



Technical Manual

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Hydraulic Tank



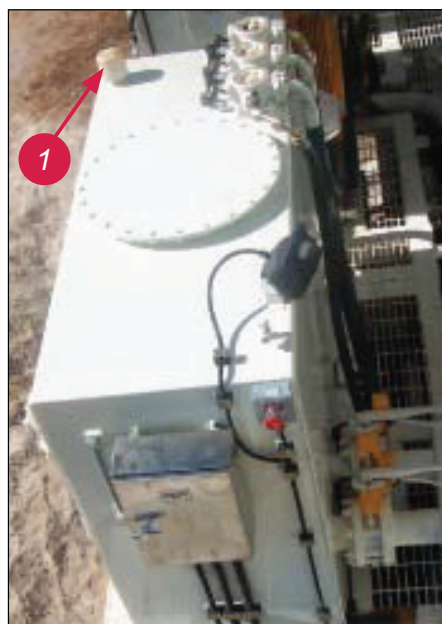
CAUTION: Relieve pressure on hydraulic and pneumatic systems before loosening connections or parts.

The hydraulic system consists of a hydraulic reservoir / tank that supplies oil to hydraulic pumps. These hydraulic pumps provide hydraulic pressure to operate all machine functions outside of the electrical and compressed air circuits. From the pumps oil is supplied to the levers and control valves which operate hydraulic motors or cylinders. Another important feature of hydraulic systems is the filters. All the oil returning to the tank flows through either the **return manifold**, the **drain manifold**, or the **case manifold**. Oil returning from the return manifold must pass through the **return filter** before entering the tank. Oil returning from the drain and case manifolds is first teed together before passing through the **case return filter**. Both these filters have by-pass check valves in case the filters become blocked.

It is important to remember that the pressure in the return, drain, and case manifolds is different. The pressure in the return manifold is around 20+psi, and in the drain and case manifolds is only <7psi. This is particularly important when connecting case drains from motors or pumps. If they are connected to the return manifold the increased pressure will prevent the case drain from draining, which will result in too much oil in the case and blowing out the shaft / oil seal.



Fig. 7-1 Hydraulic Tank (ref. 421074)



1. 10 Micron Breather
2. Main Return Filters (2)
3. Case Return Filter
4. Shut-off Valve
5. Sight Gauge Oil Level

Right Track, Left Track / Rotation Pumps

Technical Data (Cont.)

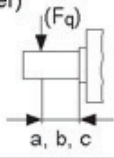


AA4VG Specifications (Theoretical values; rounded)

Size			40	56	71	90	125	180		
Displacement	Variable pump	$V_{g,max}$	cm ³ /rev	40	56	71	90	125	180	
			in ³ /rev	2.44	3.42	4.33	5.49	7.63	10.98	
	Charge pump	V_{gH}	cm ³ /rev	8.4	11.1	18.7	18.7	25.7	36.9	
			in ³ /rev	0.51	0.68	1.14	1.14	1.56	2.25	
Speed	max. rpm at $V_{g,max}$	$n_{max,cont}$	rpm	4000	3600	3300	3050	2750	2400	
	limited max. rpm ①	$n_{max,limit}$	rpm	4200	3900	3600	3300	3100	2900	
	intermittent max. rpm ②	$n_{max,interm}$	rpm	5000	4500	4100	3800	3450	3000	
	minimum rpm	n_{min}	rpm	500	500	500	500	500	500	
Flow	at $n_{max,cont}$ and $V_{g,max}$	Q_{max}	L/min	160	202	234	275	344	432	
			gpm	42.3	53.4	61.8	72.7	90.9	114.1	
Power	at $n_{max,cont}$	$\Delta p = 400 \text{ bar}$ $\Delta p = 5800 \text{ psi}$	P_{max}	kW	107	134	156	183	229	288
				hp	144	180	209	245	307	386
Torque (without charge pump)	at $V_{g,max}$	$\Delta p = 400 \text{ bar}$ $\Delta p = 5800 \text{ psi}$ $\Delta p = 100 \text{ bar}$ $\Delta p = 1450 \text{ psi}$	M_{max}	Nm	254	356	451	572	795	1144
				lb-ft	187	263	333	423	586	844
				Nm	63.5	89	112.8	143	198.8	286
				lb-ft	46.8	65.6	83.2	105.5	146.6	210.9
Moment of inertia (about drive axis)		J	kgm ²	0.003	0.0051	0.0072	0.0106	0.0164	0.0323	
			lb-ft ²	0.0712	0.1210	0.1709	0.2515	0.3892	0.7665	
Weight (standard model without through drive)		m	kg	31	38	50	66	80	104	
			lbs.	68	84	110	145	176	229	

- ① Limited maximum rpm: – at half corner power (e.g. at $V_{g,max}$ and $p_H/2$)
- ② Intermittent maximum rpm: – at high idle speed
– during engine overspeed: $\Delta p = 70\text{--}150 \text{ bar}$ (1015–2176 psi) and $V_{g,max}$
– with reversing loads: $\Delta p < 300 \text{ bar}$ (4350 psi) and $t < 5 \text{ seconds}$

V_g = Displacement (cm³ or in³) per revolution
 Δp = Differential pressure
 n = Speed (rpm)

Input Drive (Permissible axial and radial loading on drive shaft)

Size			40	56	71	90	125	180		
Distance of F_q (from shaft shoulder)		a	mm	17.5	17.5	20.0	20.0	22.5	25.0	
		a	in	0.69	0.69	0.79	0.79	0.89	0.98	
		b	mm	30	30	35	35	40	45	
		b	in	1.18	1.18	1.38	1.38	1.57	1.77	
		c	mm	42.5	42.5	50	50	57.5	60	
		c	in	1.67	1.67	1.97	1.97	2.26	2.36	
Max. permissible radial load at distance		a	$F_{q,max}$	N	3600	5000	6300	8000	11000	16000
		a		lbs.	809	1124	1416	1798	2473	3597
		b	$F_{q,max}$	N	2891	4046	4950	6334	8594	12375
		b		lbs.	650	910	1113	1424	1932	2782
		c	$F_{q,max}$	N	2416	3398	4077	5242	7051	10150
		c		lbs.	543	764	917	1178	1585	2282
Max. permissible axial load		$\pm F_{q,max}$	N	1500	2200	3500	3500	4800	6000	
			lbs.	337	495	787	787	1079	1349	

Filtration Options

Many factors influence the selection of a filter to achieve the desired cleanliness level, including: dirt ingress rate, required cleanliness level, and system complexity. We have found the following filter Beta (B) ratios (ISO 4572) to be satisfactory:

Suction Filtration..... $\beta_{10} \geq 2.0$ & $\beta_{30} \geq 100$
 Charge Pressure Filtration..... $\beta_{10} \geq 10.0$ & $\beta_{20} \geq 100$

Machine testing is necessary to confirm the ability of the selected filter to maintain the desired fluid cleanliness levels.

Charge Flow Suction Filtration (standard model)... S

Filter type: Filter **without** bypass

Filter element pressure drop:
 at $V = 141 \text{ SUS}$ (30 cSt); $n = n_{max}$ $\Delta p \leq 0.1 \text{ bar}$ (1.5 psi)
 at $V = 4635 \text{ SUS}$ (1000 cSt); $n = 1000 \text{ rpm}$... $\Delta p \leq 0.3 \text{ bar}$ (4.5 psi)

Min. pressure at charge pump inlet port (S):
 at $V = 141 \text{ SUS}$ (30 cSt)..... $p \geq 0.8 \text{ bar abs.}$ (6.3 in-Hg.)
 at cold start..... $p \geq 0.5 \text{ bar abs.}$ (15.2 in-Hg.)
 The filter should be fitted with a ΔP indicator and/or switch.

Hydraulic Centreing

When the control module is replaced, it is generally necessary to centre the new module. Follow the steps listed below:

1. Install a 0-6000psi (0-414bar) hydraulic pressure gauge into ports M_A and M_B .
2. Install a 0-600psi (0-41bar) hydraulic pressure gauge into ports X_1 and X_2 .
3. Disconnect and plug the X3 port (fig. 7-7c) for the rotation torque control (if used).
4. Loosen the lock nut on top of the control module with a 4mm allen wrench. Use a 4mm allen wrench to turn the adjusting screw. The adjustment screw is an eccentric, therefore turning the screw more than 90° in either direction will have no further effect, and could cause damage to the eccentric pin.
5. The neutral position is correctly adjusted when:
 - a. Approximately equal pressures are at X_1 and X_2 ports.
 - b. The hydraulic motor does not turn when the brake is released.
 - c. Charge pressure registers equal at M_A and M_B ports when the pump is deadheaded.

NOTE: Use one gauge and swap between ports X1 and X2. Even new gauges may not read identical pressures.

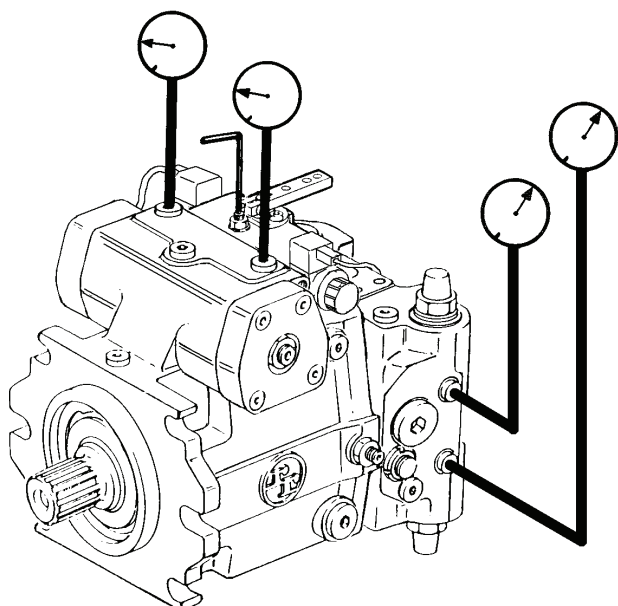


Fig. 7-8c Hydraulic zero position – with EP pump control.

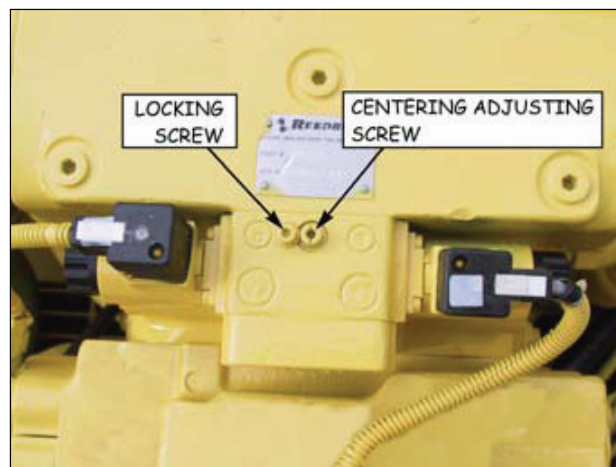


Fig. 7-8d Hydraulic Centreing Adjusting Screw – with EP pump control.

Loop Filters

Routine Maintenance

The loop filters do not normally require special attention except for periodic monitoring of the dirty element warning device. See lubrication section for filter change intervals. Refer to Figure 7-14 for item numbers.

1. If external leakage is noted, replace O-ring at leak. For bowl seal leaks, replace O-ring (9) and backup ring (8), locating backup ring away from fluid and toward bowl. If leakage persists, check sealing surfaces for scratches or cracks; replace any defective parts.
2. Differential pressure switch (26) fig.7-14 acts as a dirty element warning device and will flag an alarm on the Vigilante Alarm Screen 3 when differential pressure across the element becomes excessive because of plugging by contaminant. The hydraulic fluid temperature must be greater than 55°C and the switch activated for three minutes to enable alarm. This avoids false triggers caused by high fluid viscosity at low temperatures and sudden increases in flow.



Fig.7-12 Loop Filters

Rotary Drive Gearbox Motor

Trouble Shooting (cont.)

Effect of Trouble	Possible Cause	Fault Which Needs Remedy
High wear	Improper fluid	Fluid too thin or thick for operating temperature range Breakdown of fluid with time/temperature/shearing effects incorrect additives in new fluid Destruction of additive effectiveness with chemical aging
	Improper repair	Incorrect parts Incorrect procedures, dimensions, finishes
Unwanted water in fluid	Condensation	Faulty breather / strainer Heat exchanger leakage Faulty cleanup, practice Water in make-up fluid
Pressure shocks	Cogging load	Mechanical considerations
	Worn relief valve	Needed repairs
	Slow response in check valves	Replace or relocate
	Excessive decompression	Improve decompression controls energy rates
	Excessive line capacitance	Reduce line size or lengths. Eliminate hose (line volume, line stretch, Bleed air accumulator effects)
	Barrel blow-off	Recheck hold-down rotating group, drain pressure
Heating of fluid	Excessive motor leakage	Recheck case drain flow and repair required Fluid too thin Improper shaft assembly, port timing
	Reservoir	Too little fluid Entrained air in fluid Improper baffles Insulating air blanket that prevents heat rejection Heat pickup from adjacent equipment

Auxiliary and Feed Circuits

The auxiliary and feed circuits are supplied by a variable displacement piston pump. The pump is a Rexroth AA11VLO190 DRS so is pressure compensating and load sensing. Maximum setting of the pump is 3000psi (206.8bar) but is reduced by load sense relief's for auxiliary functions and is fully load sensing for pulldown. The only time the pump reaches full pressure is when the hoist is stalled.

When any function switches on the operators console for the 6 or 9 spool auxiliary valves are operated, the PLC energises the Auxiliary Pump load solenoid (**V03**) which will load the pump to **2500psi (172.4bar)**, set by the auxiliary load relief (**V05**). The 0.032" orifice at the M port of the pump will generate a pressure drop when the relief reaches its setting and flow begins. The load sense pressure is directed via shuttles (**V04**) and **V19** to the X port on the pump to load it.

The jacks and mast raise functions are fully load sensing and the pressure is limited by the Jacks/ mast raise load sense relief (**V06**) set at **2800psi (193bar)**. Orifice **V20** generates a pressure drop when the relief reaches its setting and flow begins.

Pilot pressure to jacks/mast raise pilot valve is supplied from charge pressure via the set-up interlock solenoid valve (**V11**). (**V11**) will only allow pilot pressure to the pilot valve when it is energised, (**V11**) becomes energised when 1) pipe is not in hole, 2) ladder is up 3) hydraulic function enable button 'touchscreen' has been set.

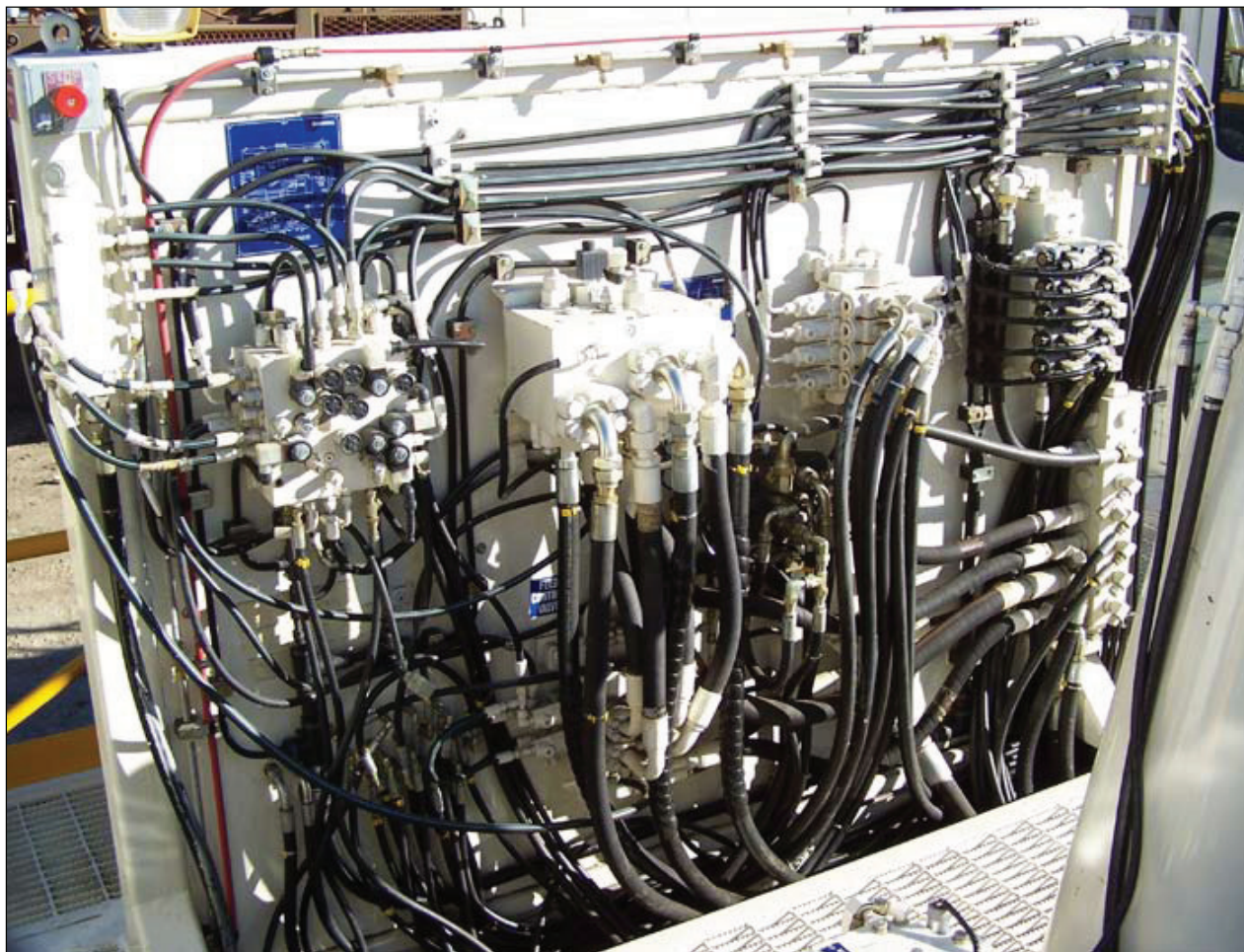
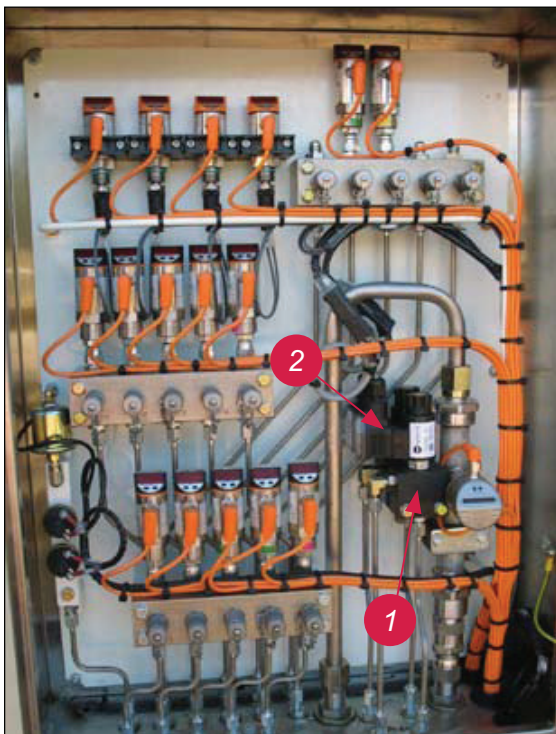


Fig. 7-24 Valve Stand Assembly

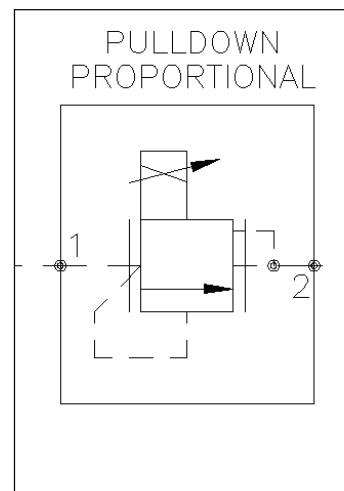
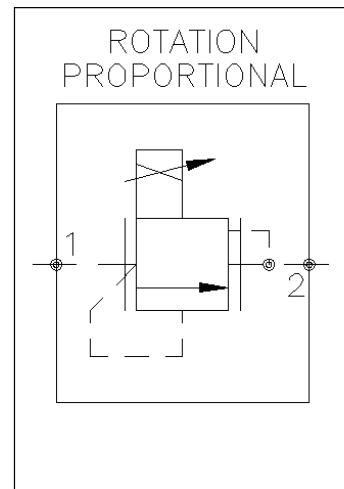
Electro Proportional Relief Valve



1. Pulldown proportional relief valve vents Port 3 of V15 in the pilot control manifold
2. Rotation proportional relief valve vents Port 3 of V21 in the pilot control manifold

Pulldown / Forward Rotation Proportional Relief Valve

- This 2-port, pilot-stage, direct acting relief cartridge is an electro-proportionally controlled, normally closed pressure regulating valve. The proportional control allows for infinite, step-less adjustability within the selected pressure range. When the pressure at Port 1 (inlet) is sufficient to overcome the solenoid forces, as determined by the analog input signal, the poppet lifts and allows flow from Port 1 to Port 2.
- This valve is used with Amplifier Valve Controller (as on this slide) and is controlled by potentiometer in cab, allowing operator to control pressure from just above charge pressure to maximum setting as set on V04/V08.



Amplifier Plug (91A11488001)

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Holdback Control

The Holdback control consists of a Solenoid valve and a Relief valve (Fig 7-28). When the Holdback Solenoid is activated, the pilot pressure acting on the feed Counterbalance valve (A) Item 2 Fig 7-13a is controlled by the Holdback Relief. The Orifice (Item 4, Fig 7-29a) generates a pressure drop from Pulldown pressure and enables the pressure to be controlled by the Holdback Relief.

The reduced Pilot pressure will only partially open the Pulldown Counterbalance Valve so the exhaust side of the Hoist/Pulldown cylinder will be restricted during Pulldown so will 'Holdback' the Rotary Head.

Adjustment is anticlockwise to increase Holdback, clockwise to decrease holdback.

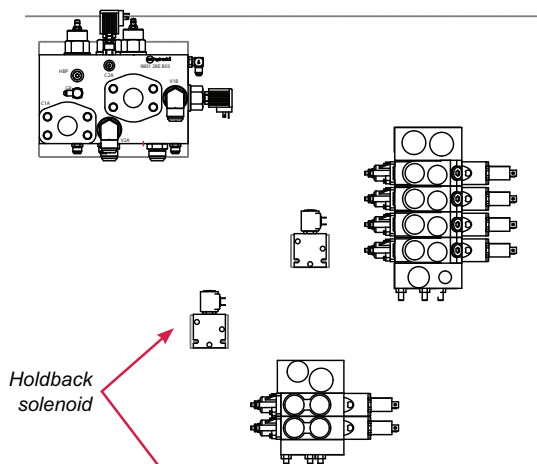
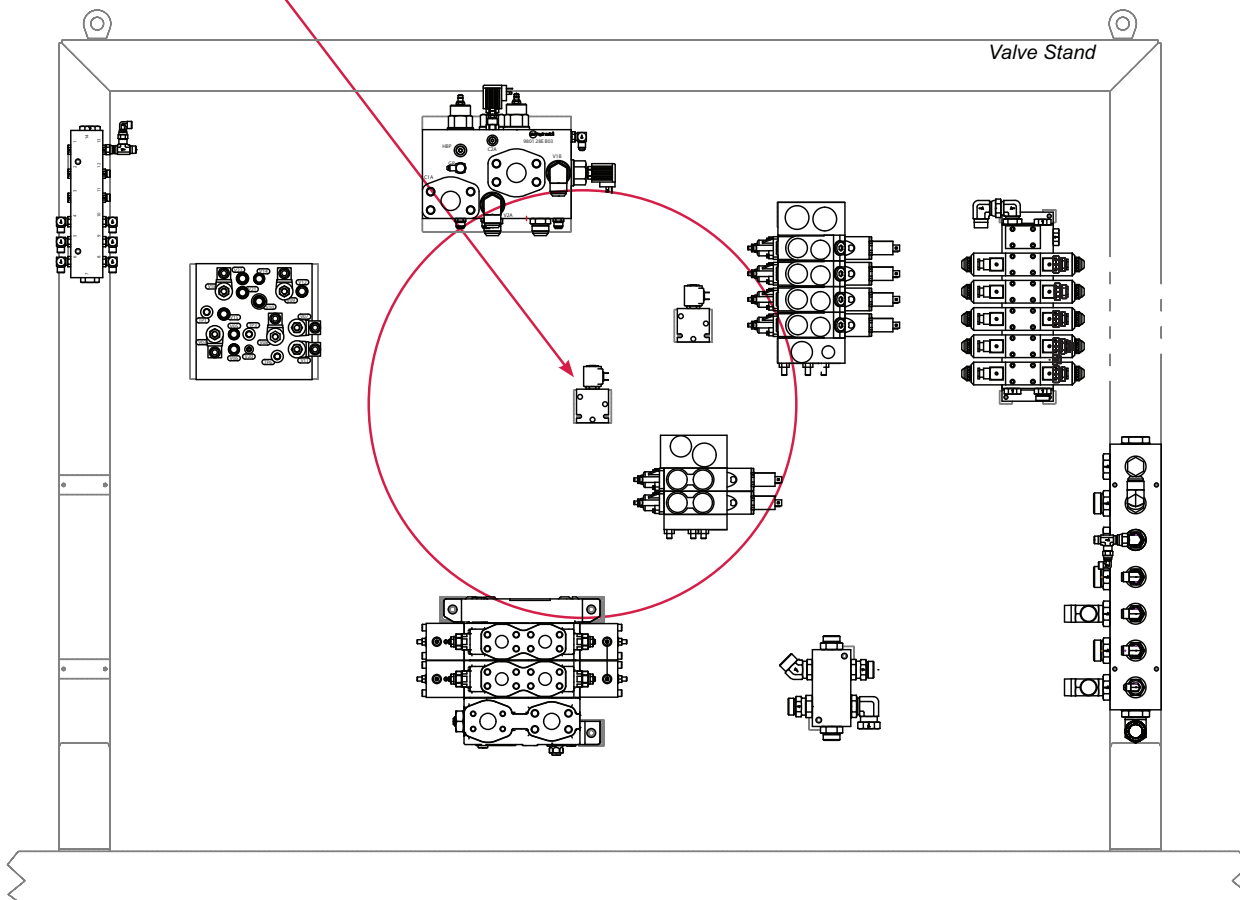


Fig. 7-28 Holdback Pressure control in Cab



Levelling Jack Cylinders

The function of the counterbalance valves on the levelling jacks is to ensure that the drill stays in the intended position for drilling when the jacks are extended.

Counterbalance Valve Test Procedure

If a counterbalance valve is suspected to be bad, use the following procedure to check.

1. First, be sure machine is on solid level ground. Lower jacks to ground, but do not lift machine up. Shut down machine and relieve pressure from hydraulic system.
2. Tag, remove, and cap or plug lines from counterbalance valve. Install a tee and 6000psi (414bar) gauge in Port 1 of valve. Attach a hand pump to the tee. Do not connect pilot assist to Port 3, leave open.
3. Pressurize port 1 with the hand pump and adjust screw so valve holds 3000psi (207bar). Replace cartridge if valve will not hold at 3000psi (207bar).
4. Install lines to counterbalance valve. Start machine and purge air from lines BEFORE lowering jacks. Tighten hose fittings and lower jacks to raise machine off the ground. Check to be sure machine does not creep down.
5. Level the machine and jack the front of the machine up and down slightly. If the machine twists slightly when the machine is lowered, slightly increase the setting of the valve which opens first.

NOTE: If all counterbalance valves are functioning properly but machine still creeps down when up on jacks, then the jack cylinder(s) most likely is leaking internally or air is trapped in the cylinder. Further diagnostics and repair or replacement will be necessary.

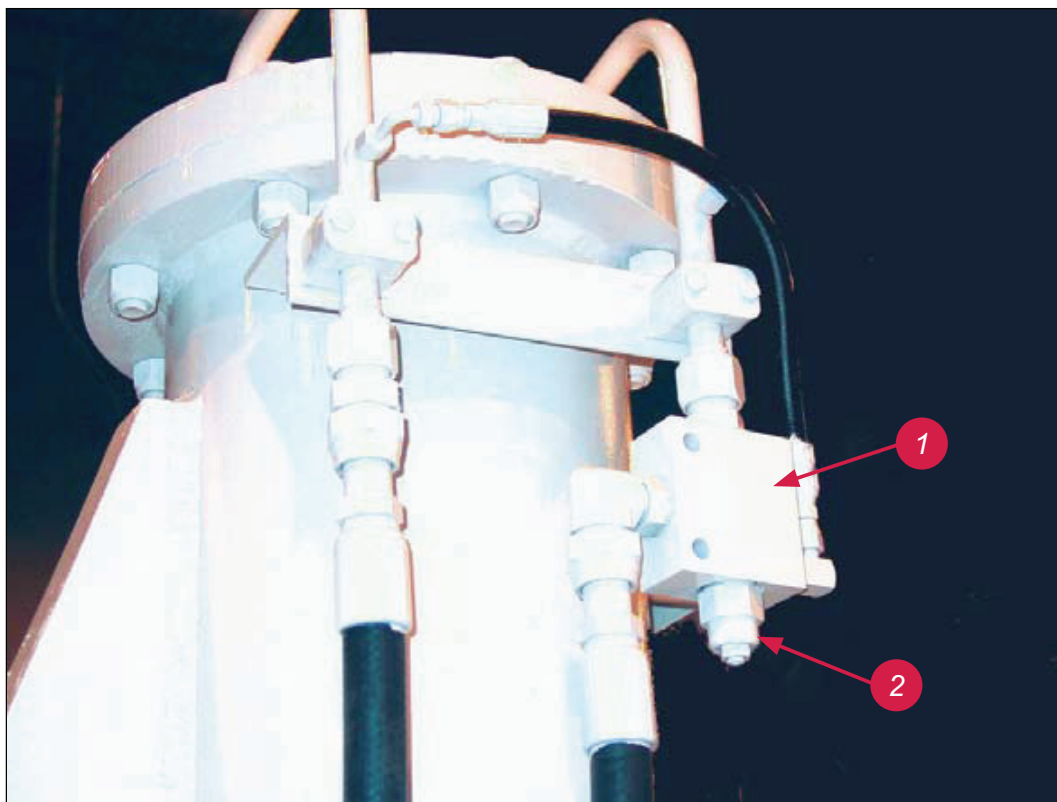


Fig. 7-39b Jack Counterbalance Valve (1 per jack)

1. Counterbalance Valve
2. Adjustment Screw

Hydraulic Operated Breakout Wrench

Setting of HOB0 Sequence Valves

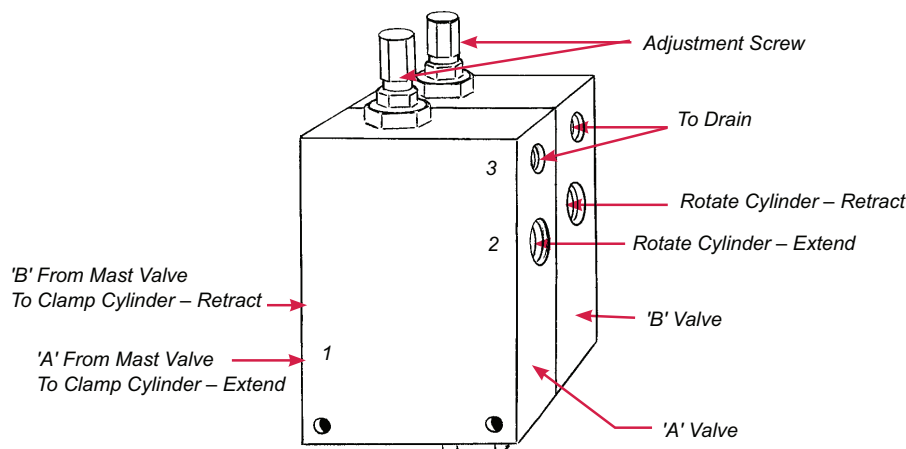


Fig. 7-46 Sequence Valves for Breakout Wrench – refer to schematic, Fig. 7-43

1. Position H.O.B.O. wrench in open position.
3. Loosen and remove cap nut from adjustment screws. Loosen locknut.
3. Screw both adjustments fully in, but not overly firm.
4. Operate breakout wrench to undo pipe. Pipe clamp cylinder will operate to full stroke, but rotate cylinder will not move.
5. While holding valve in 'ON' position, adjust screw of the 'A' (outer) valve slowly outward until rotate cylinder actuates, adjust screw slightly more so that the cylinder operates freely. 'A' valve is now correctly set – lock locknut.
6. Operate breakout to retract, clamp cylinder will release pipe but rotate cylinder will not move.
7. While holding lever to retract, adjust screw on 'B' (inner) valve slowly outward until actuation occurs. Adjust slightly more to achieve free movement.
8. Tighten adjustment locknut, install both protection caps.
9. Breakout sequencing now correctly set.

See fig. 7-43 for breakout wrench schematic.

H.O.B.O Float Valve

The H.O.B.O Float Valve is piloted from the clamp porting of the Clamp Cylinder to open both ports of the H.O.B.O Float Cylinder, allowing the Float Cylinder to 'float' and adjust to the diameter of the pipe.

Note: This function is only to account for pipe wear not different sized pipes. The H.O.B.O die holders need to be changed if the pipe design diameter is changed.

Cooler Fan Motor

Hydraulic Motor (cont.)

Specifications and Tools

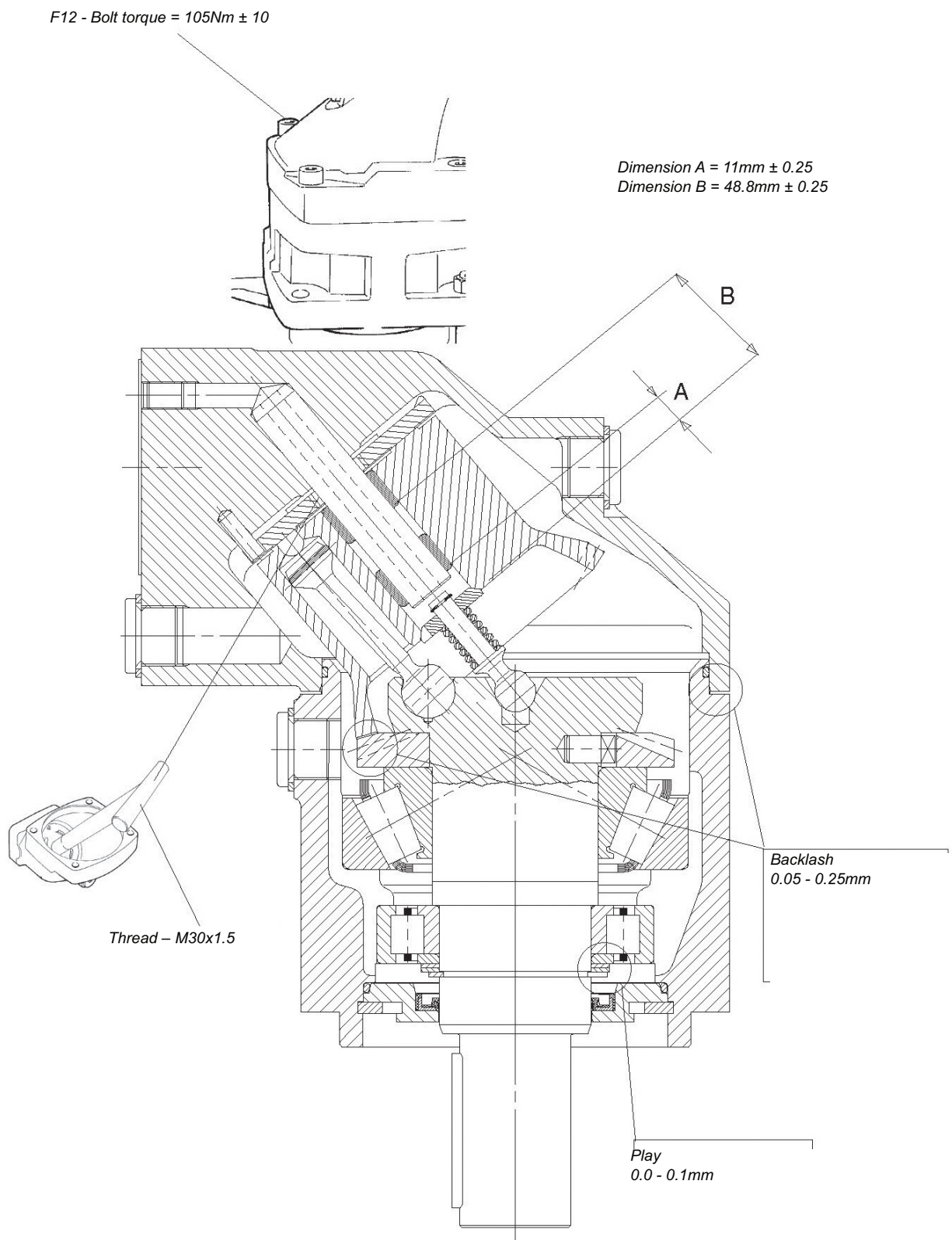


Fig 7-47e Cooler Fan Motor Cross Section

Water Injection / Foam Injection Circuit

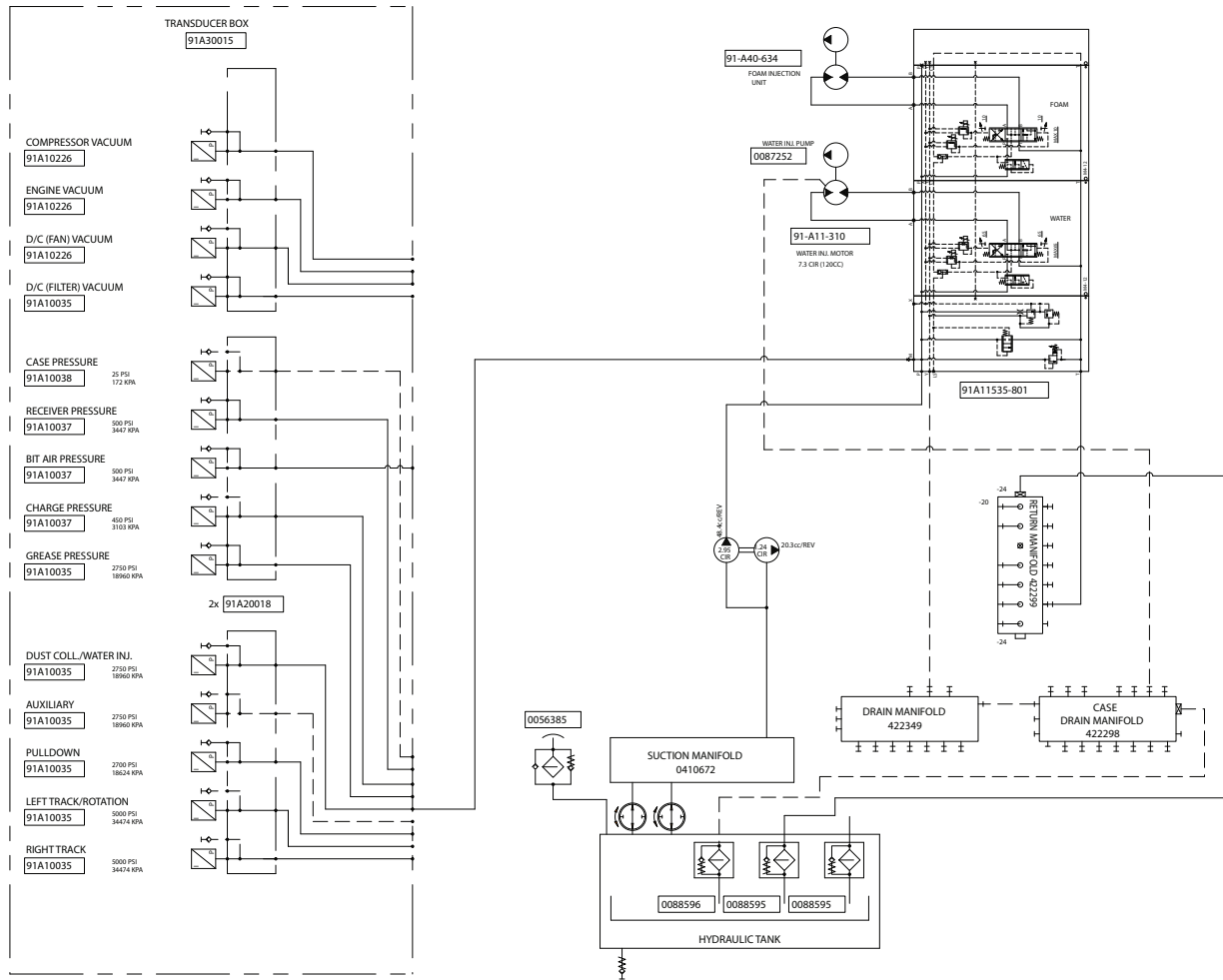
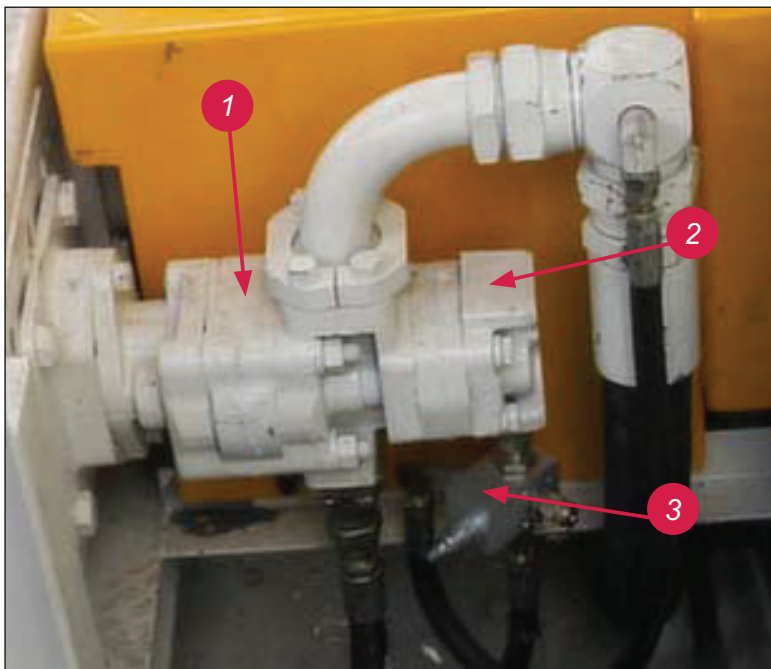


Fig. 7-52 Water Injection / Foam Injection Circuit



1. Water / Foam Injection Pump
2. AC pump
3. AC Relief

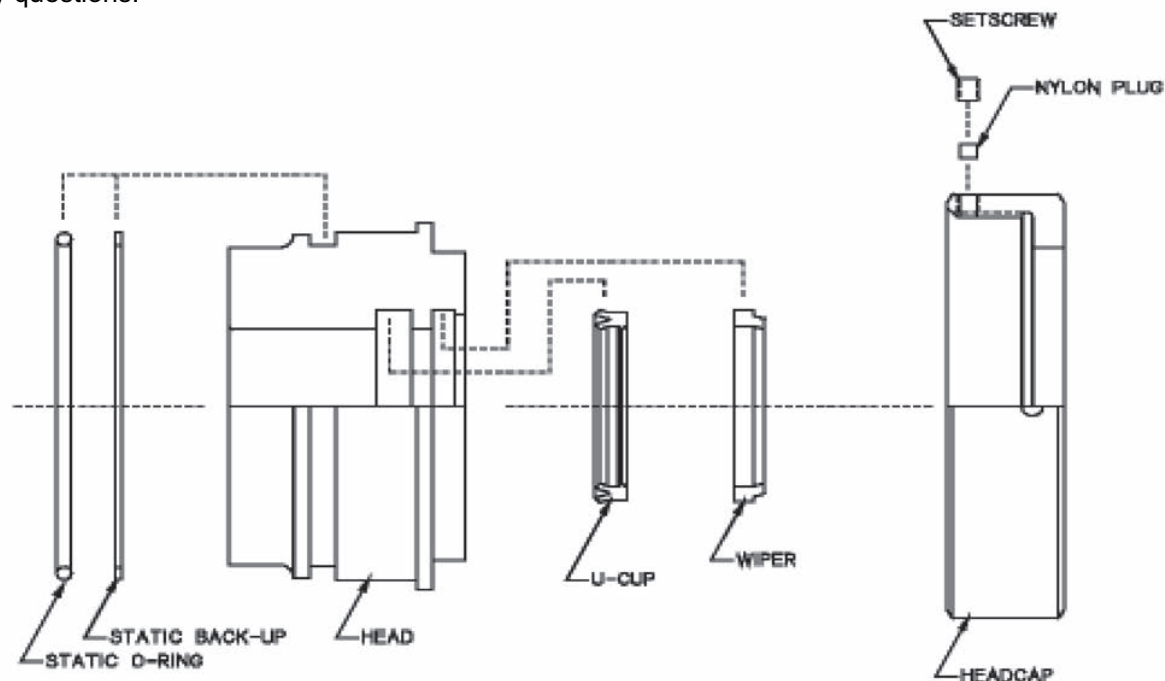
Fig 52a Water Injection / Foam Injection Pump / AC Pump

Hydraulic Cylinder Repair

H Head

General

The H series head uses aluminium material and has a polyurethane U-cup as the primary sealing element. The wiper is a standard type D polyurethane. The head is retained within the tube by means of an internally threaded headcap. General procedures for teardown, inspection and rebuild are contained in the General Procedures Maintenance Manual. See your Texas Hydraulics Sales Engineer if you have any questions.



Teardown

Remove the head retaining device as follow: Locate the setscrew in the headcap (a headcap is the internally threaded head retaining nut threaded onto the tube external threads). Remove this setscrew and insert a spanner wrench into the holes provided. Turn the headcap counter-clockwise (it is a right-hand thread) to remove it. If the headcap is stuck or moves erratically, tap the headcap with a brass or plastic mallet while turning it. Warp the headcap with a soft cloth or provide some other means to insure that the inner diameter of the headcap does not contact the chromed surface of the rod.

Rebuild

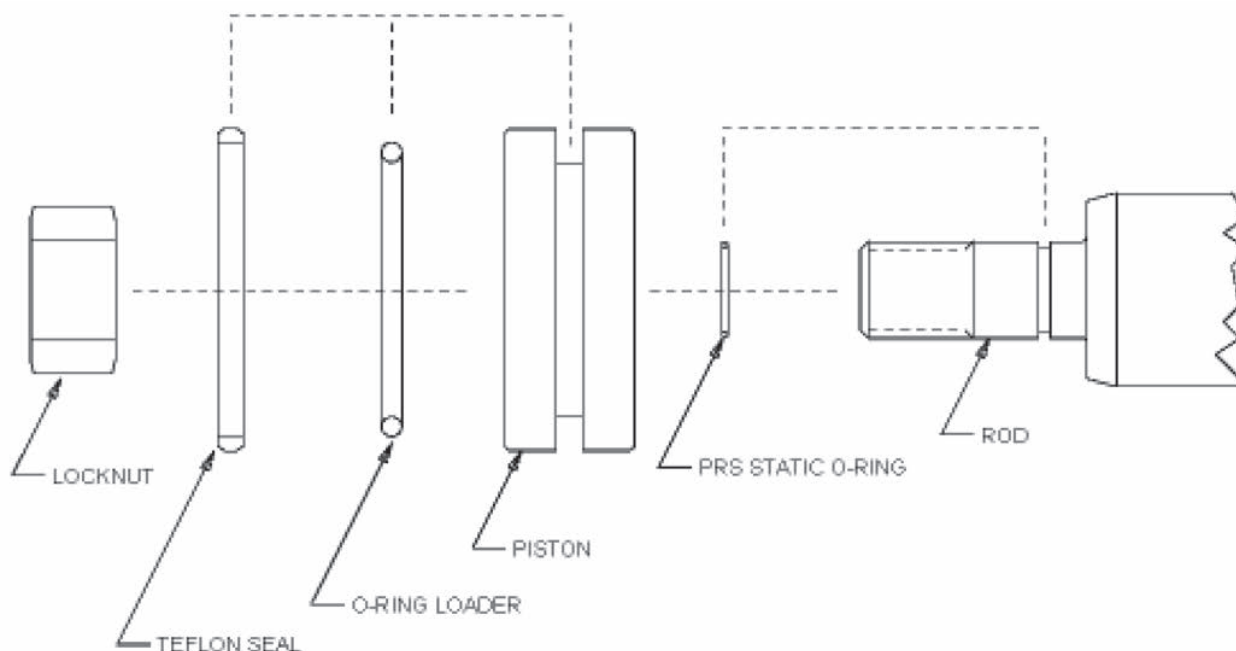
Lubricate the head and all seals with hydraulic fluid prior to installation. Using round-nose pliers or special installation tools, twist the dual lip U-cup seal into a 'C' shape and allow it to snap into groove. Use a similar technique for installing the wiper. Install the static O-ring and backup into the static seal groove verifying that the backup is closed to the headcap retaining lip. If possible, the head/seal assembly should sit for at least one hour to allow the seals to elastically restore.

Place the rod on a clean table. Slide the headcap onto the rod. Wrap it so that it does not damage the chromed surface. Install the head followed by the piston onto the rod noting the proper orientation of each component.

Slide the headcap onto the tube and engage it with the threads. Turn the headcap counter-clockwise until the first thread just passes the engagement point (The headcap will move noticeably) then turn the headcap clockwise until it is hand tight or fully seated. Insert a spanner wrench into the holes provided and tighten 1/8 to 1/4 turn past fully seated. Insert the nylon plug and setscrew into the setscrew hole and tighten the setscrew securely.

Hydraulic Cylinder Repair

M Piston (cont.)



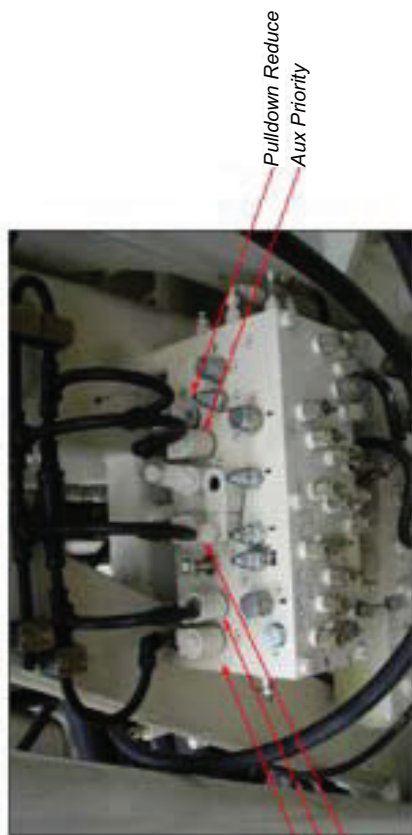
Teardown

After removing the piston, remove and discard the PRS static O-ring from the groove in the rod. Remove the teflon seal and O-ring loader by means of blunt instruments of bronze or aluminium. Be sure there are no sharp edges on these tools. Be particularly careful of scratching the groove surface finish.

Rebuild

For easiest installation, warm the teflon seal in 120 to 1500°F hydraulic fluid. Lubricate the piston and all components with hydraulic fluid. Install the O-ring loader in the groove and verify that the O-ring has not twisted. Place one side of the teflon seal in the groove and stretch remaining portion into place. Never use sharp instruments of any kind. Be extremely careful to avoid damaging the seal grooves during installation. Scratching the groove may cause by pass leakage. If possible, allow the piston/seal assembly to sit at least one hour to allow seals to elastically restore.

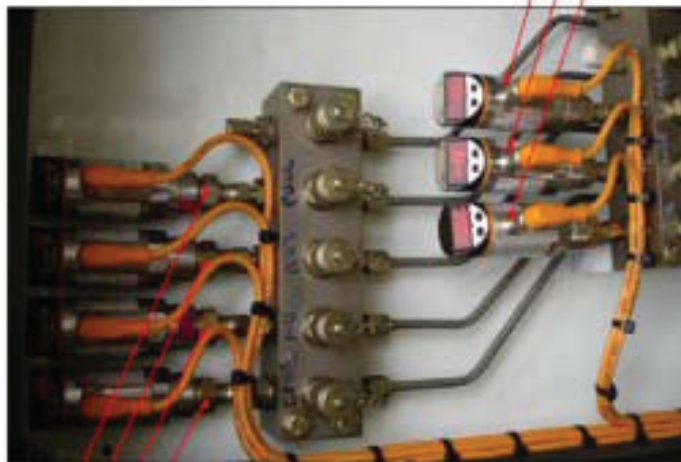
Electrical Locator



LOWER SOLENOID BANK

Pulldown Reduce
Aux Priority

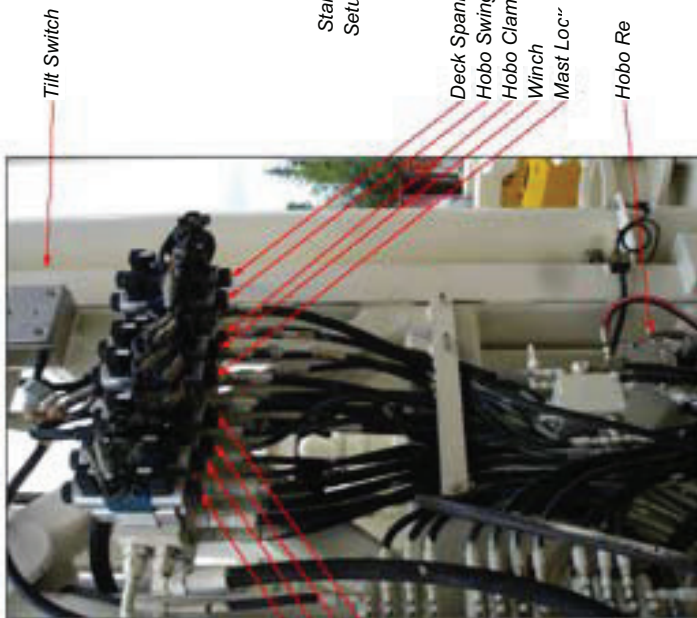
Start Unloader
Setup Interlock
Drill Tram



TRANSDUCER BOX

Charge Pressure
Gauge Pressure
Bit Air Pressure

Pulldown Pressure
Rotation Pressure
Air Pressure
Case Pressure



UPPER SOLENOID BANK

Tilt Switch

Carousel Rotate
Carousel Swing
Carousel Lock
Pipe Positioner

Deck Spanner
Hobo Swing
Hobo Clamp
Winch
Mast Loc"
Hobo Re

Isolator Trip Relay
Eng Control Relay
Drill Tram Relay
Hyd Valve Isolator Relay

Access Light Timer
Pulldown Control
Main Relay
Main Light Relay
Light Relay



ENGINE J-BOX

LASER DEPTH SYSTEM

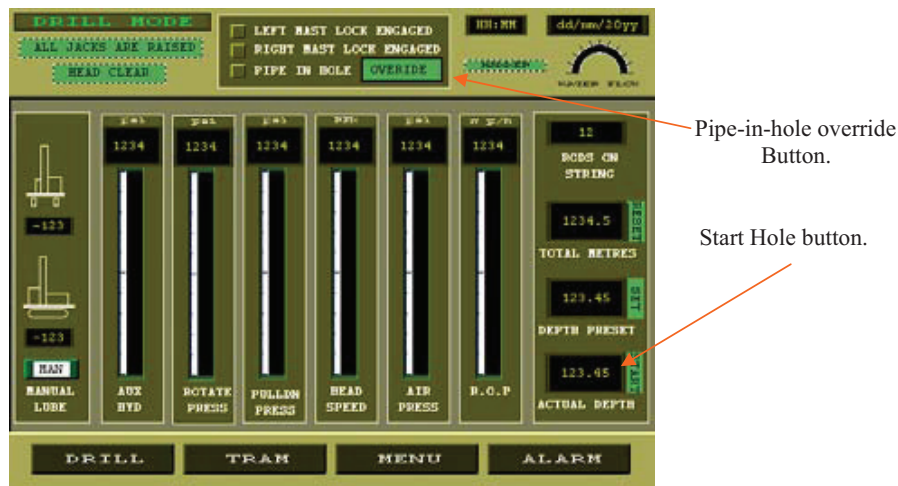
General Info

A laser is used to indicate depth on the Drill PLC System. This introduces a reliable method of detecting depth without contact and avoids the use of unreliable encoders and pull wire devices.

The Laser is "only powered up" when the engine is running and the mast is raised.

The added optional functionality incorporated into the Drill PLC Depth system is....

- Pipe in hole detection
- Head clear indication
- Auto retracting of the Pipe Positioner, Centre guide, Hobo
- Prevent the Pipe Rack from swinging into the Head



Pipe-in-hole override Button.

Start Hole button.

Functional Description of Operation

- When the operator switches from Tram to Drill mode, the Rod counter will equal zero.
- The operator must push the START HOLE button on the Touchscreen when first starting to drill a hole. As soon as he does this, the Rod counter display will equal 1 (1 rod on string) and the depth system will be enabled.
- The Rod Counter proximity switch is used to detect that a rod has been either added or subtracted. It does this by detecting the pipe rack position. When the Pipe Rack is swung under the Head and then moved back into the parked position, a flag in the PLC is "set".
- After the Rod counter flag has been "set", the Laser then determines the position of the Head.
- With the Head above the "midpoint" and the Deck Wrench is operatedthen a rod will be ADDED
- If the Head moves down to a set point approx 200mm above "deck wrench" position without the Deck Wrench being operated.....then the rod will be SUBTRACTED

Setting up the Laser

- Mount Laser. With head right down measure a distance 400mm away from Laser to Target position on sheath. Move head to its right up position and hold Target on marking. Apply 24V dc to Laser and make sure red dot is in middle of the Target. Mount the Target in this position.
- Move head from full down position to full up position and make sure the analog signal is reading over full length of head travel in the PLC/Touch screen. For the Touch screen this can be seen in the general **1057** password protected area – calibration – 'Laser Actual' reading.
- Laser is now ready to be calibrated for depth reading.

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