operated auto pilot pump, Kobelt part No. 7201. This pump is available in either 12 or 24 Volt DC. The pump is controlled by either an auto pilot or jog lever. Relays (7201-RL12-24) must be installed between the auto pilot and the pump since the motor can draw up to 40 amps in a 12 Volt system. Safety valves and flow controls are integrated into the pump. A header tank is recommended for this type of system.

Hydraulic Lines and Fittings

For a manual Helm system it is recommended to install hydraulic tubing or lines with a minimum 1,000 psi operating pressure. The tubing must be kept absolutely clean during the installation and all fittings must be of good quality. Since the steering cylinders go through an arc when turning the rudder, a flexible hose must be installed between the tubing and cylinder. This flexible hose must be long enough not to cause any flexing of the tubing and again the hose must withstand a minimum of 1,000 psi working pressure.



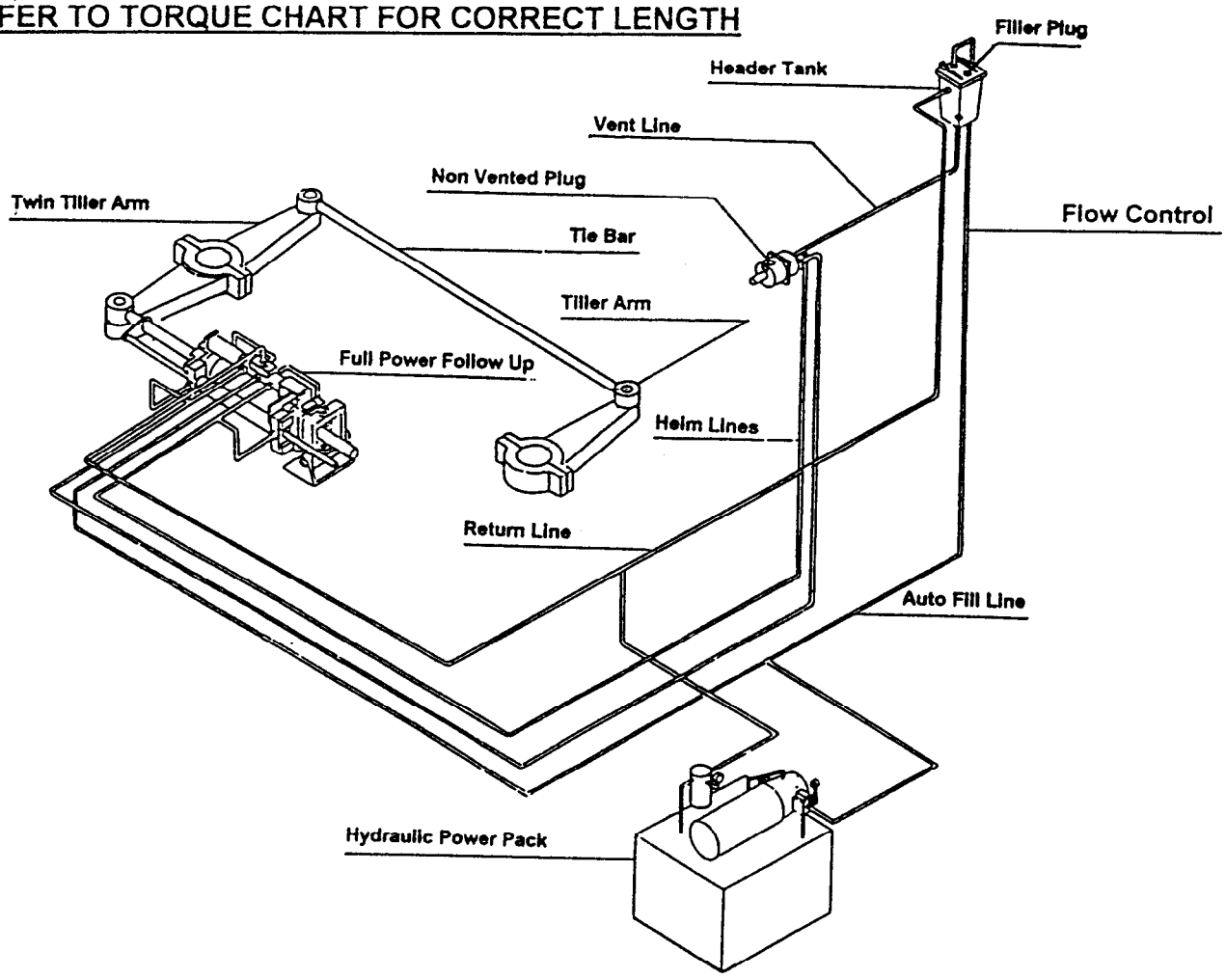
SYSTEM No. 6

Full Follow-Up Power Assist Steering Model 7147

U.S. Patent No. 5,289,756

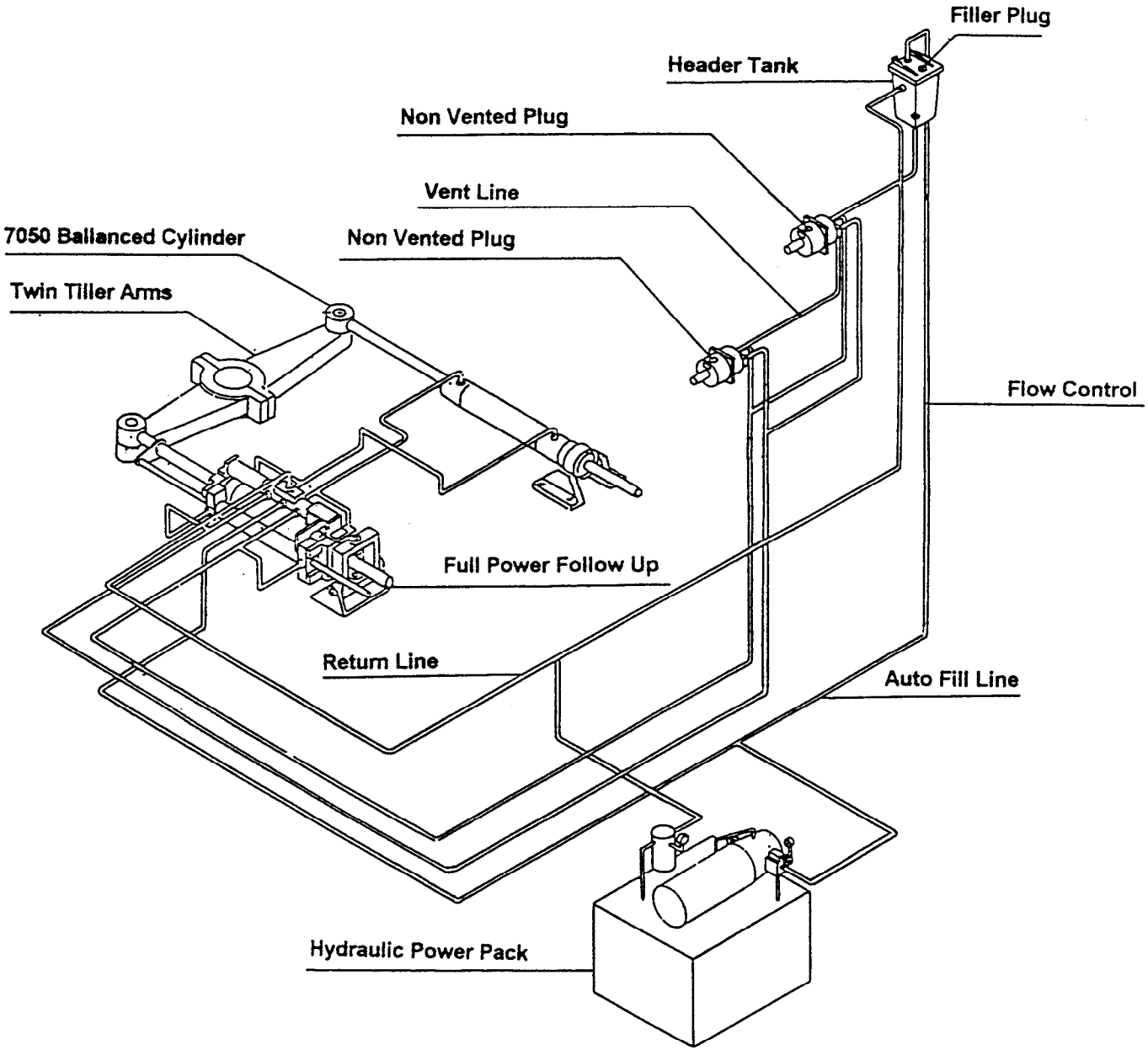
The 7147 Full Power Follow-Up is the latest development from Kobelt in the steering gear line. This unit is an extremely compact device and provides the ultimate in simplicity as far as installation and maintenance is concerned.
This unit is primarily designed for boats from 30 ft. to 80 ft., depending on power and speed. Its function is to turn manual steering into power steering which will provide the operator with finger tip control over the rudder. A source of hydraulic pressure is required to make this unit functional. It is capable of handling up to 8 gallons per minute at 1000 psi. However, should the hydraulic power fail, the valving arrangement will switch this unit automatically to manual steering. Additional turns and effort will be required for the manual mode. This provides the ultimate safety. It can be used with a single cylinder or twin cylinder installation (System 7). This is achieved by adding one cylinder (7050) and two hoses.
Our **7146** for Auto Pilot Jog Lever Interface, can easily be incorporated into the system. Maximum rudder torque of 1,680 ft. lbs. or 232 Kilogram Metres. The cylinder (7147) is available in 7 ½, 10 and 12 inch stroke. It is constructed entirely in bronze and stainless steel. Since a full power follow-up valve and servo cylinder is incorporated on to the main cylinder, no linkage is required to make this unit work.

REFER TO TORQUE CHART FOR CORRECT LENGTH



SYSTEM No. 7

This system is basically identical to system No. 6 but has an auxiliary cylinder Model 7050. This cylinder must have the same strokes as Model No. 7147. With this arrangement the torque can be doubled. It is also possible to install the same system on a two rudder installation. The maximum torque that can be obtained (at 1000 psi working pressure) with 1 model 7147 and 1 model 7050 would be 3608 ft lbs 499 kgm on a 35° rudder angle installation.

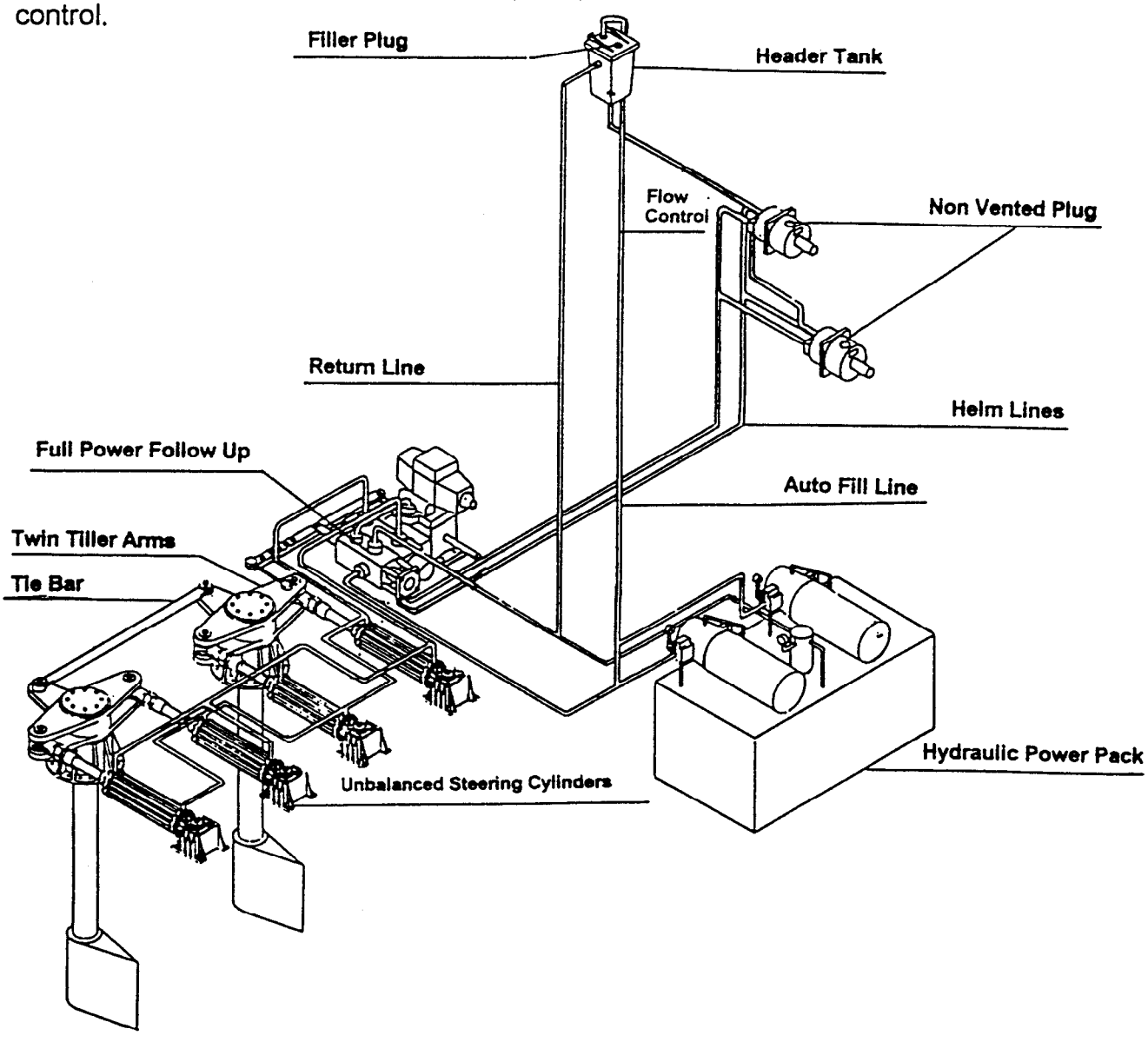


System No. 8

Full Follow-Up Power Assist Steering Model 7148

U.S. Patent No. 4,357,771

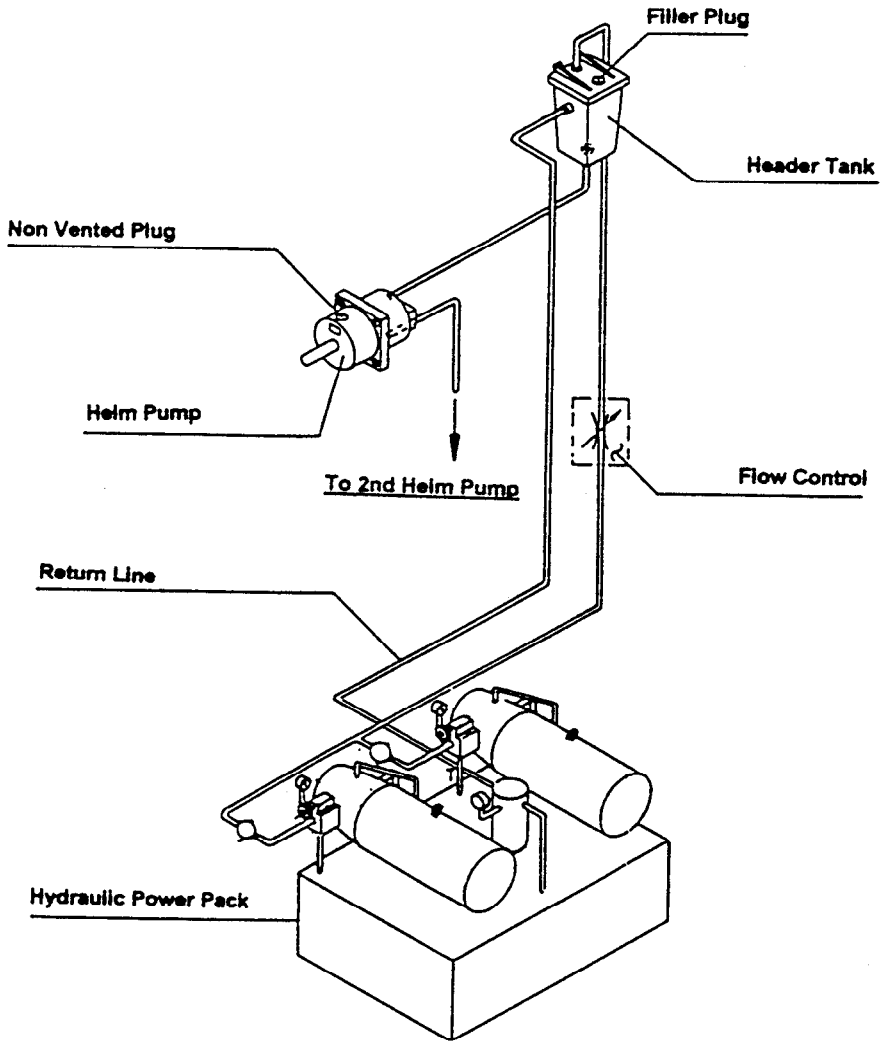
This unit is capable of handling up to 24 gallons per minute with a maximum pressure of 1500 PSI. It is designed to give the operator finger tip control over the rudder, with the helm pump. A hydraulic power pack (2 pumping units recommended) is required to make the system operative. If hydraulic pressure is available from the pumping units the 7148 will shift into a power mode whereby the helm pump only operates the servo cylinder which requires very little fluid (13 cu ins) and also very little pressure. All the oil required to operate the main steering cylinders will then come from the full follow-up four way steering valve. If, however, the pressure source fails, the rudder can still be controlled manually by the helm pump. More turns (of the helm pump) are required to move the rudder hardover to hardover. The 7148 is also equipped with a solenoid valve which can be used for either auto pilot, jog lever or full follow-up electronic control.



SYSTEM No. 9

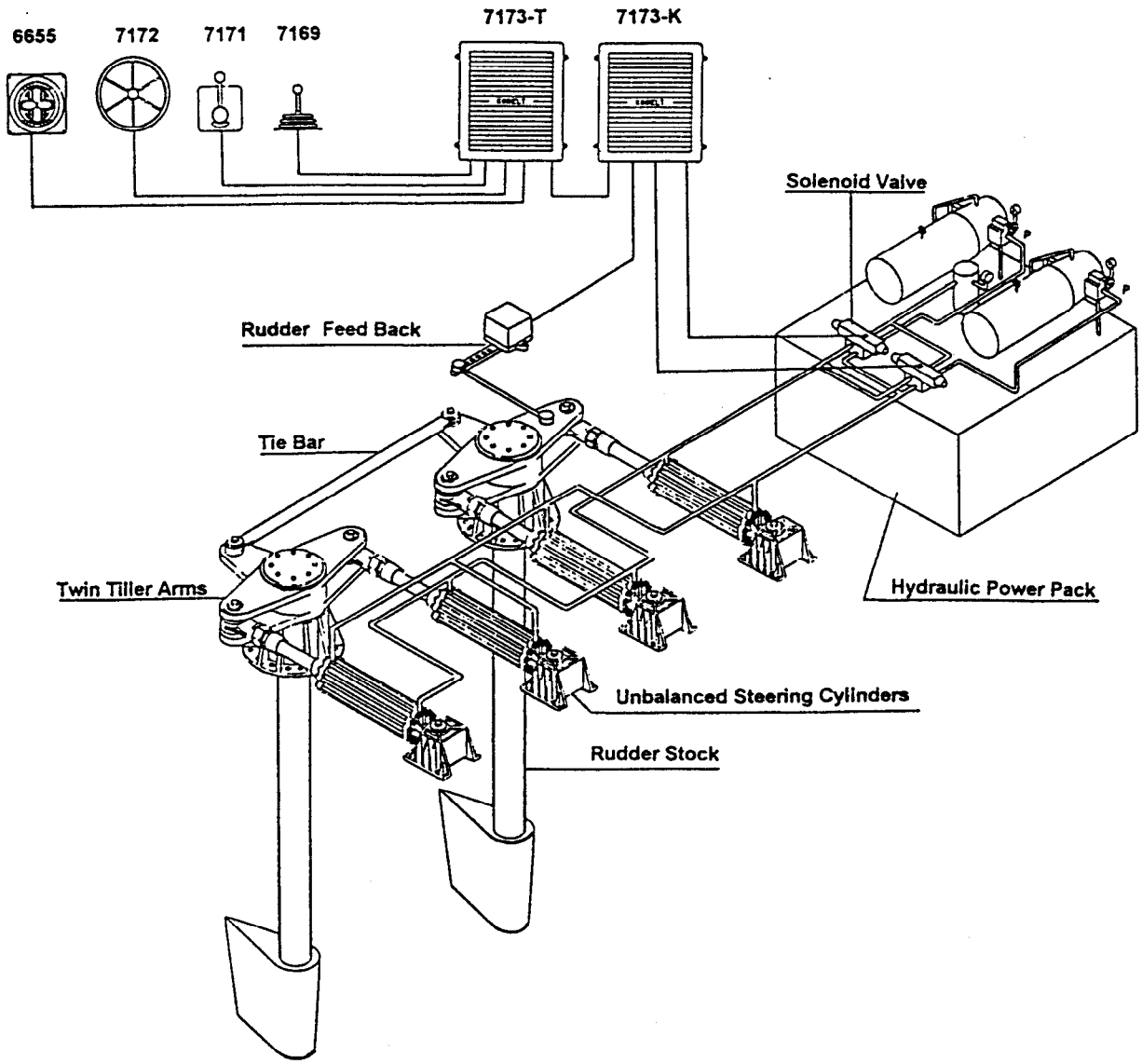
On medium size boats with power assisted steering gear we recommend to install an auto fill system that more or less fills the steering system automatically. Once the system is completely installed and all pipe connections have been double checked to make sure that all the piping connections are tight, the power system can be turned on. Please insure that there is oil in the tank before doing so and also check that the rotation of the motor is correct. Since from the power system there is a small flow control that will provide a trickle of oil into the header tank and Helm pump, the manual part of the steering system will be filled. An overflow line is also provided from the header tank to the main tank. This allows any excess oil in the system to drain back to the main tank. It is recommended to use either the jog lever or follow-up to charge the system rather than using the Helm pumps. After the system has been operative in a power mode, the Helm pumps and Helm lines are relatively easy to bleed.

Kobelt Manufacturing provides steering gear requiring power packs from 5 gallon to 100 gallons per minute.



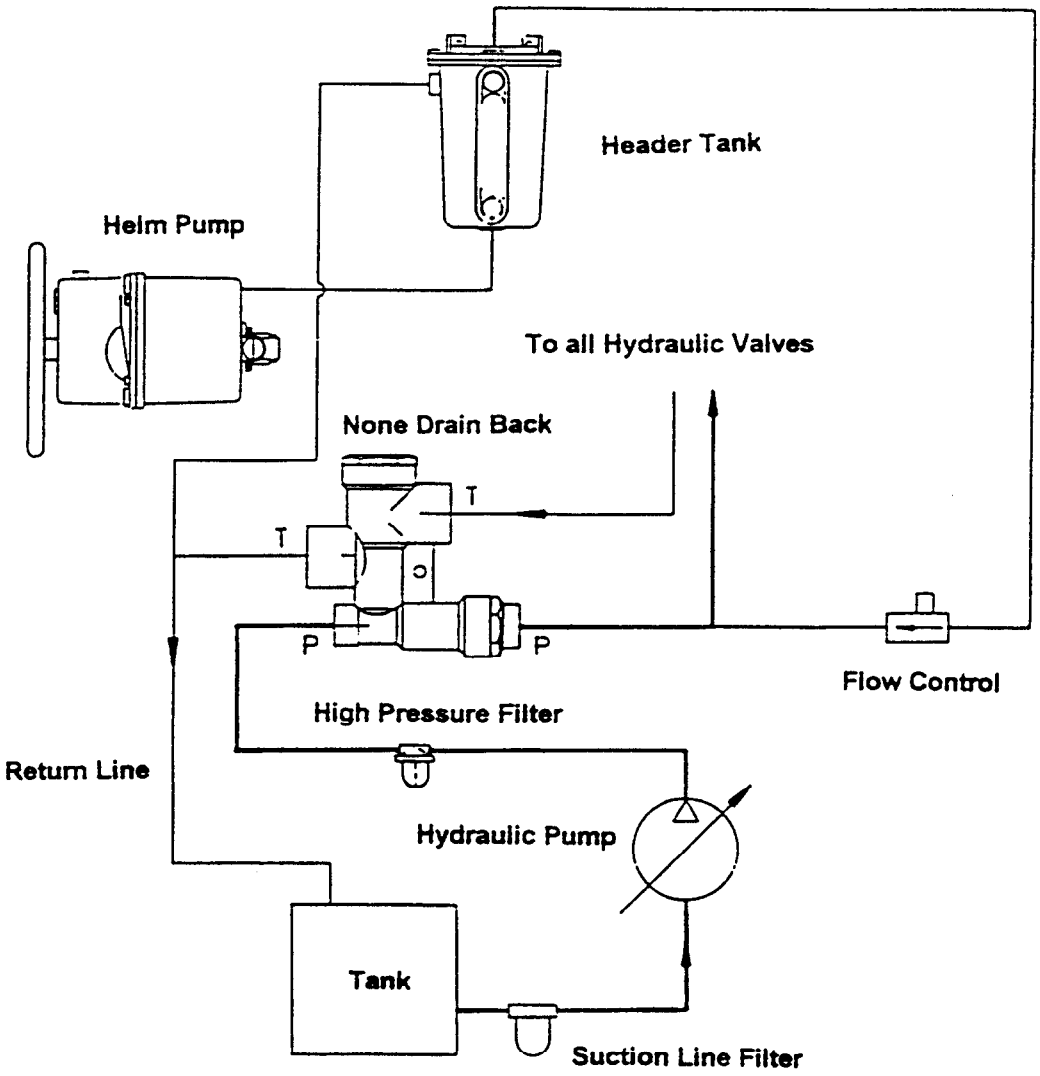
SYSTEM No 10

Hydraulic power steering systems, pump power packs, can be arranged in many ways, but it is recommended to have a standby pump in case of motor or pump failure. In most cases, especially on commercial vessels, two independent motor driven pumps are installed mostly on a common tank. On larger vessels, manual helm pumps play a minor role since the volume of oil is just too large for manual operation. If a source of energy steering is required, a DC motor driven pump can be installed as a last source of rudder control. Most of the rudders are then remote controlled electronically,When Multiple stations are Required a station Select Unit (7173-T) will be required. (see the installation instructions) Kobelt Manufacturing makes all the various devices to control large ship steering gear. We will give an example of how these units can be combined.



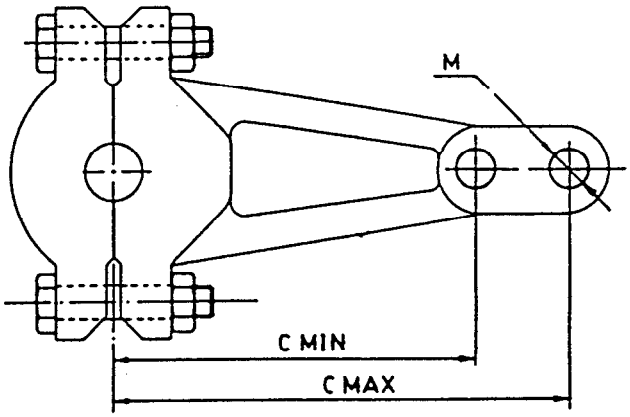
Non-Drain Back

KOBELT MANUFACTURING also developed a non-drain back valve, our model 7143. This valve serves an extremely useful purpose in the servo steering systems where a hydraulic power pack provides normally all the power to operate the rudder and helm pumps are used for manual steering. All hydraulic solenoid valves are designed on a spool type principle which is a sliding fit and all spool valves have a tendency to leak internally, after a vessel is tied up for any length of time, Oil will drain back from the highest point to the lowest point (the tank) this would cause the hydraulic helm pump to run dry and in an emergency situation, the pump would be empty and not functional, therefore making steering impossible. The 7143 valve, if properly installed, will retain all the oil in the system and will therefore, not cause any problems in an emergency steering mode.



TILLER ARMS

Kobelt Manufacturing produces a variety of tiller arms, for cylinders up to 3" I.D. and ruddder stocks up to 5.5" These are stock items. In order however, to select the proper tiller arm, you must know the stroke of the cylinder and the degrees of rotation of the rudder. Larger tiller arms for model 7094 up to 7100 are custom made. In most cases, these tiller arms are cast in steel and machine to suit custom requirements. Before the machining the tiller arm can begin a drawing is required with precise measurements of the rudder stock also showing the desired key way.
On vessels that are to be refitted with Kobelt steering cylinders it is quite possible to utilize the existing tiller arm and make special adjustments for our cylinders to be fitted. The responsibility for this would mostly fall onto the shipyard's. The tables below show minimum and maximum dimensions on our standard tiller arms

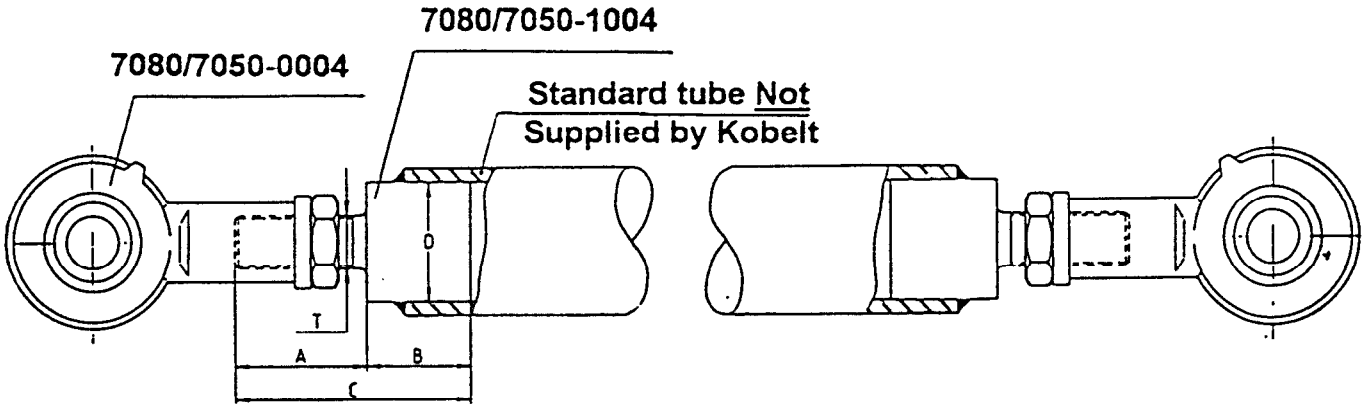


TILLER ARM TYPE	C MIN		C MAX		M	
	in	mm	in	mm	in	mm
7041	6.375	162	6.540	166	5/8	15.9
7042	8.375	213	8.720	221	5/8	15.9
7051	4.790	122	6.625	168	3/4	19.1
7052	7.850	199	10.460	266	3/4	19.1
7081	6.0	152	7.070	180	1	25.4
7082	7.750	197	10.610	269	1	25.4
7083	8.0	203	12.50	318	1	25.4
7084	10.5	267	13.95	354	1	25.4

STROKE		C 35°		C 45°	
in	mm	in	mm	in	mm
5.5	140	4.79	122	3.89	99
6.0	152	5.23	133	4.24	108
7.0	178	6.10	155	4.95	126
7.5	191	6.54	166	5.30	135
8.0	203	6.97	177	5.66	144
9.0	229	7.85	199	6.36	162
10.0	254	8.72	221	7.07	180
11.0	279	9.59	244	7.78	198
12.0	305	10.46	266	8.49	216
13.0	330	11.33	288	9.19	233
14.0	356	12.20	310	9.90	251
15.0	381	13.08	332	10.61	269
16.0	406	13.95	354	11.31	287

MECHANICAL TIEBARS

On multi rudder installations where the rudders are connected with mechanical tiebars, Kobelt Manufacturing normally does not supply the tiebars. We do, however, make tiebar ends that can be readily welded into a piece of steel pipe that is normally supplied by the shipyard. In most cases these tiebars are quite long and it is not practical to ship a pipe halfway around the world when it is readily available from a local supplier. A mechanical tiebar should, however, have a thread on one end so that the tiebar rod end can be adjusted to give precise alignment between the rudders.



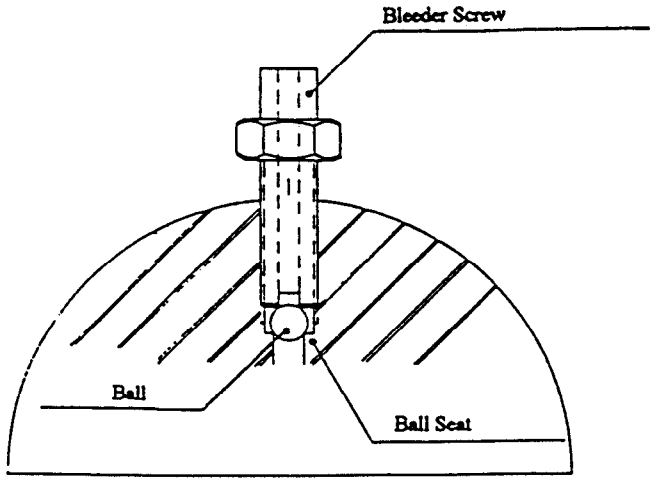
ROD END TYPE	A		B		C		D		T
	in	mm	in	mm	in	mm	in	mm	
7080	2½	63.5	2	50.8	4½	114.3	2	50.8	1"-14 UNS
7050	1¾	44.5	2	50.8	3¾	95.3	1½	38.1	5/8"-18 UNF

ADJUSTMENT INSTRUCTIONS FOR HYDRAULIC STEERING GEAR CYLINDERS EQUIPPED WITH STOP NUTS

The Kobelt 4", 6", 8" and 10" I.D. cylinders come equipped with stop nuts attached to the piston rod. On special custom-orders, it is possible to shorten the piston rod by eliminating the stop nuts. The purpose of the stop nut is to adjust the stroke of the cylinder; the more the stop nut is turned towards the cylinder end cap, the shorter the stroke becomes and the more the stop nut is turned towards the piston rod end, the longer the stroke becomes until, of course, the piston bottoms out on the foot end of the cylinder. Since all of these cylinders are unbalanced, it is necessary to have two cylinders in a steering system. When two cylinders are installed on a common tiller arm, it is of extreme importance that the strokes are balanced. In other words, when one cylinder is extended to the maximum and the opposite cylinder is contracted to the maximum, they must both come to a mechanical stop which is -- either the cylinder totally contracted, hitting the stop nut and the opposite cylinder totally extended and the piston in the cylinder contacting cylinder end cap. The way this is accomplished is by turning the clevis on the rod end in and out and adjusting the stop nut in and out until both cylinders simultaneously hit the mechanical stops. If mechanical tie rods are installed between two rudders, it is even more important that the cylinder or cylinders operating one rudder are in absolute synchronization with the second rudder, that is connected to the tie bar. If the two rudders travel unequally, the tie bar can be damaged.

CYLINDER BLEEDER SCREWS

The Kobelt steering cylinders for inboard applications are equipped with bleeder screws. When installing the cylinder, it is recommended to have the bleeder screws facing up. This will allow the installers to bleed the air out of the cylinder during startup. It is best to move the cylinder hardover to hardover when doing so.



The bleeder screw itself is basically just a threaded stainless steel hex (as above) with a ball seat in the actual cylinder end cap and a ball being compressed against the seat. This makes an ideal one-way check valve. The fluid and air can escape from the cylinder, but with the bleeder screw facing up, air cannot enter the cylinder. Moving the cylinder hardover in either directions will pressurize the cylinder at either end, the air will escape through the bleeder screws continue until a solid flow of hydraulic fluid is available.

To prevented oil spills, a plastic hose can be attached to the outer part of the bleeder screw and any oil can be collected in a container and re-cycled (providing it is clean).

If the bleeder screw is removed totally, the possibility of losing the ball does exist since hydraulic fluid will wash it out of the bleeder screw hole and without the ball, the steering system is inoperative. It is therefore recommended not to remove the bleeder screw and only loosen it approximately one turn to let the air escape. Care must also be taken not to over tighten the bleeder screw. Over tightening could cause the expansion of the bottom part of the bleeder screw and therefore make it cease in the casting and probably break the screw. We recommend a torque of approximately 4 ft. lbs. for the small cylinders and 10 ft. lbs. for the larger cylinders.

When centring the steering gear components, one must be extremely cautious to avoid any moving steering gear components since high pressure hydraulics exerts tremendous forces and could shear off a human limb easily.

After the installation is completed, ensure that all fasteners are securely tightened.

HYDRAULIC POWER PACKS

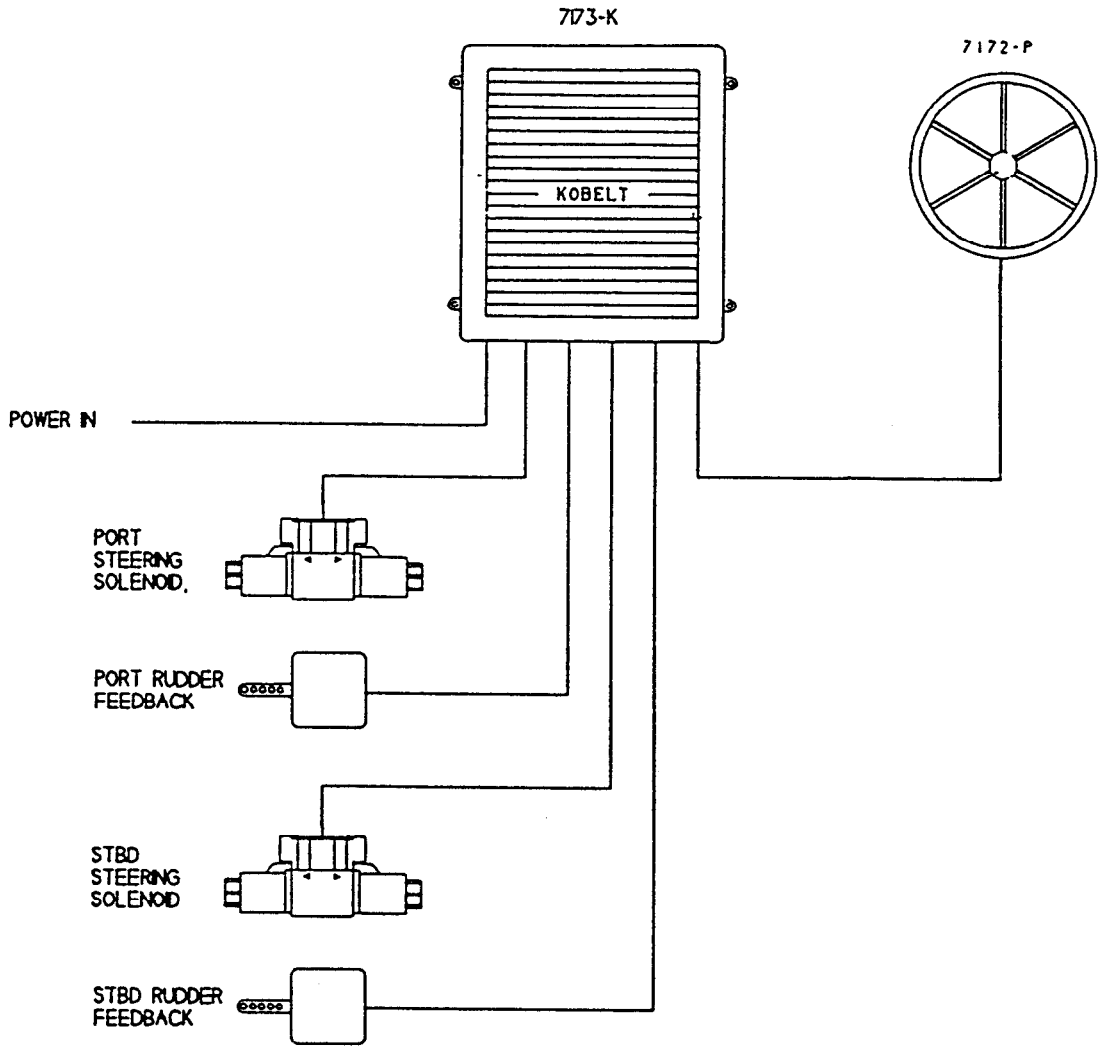
A hydraulic power pack basically consists of a tank which should have a minimum five times the flow capacity of the pump or pumps. The Power Pack must be equipped with a filter or strainer on the suction side, filter on the high pressure side, a pressure gauge on the output side, a sight glass or dip stick to indicate the oil level. If the steering gear is tied onto an alarm system, a pressure switch for each pump should be installed, a device indicating pumps in operation or not in operation to interconnect with the pressure switch. Also indication of oil level and oil differential. After the selection of the proper size power pack is made, one must also remember that the appropriate size hydraulic lines and valves must be installed to handle the oil flow. The table below indicates the minimum tubing size.

Power Pack Hydraulic Line Sizes

Flow Capacity GPM	Pressure Line Pipe O.D. Min: Inch (mm)	Return Line Pipe O.D. Inch (mm)
5	1/2 (13)	3/4 (19)
10	3/4 (19)	1 (25)
20	1 (25)	1 1/4 (32)
30	1 1/8 (29)	1 1/2 (38)
40	1 1/4 (32)	1 1/2 (38)
50	1 3/8 (35)	1 1/2 (38)
60	1 1/2 (38)	1 3/4 (44)
70	1 1/2 (38)	1 3/4 (44)
80	1 3/4 (44)	2 (51)
90	2 (51)	2 1/4 (57)
100	2 1/4 (57)	2 1/2 (64)

ELECTRONIC RUDDER SYNCHRONIZATION

In some of the dual rudder installations it is not possible to have a mechanical tie bar between the tiller arms. This holds especially true on catamaran type vessels. Kobelt Manufacturing has developed a system whereby the rudders are electronically synchronized at all times. The system is rather inexpensive, not complicated, very reliable and accurate. Our model 7173 amplifier plus our standard rudder feed back units 7168 and 7174 have a variety of controls that can be used, such as our model 7171 and model 7172 or even our control heads model 6655 which will combine engine and rudder control, can be applied to provide complete control over the rudders.



FULL FOLLOW-UP ELECTRONIC CONTROL

Kobelt Manufacturing has engineered an electronic control Model 7173 which is the heart of our electronic steering. A potentiometer signal is sent from our control device model 7171, 7172, 7167 or 6655. These signals are fed into our 7173. The rudder position is also fed into our 7173 from our rudder feed back device model 7168 or 7174. The purpose of the 7173 full follow-up amplifiers is to process these signals and send an electric signal out to the solenoid valve which will disperse oil to the steering cylinders in the desired direction. The 7173 can be used in various functions the most common being a single hydraulic steering system for single or multi rudder. The second purpose would be to use it as a 2 speed hydraulic steering control for single and multi rudders in a 2 speed configuration. The 7173 will make big corrections very rapidly and small corrections slowly. In order to make the two speed steering system function, a double solenoid is required. The solenoid should be equipped with flow controls so that the high speed can be adjusted for rapid flow and slow speed can be adjusted for lesser flow. A valve such as the 7145 is ideally suited for systems up to 15 gallons per minute. Larger valves are available on request. The third function that the 7173 is ideally suited for is catamaran applications where it is impossible to install a mechanical tie bar. A single potentiometer can be used for a rudder demand position, A separate steering systems can be installed onto each rudder with a common hydraulic power pack. Two rudder angle feed back units, one on each rudder that will in turn feed the rudder position into the 7173. The 7173 will then keep the rudders electronically synchronized. This has proven to be extremely successful. It is a very simple and inexpensive solution. (See next page) The instruction manual for our 7173 is available.

Electronic full follow up system can have as many steering stations as desired. It is, however, most important that a station transfer (7173-T) system is installed, that will allow only one steering station to be in command at any one time. If there is an auto pilot aboard the vessel, it must be treated as a separate control. All other devices must not be operational when the auto pilot is in command. The wiring (as shown below) for the hydraulic solenoid valve should be connected in such a manner that will not allow any feed back to our 7173.

This is best achieved by switching the power Imput and output from the 7173 to the Auto pilot therefor rendering the other inoperative