200 Gallon Hydraulic Power Unit
200HPUH02 Module
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1A: HPU Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir capacity:</td>
<td>200 US Gallons Nominal</td>
</tr>
<tr>
<td>Reservoir fluid conditioning:</td>
<td>Heating / Cooling / Particle Filtration</td>
</tr>
<tr>
<td>Maximum EHC pump operating pressure:</td>
<td>2400 PSI</td>
</tr>
<tr>
<td>Maximum EHC pump flow:</td>
<td>32 GPM</td>
</tr>
<tr>
<td>EHC Pump Motor:</td>
<td>40 HP / 1800 RPM</td>
</tr>
<tr>
<td>Maximum Kidney Pump Operating Pressure:</td>
<td>150 PSI</td>
</tr>
<tr>
<td>Maximum Kidney Pump Flow:</td>
<td>6.5 GPM / 1800 RPM</td>
</tr>
<tr>
<td>Kidney Pump Motor:</td>
<td>2 HP</td>
</tr>
<tr>
<td>Hydraulic Fluid Compatibility:</td>
<td>Phosphate Ester, Polyalkylene Glycol, and Polyol Ester based fluids</td>
</tr>
<tr>
<td>Pressure Transmitters:</td>
<td>4-20 mA / 0-2400 PSI</td>
</tr>
<tr>
<td>Reservoir Immersion Heater:</td>
<td>2 kW</td>
</tr>
<tr>
<td>Temperature Transmitter:</td>
<td>4-20 mA / 0-200°F</td>
</tr>
<tr>
<td>Reservoir Level Transmitter:</td>
<td>4-20 mA / 3-16 inches from top of Reservoir</td>
</tr>
<tr>
<td>EHC Pump Type:</td>
<td>Pressure Compensated Variable Volume Axial Piston Pump</td>
</tr>
<tr>
<td>Seal Material:</td>
<td>Viton™</td>
</tr>
<tr>
<td>Cooling Water Requirements:</td>
<td>95°F maximum inlet temperature</td>
</tr>
<tr>
<td></td>
<td>50-150 PSI maximum / 15 GPM Max</td>
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</tbody>
</table>

1B: HPU Assembly Description

200 GALLON HYDRAULIC POWER UNIT (200HPUH02)

The Hydraulic Power Unit (HPU) consists of a 200 gallon reservoir, two EHC supply pumps, a Kidney pump and interconnecting piping, valves, and instrumentation all mounted on a structural steel frame. Each EHC pump can provide up to 2400 psig EHC fluid at 32 gpm to system components, specifically valve actuators and trip manifolds. The kidney loop pump operates continuously pumping 6.5 gpm of hydraulic fluid through the kidney pump circuit to condition the fluid in the HPU reservoir.

The HPU pumps can be controlled locally from the door switches on the electrical panel located on the panel stand or remotely from the DCS controls. Remote control is enabled only when the local control switches are in the Auto mode.

The HPU is designed with an elevated reservoir that provides net positive suction head to the EHC and kidney pumps. The reservoir is fabricated from stainless steel to prevent fluid contamination due to reservoir wall corrosion. The reservoir contains two gasketed clean out covers to permit access to all internal reservoir components. The top of the reservoir contains twelve fluid return ports with internal anti-siphon tube lines to accommodate the field return and drain lines. When system requirements dictate the need for a pressurized return header, the R1 return port on the HPU reservoir can be fitted with a spring loaded check valve that will maintain specified pressure in the return header. The internal tank baffle plate is designed to maximize fluid residence time within the reservoir to permit fluid de-aeration and maintain consistent fluid temperature. The HPU reservoir incorporates visual fluid temperature and level indicators in addition to the fluid level and temperature instrumentation. All instrumentation on the HPU is wired to a common terminal box mounted on the HPU.
Installation and Mounting Dimensions

Fig. 1: Front View
Fig. 2: Side View
Fig. 3: Plan View
1C: HPU Description of Operation

The hydraulic power unit is designed to provide conditioned high pressure hydraulic fluid to the EHC system to operate valve actuators and trip manifolds that control the operation of the turbine. The hydraulic power unit contains two (2) different hydraulic circuits. These two circuits are the EHC Pump Circuit and Kidney pump circuit. The EHC Pump Circuit is comprised of two separate pump assemblies and provides hydraulic fluid to power valve actuators and also provides hydraulic fluid to pressurize the turbine's emergency trip system. Typically when the turbine is on line, one of the two EHC pumps will be in operation while the second pump remains in standby. The Kidney pump circuit routes fluid from the HPU reservoir through a loop that provides fluid filtration, fluid cooling or fluid heating as required to maintain the hydraulic fluid's condition. The Kidney pump circuit typically operates continuously when the turbine is on line but can be shut down for brief periods to permit filter element replacement.

1C.1 EHC Pump Circuit

The EHC pumps pressure compensated variable displacement type pumps are powered by 40 HP, 1800 RPM TEFC Electric Motors. This type of pump employs multiple pistons arranged axially in parallel to the pump shaft within the pump housing. Each piston is connected by a ball and socket arrangement to a swash plate that rotates with the pump shaft. The swash plate pivots from a zero degree position (deadhead position), which is perpendicular to the pump shaft, to a maximum angular position. When the swash plate is at the deadhead position the pump discharge is negligible. When the pump swash plate is at its maximum angle, the pump discharge is at the maximum specified flow rate. The discharge pressure of the pump is controlled by adjustment of the pump pressure compensator control. The discharge flow rate of the pump, i.e. position of the pump swash plate, is controlled by the hydraulic circuit demand.

The pump operates continuously to maintain constant pressure in the hydraulic system circuit by modulating pump discharge. When there is no flow demand in the hydraulic circuit, the pump swash plate deadheads and produces only the flow required to maintain the set pressure in the hydraulic circuit. When flow demand occurs, the pump compensator control detects a pressure drop in the hydraulic circuit and shifts the swash plate to increase pump flow and re-establish the set pressure. When flow demand ceases, the pump swash plate will return to the deadhead position.

In normal operation, one out of two (2) EHC pumps operates continuously while the second pump remains on standby. At predetermined time intervals, the standby pump typically is switched over to become the operating pump and the current operating pump is switched to standby. This is done to distribute pump operating hours equally between the two EHC pumps. The pump switching intervals are controlled through the DCS logic. In the case of low system pressure or failure of the operating pump, DCS logic will create a fail over command to start the standby pump. Each EHC pump is capable of individually meeting system operating requirements.

The EHC pump discharge is routed through a high pressure duplex particle filter before distribution to the system components. The duplex filter assembly is designed to permit switching the pump discharge flow through the No. 1 filter element or through the No. 2 filter element when the HPU system line is pressurized. In this manner the filter element in the unpressurized filter bowl can be replaced without shutting down the HPU. The particle filter contains a differential pressure switch that provides an alarm when the filter element requires replacement. Check valves in the filter assembly outlet lines prevent fluid back flow from occurring. The duplex filter assembly
1C.2 Kidney Pump Circuit

The kidney pump is a fixed displacement gear pump powered by 2 HP, 1800 RPM TEFC Electric Motor. This type of pump employs two meshing gears driven by the pump shaft. Hydraulic fluid is pumped by the action of the meshing gears disengaging on the inlet side of the pump cavity and engaging on the discharge side of the pump.

The kidney pump continuously pumps reservoir fluid through a conditioning circuit that cools or heats the fluid as required to maintain the recommended hydraulic fluid operating temperature. A filter assembly is integrated into the conditioning circuit to remove particle contamination. A flow switch in the circuit alarms when flow in the conditioning circuit falls below 4 gpm.

The particle filter contains a differential pressure switch that provides an alarm when the filter element requires replacement. The cooling water supplied to the heat exchanger is controlled by switching a solenoid controlled water valve on the cooling water inlet of the heat exchanger. Fluid temperature in the HPU reservoir is monitored by a temperature transmitter input to the DCS which then switches the cooling water solenoid valves on and off as required to maintain recommended reservoir fluid temperature range.

The kidney pump is protected from excess pressure by a manifold mounted pressure relief valve. Kidney pump circuit pressure is monitored by a pressure transmitter and the kidney pump circuit flow is monitored by a flow switch.

The kidney pump also doubles as a fill pump when filling the HPU reservoir from 55 gallon drums. This can be done by connecting a fill hose assembly to the fill port on the suction side of the kidney pump, opening the ball valve on the fill port and closing the ball valve on the pump suction line. With the fill hose assembly inserted in the 55 gallon drum, the kidney pump can be started to transfer the drum contents through the filter and into the HPU reservoir. After the filling process is completed, the fill hose must be disconnected and the ball valves returned to the normal operating positions.

If a phosphate ester fluid is used in the hydraulic system, the kidney circuit will require the addition of a neutralization filter in the loop. The neutralization filter is required to maintain water and acid levels in the hydraulic fluid within recommended specifications.

1D: HPU Maintenance Requirements

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>INTERVAL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir Level</td>
<td>Daily</td>
<td>Check sight-glass for leaks in the system</td>
</tr>
<tr>
<td>Reservoir Temperature</td>
<td>Daily</td>
<td>Check local thermometer</td>
</tr>
<tr>
<td>Pump and Motor Operation</td>
<td>Daily</td>
<td>Check for abnormal noise and temperature</td>
</tr>
<tr>
<td>EHC Pump Filters</td>
<td>Daily</td>
<td>Check D/P gages</td>
</tr>
<tr>
<td>Kidney Pump Filter</td>
<td>Daily</td>
<td>Check D/P gage</td>
</tr>
<tr>
<td>Hydraulic Fluid</td>
<td>Monthly</td>
<td>Sample and analyze</td>
</tr>
<tr>
<td>EHC Pump Pressure</td>
<td>As Required</td>
<td>Check adjustment</td>
</tr>
<tr>
<td>Compensator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EHC Pump Relief Valve</td>
<td>As Required</td>
<td>Check adjustment</td>
</tr>
<tr>
<td>COMPONENT</td>
<td>INTERVAL</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>EHC Pump Volume Compensator</td>
<td>As Required</td>
<td>Check adjustment</td>
</tr>
<tr>
<td>All Filter Elements</td>
<td>Annual or as needed</td>
<td>Replace</td>
</tr>
</tbody>
</table>

**Table 1: Maintenance Schedule and Comments**

1D.1 Hydraulic Fluid Sampling

After initial start up, ABB recommends that hydraulic fluid be sampled on a monthly basis to check water content, fluid viscosity, acid number and solid particle contamination level. Refer to the fluid manufacturer's specifications for maximum water content, viscosity range and maximum acid number recommendations. The fluid solid particle count should not exceed 15/13/10 per the ISO 4406 particle coding method. Once a stable operating history has been established, sampling can then be done on a quarterly basis.

The hydraulic fluid must be maintained per the requirements of the hydraulic fluid manufacturer and the requirements of the hydraulic component manufacturers. Fluid samples should be taken while the system is in operation from the HPU reservoir and at test ports on the system valve actuators and trip manifolds. Each fluid sample should be deposited in an approved sample bottle and sealed and labeled with sample location and date.
1D.2 EHC Pumps

The pressure compensator and pressure relief valve settings need to be checked periodically as the settings on these devices can drift. If the pressure relief valve setting has drifted below the pump pressure compensator setting, the relief valve will bleed continuously and overheat the reservoir fluid. The pressure relief valve should be set 250-300 psig above the pump pressure compensator setting.

1D.3 Desiccant Breather Element

The HPU reservoir breather element should be replaced when the color changes from blue to pink. Failure to replace the breather will allow moisture to enter the reservoir and contaminate the fluid.

1D.4 Filter Elements

The filter assembly differential pressure indicators are useful during a system flush when flow is consistent. However, because of the variable flow conditions during normal hydraulic system operation, these indicators are unreliable for assessing filter cleanliness and may even cause a false sense of security if the readings are not interpreted properly. All filter elements should be replaced on a periodic basis, regardless of the differential pressure indication.

If an EHC Pump filter differential pressure gage exhibits a continuous reading of 10 PSID or more when the system is stable (no valve movements), the filter element should be replaced. Normal system flow is considerably less than the pump capacity. Since the filter pressure drop is a square root function of flow, even a low differential pressure can be indicative of a dirty filter element at low flow conditions. The Kidney Pump is a positive displacement pump. Therefore the filter differential pressure gage for the Kidney Pump filter provides adequate indication of filter cleanliness. The Kidney Pump filter should be replaced whenever the differential pressure exceeds 80 PSID.

1D.5 HPU Motor Lubrication

The system pump motors generally have two grease fittings, one at each end, for bearing lubrication. The motors should be greased with petroleum based grease, NGLI class 2.0 or 2.5. Refer to additional information pertaining to this component in Section 3 of this manual.

1D.6 HPU Instrumentation

The pressure transmitters are mounted on a manifold block which is connected to the exterior of the reservoir side wall. Each pressure transmitter is connected to integral block and bleed valves and a test port mounted within the manifold block. The pressure transmitters can be calibrated without removing them from the manifold block.

The reservoir temperature transmitter is connected to a thermowell mounted in the reservoir side wall. Remove the transmitter and element from the thermo-well for calibration.

The fluid level transmitter is mounted on the top surface of the HPU reservoir with the sensing element extending down into the reservoir fluid. Remove the entire transmitter assembly from the reservoir for calibration.
The kidney loop flow switch is located on top of the HPU at the outlet of the heat exchangers. The switch is preset at 4 GPM. The actual set point is not critical as the flow switch indicates flow or no flow conditions within the kidney pump circuit. The switch should be replaced if circuit flow conditions are not correctly detected.

1D.7 General System Inspection

The entire hydraulic system should be checked periodically for leaks, loose components, and general wear and tear. The suction connection from the reservoir to the EHC pump inlets should be checked periodically as this fitting can loosen due to the high frequency vibration of the piston pumps. A suction line leak is difficult to detect and may cause air to be entrained in the hydraulic fluid.

1D.7 Filter Replacement

1D.7.1 EHC Pump Filter

This procedure should be performed whenever the D/P across the filter element reaches 80 psid or annually, whichever occurs first. If possible, schedule this for a period when the HPU can be shutdown. The following procedure is for the Parker 30PD duplex filter assembly.

CAUTION: Fluid spillage may occur during this procedure. Place rags or containers below the filter. Hydraulic fluid is a known skin irritant so gloves and face and eye protection should be used.

1. Shift EHC Pumps if required.
2. Place the associated pump's control switch in OFF and tag as required.
3. The arrow on the diverter handle points to the off-duty chamber.
4. Open the off-duty vent valve.
5. Open the balance valve slowly to admit fluid into the off duty chamber.
6. When fluid is discharged from the vent port, close and tighten.
7. Pull up on the detent pin and rotate diverter approximately 90 degree until the diverter relocates in its seat.
8. Close and tighten the balance valve.
9. Open the new of-duty vent valve to relieve pressure.
10. Loosen and remove the bowl.
11. Remove the filter element from the housing.
12. Place the new filter element in the housing, centering it on the element locator.
13. Inspect the bowl o-ring and replace if necessary.

14. Install the bowl and tighten to the specified on the tag on the housing

15. Close and tighten the vent valve.

16. The filter element replacement procedure is now complete.

1D.7.2 Kidney Pump Filter

The Kidney Pump must be shut down to perform this task. The pump can be shut down for short periods of time without adversely affecting HPU operation or Turbine operation. The following procedure is for the Parker 30P filter assembly.

CAUTION: Fluid spillage may occur during this procedure. Place rags or containers below the filter. Hydraulic fluid is a known skin irritant so gloves and face and eye protection should be used.

1. Stop the Kidney Pump and tag as required.

2. Relieve any pressure in the filter line and drain the filter bowl using the drain plug on the bottom of the bowl.

3. Loosen and remove the bowl.

4. Remove the element from the housing.

5. Place the new, clean element in the housing, centering it on the element locator.

6. Inspect the bowl o-ring and replace if necessary.

7. Install the bowl and tighten to the specified on the tag on the housing

8. The filter element replacement procedure is now complete.

1D.8 Adjusting EHC Pump Compensator Pressure and Pressure Relief Valve

CAUTION: The Rexroth EHC pumps are supplied with a type DR pressure compensator control mounted on the port end of the pump. To adjust the pressure compensator, the cap nut on the compensator control block must be removed to access the compensator adjustment screw. Some of the DR pressure compensator blocks may have two cap nuts. In this case, the cap nut closest to the pump body must be removed for access to the compensator adjustment screw. The EHC pump pressure relief valve is a Parker R5V063 type that is mounted directly to the EHC pump discharge port. An single adjustment knob on the pressure relief valve body is used to set relief pressure.
The pump pressure compensator and the pressure relief valve are set in the following procedure. Use the HPU pump pressure transmitter display to monitor pump discharge pressure when setting the pump compensator and pressure relief valve. If the pressure transmitters are not powered up, a pressure gauge can be installed on the pressure transmitter manifold test port to monitor pressure.

a. Verify the pump suction valve is open and start the EHC pump.

b. Adjust the pump pressure relief valve to the minimum setting.

c. Adjust the pump pressure compensator to the maximum setting.

d. Close the EHC Pump discharge valve. This will result in fluid from the pump discharge flowing to the HPU reservoir through the pump pressure relief valve.

e. Adjust the pump pressure relief valve from the minimum position to the specified value. To adjust, the pressure relief valve adjustment knob is turned clockwise to increase the relief pressure and counterclockwise to decrease the relief pressure. The relief pressure should be set 250 to 300 phi above the pump pressure compensator setting.

f. Adjust the pump pressure compensator by loosening the adjusting screw lock nut and turning the adjusting screw. Turning the screw counterclockwise will decrease pressure and turning the screw clockwise will increase pressure. One complete turn will change pressure approximately 700 psig. Tighten the locknut when pressure is set to the specified value (normal operating pressure is typically 1800 - 2000 psig).

g. Open the EHC pump discharge valve

h. Repeat the above process for the second EHC pump.