



Push and Pull  
Hydraulic steering  
Electronic controls  
Pneumatic controls  
Disc brakes

---

KobelT Manufacturing Co. Ltd. Technical Information October 15, 2007

---

## **7148 PRINCIPLE of OPERATION**

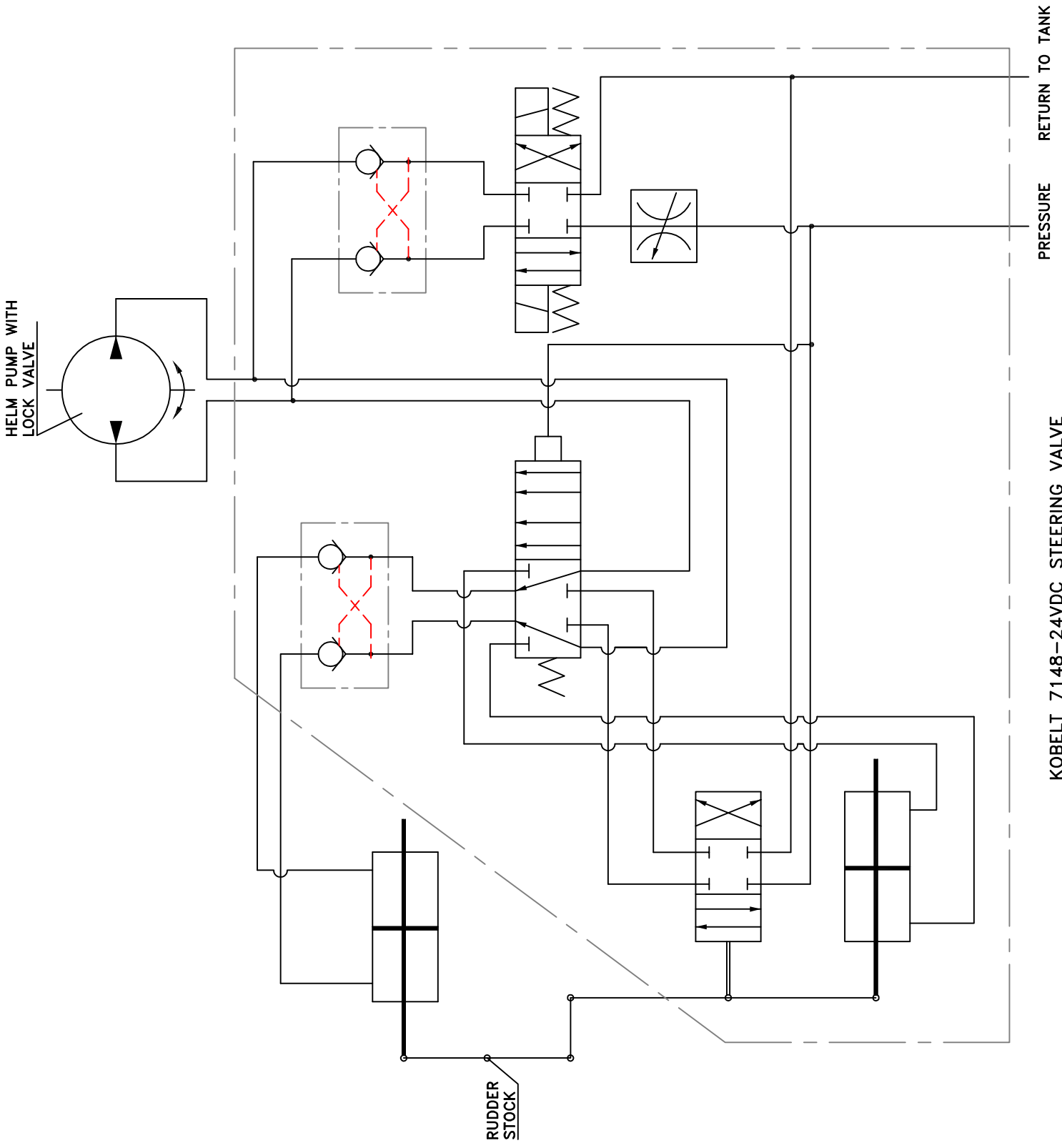
- Introduction
- Components of 7148
- Options
- Specifications
- Rudder angle steering commands
- How it works hydraulically
- How it works electrically
- Helm pumps
- Port and starboard rudder movements
- Steering pumps
- Installation overview

### **-INTRODUCTION**

The Kobelt 7148 full power follow-up is marine hydraulic steering control valve located in the steering gear compartment that allows the pilot house to steer the rudders with very little effort and be able to maintain fast precise control. Rudder movement is exactly proportional to the rudder angle steering commands.

The 7148 full follow-up steering system (also called telemotor system) consists of one or more steering cylinders (rams) to steer the vessel's rudders, a power full follow-up control valve (telemotor receiver) to receive rudder angle commands transmitted hydraulically from the pilot house helm pump (telemotor transmitter) and to direct hydraulic oil to the steering cylinder(s) for port and starboard rudder movement. The power full follow-up (telemotor system) is powered by pressure compensated piston steering pumps(s) which are driven by electric motor(s) or directly from the propulsion engines or its' gear box.

A hydraulic power follow-up system must be limited to vessels less than 10,000 gross tons and upper rudder stock diameter less than 9" (230 mm).



RETURN TO TANK

PRESSURE

**KOBELT 7148-24VDC STEERING VALVE**  
HYDRAULIC SCHEMATIC

RUDDER STOCK

## **COMPONENTS of 7148**

The major components of a Kobelt hydraulic power follow-up assembly are the servo cylinder to receive rudder angle commands, a mechanical 4-way control spindle to direct hydraulic oil to the steering cylinders for port and starboard rudder movements, and a floating feedback linkage arm to provide mechanical feedback signal from the rudder(s) to the mechanical 4-way control spindle.

The Kobelt 7148 has two lock valves (sometimes called non return valves). One lock valve is used to positively hold the servo cylinder in position when the mechanical 4-way control spindle is in the neutral position. The second lock valve to isolate the rudder loads and to provide a positive means of holding the rudder(s) in any position.

A feature of all Kobelt power follow-ups is the built-in automatic changeover valve. In case of loss of oil pressure, the changeover valve will divert control with your helm pump from power steering mode to a proper manual hydraulic steering mode. Additional wheel turns and effort will be required for manual hydraulic steering.

## **OPTIONS**

A solenoid-operated directional control valve can be bolted directly to the 7148 control valve or for access reason, be fitted to the hydraulic power unit.

## **SPECIFICATIONS**

Weight: 30 lbs (13.6 Kg) and with a solenoid valve 35 lbs. (16 Kg)

Power source: Pressure compensated piston pumps

Pressure: 1500 PSI (103 bar)

Flow rate: 20 GPM (75 L/Min)

Servo cylinder displacement: 13.2 cubic inches (206 cm<sup>3</sup>)

## **RUDDER ANGLE STEERING COMMANDS**

The steering starts at the pilot house. The desired rudder angle command is transmitted hydraulically or electrically from the pilot house to the hydraulic power follow-up (telemotor receiver) located in the steering gear compartment. From the pilot house steering commands are made hydraulically by turning the steering wheel of a helm pump port or starboard and made electrically by pushing a jog steerer, a spring return to center controller, port or starboard, or by an automatic pilot. Both actuate the servo cylinder.

The helm pump is generally used for maintaining your heading and/or for small course correction since you can turn the steering wheel very slowly for precise control. You can also turn the steering wheel as fast as the hydraulic oil flow available from the power steering pump(s).

The jog steerer is generally located at a maneuvering station such as a wing station and/or fly bridge station for fast rudder speed. The rudder speed is regulated by the adjustable

flow control valve under the solenoid valve. Again the rudder speed can be as fast as the hydraulic oil flow available from the power steering pump(s).

### **HOW it WORKS -HYDRAULICALLY**

A steering wheel is fitted directly to the helm pump (telemotor transmitter). Two hydraulic hand lines from the lock valve on the rear of the helm pump connects to a double acting balanced displacement servo cylinder (also called telemotor cylinder) located on the hydraulic power follow-up in the steering gear compartment. Movement of the servo cylinder controls the port and starboard direction of the main steering cylinder(s) via the mechanical 4-way control spindle.

Turning the steering wheel will pump hydraulic oil to one end of the servo cylinder and as the servo cylinder moves, oil from the other end of the servo cylinder is pushed back up to the opposite of the helm pump. This is called a two-line system.

When you stop turning the steering wheel and the steering gear has stop, the lock valve in the 7148 will hold the mechanical 4-way valve in the position and will not allow the steering gear to move until you issue a new rudder angle command.

The lock valve manifolded to the rear of the helm pump allows for multiple hydraulic stations. The lock valve isolates the helm pumps hydraulically from each other and for helm pumps not in use, the steering wheel do not turn. When the helm pump is at rest both check balls in the lock valve remain seated and any hydraulic pressure in the port and starboard hand lines will be isolated from the helm pump.

When you turn the steering wheel the actual pressure in the hand lines from the pilot house is very low. The person turning the steering wheel creates the pressure to open and close the mechanical 4-way control spindle.

### **HOW it WORKS -ELECTRICALLY**

The electric steering commands are made by the jog steerer, spring return to centre controller, or by an automatic pilot that transmits a signal to the solenoid -operated directional control valve. The solenoid valve "A" and "B" outlet ports are connected to the same two hydraulic hand lines in parallel from the pilot house helm pump.

When you energized the solenoid valve, hydraulic oil at full pressure is directed to the servo cylinder, similar to operating the helm pump.

When you are operating the jog steerer or automatic pilot, only the two hydraulic hand lines and the lock valve on the rear of the helm pump are subject to full pressure. The hand lines are supplied and installed by the shipyard should be rated with four to one safety factor between the burst pressure rating and the working pressure rating.

The lock valve on the rear of the helm pump is designed to withstand over 1500 PSI. This is necessary when the ship's hydraulic lines are tested to 1.5 times system working pressure of 1000 PSI.

It is not necessary to install limit switches to stop the travel of the servo cylinder when operating with a jog steerer. Holding the solenoid valve open when the steering gear is hard

over against its stops will not cause any damage to the hydraulic system. The power steering pump(s) will sense zero flow is required and will return the internal swash plate to zero oil flow output. The pressure gauge will read full system pressure.

It is not necessary to install a helm order indicator (desired rudder angle command) to indicate the actual position of the servo cylinder. The rudder speeds are generally fast for most hydraulic power follow-ups. The actual rudder angle and helm order indicator (the desired rudder angle) will be the same when you turn the steering wheel slowly (less than ½ turn per second) and only a few seconds behind when you turn the steering wheel quickly or operate the jog steerer. With the fast rudder speed during maneuvering, the helmsman is more than likely paying attention to where he going rather ensuring the actual rudder angle agrees with his desired rudder angle. The helm pump is likely not to be used when the jog steerer is in operation.

When an automatic pilot is installed, the auto pilot feedback unit must be located near the Kobelt servo cylinder and mechanically linked to same. The automatic pilot feedback must not be connected to the rudder stock.

## **HELM PUMPS**

The pilot house hydraulic helm pump provides two modes of steering control. The primary function is to transmit rudder angle commands to the servo cylinder for power steering mode and secondarily to provide manual hydraulic steering control for emergency auxiliary steering.

In the event of loss of oil pressure or system shut down, the automatic changeover valve in the hydraulic power follow-up shifts to manual hydraulic steering mode, allowing the pilot house helm pump to operate the main steering cylinder(s) directly. It will take about 30 wheel turns (approximately 30 seconds) to move the rudders from 15 degrees to 15 degrees on the opposite side. Our experience has shown with the rudder at 15 degrees and vessel at full speed, the steering gear hydraulic pressure is less than 15 percent of the system full pressure. With the correct size of steering wheel, the rim load would be less than 35 lbs. (16 Kg). When the vessel speed is reduced to seven knots, the steering wheel rim load will be reduced by ½. The helmsman operating the vessel under emergency condition with the manual hydraulic helm pump can easily maintain this effort as the get-home-steering.

## **PORT AND STARBOARD RUDDER MOVEMENTS**

Stroking of the servo cylinder controls the mechanical 4-way control spindle to direct hydraulic oil from the power steering pumps to the steering cylinder(s) for port and starboard rudder movements. All three are mechanically connected to floating lever arm which provides mechanical feedback to the servo cylinder.

Moving the 4-way control spindle in one direction allow hydraulic oil to flow to the steering cylinders. The rudders will continue to move at a constant speed until the rudders have reached its new position. The floating lever arm returns the 4-way control spindle to its center position and the hydraulic oil flow from the power steering pumps stops.

## **STEERING PUMPS**

A variable volume piston pump(s) driven by electric motor(s) or directly from the propulsion engine(s) or its' gear box provides the hydraulic oil pressure to the Kobelt 7148 hydraulic power follow-up. These pumps will only deliver oil flow as needed.

Operating the Kobelt hydraulic power follow up system, you will notice the pressure gauge reads a steady 1000 PSI (69 bar). When a rudder angle command is made, the pressure reading drops and after the rudders reaches its new desired angle, the system pressure returns to 1000 PSI with zero oil flow from the power steering pump(s). The power steering pumps have an adjustable pressure compensator which is set at 1000 PSI (69 bar). This becomes the system working pressure.

The steering gear reservoir includes a hydraulic manifold valve block which includes a relief valve and a flow control valve. Both are adjustable and can be re-set in the field as required. The relief valve in the manifold valve block is set at 1250 PSI (86 bar) which 1.25 times the system PC setting of 1000 PSI. This becomes the system maximum pressure. The flow control in the manifold valve block is adjusted to set the rudder speed with both engine driven pumps running at engine idle. This becomes the maximum oil flow for the steering system. One engine driven pump running at high engine idle will deliver the same volume of hydraulic oil as two pumps at engine idle.

### Operating Characteristics of Pressure Compensated Piston Pump In Closed Center systems

- Constant Pressure and variable flow.
- Pump is in high-pressure standby mode when system is not actuated.
- Pump automatically adjusts output flow to meet system requirements.
- Allows for simultaneous operation of multiple functions.
- Fast response to system pressure or flow requirements.
- One pump may be used instead of multiple pumps.

Closed Center systems are ideal when the hydraulic system requires several separate functions to operate simultaneously.

With a closed center control valve, and the hydraulic system is not actuated, the pressure compensated piston pump will remain in the high-pressure standby mode.

The pump will maintain the high pressure and zero flow as long as the system is not operated.

When a hydraulic function is actuated, (via helm pump or solenoid valve) the pressure compensated piston pump senses the change in the demand for flow and adjusts the pump displacement to increase the flow required while maintaining full system pressure up to the control valve.

The pump will strive to maintain maximum system pressure to the control valve under all working conditions.

The pump will adjust output flow to meet any change in system flow requirements.

The pump will maintain full system pressure as long as the system flow requirement does not exceed the total flow capacity of the pump.

With a constant system pressure and a known working pressure, each function can be independently orificed to provide simultaneous operation.

If the hydraulic system stalls out under a load, the pump will go into the high-pressure standby mode until the load is overcome.

This prevents a large volume of pump flow from passing over the system relief valve as happens in the typical open center hydraulic system.

## **INSTALLATION OVERVIEW**

The Kobelt 7148 power follow-up should be positioned about the rudder stock at a convenient elevation, with mechanical feedback linkage is square between the rudder stock and power follow-up assemble when the servo cylinder and steering cylinder(s) are in the mid-ship position. Ensure adequate clearance is provided to allow room for the floating lever to move.

The foundation for the 7148 power follow-up assemblies should be flat, vibration free and securely attached to the ship's hull. All connection points on the feedback linkage should be tight. Loose linkage pins can cause inaccurate steering and in severe cases cause the follow-up to "hunt"

If on start-up you find the steering gear hard over and stays hard over, reverse the two hydraulic lines to the steering cylinder(s)

If on start-up you find the steering wheel turns in the wrong direction, reverse the two hydraulic lines to the helm pump.

The steering system should be examined daily.

Check the oil level and unusually high oil temperature.

Check for loose hydraulic connections, and oil leaks in piping or components,

Check all mechanical connection and mountings are tight and secure

SE