Section 4
Hydraulic System

GENERAL DESCRIPTION

This section describes the functional operation of the hydraulic system and contains the procedures for performing basic maintenance and servicing of the major components within the system.

The machine's hydraulic system consists of four independent circuits that are supplied from a common reservoir. The reservoir is pressurised to 69 kPa (10 psi) to prime the four hydraulic pumps and aid in reducing foreign contaminants into the system.

These circuits are the steering and brake circuit, the main hydraulic circuit and the auxiliary circuits for the cooling fan drive and alternator drive.

Steering Brake Circuit

The steering and brake circuit is supplied from a pressure compensated/variable displacement piston pump driven from the output of the transmission torque converter. Circuit filtration is via a pressure line filter, which has a 354 kPa (51 psi) bypass feature. Oil is fed into a main steering and brake circuit manifold where a system relief pressure of 20.7 MPa (3000 psi) is provided. The circuit is split to separate steering and brake circuits. Both circuits are fitted with hydraulic accumulators which act as pressure storage. This allows the pump not to have to come on stroke with every application of the brakes or steering, also they provide a reserve for emergency applications.

The brake circuit is interlocked with the pneumatic system for automatic and manual application and release of the spring applied hydraulic release Posi-Stop brakes. Braking is achieved via actuation of the brake pedal reverse modulating valve which bleeds pressure from the Posi-Stop brakes proportional to the pedal stroke. The brake accumulator acts as pressure storage for multiple brake applications without the need to keep the pump on stroke to maintain system pressure.

The steering circuit is controlled by an orbital steer valve which pilots a hydraulic steer DCV that directs hydraulic oil pressure to the steering cylinders. Cylinder protection from external shocks is achieved by relief valves fitted in the steering DCV. The brake accumulator acts as pressure storage for brake release without the need to keep the pump on stroke to maintain system pressure.

The steering and brake system also supplies a pilot pressure, reduced to 2.4 MPa (650 psi), for manually activated pilot control of the main hydraulic circuit valve bank.

Main Hydraulic Circuit

The main hydraulic circuit is supplied via fixed displacement gear pump driven from a output of the transmission torque converter. Hydraulic oil is supplied to the open centre main valve bank at a fixed displacement, depending on engine speed. System relief of 20.7 MPa (3000 psi) is provided at the inlet to the main valve bank.

Each working section of the valve bank is fitted with 22.4 MPa (3250 psi) port reliefs. The working sections of the main hydraulic valve bank control; lift and tilt (lift arms), the winch and attachments which are fitted to PTO. These are pilot activated via a four-way joystick control lever for the lift and tilt. The winch system and PTO attachments are controlled by 2 two-way hydraulic control levers. Relief pressure is via a separate inline port relief valves and the main relief valve all situated in the valve bank.

Auxiliary Circuits

The auxiliary circuits for the cooling fan are supplied by a separate pump driven from the transmission, pressure relief is by a separate inline relief valve set at 17.2 MPa (2500 psi). The fan motor receives a constant flow of 79 lpm at 2600 RPM. Hydraulic oil is supplied through the fan motor which then returns back to tank.

The auxiliary circuit for the alternator motor is supplied by a gear pump piggybacked on the cooling fan pump. This supplied hydraulic oil to a manifold assembly which houses a logic element that controls a flow of 19 lpm for the alternator motor RPM control. Internally there are two relief valves set at 17.2 MPa (2500 psi).

SAFETY PRECAUTIONS

All personnel performing maintenance tasks on this machine should have been trained, assessed and be deemed competent. They should be appointed by the mine management.

The following safety precautions are not intended to be exhaustive. Safe work practices should be used when servicing or operating heavy machinery.

ALWAYS give the engine an opportunity to cool down before performing servicing around the rear frame as engine components around this location are hot and could cause burns or scalding.

ALWAYS be aware of, and isolate, other forms of energy and pinch points (fan, belts, pulleys and drive lines) when accessing the engine compartment including pneumatic stored pressure, engine coolant pressure, hydraulic oil pressure and other heat sources such as engine block and exhaust system components.

ALWAYS install the articulation lock when accessing the machine articulation area as machine articulation will result in crush injuries.

ALWAYS install the place stands under the lift arm lock when access underneath the lift arm assembly is required. Remove any load before raising and securing the lift arm assembly.

NEVER assume that all forms of energy have been isolated unless you have confirmed for yourself.

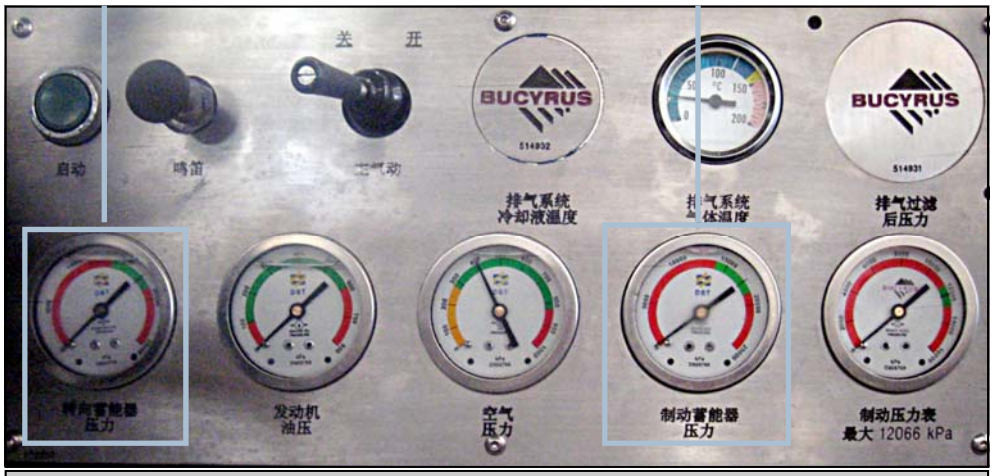
HYDRAULIC ISOLATION

To isolate the hydraulic system perform the following procedure:

1. Ensure the area is clear of any obstruction and area is fit for carrying out safe operation and maintenance.
2. Lower the lift arms to the ground, shutdown the engine, fit a danger tag to the on/off toggle switch, connect the articulation lock and chock the wheels.
3. Depress the attachment quick connects button located in the operator's compartment. This will remove any residual pressure stored in the PTO lines.
4. Observe both steering and brake pressure gauges located in the operator's compartment. The hydraulic system features a steering and brake accumulator automatic dump off which removes hydraulic pressure from both accumulators once the engine and main air has been stopped. This is immediate. This is done by an air pilot from the air circuit.
5. Remove hydraulic tank pre-charge pressure (50 kPa) by cracking hydraulic tank filler cap

Steering Accumulator Pressure Gauge

Brake Accumulator Pressure Gauge



Right Hand Side Operator's Display Panel

Serious injuries can occur from hydraulic oil under pressure. Always ensure that the hydraulics are isolated and safety eyewear is worn when working on hydraulic systems.

PUMPS AND MOUNTINGS

STEERING/BRAKE PUMP

The steering/brake pump is an axial piston type that utilises a pressure control that provides a flat cut off in flow at a preset screw adjustable pressure level. While system pressure is below the pressure setting, full flow is available from the pump. When system pressure reaches the preset value the pump is de-stroked to maintain the pressure level. The compensated steering/brake pump is mounted on the rear of the main hydraulic pump and is driven via the main pump drive shaft which in turn is driven from the transmission.

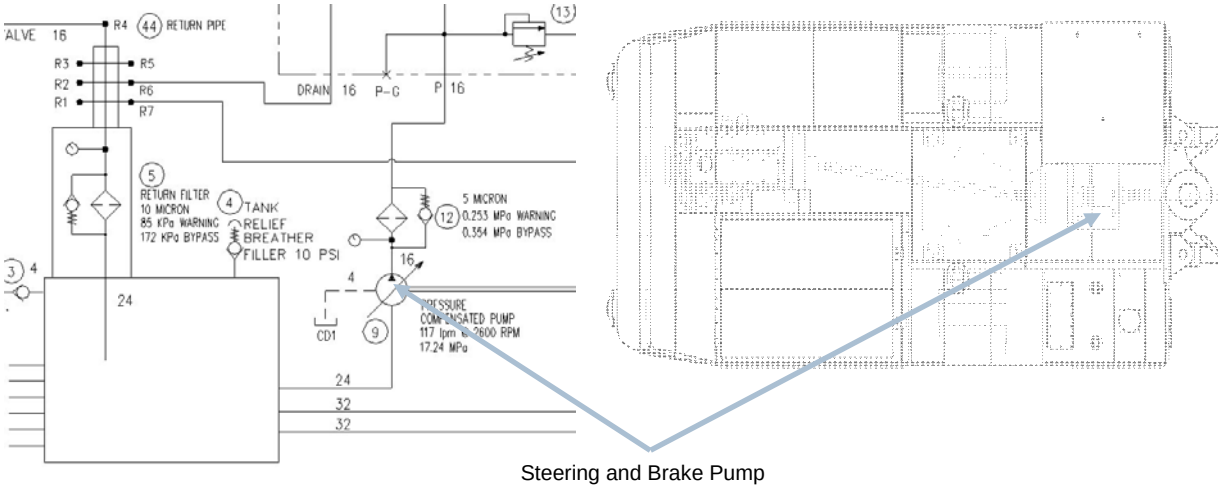
The compensated pressure setting should be checked by the operator daily, by checking the pressure on the steering and brake accumulator gauges.

To adjust the steering/brake pump compensated pressure setting:

1. Park the machine in a clear area, apply the park brake and install the articulation lock and chock the four wheels.
2. With the engine running at idle, release the park brake, access the steering/brake pump by removing the transmission cover and locate the pressure compensator adjustment on the underside of the pump housing.
3. Loosen the adjusting locking grubscrew and rotate the adjusting screw clockwise to increase the compensating pressure or counter-clockwise to decrease the compensating pressure.
4. Pressure can be observed at either the steering or brake accumulator pressure gauges located in the operator's compartment, alternatively a gauge may be fitted into the test port on the steering/brake manifold.
5. When the correct pressure is set tighten the adjusting locking grubscrew.

Pressure Compensated Steering and Brake Pump

Pressure Compensated Steering and Brake Pump



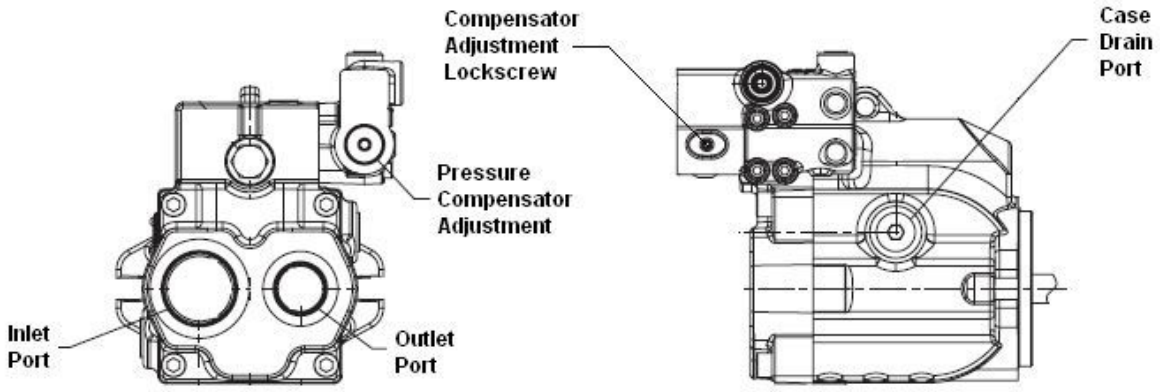
Steering and Brake Pump

Installation Pump Priming:

When mounting the pump on this system the fluid level is below the mounting position, the following startup procedure is recommended.

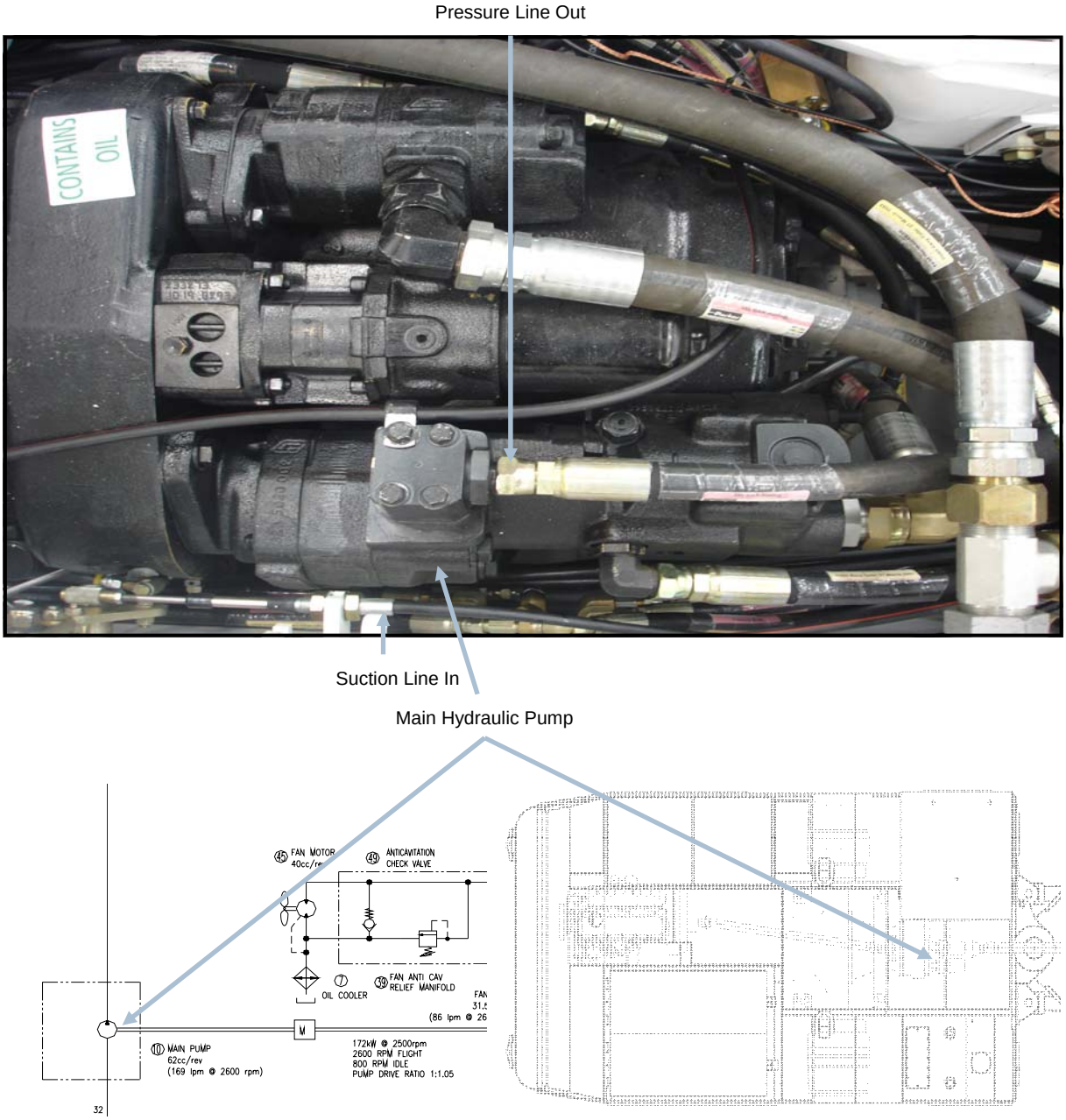
1. Ensure that the pump case is full of oil before starting. The case can be filled through the case drain port.
2. Charge the hydraulic tank via the recharge valve located on the top of the tank to ensure there is 50 kPa of air pressure in the tank to assist in pushing the hydraulic fluid through the suction hose.
3. Start motor and run until pump primes or a maximum of 30 seconds. If pump does not prime in 30 seconds, stop motor and repeat until pump primes.

DO NOT run the pump if in a dry state as this will reduce its service life.



MAIN HYDRAULIC PUMP

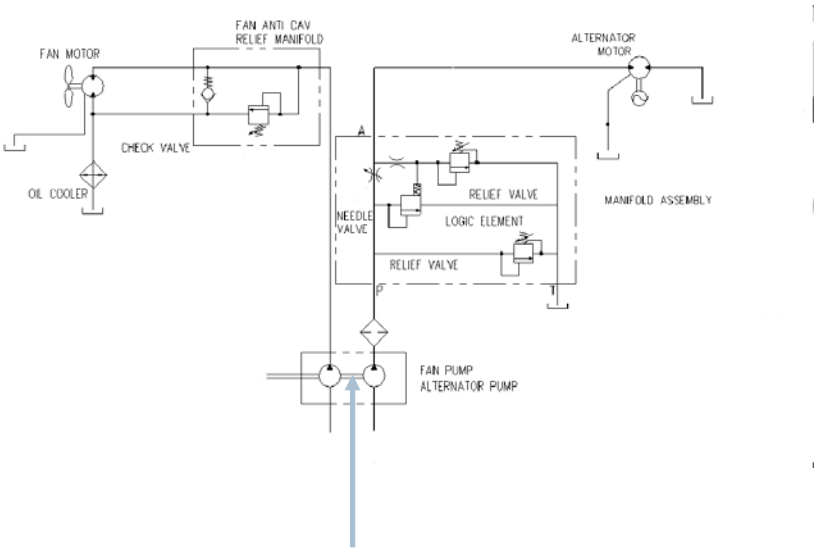
The main hydraulic pump is single section, fixed displacement gear type that has a fixed flow rate dependant on engine speed. Oil is fed from the suction side of the pump and directed to the pressure port via the internally rotating gear. Flow is independent of system pressure and the circuit is connected as open centre with oil passing through the main control valve and back to tank.



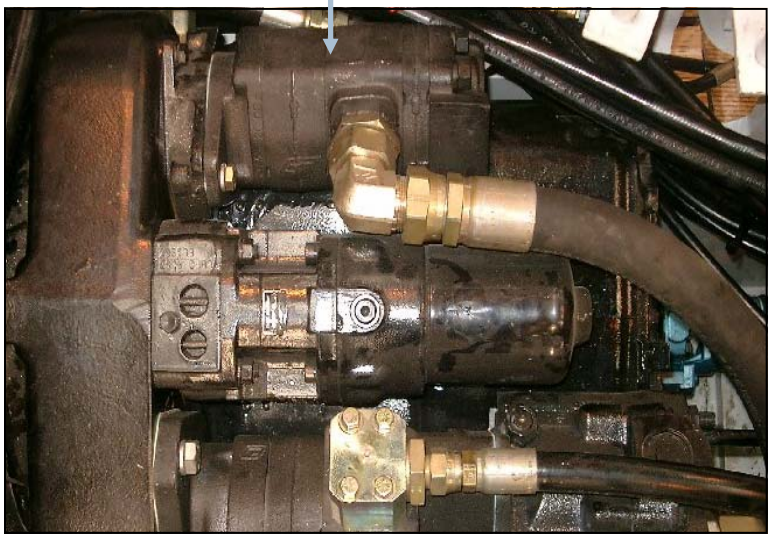
AUXILIARY HYDRAULIC PUMPS

The auxiliary pumps are fixed displacement gear pumps piggybacked using the same suction line supply.

The first section supplies the fan motor and is fitted with an inline relief valve set at 17.2 MPa and priority valve. The second section supplies the alternator drive motor and is fitted with a manifold assembly which houses two relief valves set at 17.2 MPa and a logic element and a needle valve to allow flow at 19 lpm.



Auxiliary Pumps



HYDRAULIC TANK

CHECKING AND FILLING HYDRAULIC OIL

The hydraulic oil tank is integral with the rear frame chassis and located on the off driver's side. The oil level should be checked daily.

To check the hydraulic oil level:

1. Locate the sight gauge on the hydraulic tank side wall on the off driver's side of the machine.
2. Observe the oil level indicated in the sight glass. The level should be adjusted if the oil level is below the top sight glass.

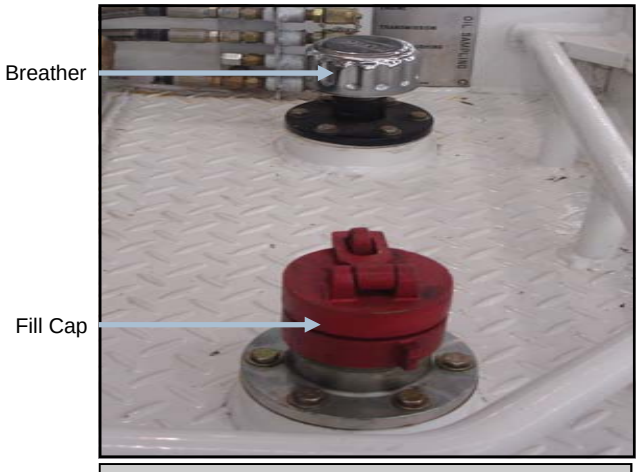
To top up the hydraulic oil level:

1. Locate the hydraulic tank filler cap on the rear frame on the off driver's side. The cap is accessible from outside the machine.
2. Slowly unscrew the filler cap to release air pressure from the tank.

The hydraulic tank is charged with 50 kPa of air pressure. Hot hydraulic fluid can cause burns or scalding. Wear eye protection and long sleeve clothing when accessing the oil filler cap.

3. Remove the filler cap and top up the hydraulic tank with clean oil to the specification shown in Section 1.
4. Observe the oil level on the sight glass rise as oil is added to the tank. *Do not over fill.*
5. Replace the filler cap when filling is complete.
6. Locate the pre-charge valve on the hydraulic tank, above the sight glass and outside the machine covers, and apply an external air pressure above 50 kPa (7.25 psi) until bypass is evident at the filler cap. This will provide the required pre-charge to the hydraulic tank.

Hydraulic Tank Sight Glass



Hydraulic Tank Filler Cap

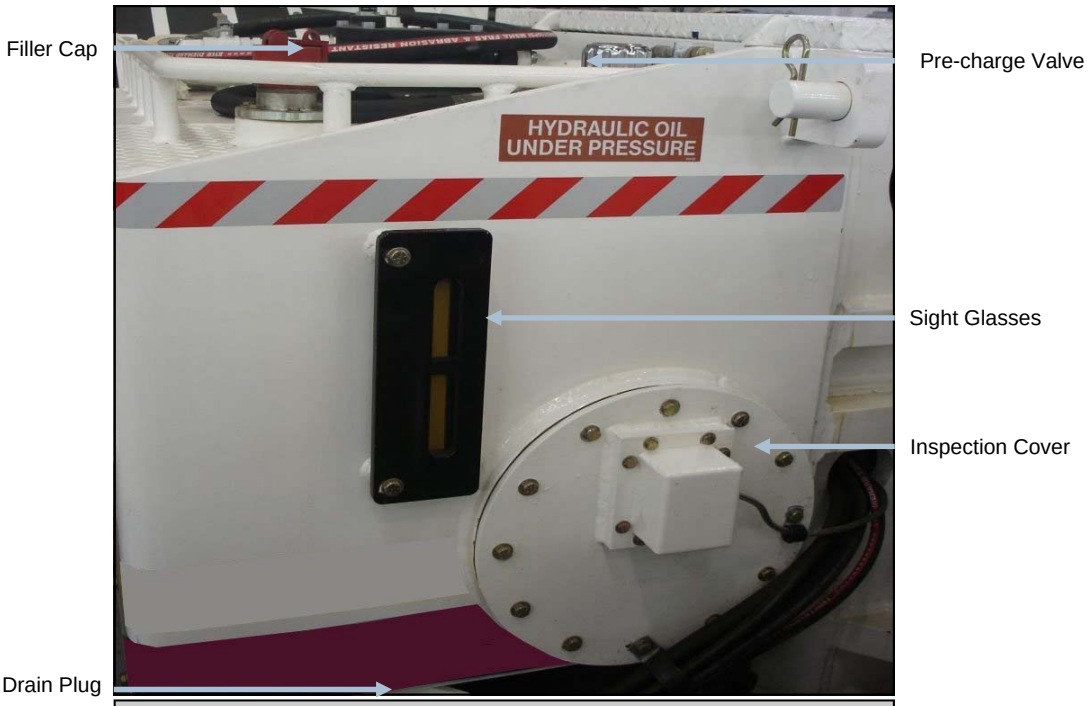
CHANGING HYDRAULIC OIL

The hydraulic oil should be changed every 2000 service hours.

To change the hydraulic oil:

1. Park the machine in a straight line and ensure all other cylinders except for the steering cylinder are fully retracted.
2. Ensure that the engine has had sufficient time to cool and is isolated and tagged as described in Section 1.
3. Release hydraulic tank pressure by slowly removing the filler cap.
4. Remove the filler cap to allow breathing when draining hydraulic oil.
5. Locate the hydraulic tank drain plug on the underside of the hydraulic tank.
6. Place a suitable container under the drain plug. The hydraulic tank contains approximately 250 litres.
7. Remove the drain plug and allow hydraulic oil to drain out of the tank.
8. When the oil has drained from the tank remove the inspection covers from the tank wall to enable the inside of the tank to be accessed. Clean around the floor of the tank with clean lint free rags.
9. Replace the inspection cover and the drain plug then refill the tank.

Ensure that the hydraulic pumps are primed after refilling the hydraulic tank. Failure to prime pump will result in pump failure.



Hydraulic Tank

CHECKING AND CLEANING FILLER NECK SCREEN

The hydraulic tank fill point is fitted with a screen for filtering large contaminants that may be introduced during the filling process. This screen is not intended to provide system filtration but rather as a preventative measure to screen contaminants from the system, such as large dirt or rock particles accidentally introduced via a filling hose.

The filler neck screen should be removed and cleaned every 250 service hours.

To remove and clean the filler neck screen:

1. Locate the hydraulic tank filler cap on the top of the hydraulic tank.
2. Slowly unscrew the filler cap to release air pressure from the tank.

The hydraulic tank is charged with 50 kPa of air pressure. Hot hydraulic fluid can cause burns or scalding. Wear eye protection and long sleeve clothing when accessing the oil filler cap.

3. Remove the filler cap and locate the filler neck screen inside the filler neck.
4. Remove the filler neck screen from the filler neck.
5. Clean the screen with fuel oil and inspect for damage. Replace if necessary.
6. Relocate the screen inside the filler neck and replace the filler cap.
7. Locate the pre-charge valve on the hydraulic tank, to the rear of the return filter on the top of the hydraulic tank, and apply an external air pressure above 50 kPa (7.25 psi) until bypass is evident at the filler cap. This will provide the required pre-charge to the hydraulic tank.

Hydraulic Tank Sight Glass

Hydraulic Tank Filler Cap

CHECKING AND REPLACING THE RETURN FILTER

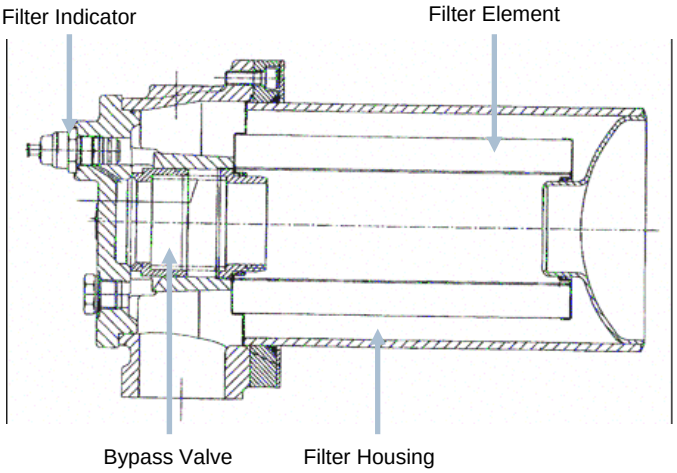
The hydraulic system return filter is flange mounted onto the hydraulic tank, on the opposite end to the filler cap, with the filter bowl assembly inside the tank. Return oil enters the filter housing and passes through a ten micron filter element before entering the main tank. The filter element will be bypassed when the return pressure differential reaches 172 kPa (25 psi).

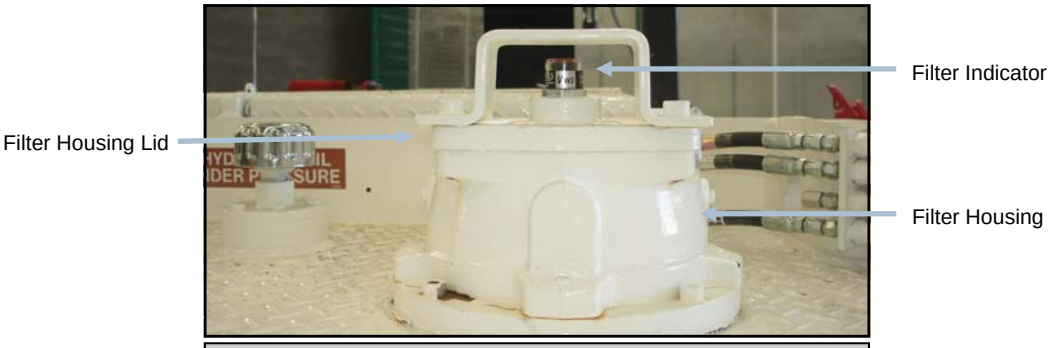
The return filter indicator should be checked every 250 service hours and filters replaced if necessary.

The filter element should be replaced on the 250 hour service. Failure to carry out this will result in return filter bypass and possible system contamination.

To replace the return filter element:

1. Ensure that the engine has had sufficient time to cool and is isolated and tagged as described in Section 1.
2. Release hydraulic tank pressure by slowly removing the filler cap.
3. Locate the return filter housing on top of the hydraulic tank.
4. Undo the return filter cover bolts and remove the cover. Take care not to damage the cover spigot o-ring.
5. Remove the filter element and dispose of it in responsible manner.
6. Insert the new filter element ensuring the element is seated over the bottom spigot in the bowl assembly.
7. Replace the cover and fasten the retaining bolts.





Hydraulic Return Filter Assembly

STEERING AND BRAKE HYDRAULIC MANIFOLD

The main hydraulic manifold interfaces the steering/brake pump to the steering and brake circuits. This provides steering interlocking as well as accumulator automatic drain on loss of brake release pressure. The manifold also provides reduced pressure to the controls for lift, tilt PTO and winch. Machine hosing is simplified with the manifold, providing only one tank return line, one drain return line and one pressure line connection.

The steering/brake system pressure is primarily governed by the compensated pressure setting of the steering/brake pump. The system normally is set to a compensated pressure of 17.2 MPa (2500 psi). The system is backed up by a system relief valve mounted in the main hydraulic manifold set to divert flow to tank at a relief pressure of 20.7 MPa (3000 psi). The relief valve would not factor into normal system operation however, should a system failure occur the relief valve will limit available pressure to 20.7 MPa (3000 psi).

The steering/brake system relief valve setting should be checked 2000 service hours.

To check and adjust the relief valve setting:

1. Park the machine in a clear area, apply the park brake and install the articulation lock and chock the wheels.
2. With the engine running at idle access the steering/brake pump by removing the transmission cover and locate the pressure compensator adjustment on the side of the pump housing.
3. Release the park brake.
4. Loosen the adjusting screw lock nut and rotate the adjusting screw clockwise to increase the compensating pressure.
5. Have an observer watch the steering or brake accumulator pressure gauge while increasing the pump compensating pressure.
6. When the pressure approaches 20.7 MPa (3000 psi) the relief valve will operate forcing the pump to remain on stroke. If this is the case then the relief valve is correctly set.
7. If the pump fails to come on stroke or comes on stroke too early it will be necessary to adjust the relief valve pressure setting.
8. Locate the relief valve on the main hydraulic manifold.
9. Loosen the lock nut and rotate the relief valve adjusting screw clockwise to increase the relief pressure and counter-clockwise to decrease the relief pressure.
10. When the correct main relief valve adjustment is achieved tighten the adjusting screw lock nut.
11. Adjust the compensator valve back and reduce the pressure in the system to below 2500 psi by working the steering or brakes.
12. Adjust the compensator on the steering/brake pump screw to bring the pressure back to 2500 psi when this is correct lock the compensator adjustment screw.
13. Refit the covers.

The main hydraulic control valve, is supplied at reduced system pressure via a pressure reducing valve located in the main hydraulic manifold.

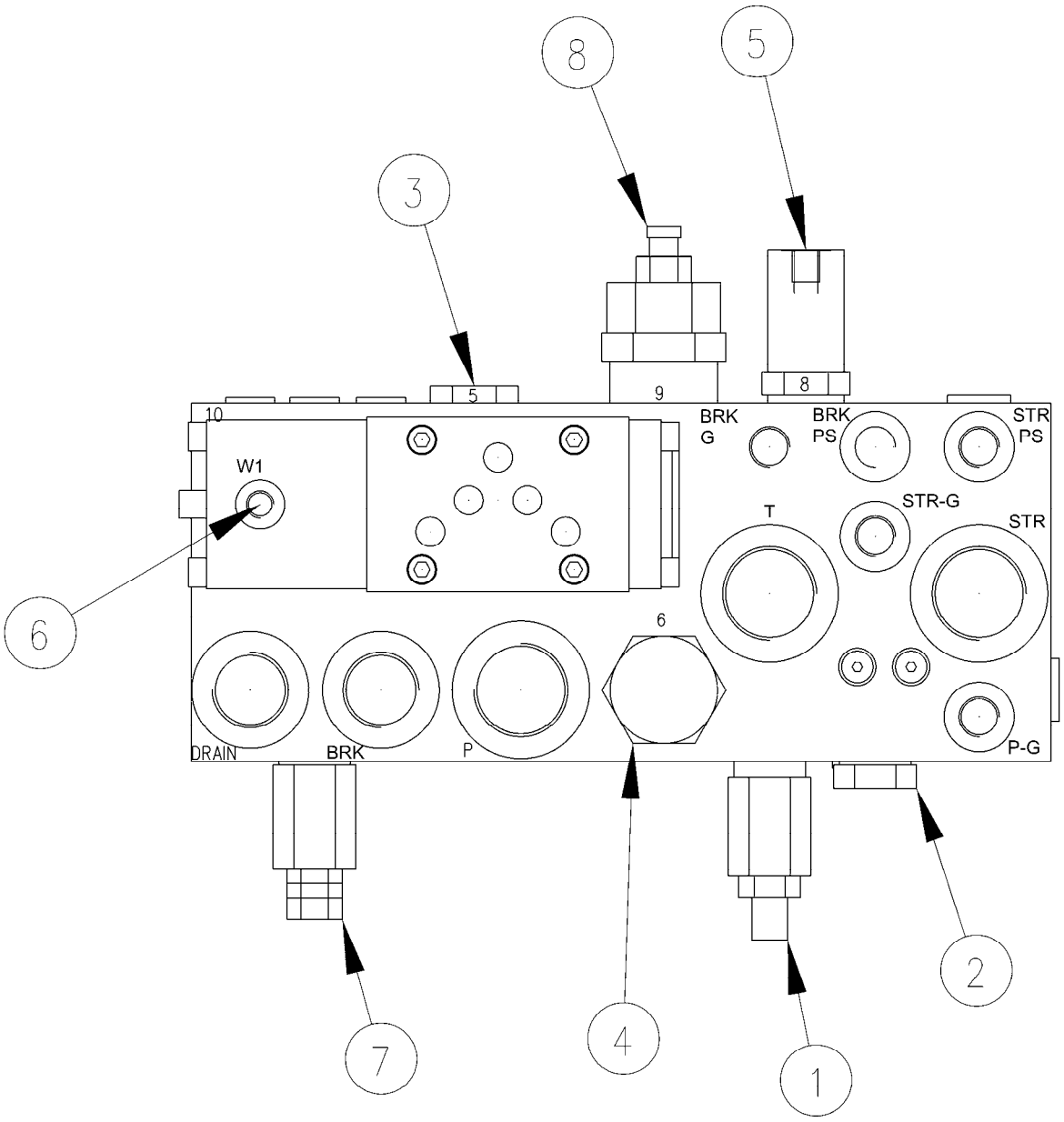
The pressure reducing valve setting should be checked every 2000 service hours.

To check and adjust the pressure reducing valve setting:

1. Ensure the machine is isolated and tagged as described in Section 1.
2. Ensure that both accumulators are completely drained of oil pressure as per Section 1.
3. Locate the main hydraulic manifold.
4. Locate either port PJ or PJ-G on the main manifold block. These ports are supply ports from the manifold to the No. 1 and No. 2 two-way hydraulic control levers at reduced pressure.
5. Remove either hose from P2 or P3 and install a pressure gauge with a full scale deflection of 6.89 MPa (1000 psi).
6. With the engine running at idle observe the pressure at the gauge. This pressure should read 4.5 MPa (650 psi).
7. If the pressure requires adjustment locate the pressure reducing valve on the main manifold.
8. Loosen the lock nut and rotate the reducing valve adjusting screw clockwise to increase the pressure and counter-clockwise to decrease the pressure.
9. When the pressure reaches 4.5 MPa (650 psi) the reducing valve is correctly set.
10. Tighten the adjusting screw lock nut, shutdown the machine, isolate hydraulic pressure, remove the gauge and reconnect the hose.

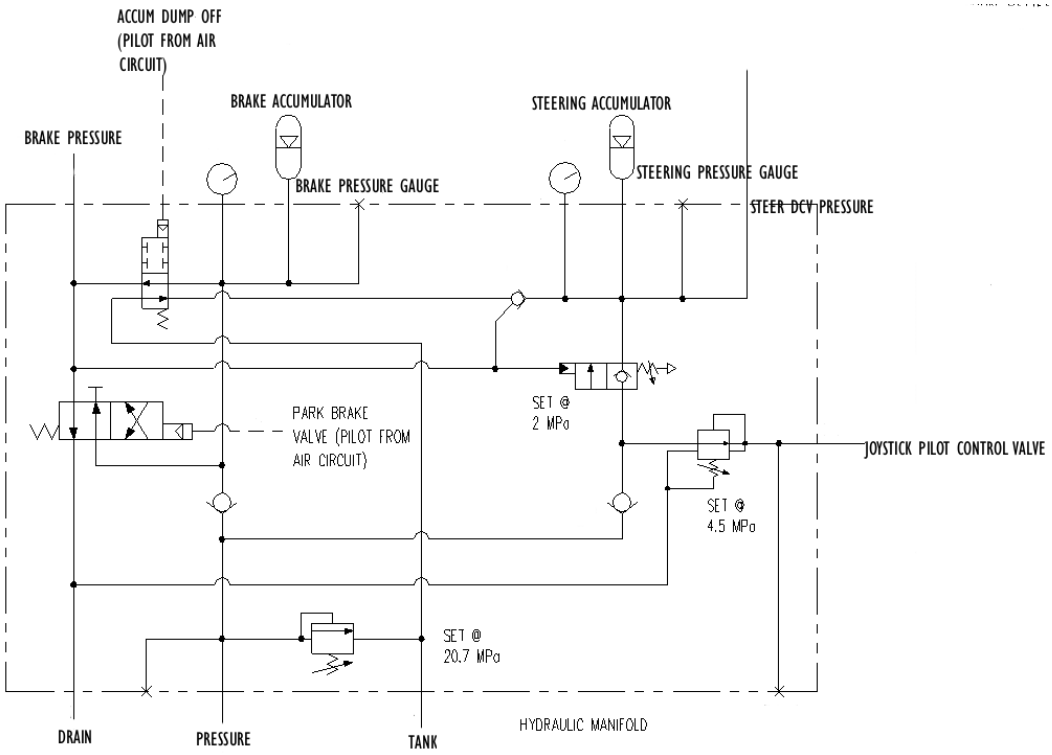
Ensure that all accumulator pressure is removed before disconnecting hydraulic hoses.

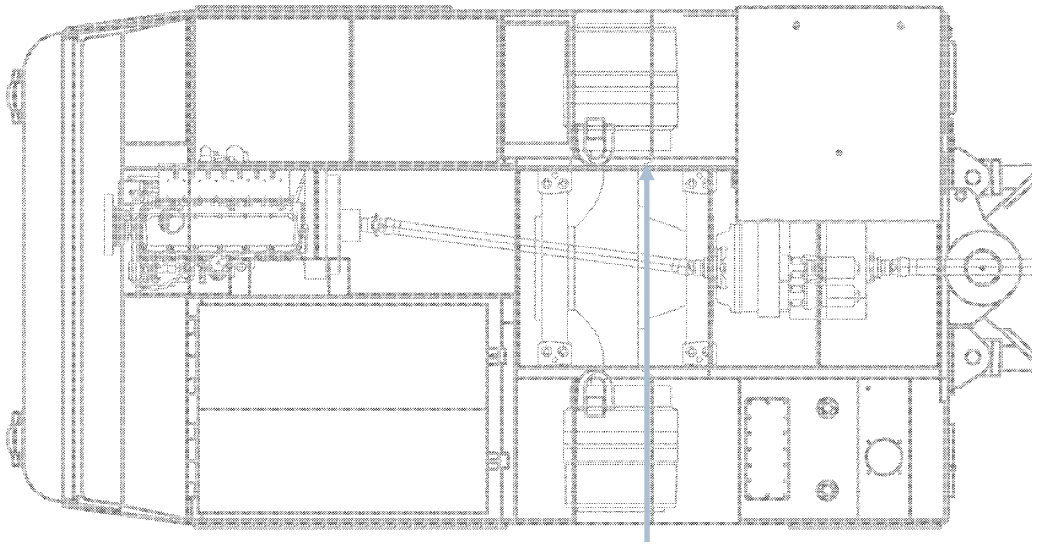
The drive line inside the compartment which contains the main manifold is rotating whenever the engine is running. Keep clear of the rotating parts when accessing this compartment with the engine running.



Key

(1) Relief Cartridge
(2) Pilot Operated Check Valve
(3) Check Valve
(4) Check Valve
(5) Pilot Operated 4/2 Valve
(6) Pilot Operated C-Top 4/2 Valve
(7) Pressure Reducing Valve
(8) Pilot Operated Direction Control





Steering and Brake Hydraulic Manifold

STEERING/BRAKE PUMP PRESSURE FILTER

The hydraulic steering/brake system utilises a pressure inline filter which is remote mounted adjacent to the air cleaner. Fluid enters the filter housing and passes through a five micron filter element before entering the main manifold. A pop up type blocked filter indicator is located on the filter housing cover and indicates when the return pressure reaches 250 kPa (36 psi) and will bypass the filter element when the return pressure reaches 350 kPa (50 PSI).

The pressure filter indicator should be checked daily and the filter replaced every 250 hours or if *red* indicator is showing.

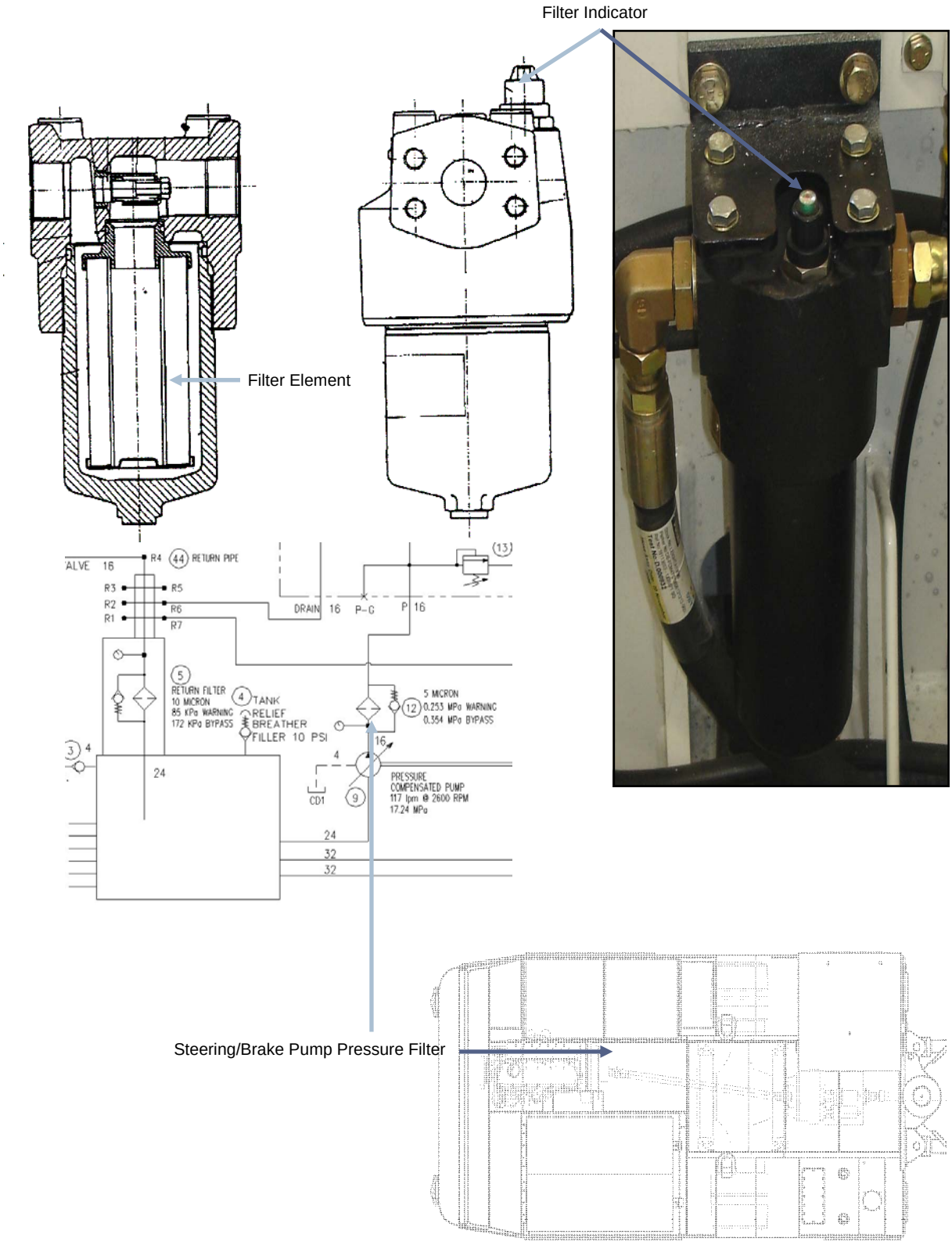
To check the condition of the pressure filter element:

1. Park the machine in a clear area, apply the park brake and install the articulation lock.
2. Locate the pressure filter housing adjacent the air cleaner.
3. With a helper in the operator's compartment run the engine at high idle and press the brake pedal several times to allow the brake accumulator to be drained and the pump to come on stroke.
4. Observe the position of the indicator on top of the housing cover when the pump is on stroke. The indicator will be in the *red* position if the filter is blocked. As the indicator is an auto reset type, oil flow needs to be present through the filter for the indicator to sense differential pressure.

Change the pressure filter element if the indicator is showing blocked. Failure to change the filter element will result in pressure filter bypass and possible contamination of the main manifold valves.

To replace the pressure filter element every 250 hours:

1. Ensure the machine is isolated and tagged as described in Section 1.
2. Ensure that both accumulators are completely drained of oil pressure as per Section 1.
3. Access the filter housing via the air cleaner compartment.
4. Locate the pressure filter housing adjacent to the air cleaner.
5. Undo the pressure filter by unscrewing the filter cover from the housing.
6. Remove the filter element and dispose of in responsible manner.
7. Insert the new filter element ensuring the element is seated on the spigot.
8. Replace the cover and tighten.


Filter Indicator
Filter Element
ALVE 16
R4
44 RETURN PIPE
R3
R5
R2
R6
R1
R7
DRAIN 16
P-C
P 16
13
5
RETURN FILTER
10 MICRON
85 KPa WARNING
172 KPa BYPASS
4 TANK
RELIEF
BREATHER
FILLER 10 PSI
5 MICRON
12 0.253 MPa WARNING
0.354 MPa BYPASS
3 4
24
16
4
CD1
9
PRESSURE
COMPENSATED PUMP
117 lpm @ 2600 RPM
17.24 MPa
24
32
32
Steering/Brake Pump Pressure Filter

STEERING CIRCUIT

The steering circuit consists of an oil accumulator, orbital steer valve, DCV manifold and steering cylinders, this circuit enables the machine to be articulated. The operator controls the amount of articulation via rotating the steering wheel in the operator's compartment. As the steering wheel is rotated oil flow is delivered to the respective cylinder ports at steering/ brake pump pressure. The steering cylinder is actuated at opposite ports to steer left and right, protection from external shocks is achieved by relief valves fitted in the steering DCV manifold.

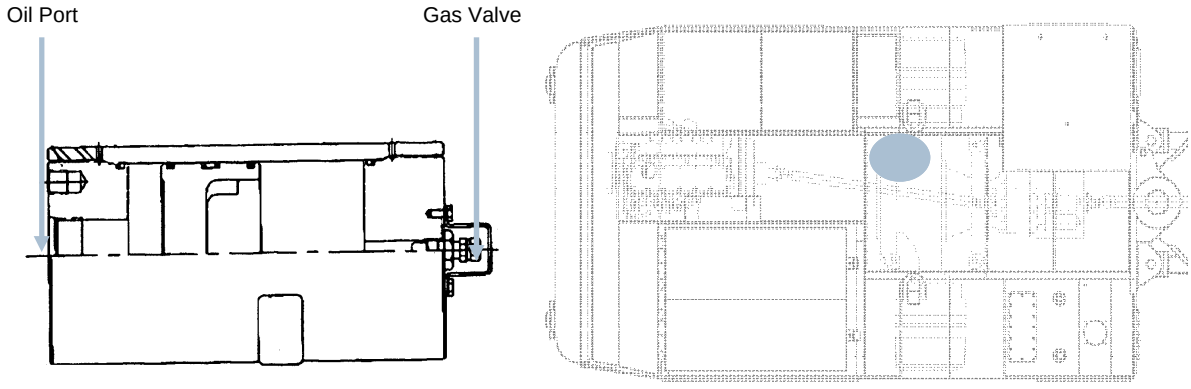
STEERING ACCUMULATOR

The steering system accumulator provides a reserve oil at pressure to provide emergency steering should a loss of pump pressure occur and to minimise the amount of times the pump is required to come on stroke.

The accumulator has a 5.7 litre oil capacity and is of a piston type construction. Oil is fed into one end of the accumulator and is pressurised by compression of an internal piston against a pre-charge of nitrogen gas. The gas pre-charge pressure is preset at 6.2 MPa (900 psi). A poppet type gas valve is located at the top of the accumulator for checking and setting the pre-charge pressure. Access to the gas valve is via removal of a bolt on valve protector bracket. When the bracket is removed the gas valve is available for access.

The accumulator pre-charge pressure should be checked every 2000 service hours.

The pre-charge pressure should be maintained at 6.2 MPa (900 psi) when the accumulator is drained. Stored nitrogen under pressure may cause personal injury when expelled. Wear suitable eye protection when servicing accumulator pre-charge. DO NOT attempt to access the gas valve connection unless you are suitably trained in recharging pressure vessels and accumulators.

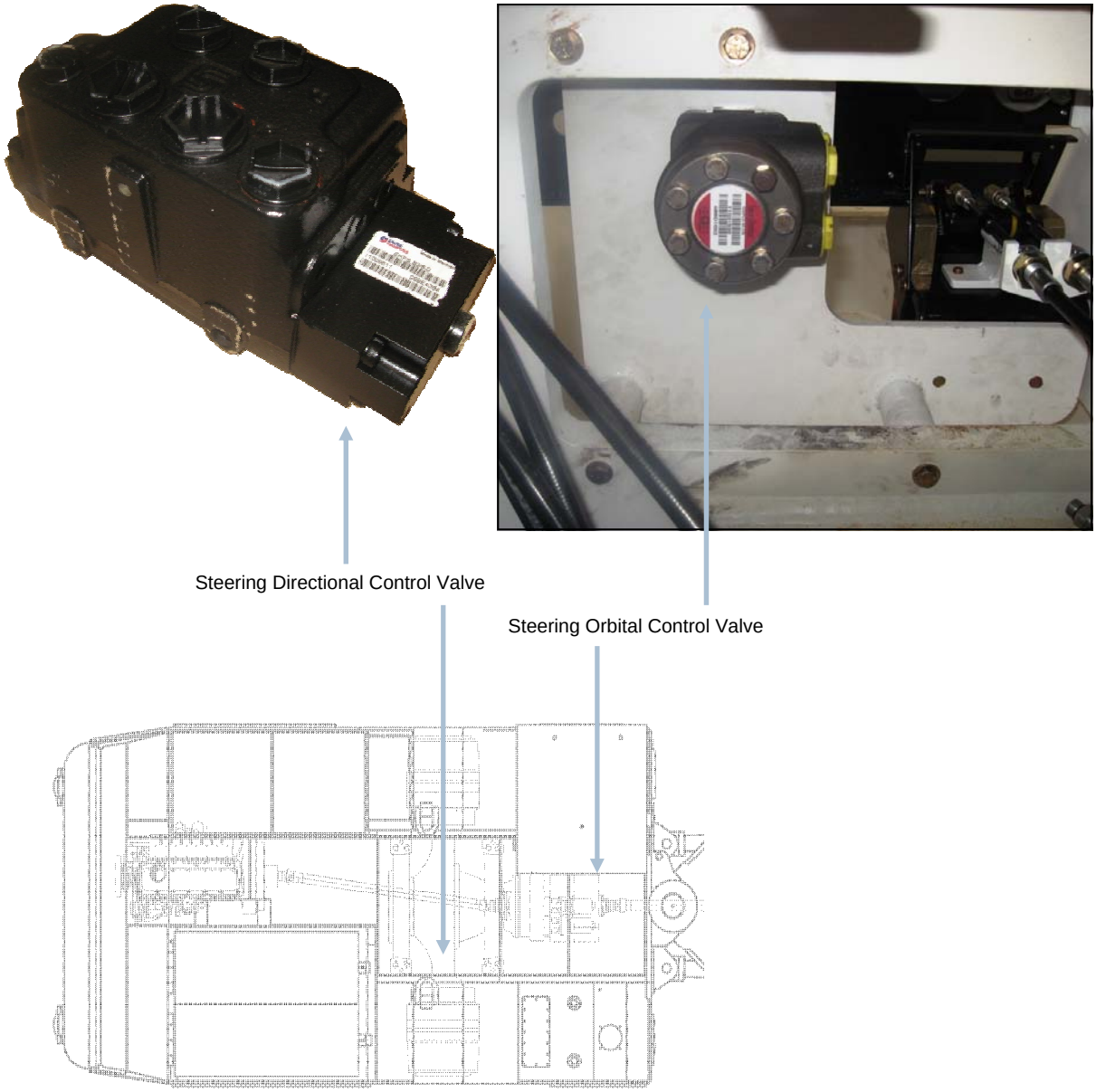


Steering Accumulator

STEERING CONTROL VALVE

The orbital steering valve pilots the direction of flow of oil to and from the steering cylinders through a hydraulic DCV. This is achieved at a metered rate and is unaffected by pump flow. The steering DCV is fitted with internal reliefs for the cylinder in the event of an excessive external force.

No routine servicing is required on the steering control valve assembly other than routine checking for the presence of oil leaks.



BRAKE CIRCUIT

The brake circuit consists of two parallel circuits, providing independent brake and park brake actuation. The system consists of an oil accumulator, brake reverse modulating valve and an air pilot operated valve located in the main manifold.

When the engine is running the pressure compensated pump charges the accumulator to system pressure. Actuation of the park brake release directs oil at system pressure into the brake reverse modulating valve where pressure is regulated to 10.3 MPa (1500 psiI) and supplied to the spring applied, pressure released brakes.

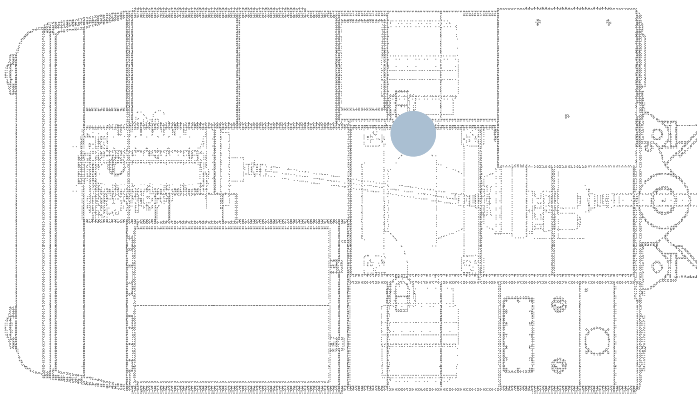
Actuation of the park brake will drain pressure and apply the brakes. Similarly actuation of the brake pedal will release brake pressure proportional to the stroke of the modulating valve push rod, actuated by the brake pedal. When the brake pedal is released oil pressure will be delivered to the brake units to a maximum of 10.3 MPa as set by the reverse modulating valve.

BRAKE ACCUMULATOR

The brake system accumulator provides reserve oil at pressure to allow brake release operation should a loss of pump pressure occur and to minimise the amount of times the pump is required to come on stroke when actuating the brakes.

The accumulator has a 1.9 litre oil capacity and is of a piston type construction. Oil is fed into one end of the accumulator and is pressurised by compression of an internal piston against a pre-charge of nitrogen gas. The gas pre-charge pressure is preset at 6.2 MPa (900 psi). A poppet type gas valve is located at the top of the accumulator for checking and setting the pre-charge pressure. Access to the gas valve is via removal of a bolt on valve protector bracket. When the bracket is removed the gas valve is available for access. The accumulator pre-charge pressure should be checked every 2000 service hours.

The pre-charge pressure should be maintained at 6.2 MPa (900 psi) when the accumulator is drained. Stored nitrogen under pressure may cause personal injury when expelled. Wear suitable eye protection when servicing accumulator pre-charge. DO NOT attempt to access the gas valve connection unless you are suitably trained in recharging pressure vessels and accumulators.



Brake Accumulator

BRAKE VALVE

The brake pedal operates a brake valve which delivers oil to the brake units at a pressure, set by its own regulator, and proportionally dumps this pressure relative to the stroke of its actuating push rod when the operator applies the brakes.

The brake valve is mechanically linked to the brake pedal. Application of the brake pedal will stroke the valve push rod, removing pressure from the spring applied, hydraulic released brake units back to tank. The amount of pressure removed from the brake units, hence the severity of brake application, will be proportional to the stroke of the push rod.

When the brake pedal is released maximum regulated pressure (1650 psi-1750 psi) is delivered to the brake units, releasing the brakes.

Pressure regulation and reverse modulation is achieved via internal shimming inside the valve block head. No serviceable components exist in the brake valve. If the brake head pressure, indicated by the pressure gauge in the operator's compartment is outside the normal operating range the valve should be replaced.

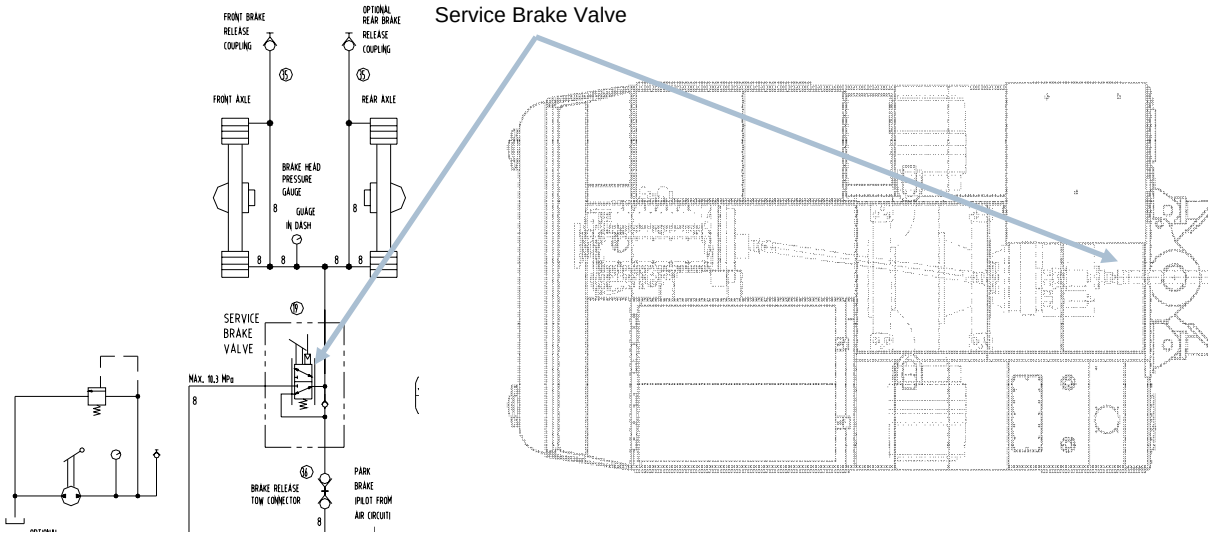
A high pressure delivered to the brake heads can damage the piston seals.

A pressure below 1600 psi will cause the brake plates to drag cause heat build up and excessive wear. The brake valve should be resealed and bench tested every 5000 hours.

Brake head pressure should be checked daily.

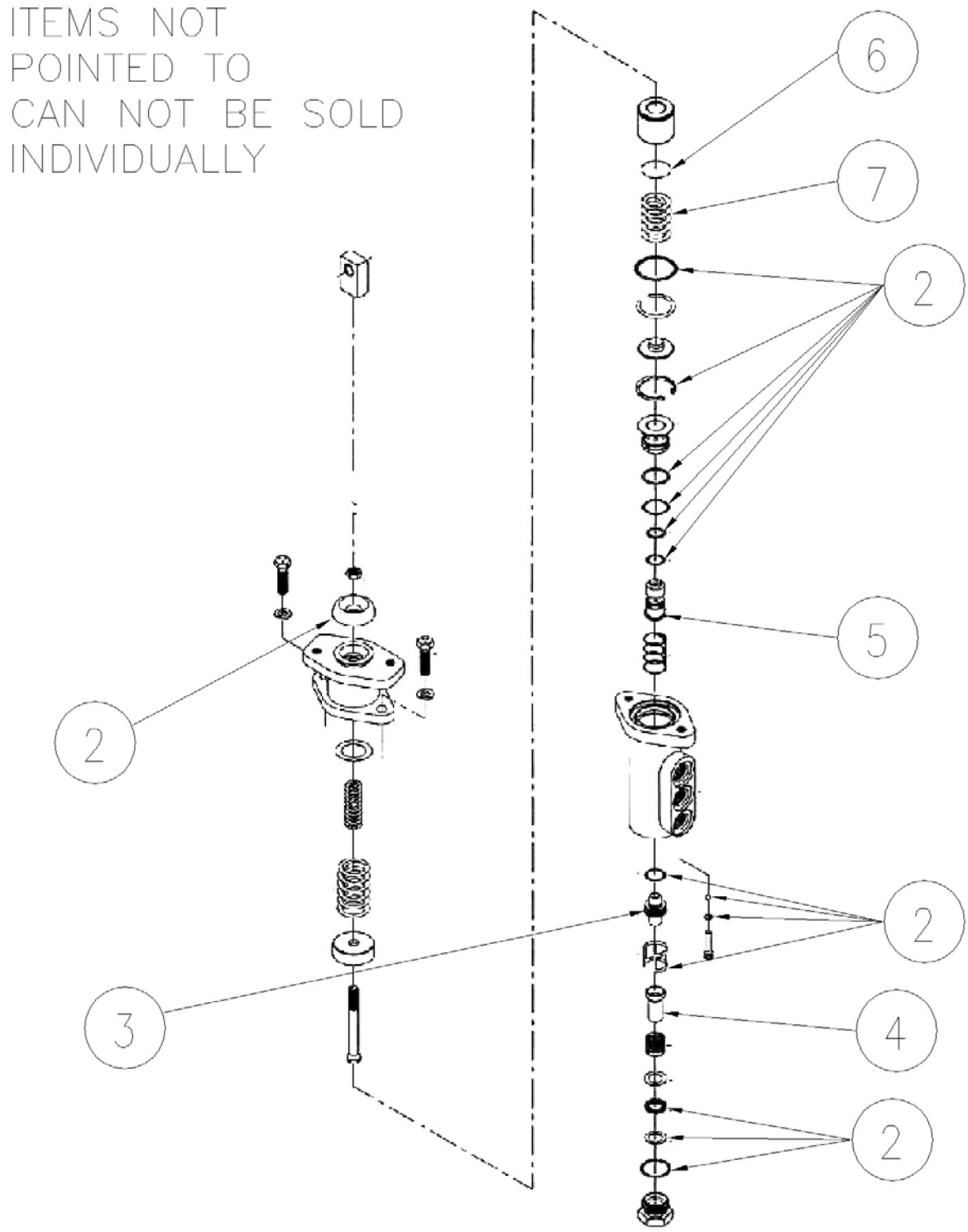
To verify brake head pressure:

1. With the machine running release the park brake.
2. Remove your foot from the brake pedal and record the brake head pressure on the gauge in the operator's compartment.
3. Brake head pressure should be 1700 psi.
4. Remove and replace the brake valve if release pressure is outside this range.



Disassembly:

1. Depress pedal and remove pedal stop screw and jam nut from base. Also loosen jam nut for later removal of clevis.
2. Remove cap screws and lock washers from base.
3. Remove e-rings from ends of pins. Remove pins.
   NOTE: Some models use threaded studs, in place of pins and e-rings.
4. Remove set screw from pedal. Remove e-rings from both ends of pin.
   NOTE: Not all models use e-rings.
5. Separate pedal and base by removing pin through clearance hole in pedal. Remove pedal and base.
6. Temporarily insert pin into clevis and record distance from top of pin to mounting flange of housing. This measurement will be necessary for reassembly purposes.
   NOTE: Apply slight downward force on clevis while taking measurement to assure that rod is in contact with piston.
7. Remove clevis and jam nut from rod.
8. Separate housings by removing cap screws and lock washers.
9. Remove rod, piston, spring, spring and washer from housing. Remove boot (2) from housing.
   NOTE: Not all models use spring or washer.
10. Remove piston, shim(s) (6) and spring (7) from housing bore. Note number of shims being removed for reassembly purposes.
11. Remove o-ring (2) from housing bore.
    NOTE: Be careful not to scratch or mark the housing bore.
12. Remove retaining ring from housing bore
    NOTE: Be careful not to scratch or mark the housing bore.
13. Remove retainer from housing bore.
14. Remove retaining ring (2) from housing bore.
15. Remove piston and sleeve assembly (5) from housing bore. Separate piston (5) from sleeve.
16. Remove o-ring (2) and backup ring (2) from sleeve.
17. Remove spring from housing bore.
18. Remove cup (2) and backup ring (2) from piston (5).
    NOTE: A check ball is located inside piston (5). Make sure ball is clean and moves freely. Some models use an o-ring in place of cup (2) and backup ring (2).
19. Remove plug from housing.
20. Remove o-ring (2), cup (2), backup ring (2), washer, spring and guide (4) from plug.
    NOTE: Some models use an o-ring in place of cup (2).
21. Remove cage (2) from housing bore.
22. Remove valve assembly (3) from housing bore.
23. Remove o-ring (2) from valve assembly (3).
24. Remove plug and ball (2) from housing. Remove o-ring (2) from plug.



Key

(1) Kit - Complete Rebuild - Brake Valve
(2) Kit - Seal - Brake Valve
(3) Valve - Ball Assembly - Brake Valve
(4) Guide Assembly - Brake Valve
(5) Piston Assembly - Brake Valve
(6) Shim Kit
(7) Brake Valve Spring

Assembly:

Clean and inspect all parts for wear. Lubricate all rubber components from repair kit with clean system fluid.

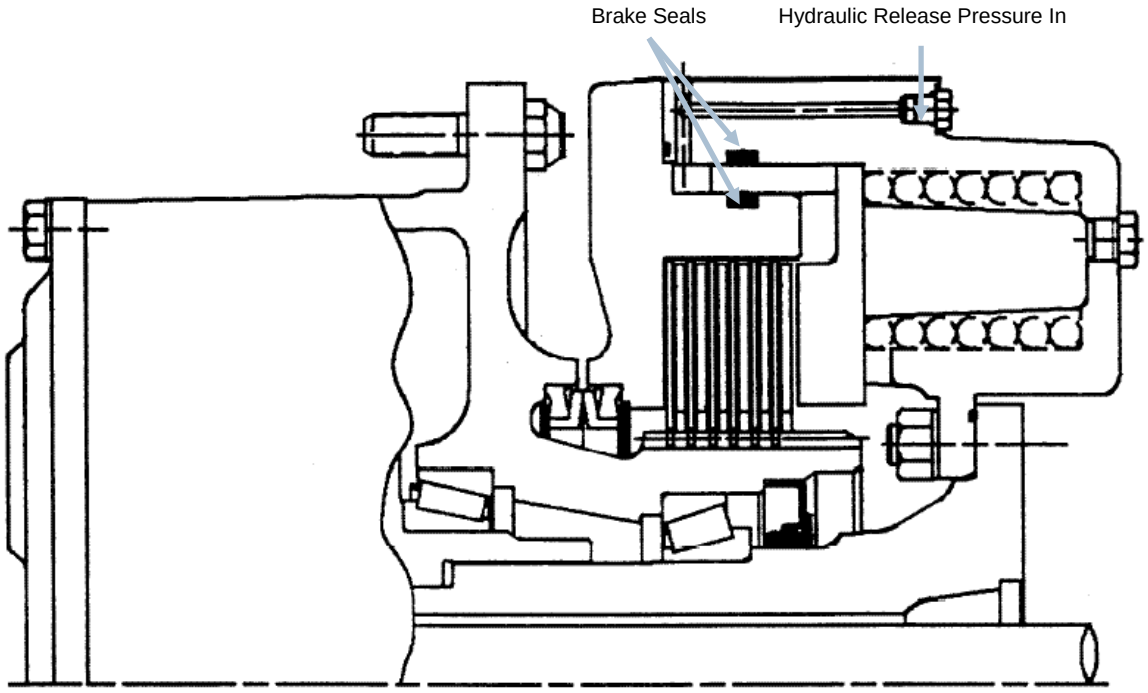
1. Install new o-ring (2) on plug. Install new ball (2) and plug in housing. Torque plug 88.1-101.7 N-m (65-75 lb-in).
2. Install new o-ring (2) on valve assembly (3) and insert into housing bore. Note the direction of valve assembly.
   NOTE: Be sure valve assembly seat is fully seated into housing.
3. Install new cage (2) into housing bore.
4. Install new o-ring (2) on plug.
5. Insert new backup ring (2) and new cup (2) inside end of plug. Note order of back up ring and cup.
   NOTE: Some models use an o-ring in place of cup (2).
6. Install guide (4), spring and washer in end plug. Install plug in housing and torque 54.3-67.8 N-m (40-50 lb-ft).
7. Install new cup (2) and new backup ring (2) on piston (5) and insert into sleeve. Note direction of piston and sleeve.
   NOTE: Some models use an o-ring in place of cup (2) and backup ring (2).
8. Install new backup ring (2) and new o-ring (2) on sleeve.
9. Install spring on piston (5).
10. Install piston and sleeve assembly (5) in housing bore. Note direction of assembly.
11. Install new retaining ring (2) in housing bore.
12. Install retainer and retaining ring in housing bore.
    NOTE: Be careful not to scratch or mark housing bore
13. Install new o-ring (2) in housing bore.
14. Install spring (7), shim(s) (6) and piston in housing bore. Be sure to install the same number of shim(s) as were removed during disassembly.
15. Lightly coat inside bore of housing with graphite based grease and install new boot (2) on housing.
16. Apply graphite based grease sparingly to piston in chamfered area where rod makes contact.
17. Insert rod, piston, spring, spring and washer into housing (34). *NOTE:* Not all models use spring or washer.
18. Attach housings using cap screws and lock washers. Torque 29.8-36.6 N-m (22-27 lb-ft).
19. Install jam nut and clevis on end of rod. Adjust the clevis to the distance recorded during disassembly. Lubricate all bushings and pins with graphite based grease before assembling the pedal and base.
20. Fully depress pedal and torque jam nut 27.1-32.5 N-m (20-24 lb-ft) against clevis.
21. Install pedal stop screw and jam nut.
    NOTE: With pedal in the release position, adjust pedal stop screw and jam nut so there is .38 mm-.76 mm (.015"-.030") of clearance between the pedal and top of pedal stop screw. Torque jam nut 27.1-32.5 N-m (20-24 lb-ft).

BRAKE HEADS

The brake head units are located behind each wheel.

The brakes are released by supplying oil from the brake valve at a pressure of 1750 psi. This pressure is shown in the operator's compartment on the brake head pressure gauge. Pressurised oil is supplied to the brake heads via the brake; this oil exerts pressure against the springs by means of a piston in the brake heads.

When the brake is applied oil is dumped back to tank and the springs in the brake head force the pressure plate against the fiction disc thus applying the brakes.

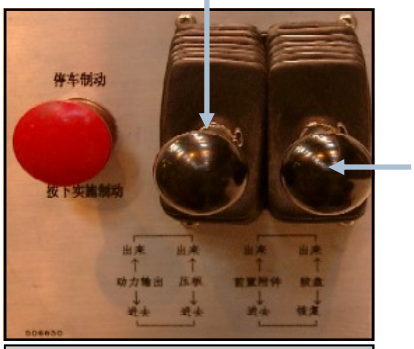


CONTROL LEVERS

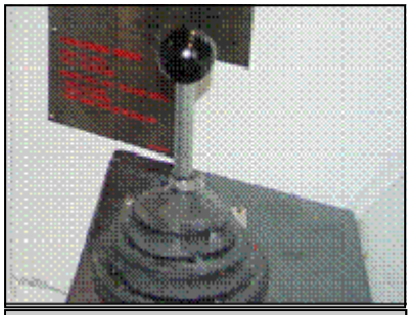
Three separate control levers are provided in the operator's compartment. These controls operate the machine lift and tilt functions and PTO lines.

The four-way joystick control lever operates the machine's lift and tilt functions. The lever has five positions *tilt back*, *tilt forward*, *lift*, *lower* and a *hold.* The lever is spring centred to the *hold* position.

The No. 1 and No. 2 two-way hydraulic control levers operate the PTO lines and the winch. These levers have three positions and are spring centred to the *hold* position. The oil pressure for these controls is supplied from the main control manifold at a pressure of 650 psi.



Two-Way Control Levers



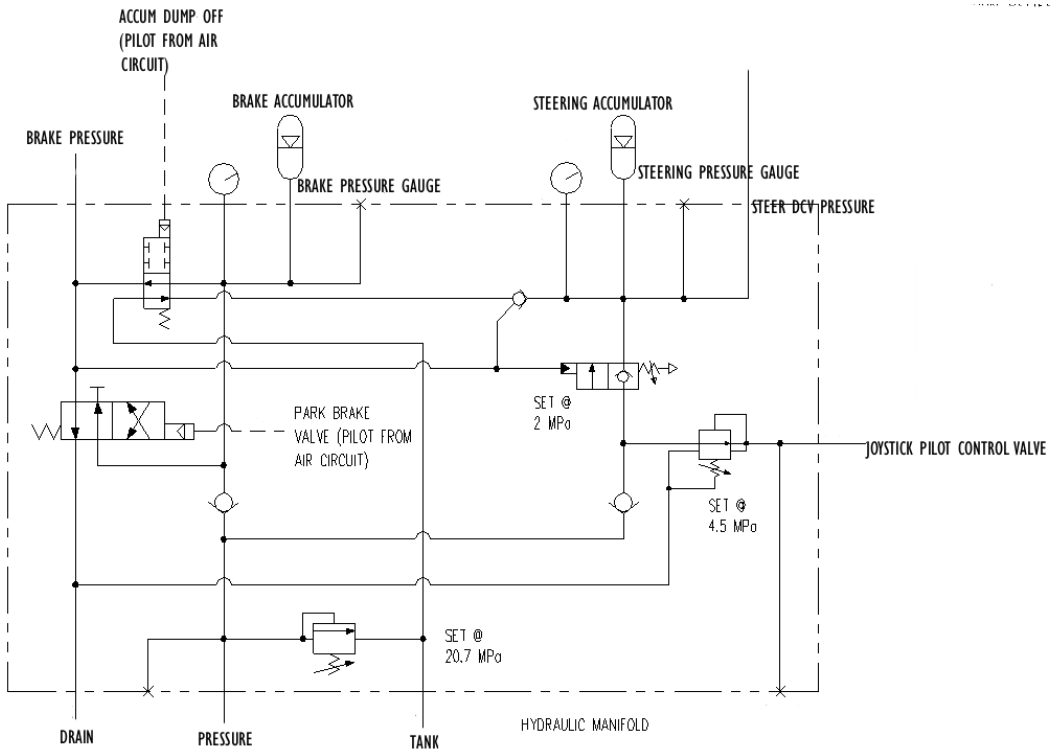
Four-way Joystick Control Lever

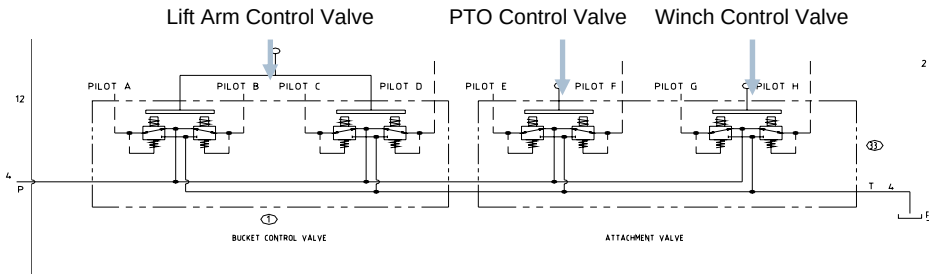
Maintenance

Inspections are to be carried out on the four-way joystick and two-way control levers as per Preventative Maintenance Inspection Schedules.

1. Inspect the control lever boots for damage.
2. Inspect operational performance.

Replace any worn or damaged parts and retest the operation of the machine or system.


ACCUM DUMP OFF
(PILOT FROM AIR
CIRCUIT)
BRAKE ACCUMULATOR
STEERING ACCUMULATOR
BRAKE PRESSURE
BRAKE PRESSURE GAUGE
STEERING PRESSURE GAUGE
STEER DCV PRESSURE
SET @
2 MPa
PARK BRAKE
VALVE (PILOT FROM
AIR CIRCUIT)
JOYSTICK PILOT CONTROL VALVE
SET @
4.5 MPa
SET @
20.7 MPa
HYDRAULIC MANIFOLD
DRAIN
PRESSURE
TANK


Lift Arm Control Valve
PTO Control Valve
Winch Control Valve
PILOT A
PILOT B
PILOT C
PILOT D
PILOT E
PILOT F
PILOT G
PILOT H
BUCKET CONTROL VALVE
ATTACHMENT VALVE

MAIN CONTROL VALVE BANK

The main control valve bank is a open centre, two section configuration, supplied from the main pump. Oil flows through the main control valve bank and returns to tank whenever the engine is running. The oil flow rate is proportional to the engine speed as the pump is a fixed displacement type. Main relief, set at 20.7 MPa (3000 psi), is via an adjustable valve located on the inlet section of the main control valve bank. Each of the two working sections are fitted with individual port reliefs set at 22.4 MPa (3200 psi).

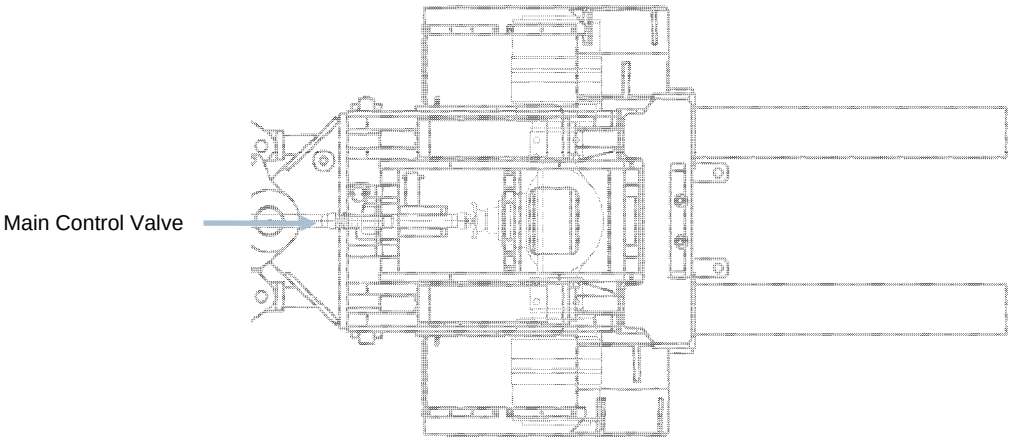
The winch and PTO controls provide pilot pressure to activate the main control valve bank respective working sections. Pilot pressure activates the main valve bank spool and directs oil from the main pump to the outlet ports of the actuated section. When pilot pressure is removed the spool returns to centre.

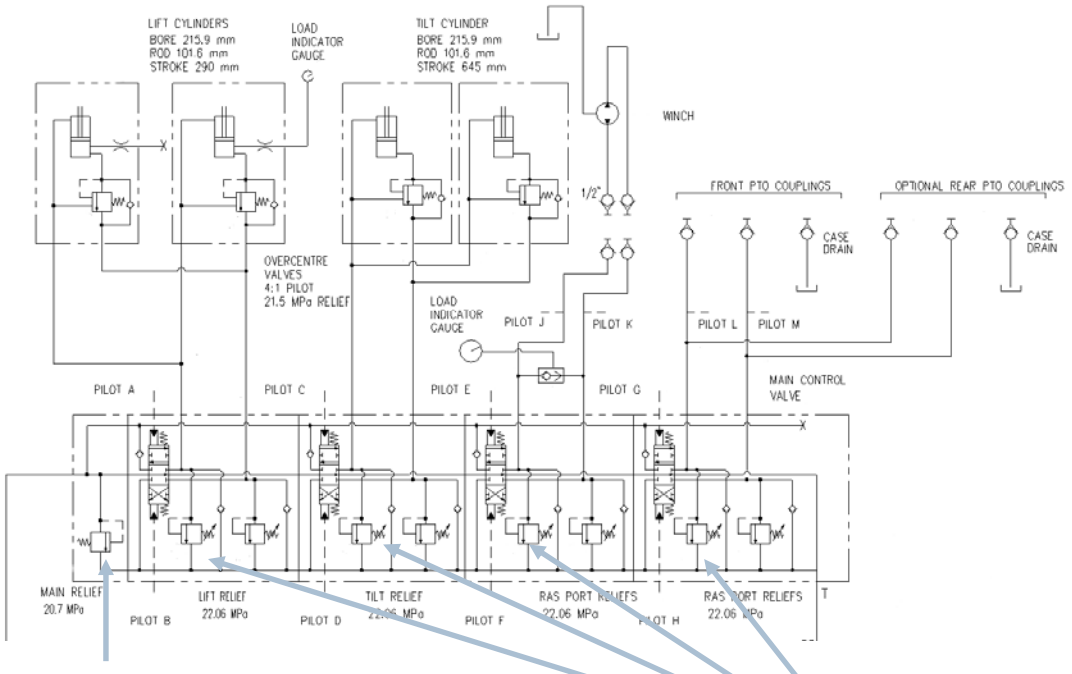
The main relief valve setting should be checked every 2000 service hours.

To check and adjust the main relief valve:

1. Ensure the machine is isolated as described in Section 1.
2. Locate the main valve bank at the articulation joint on the front frame assembly.
3. Run the machine at low idle and operate the lift function down until the lift arms drive again the mechanical stop.
4. Install a system pressure gauge 0-4000 psi on the inlet side of the main control valve.
5. With the lift arm tilt in hydraulic stall it should read between 20 MPa and 21.4 MPa (2900 psi and 3100 psi).
6. If the pressure requires adjustment locate the main relief valve on the inlet section of the valve bank.
7. Loosen the lock nut and rotate the reducing valve adjusting screw clockwise to increase the pressure and counter-clockwise to decrease the pressure.
8. When the pressure reaches 20.7 MPa (3000 psi) the reducing valve is correctly set.
9. Tighten the adjusting screw nut once the correct pressure has been set.

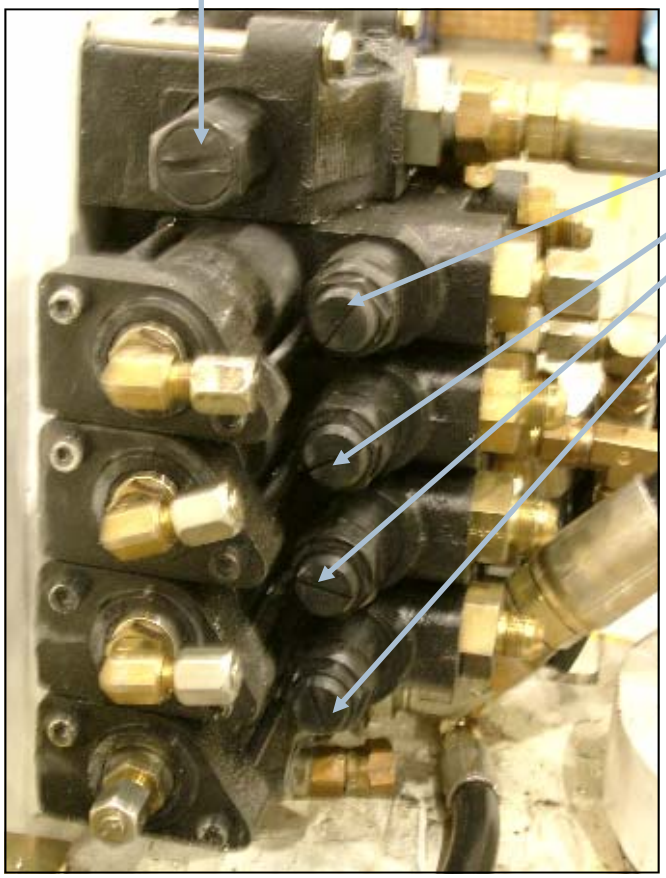
Ensure that all accumulator pressure is removed before disconnecting hydraulic hoses.





Main Relief Valve

Port Relief Valves



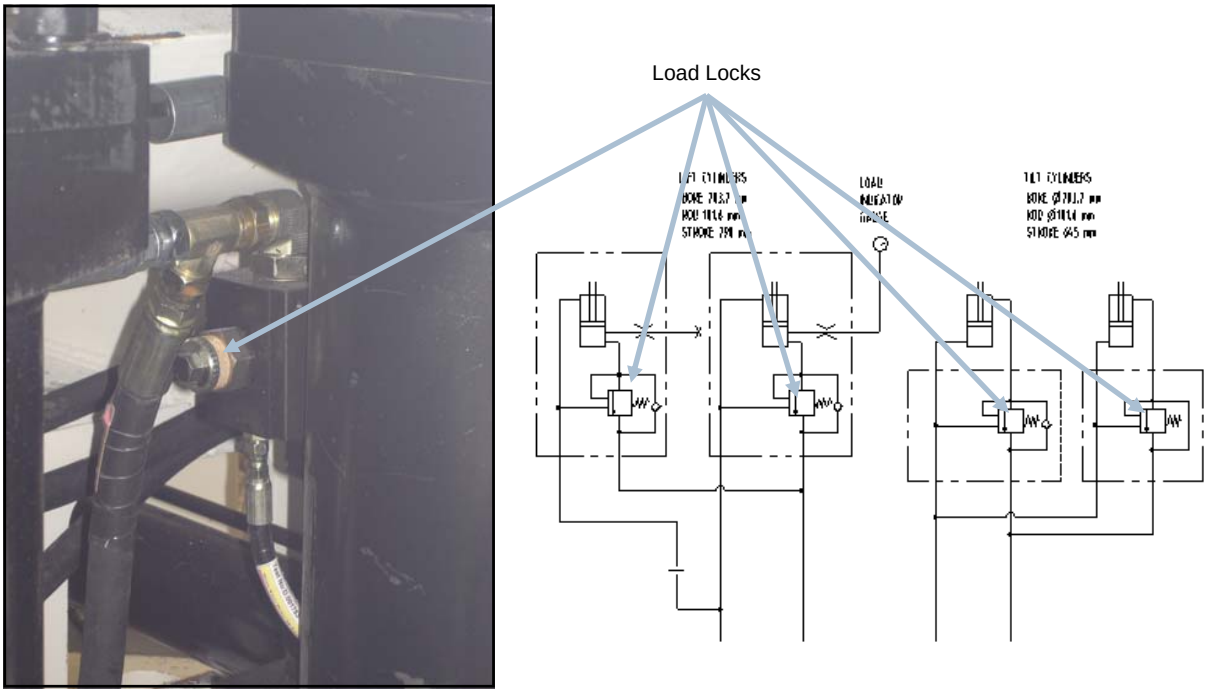
TILT AND LIFT CIRCUITS

The tilt and lift circuits are controlled by the four-way joystick control lever, operating the first two sections of the main valve bank. Pilot oil is delivered to the actuating ends of the relative valve bank working section and operates the main valve bank spool. This spool diverts main hydraulic pump flow into the cylinder lines and the system develops pressure to actuate the cylinders at the pump flow.

Both tilt and lift cylinders are fitted with over centre valves for load hold should hydraulic pressure be removed from the system. These over centre valves are set to relieve at 21 MPa (3050 psi).

The function of the over centre valves can not be confirmed in situ. It is recommended that the over centre valve be removed from each cylinder every 2000 service hours and bench tested.

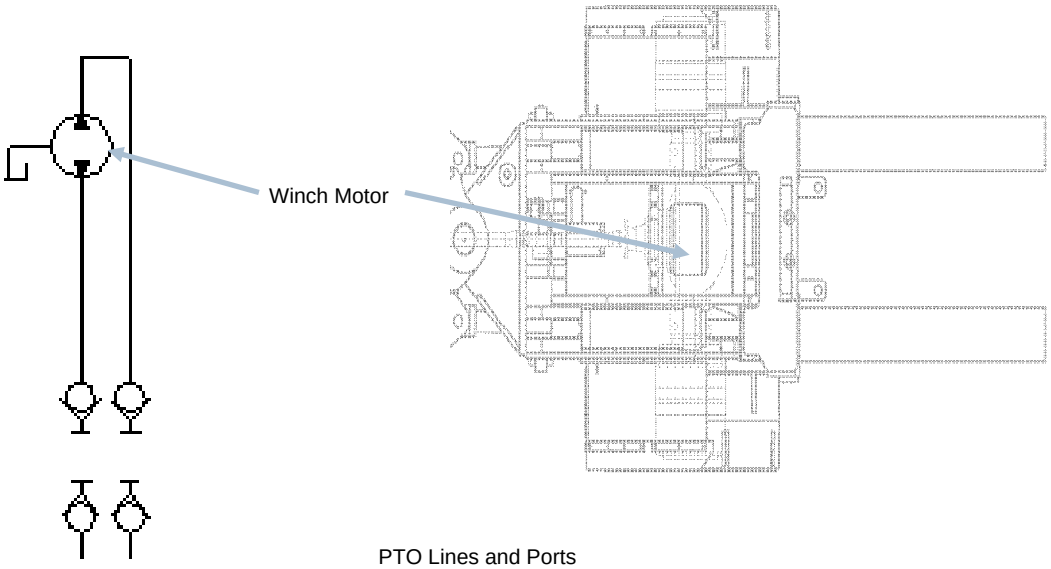
Ensure that the lift arms are lowered completely to ground level and are resting on the stops or the *lift arm stands* are installed before removing cylinder over centre valves. Removal of these valves removes the machine ability to hold load. Removal of the over centre valves when the cylinder is loaded will force pressurised oil from the open port when the valve is removed.

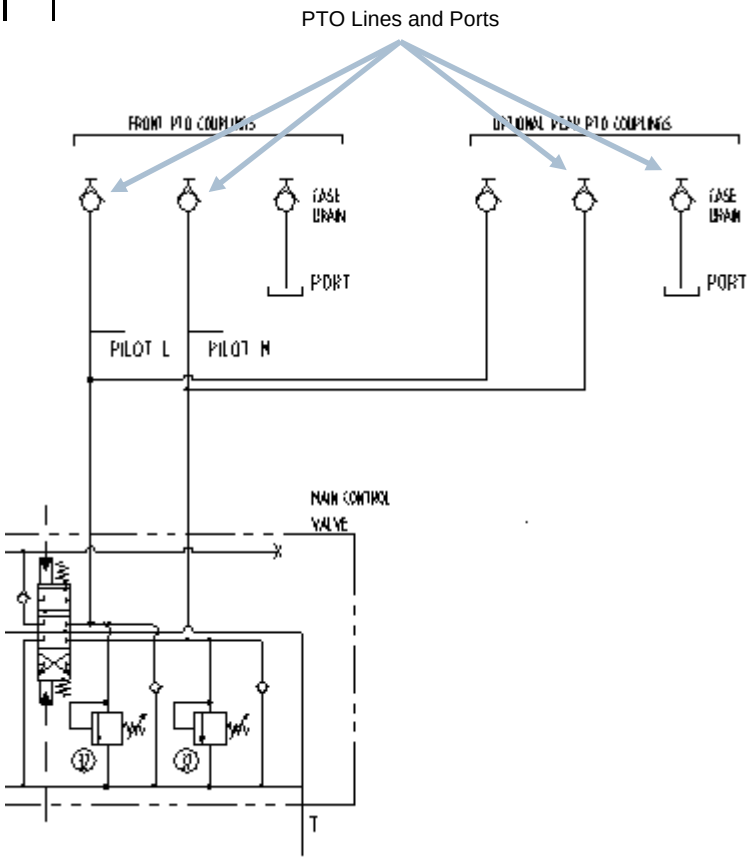


WINCH AND PTO CIRCUITS

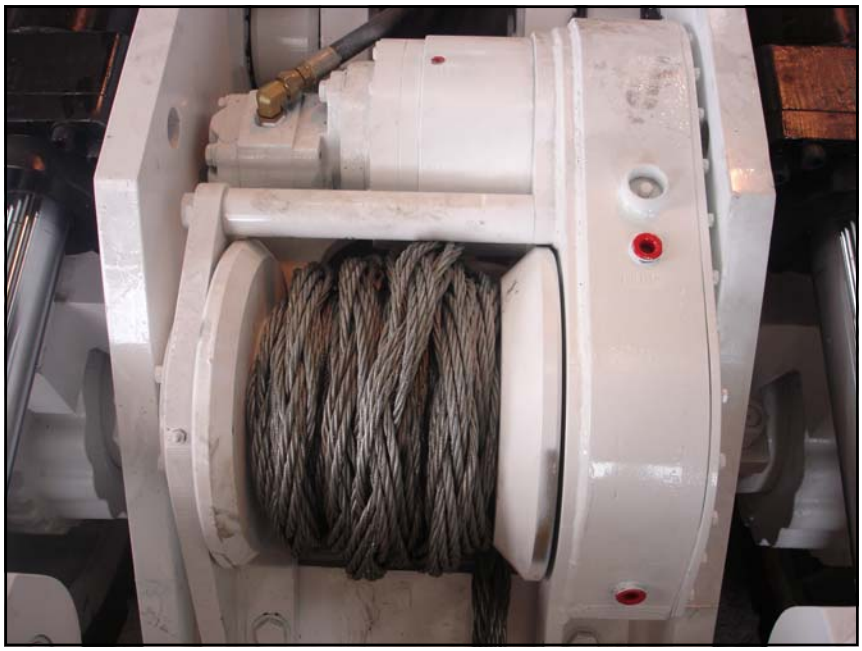
The winch and PTO circuits are controlled by two 3 position pilot valves. Pilot oil is delivered to the actuating ends of the relative valve bank working section and operates the main valve bank spool. This spool diverts main hydraulic pump flow into the winch lines and the system develops pressure to actuate the hydraulic motor to drive the gearbox assembly and winch drum.

The PTO circuit operates in the same manner as the winch circuit, the PTO circuit has two ports, one case drain and one brake at the rear of the machine there is also optional porting on the off driver's side front guard.





PTO Ports



Winch Motor and Assembly

ALTERNATOR CIRCUIT AND COOLING FAN

The auxiliary circuits for the cooling fan are supplied by a separate pump driven from the transmission, pressure relief is by a separate inline relief valve set at 17.2 MPa (2500 psi). The fan motor receives a constant flow of 79 lpm at 2600 RPM, hydraulic oil is supplied through the fan motor which then returns back to tank.

The auxiliary circuit for the alternator motor is supplied by a gear pump piggybacked on the cooling fan pump. It has an inline relief valve set at 17.2 MPa (2500 psi) and a priority valve set at 19 lpm for the alternator drive.

Hydraulic oil is supplied through the alternator motor and then back to tank.