Reliability at work

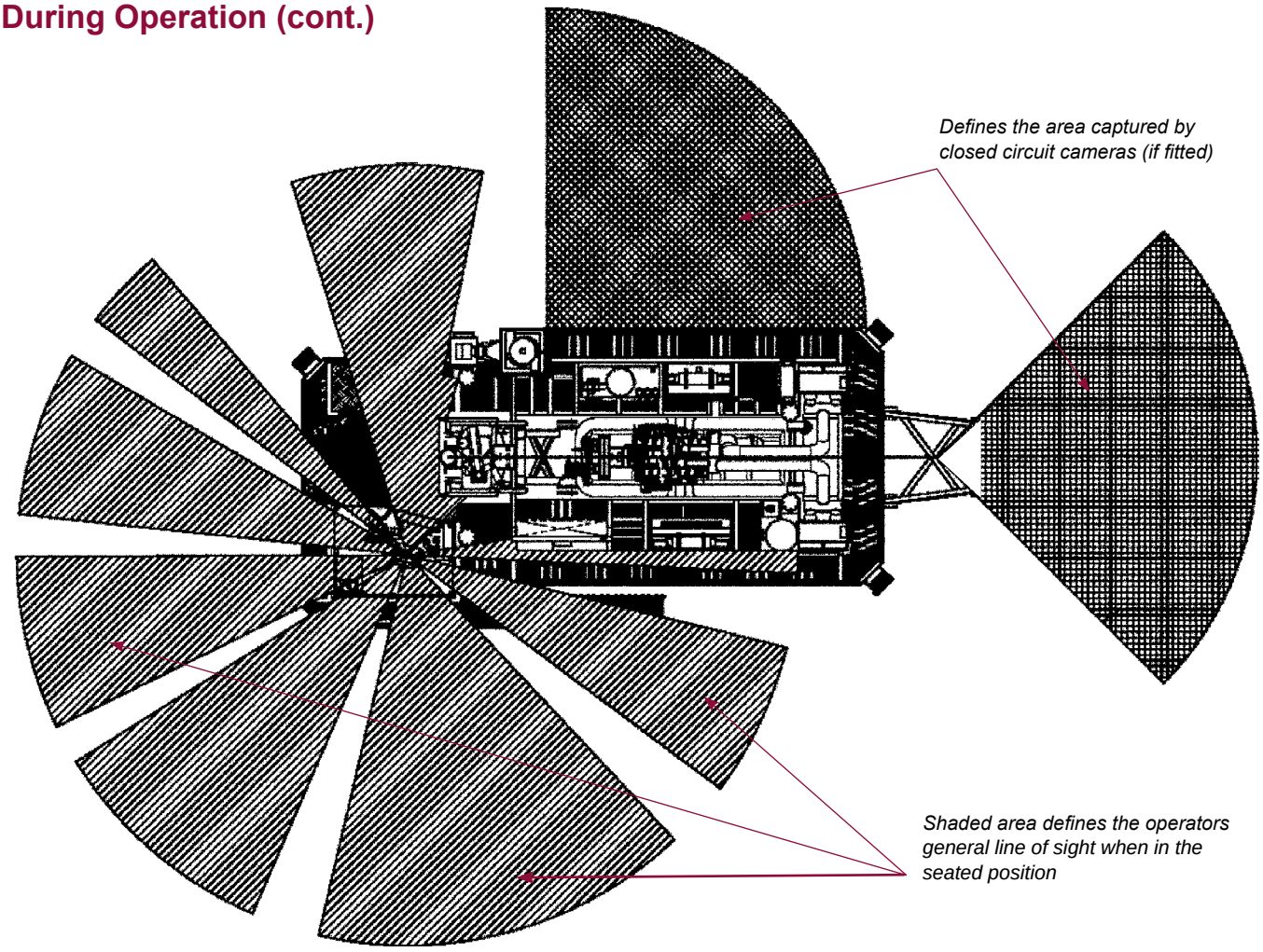
BUCYRUS®

Surface Mining Technology

SKSS Infinity Blasthole Drill
Serial No. 1S67A29
Service Manual

SERVICE MANUAL PART NO. 91-A11-684

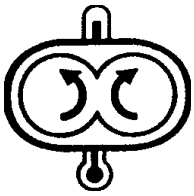
During Operation (cont.)



- Always check blind spots prior to propelling.
- Do not carry out any drilling activity on a bench until it has been examined for misfires.
- Do not drill a hole so that any portion of the hole is closer than 6 metres to a hole containing explosives. Site rules may stipulate further distances.
- Ensure adequate ventilation when running the engine in an enclosed area. Exhaust gases contain carbon monoxide, a deadly poison which is colourless and odourless.
- Ensure the drill pipes are secure in the carousel before raising or lowering the mast.
- Before lowering the mast, do make sure the carousel is rotated, locked in the non-pipe-loading centre position to ensure pipes are secured so they cannot possibly slide back and fall out of the carousel. Then swing the carousel in towards the centre of the mast.
- Do make sure dust is suppressed whilst drilling using either the dust collector or water injection.
- Do not climb the ladder to the operator cabin roof whilst the machine is running and always ensure secure footing.
- Do not under any circumstance climb the ladder giving access to the mast without wearing the appropriate safety harness. Only ever perform service work on the mast wearing approved fall arrest equipment.
- Do not travel on steep inclines, soft or unstable ground or close to unsupported excavations.
- Do not propel the machine with the mast up.

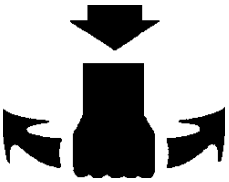
Graphic Symbol Legend

The following is an alphabetical listing of the graphic symbols and their basic description. The control functions are described in detail, following these pages.



Compressor Discharge Temperature

Engine Coolant Temperature



DRILL (Drill/Propel Switch)

Drill Hourmeter

Drilling Air Pressure

Dust Collector

Engine START

Engine Hourmeter

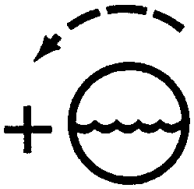
Engine RPM

Engine Oil Pressure

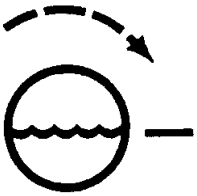
Ether Injection

Engine STOP (also By-Pass)

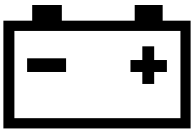
Water Injection



Water Injection Flow Control – INCREASE

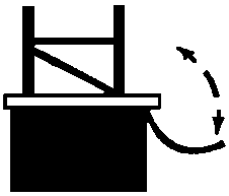


Water Injection Flow Control – DECREASE



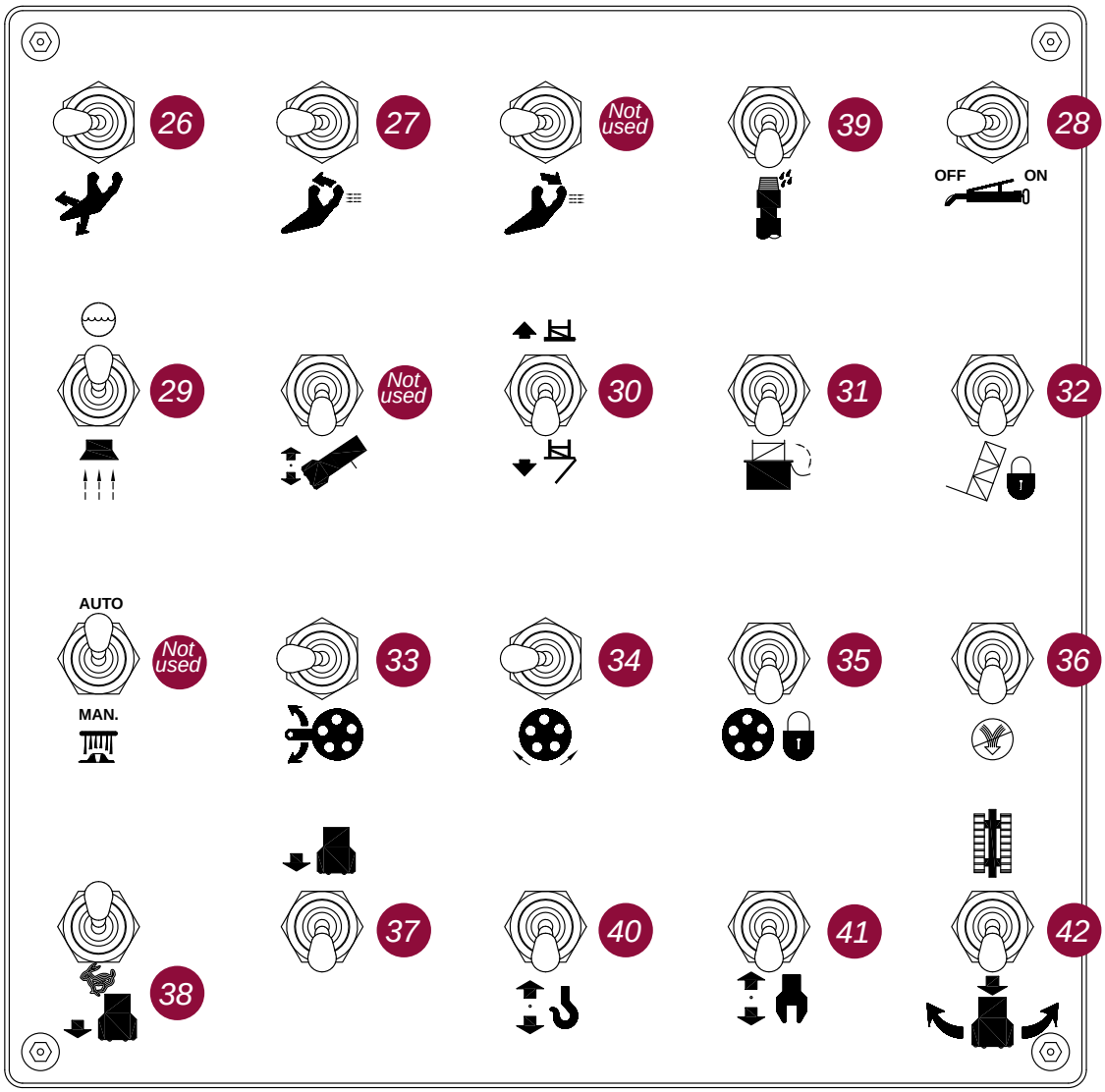
Voltage (Battery Charging)

Drill Stem Thread Lube



Dust Curtain

Switch Panel



Propelling the Machine (cont.)

3. Actuate right and left track propel control levers together slowly in the required direction of travel. Propel speed is varied by the degree of angular displacement of the propel levers, therefore very gradual movement of the levers is required. To propel in a straight line, the propel levers must be operated equally from the neutral positions otherwise the unit may tram sideways.

Propelling Through Turns:

- To turn the machine left or right, one propel lever may be engaged more than the other to make the machine turn.

CAUTION: Both tracks must be operated when propelling the machine. Never allow either track to drag by operating only one lever at a time. When this procedure is not followed, it develops heavy side load on rollers and chain, occasionally chipping roller edges and riding on the chain. Track rollers can also be torn off.

- Should a sharp turning manoeuvre be required, the tracks can be counter-rotated by engaging one lever in the forward position and the other in the reverse position. This can greatly disturb the underfoot surface therefore this manoeuvre should only be carried out where necessary in confined areas.
- Depending on the surface undulations, or build up of material against the tracks from a sharp turn, one or both tracks may stall. If this occurs, propel the machine straight ahead or backwards briefly to clear the tracks and complete the turn.

CAUTION: Never propel the machine with the mast unsupported. Always assure mast locking pins are locked, into mast pin lock holes. When tramming with mast in horizontal position, make sure the mast is always supported properly on mast rest, otherwise mast may swing abruptly sideways causing damage or breakage to the A-frame.

Propelling Up, Down and Across Grades:

CAUTION: If propelling on an incline or decline the machine should always be trammed up or down the slope where possible. Travelling across the grade should be avoided.

- The mast should always be lowered before propelling the machine up, down or across grades.
- With the multiple pass model drill, before propelling the machine up or down a grade, index the loader to the non-pipe-loading position, so that drill pipes cannot slide forward out of the carousel.
- When propelling up or down a slight grade, the machine is generally propelled rear first, because the operator has better visibility. This is particularly important when negotiating a narrow ramp.
- When propelling up or down a steep grade, the operators cab should be at the downhill end of the machine. The reason for this is that with the mast lowered, the front end of the drill is heavier than the rear (cab end) and as a consequence the machine is more stable. It is recommended that a spotter be used in this situation to assist with visibility.
- If travelling across a grade is unavoidable always take particular care, as the machine is more unstable sideways than it is lengthways. Whenever possible propel with the operators cab on the uphill side when crossing grades.

8. Release the nitrogen pressure by operating the bleed valve before attempting to repair any discovered leaks.
9. The nitrogen leak test should be repeated after all leaks have been repaired until satisfactory results are finally obtained.
10. Release nitrogen pressure by opening the bleed valve and disconnect nitrogen test equipment.

2.5 System Evacuation

A moisture free refrigerant system is essential for the correct functioning of the unit. Moisture can cause freezing and blockage at control points, etc, or the formation of hydrochloric acid when in contact with refrigerant, with detrimental effects upon valves, bearings, seals, etc.

The manifold has fittings to receive the gauges and hoses and hand valves, which provide control of the refrigerant through the manifold. The manifold gauges are connected to the compressor service valves by hoses.

The high side gauge measures pressure on the discharge side of the compressor.

The low side gauge registers both pressure and vacuum. The vacuum side is utilised to record the vacuum pulled, during evacuation of the system, in inches of mercury. The pressure portion of the gauge scale is used to record the pressure on the suction side of the compressor during unit operation.

The hand valves are utilised to open or close the gauge pressure ports. When the valve is turned all the way in (clockwise), the manifold port is closed and the pressure gauge is open to the pressure hole. The pressures on that side of the system will be recorded on the gauge above the hose. Opening the valve fully (anti-clockwise) opens the system to the middle service port of the manifold set. This is done only to let refrigerant into or out of the system, or for evacuating the system.

Refer to fig. 2-2 for correct connection of evacuation circuit components.

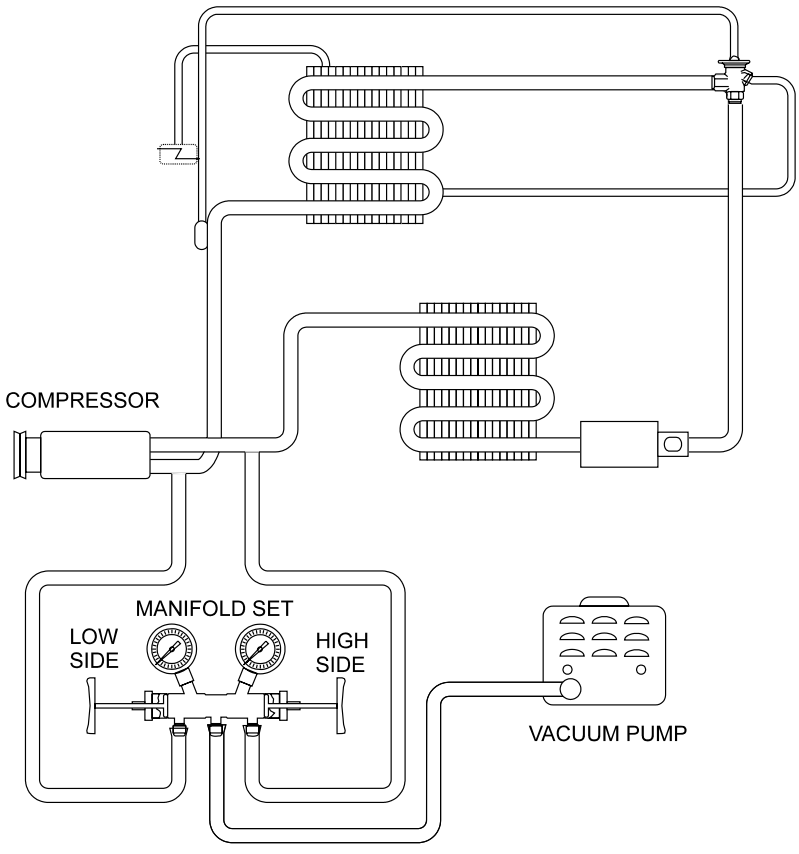


Fig. 2-2

4.2 Fault Analysis Chart Notes

4.2.1 Clogged Strainer Or Filter

Occasionally the strainer or filter in the liquid line may become clogged with foreign material left in the system during installation. When this happens, the liquid line leaving the strainer will feel cooler than the liquid entering. It is badly clogged, some sweat or frost may appear at the strainer outlet.

4.2.2 Thermal Expansion Valve Leaks

A leaky expansion valve may allow the evaporator to fill with liquid which will be 'slugged' into the suction line and into the compressor when the system starts. 'Liquid slugging' within the compressor is detrimental to valves, gaskets, etc. and should be avoided. Slugging is occurring when the compressor ‘chatters’ intermittently as liquid enters the cylinders and causes hammering.

4.2.3 Thermal Expansion Valve Stuck In Open Position

If the expansion valve is stuck in an open position, there will be an excessive amount of sweating on the suction line and compressor crankcase due to the large amount of liquid being passed into the suction line. Expansion valve should be checked for loss of charge or faulty thermal bulb contact with the suction line.

4.2.4 Power Element

The power element of an expansion valve consists of the thermal bulb, capillary tube and the bellows or diaphragm which actuates the valve pin. If this power element is defective or has lost its charge, the valve will either maintain an almost closed position or may close completely. To test for a defective power element, the thermal bulb should be removed from the suction line and warmed by holding it tightly in the hand. The valve will open if the power element is not defective. If the power element is defective, the valve will remain closed.

4.2.5 Thermal Expansion Valve Improperly Adjusted

If the expansion valve is adjusted for too low a superheat, too much liquid will be passed to the evaporator. The suction line will be abnormally cold and liquid may 'slug' back to the compressor.
If the expansion valve is adjusted for too high a superheat, too little liquid will be passed to the evaporator and the suction line will be abnormally warm. Superheat should always be adjusted carefully using thermometer and suction gauge.

4.2.6 Thermal Expansion Valve Too Large

If a replacement thermal expansion valve has been improperly selected, and its capacity is too great for the system, the valve will not maintain a consistently level suction pressure. The thermal bulb will attempt to control the flow of liquid at its superheat setting, but the oversized valve port will pass liquid too rapidly. The presence of liquid near the thermal bulb will close the valve and the pressure in the evaporator will drop until the valve opens to pass another 'slug' of liquid. This 'hunting' will cause a suction pressure variation noticeable on the suction pressure gauge.

4.2.7 Thermal Expansion Valve Too Small

If the replacement thermal expansion valve is too small, it cannot pass a sufficient amount of liquid to satisfy the evaporator. Under conditions of heavy load, the superheat will be excessive and the system will lose capacity. Under conditions of light load, the system may function properly. Too small expansion valves usually result in abnormally low suction pressure.

Section 3
Main Frame / Crawlers

Internal Counterbalance Valve

3. Support both cylinders and remove upper pins (3). Start machine and retract mast cylinder rods all the way in. This will get all of the oil out of the cylinders, which allows you to save that much more oil and reduce excess oil in cylinder when dismantling. DO NOT touch mast lock switch. If mast lock pins are retracted, mast will fall. Shut down machine and isolate the machine, then ensure that personal danger tags or locks are fitted to isolator.
4. Attach lifting strap to cylinder eye and support weight of cylinder while removing lower pin (5) and lift cylinder from machine for repair.

Repair

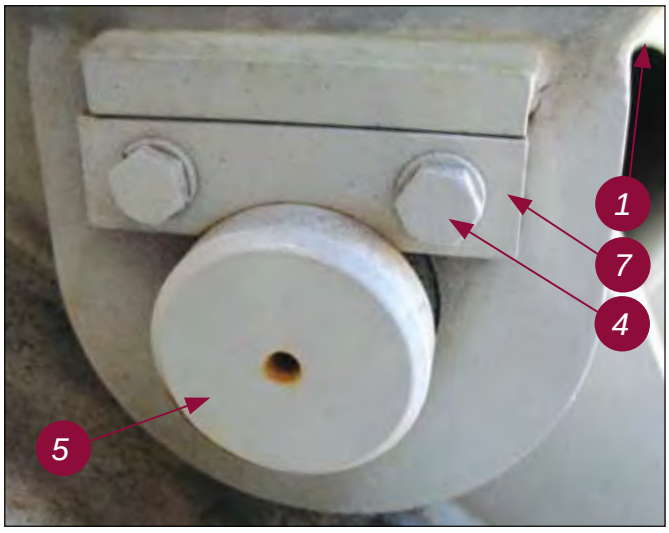
Refer to parts manual for specific cylinder and repair parts. Refer to cylinder repair information in Section 7 for type of cylinder on machine. The mast elevating cylinders have a 'N' type head and a 'Z' type piston.

Replace

1. With cylinder supported, install lower pivot pin and retainer bolts and grease fitting or grease line. DO NOT attach cylinders to mast yet.

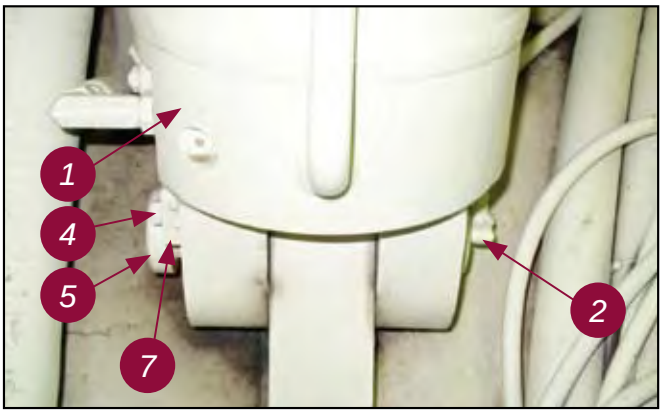
WARNING: BE SURE to cycle cylinder at least SIX times up and down to remove trapped air before attaching to mast, otherwise mast may fall suddenly when lowered.

2. Connect hoses, start up machine and cycle cylinders at least six times up and down to remove trapped air, then slowly extend cylinder to line up rod end with clevis on mast.
3. Install upper pivot pin and retainer bolt. Install grease fittings or grease line.
4. DO NOT stand under mast while lowering. Lower mast and raise up again. Check for leaks. Grease all pivot pins.

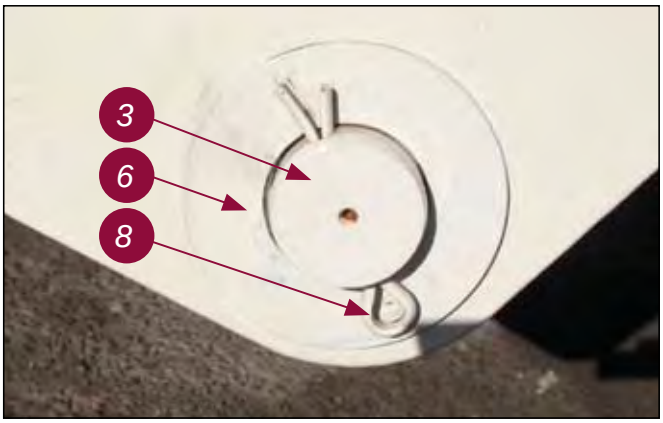


Mast Raise Cylinder Pin

1. *Hydraulic cylinder (2)*
2. *Grease fitting (4)*
3. *Upper pin (2)*
4. *Bolt (4)*
5. *Lower pin (2)*
6. *Flat washer (4)*
7. *Keeper plate*
8. *Split Pin*



Bottom Mast Raise Cylinder Pin



Top Mast Raise Cylinder Pin

Idler Unit Description

- The idler wheel is filled with oil and the running surfaces are induction hardened for reduction in wear.
- The sliding block (3) is designed in such a way that no dirt can enter the idler.
- The hydraulic tensioner (4) serves to tighten the track chain when grease is inserted with a grease gun.
- The nitrogen tensioner (5) is pressurised at the factory and normally requires no other maintenance.

WARNING: HIGH PRESSURE The nitrogen tensioner is under high pressure. Bleed off all pressure before any service work is performed on the unit. Follow instructions in this section. It is recommended that service work on the nitrogen tensioner be done only by factory authorised service agents. If service work is performed by non-factory authorised personnel, all liability and/or damage is assumed by party(ies) performing the work. If unit is disassembled, always discard all fasteners and replace with new ones.

Grease in the hydraulic tensioner is under high pressure. Grease coming out of the relief valve at the back of the hydraulic tensioner is under high pressure and can penetrate the body causing personal injury or death. When loosening the tension on the track, loosen the relief valve only one turn. DO NOT visually inspect the relief valve to see if grease is being released from the track adjuster. Instead, watch the track to see if it loosens. If the track does not loosen after opening the relief valve, move the machine forward and backward to release the tension.

Torque Turn Method (cont.)

When assembling the track shoes in the field, this method must be used because the final torque is not done with a calibrated torque wrench and although the deviation may be small, the tightening of a third of a turn more, gives the necessary clamping force independent for the required friction factor.

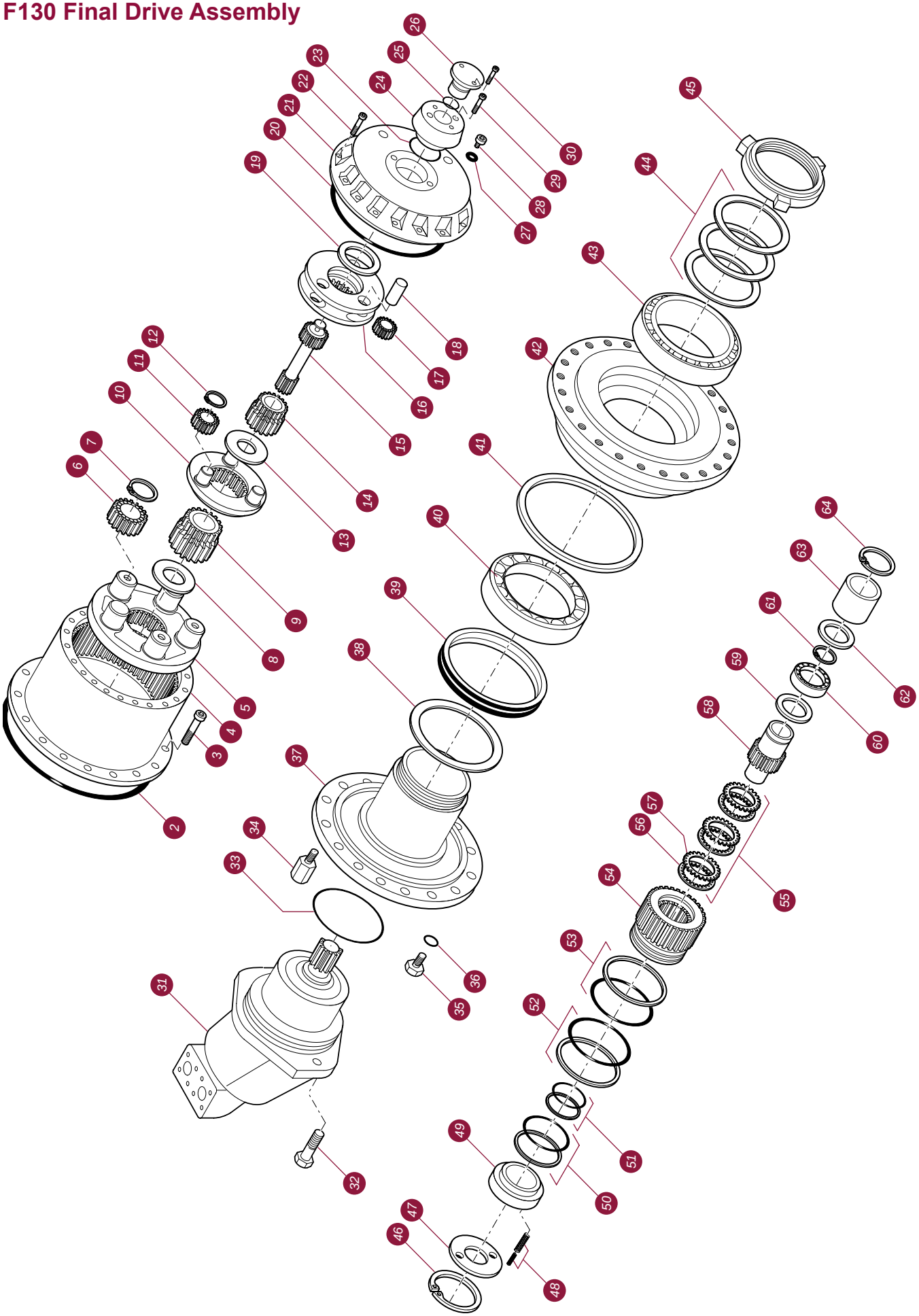
Track Shoe – Retightening

DO NOT merely retorque the bolts in the field. This would lead to failure of the joint due to the altered friction factor and a reduced preload of the bolts.

The CORRECT METHOD of retightening the bolts, is to loosen the bolts until they turn freely. Now torque the bolts using the 'torque turn' method described above.

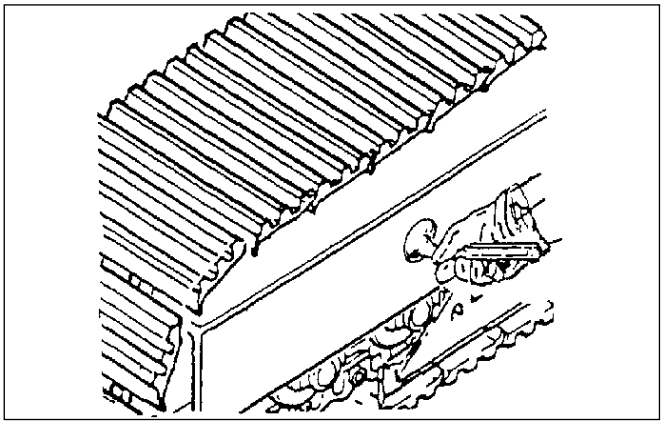
NOTE: This can only be done once and only after a short time of machine operation (approximately 50 hours). After extended operation, loose bolts and nuts must be replaced with new ones for safety reasons.

F130 Final Drive Assembly

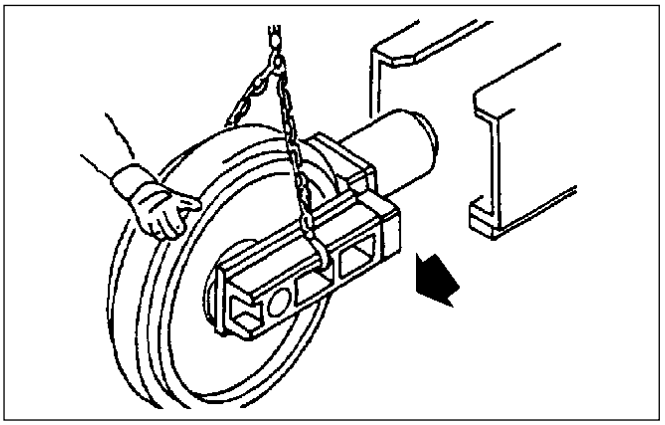


Idler Unit – Removal

WARNING: DO NOT work on track system or undercarriage unless engine is off and controls are locked out and machine is on level ground. MAKE SURE machine and components are well supported before servicing or replacing parts. RELIEVE PRESSURE on hydraulic or pneumatic systems before loosening connections or parts.

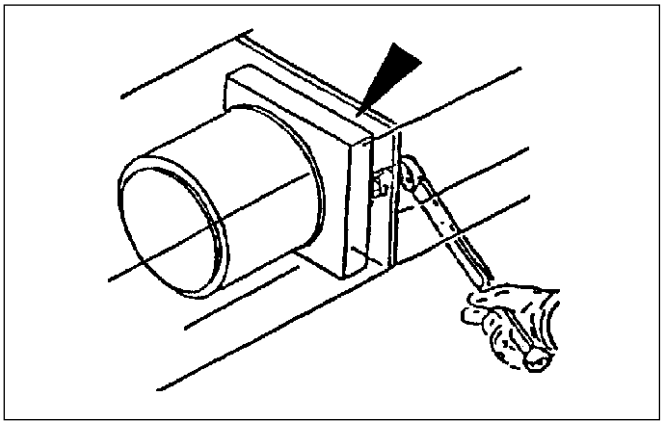


1. Release track chain tension and separate track chain. Follow instructions outlined previously.

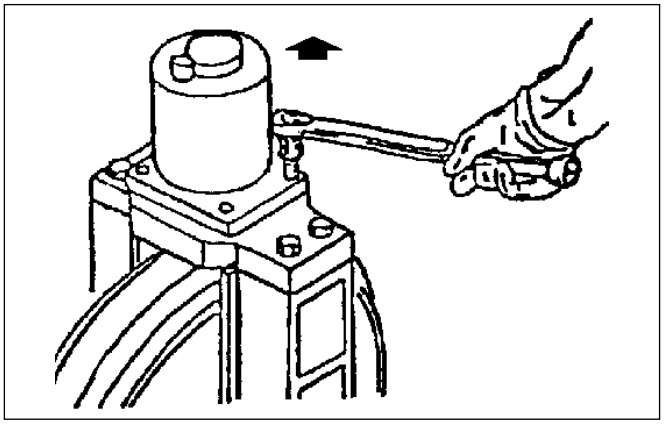


2. Clean dirt from all parts. Using an adequate lifting device, pull out the complete idler unit.

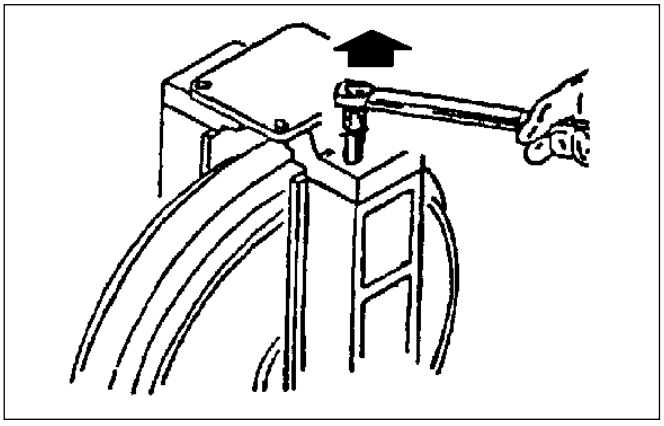
3. If either the idler or nitrogen tensioner is damaged, separate them and replace or repair as required.



4. If the hydraulic tensioner is defective, loosen the attaching bolts and remove the unit. Replace or repair the unit as necessary.



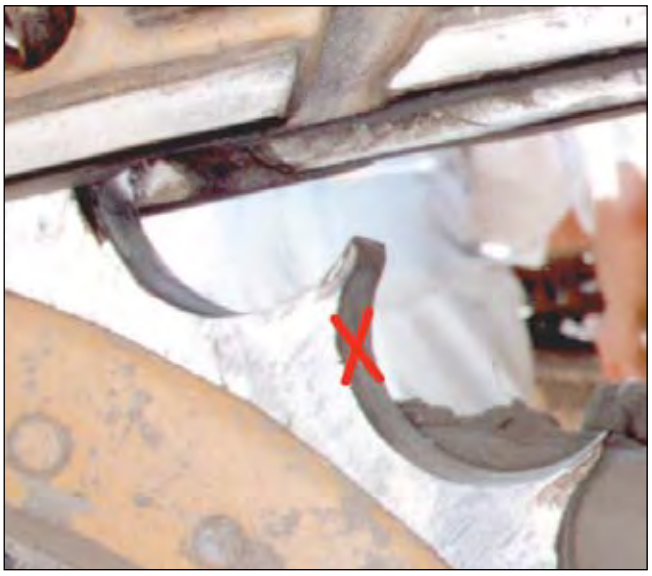
5. If the nitrogen tensioner is defective, loosen the attaching bolts from the sliding block and remove tensioner.



6. If idler unit needs repair, first loosen the sliding block. To disassemble the idler components, refer to 'Idler Assembly' instructions and carry out procedure in reverse order.

Sprocket Wear Patterns

Wear on Forward Drive Side



Considered as normal wear when driving torque of the sprocket is transmitted to the bushing.

Causes:

- Bushing moves and more towards the tooth tip of internal joint wear.
- Abrasive soils in the tooth bottom or on the tooth profile is pushed away by the bushing creating additional wear.
- Side to side movement between the bushing and tooth due to frequent turning and steering manoeuvres also causes wear between the sprocket and the bushing.
- Wear increases as the side clearance between sprocket and links increases thus higher side to side movement and increased wear.
- Sprockets with mud reliefs lead to higher surface load and thus a higher wear rate.
- Accelerated wear due to inadequate track gradient between sprocket and last roller causes bushing to be pushed into tooth bottom by machine weight.
- Tracks with pitch extension cause the contact area between bushing and sprocket move more and more to the tooth tip.

Effects:

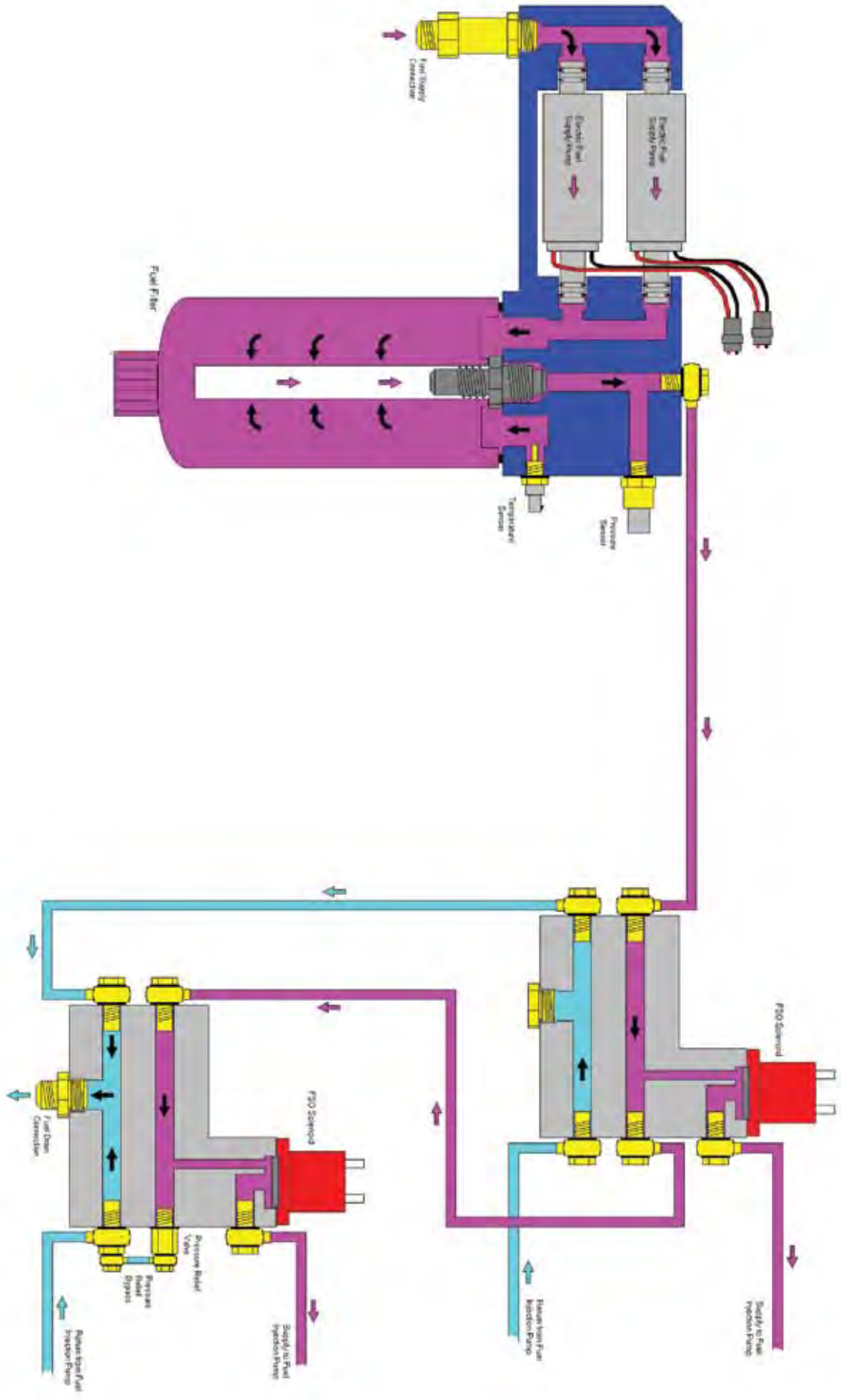
- Bushing puts more pressure on the tooth profile.
- Contact area is reduced. Contact pressure and wear increases.
- Excessive wear causes bushing to move closer to the tooth tip. Tracks more easily jump over the teeth causing damage to both the sprocket and bushings.
- Tooth spacing is increased. When changing directions, increased impacts are exerted between the bushing and sprocket. Bushings and sprockets worn beyond 100% can break.

Remedies:

- Normal wear is inevitable
- Use of lubricated track chains eliminates pitch extension allowing the chain and sprocket a more perfect match of pitches as wear occurs.
- If track gradient between sprocket and first roller is insufficient, use of spacers to lower the rollers will produce an adequate gradient.

Section 4 - Engine / Drive Train / Compressor 4-1

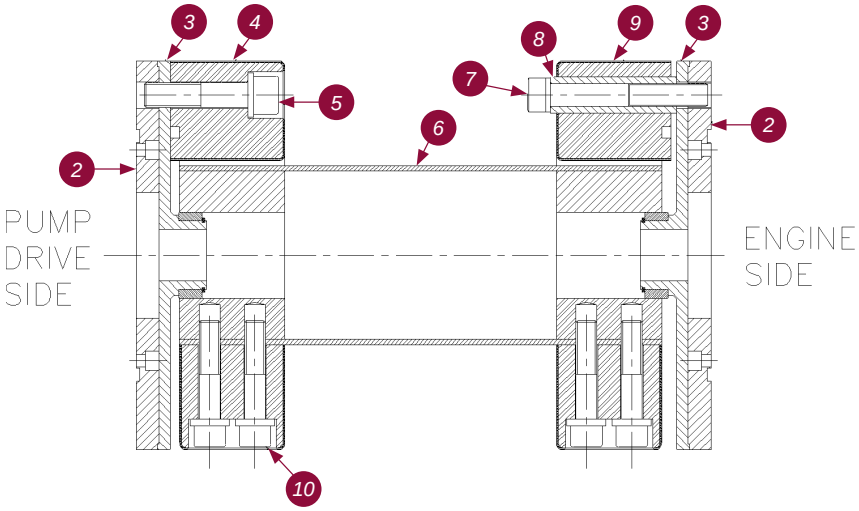
QST30 Electric Fuel Supply System Detail



Mounting Screws and Adhesive (cont.)

Fig. 4-10 Flex Drive Coupling

2. *Adaptor flanges (2)*
3. *Centreing flanges (2)*
4. *Rubber element*
5. *Axial socket head capscrew (4)*
6. *Tube assembly*
7. *Axial socket head capscrew (4)*
8. *Sleeve (4)*
9. *Rubber element*
10. *Radial socket head capscrew (8)*



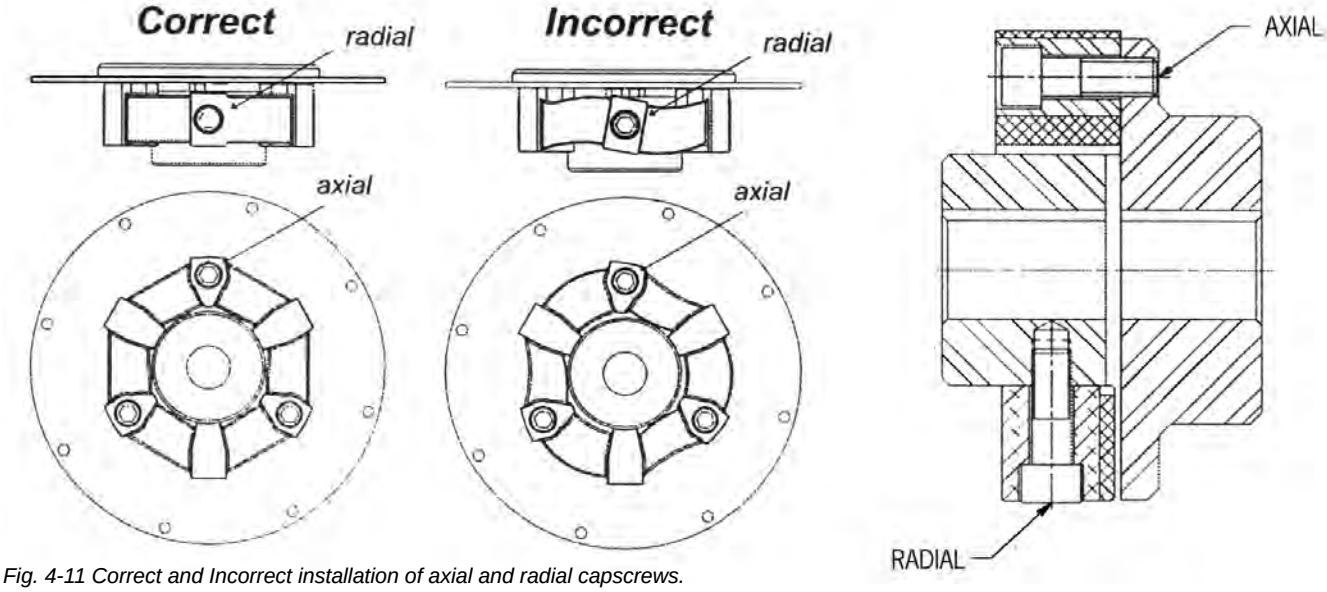


Fig. 4-11 Correct and Incorrect installation of axial and radial capscrews.

1. Be sure the flange hubs on the engine and pump drive are not damaged. Be sure they are free of nicks and burrs and that all mounting bolts are tight.
2. Place a small amount of grease under the head of each capscrew. This reduces the possibility of twisting the rubber element (see fig. 4-11). Install eight precoated axial capscrews (longer) finger tight. Be sure the flexible flange with the steel sleeves is on the engine side (fig. 4-10).
3. Rotate the tube (item 6, fig. 4-10) so all eight axial capscrews (shorter) can be installed finger tight.

NOTE: Use caution when tightening capscrews to prevent twisting of the flexible flange. This is particularly important for the radial capscrews. If the part is twisted, the cylindrical surface between the insert and the hub does not carry the load with the whole surface, but with the two corners only. If this happens the other radial bolts can loosen and the coupling will be destroyed.

4. Tighten all axial capscrews first, torque to 370ft lbs (503Nm), then tighten all radial capscrews to same torque value.
5. Install flex drive cover.

Safety (cont.)

a. Avoid bodily contact with hot fluid, hot coolant, hot surfaces and sharp edges and corners.

b. Keep all parts of the body away from all points of air discharge and away from hot exhaust gases.

c. Wear personal protective equipment including gloves and head covering when working in, on or around the compressor.

d. Keep a first aid kit handy. Seek medical assistance promptly in case of injury. DO NOT ignore small cuts and burns as they may lead to infection.

Toxic and Irritating Substances

1. **DO NOT use air from this compressor for respiration (breathing)**.

DANGER: Death or serious injury may occur from inhaling compressed air without using proper safety equipment. See OSHA standards, and /or any federal, state or local codes or regulations on safety equipment.

2. DO NOT use air line anti-icer systems in air lines supplying respirators or other breathing air utilisation equipment and DO NOT discharge air from these systems into unventilated or other confined areas.
3. Operate the compressor only in open or well ventilated areas.
4. If the compressor is operated indoors, discharge engine exhaust fumes outdoors.
5. Locate the compressor so that exhaust fumes are not apt to be carried towards personnel, air intakes servicing personnel areas or towards the air intake of any portable or stationary compressor.
6. Fuels, fluids, coolants, lubricants and battery electrolyte used in the compressor are typical of the industry. Care should be taken to avoid accidental ingestion and /or skin contact. In the event of ingestion seek medical treatment promptly. DO NOT induce vomiting if fuel is ingested. Wash with soap and water in the event of skin contact.

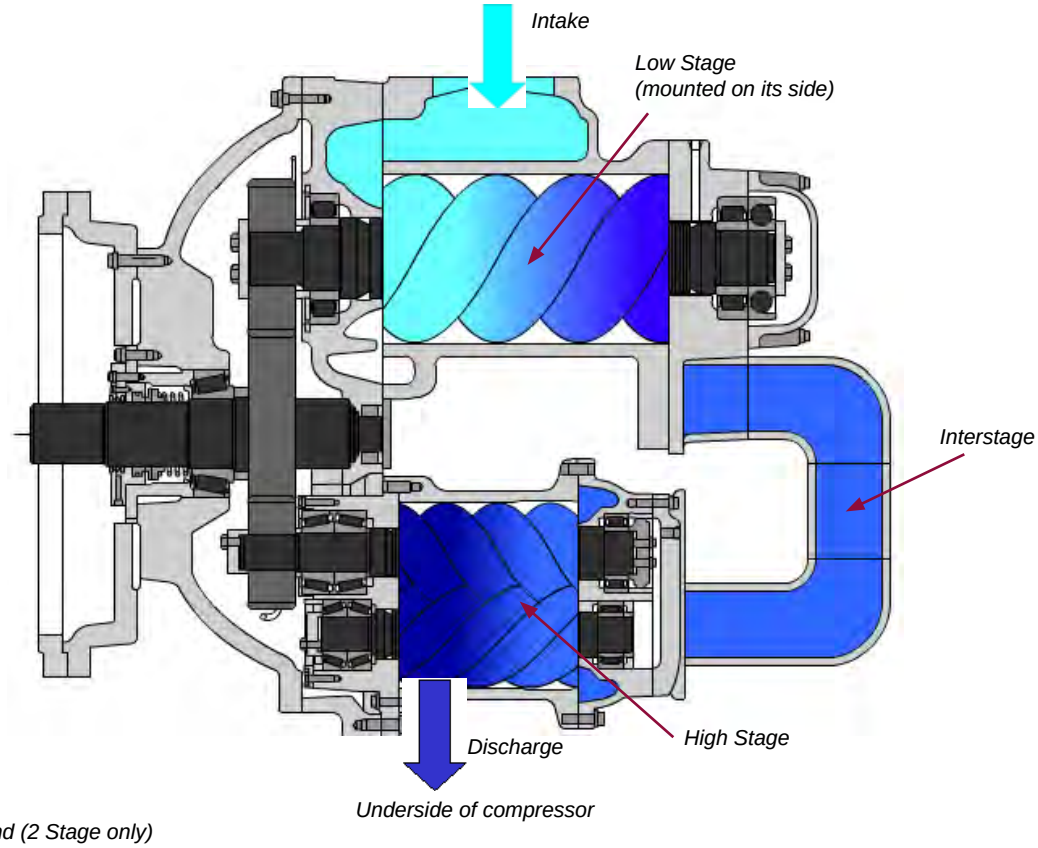
Electrical Shock

1. Keep the towing vehicle or equipment carrier, compressor hoses, tools and all personnel at least 3m (10') from power lines and buried cables.
2. Attempt repairs only in clean, dry and well lighted and ventilated areas.
3. Stay clear of the compressor during electrical storms! It can attract lightning.

Lifting

1. Make sure entire lifting, rigging and supporting structure has been inspected, is in good condition and has the correct rated capacity.
2. Make sure lifting hook has a functional safety latch or equivalent, and is fully engaged and latched on the bail/slings.
3. Use guide ropes or equivalent to prevent twisting or swinging of the compressor one it has been lifted clear of the machine.
4. DO NOT attempt to lift in high winds.
5. Keep all personnel out from under and away from the compressor whenever it is suspended.
6 Lift compressor no higher than necessary.
7. Keep lift operator inconstant attendance whenever compressor is suspended.

Compressed Air Functions (cont.)



Compressor Unit Air End (2 Stage only)

Compressor Discharge System, Functional Description

The Sullair compressor unit discharges a compressed air / fluid mixture into the sump. The discharge check valve prevents discharge air returning from the fluid sump to the compression chamber.

From the discharge valve the air/fluid mixture is directed to the sump. The sump has three basic function:

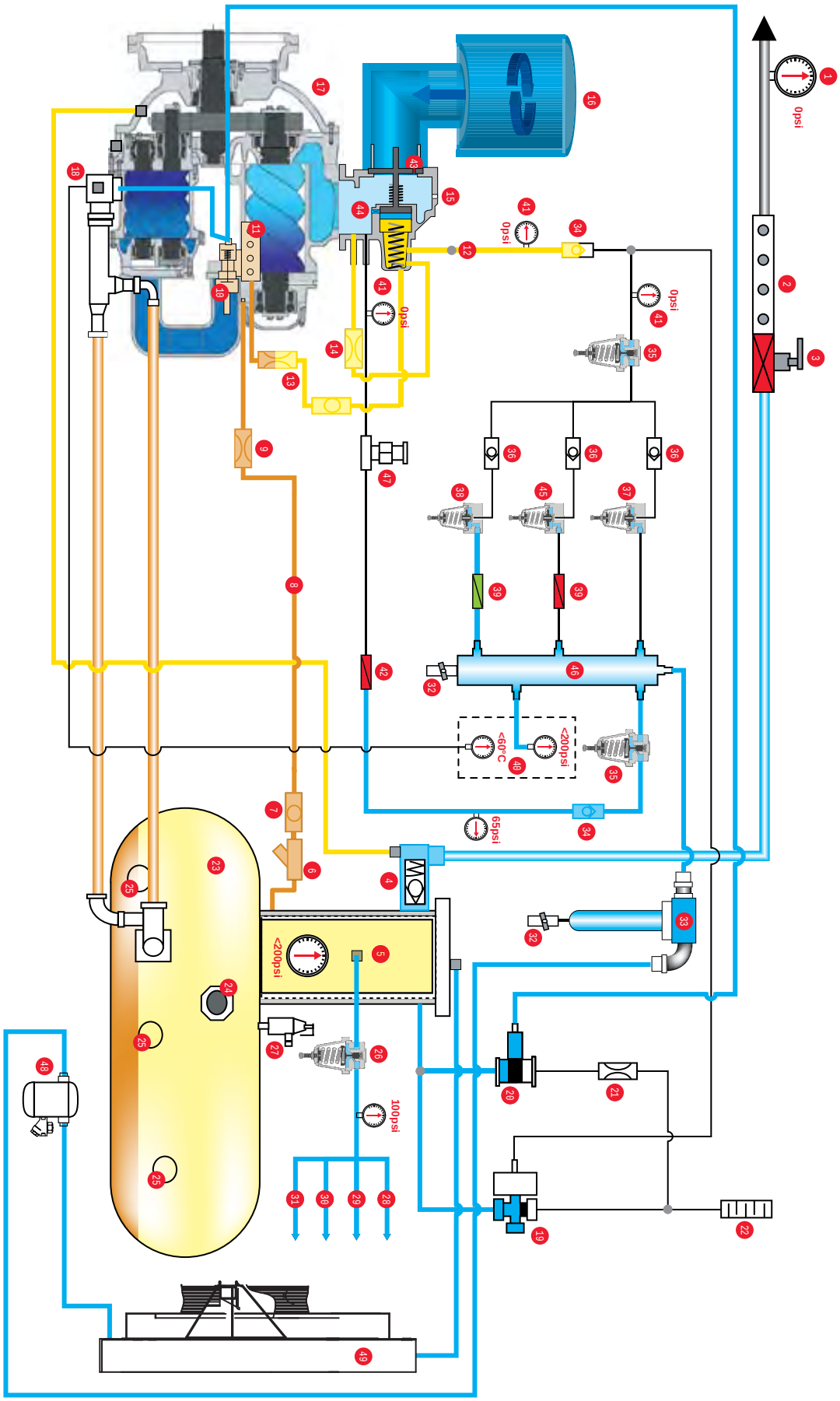
1. It acts as a primary fluid separator.
2. Serves as the compressor fluid sump.
3. Houses the final fluid separator.

The compressed air / fluid mixture enters the sump. Change of direction and reduction in velocity by the air/fluid mixture results in the larger droplets of fluid to fall to the bottom of the sump. The fractional percentage of fluid remaining in the compressed air collects on the surface of the final separator element as the compressed air flows through the separator. As more and more fluid collects in the element surface, the fluid descends to the bottom of the separator. a return line (or scavenge tube) leads from the bottom of the separator element to the gearcase of the compressor unit. Fluid collecting on the bottom of the separator element is returned to the compressor gearcase. An orifice (protected by a strainer) is included in this return line to assure proper flow.

The sump is ASME code rated at 600psig (41.4bar) as required by operating pressure. A minimum pressure valve is located downstream from the separator to assure the required minimum receiver pressure during all conditions. This pressure is necessary for proper fluid circulation and air / fluid separation.

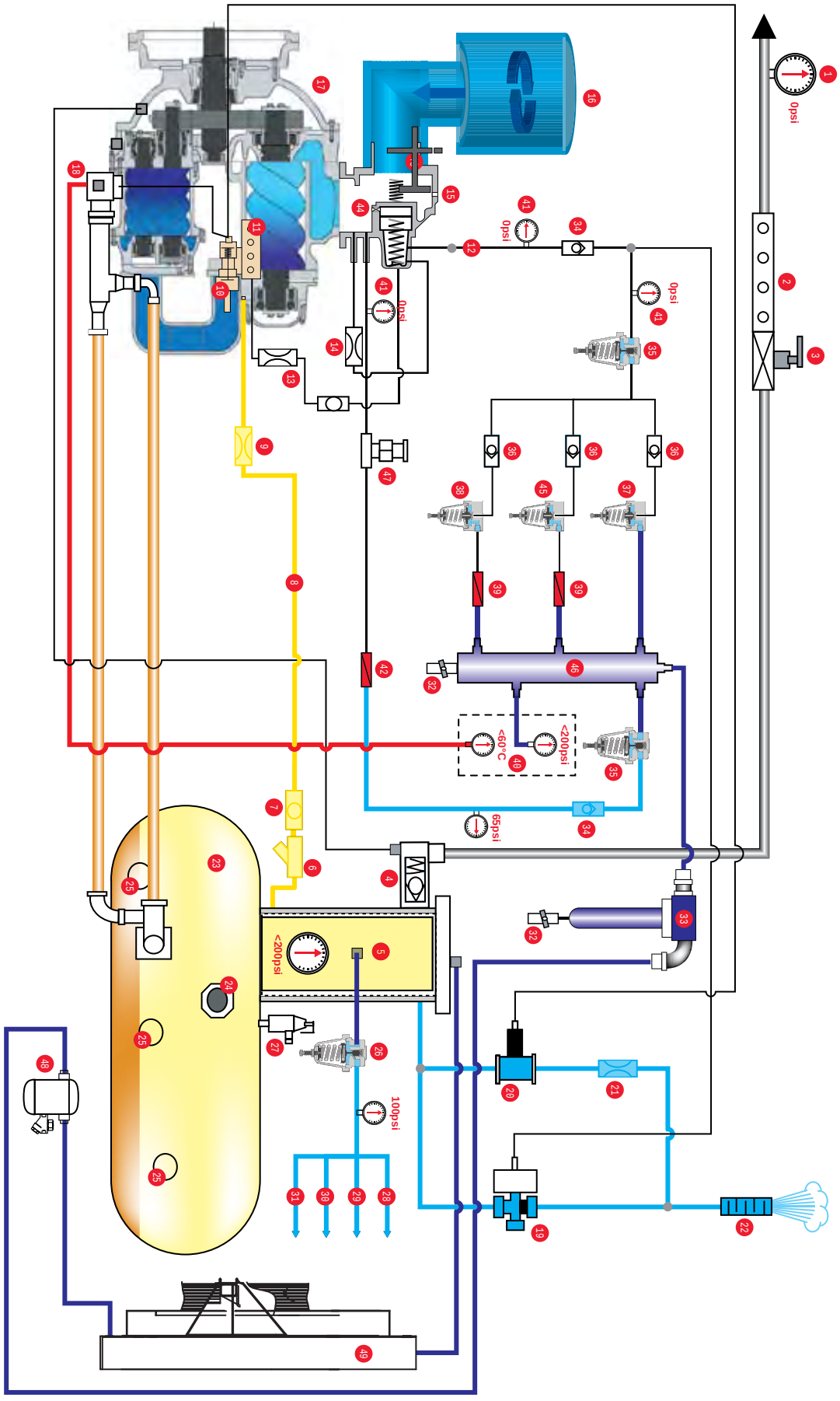
Compressor Air Circuit – 1475cfm @ 500psi

Start-up (Low Mode)

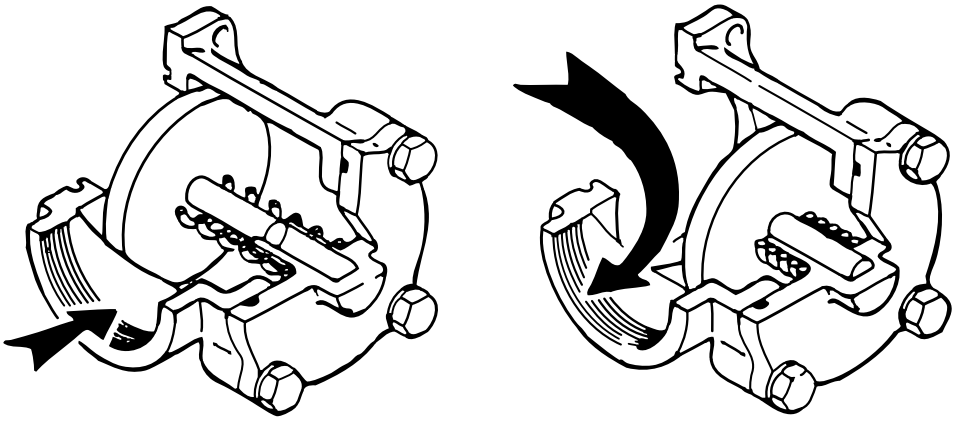


Compressor Air Circuit – 1475cfm @ 500psi

Shutting Down



Discharge Check Valve



Closed *Open*

The air / fluid mixture leaving the compressor unit overcomes a spring loaded piston in the discharge check valve, and flows into the separator/receiver tank. On shutdown, back pressure will force the piston closed, restricting flow back into the compressor unit.

If the piston does not fully close off the compressor discharge port on shutdown, back pressure will force the rotors to turn in the opposite direction of rotation, forcing air and oil out of the compressor unit and wet the Inlet air filters.

The discharge check valve:

1. Remove the capscrews from the valve body cover and remove the cover and shaft assembly.
2. Remove the gasket and spring from valve body.
3. Remove disc with bearing assembly from valve body.
4. Clean cover and valve body gasket surfaces.
5. Inspect the seat area for damage
6. Install new disc with bearing into valve housing.
7. Place spring onto the hub of the disc bearing assembly.
8. Place new gasket on the valve body.
9. Install cover/shaft assembly centring shaft into spring and disc with bearing.
10. Install the cover capscrews and torque to 80ft lbs (108Nm)

NOTE: When filter element is changed, it is important to check that all four (4) Bypass check valves are in place. (refer fig 4-20). This is done by looking up into the Filter head from the underneath side once the filter bowl and element have been removed. Inspect/check all four (4) by-pass valves in housing for cracks, chips or damage. There must be a by-pass check in all four (4) ports, if missing and the port is open then there will be no filtration occurring of the compressor fluid. Replacement valve part number V0125559.

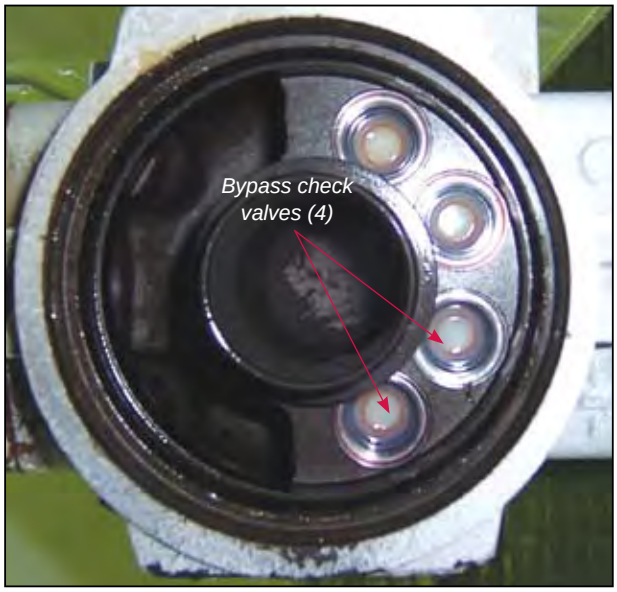


Fig. 4-20 Compressor Fluid Filter

Changing Filter Elements

WARNING: Relieve pressure on hydraulic and pneumatic systems before loosening connections or parts.
Failure to depressurise system before proceeding could result in explosive loss of fluid, damage to equipment, or possible personal injury.

1. Shutdown and depressurise the system. Open bleed plug (if fitted) one and one half turns.
2. Unscrew and remove filter cover bowl from head assembly, counterclockwise when viewed from above. It may be necessary to use a lever on the 'Rotolok Ring' of the filter bowl to loosen the bowl initially.
3. Remove filter element and carefully inspect the surface for visible contamination. Normally no dirt should show, but visible dirt or particles can be an early warning of system component breakdown and can indicate potential failure. Discard both the filter element and its O-ring. The filter element is not cleanable. Any attempt to clean the filter element can cause degradation of the filter medium and allow contaminated fluid to pass through the filter element.
4. DO NOT run the system without a filter element installed. Check that the O-ring on the head assembly is not damaged. Use replacement filter element part number called for on the element change label or in the parts book.

NOTE: The four bypass valves must be checked. A damaged bypass valve will allow fluid to pass unfiltered. These four check valves must be checked visually every service for damage and integrity.

5. Lubricate element O-ring with clean system fluid and push open end of filter element straight onto the nipple in the head assembly. Clean out filter bowl and lightly lubricate threads of filter cover assembly with clean system fluid. Screw cover assembly onto head assembly until it bottoms. O-ring sealing is not improved by overtightening.

Moisture Separator Maintenance

Daily

Open the drain petcock and allow the water to drain out at adequate intervals.

Every 500 Hours

Replace element. Remove the separator from the system. Through the 1/2” NPT OUTLET port, flush with warm water and detergent, allowing the cleaner to drain out the bottom port. Repeat the process several times, flush with clean water (DO NOT USE SOLVENTS.)

Moisture Separator

Auxiliary Regulator

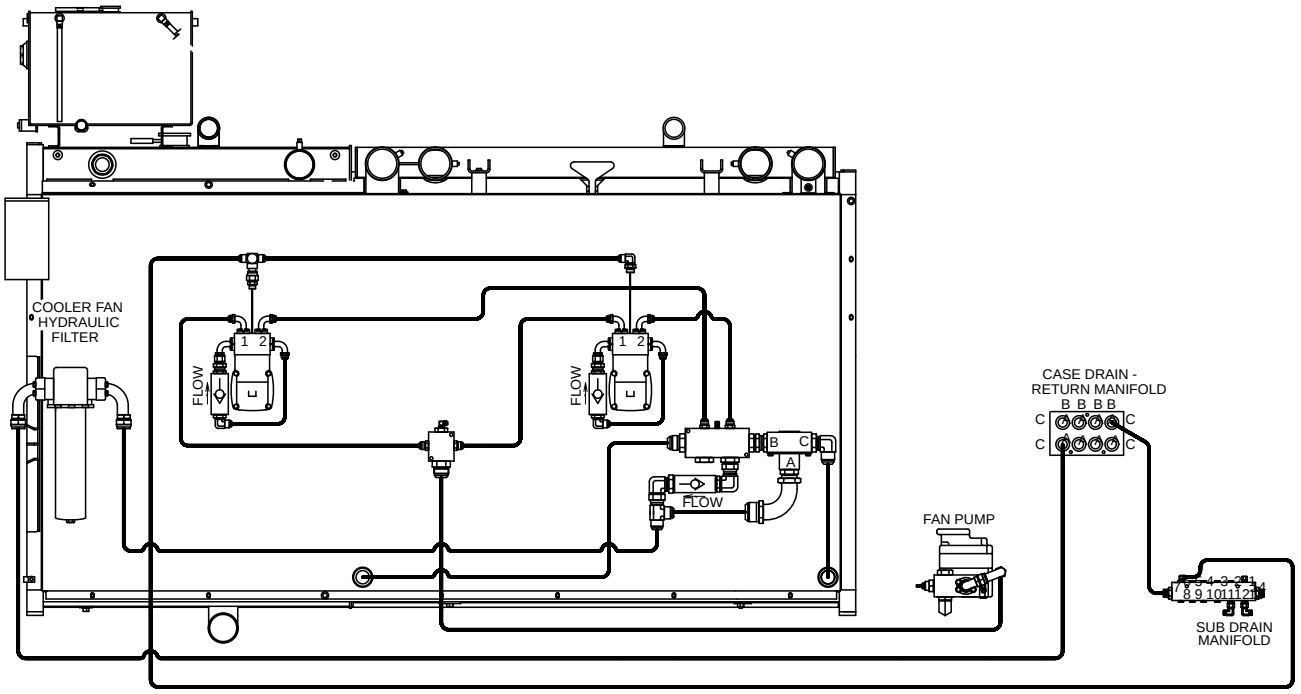
The auxiliary (reducing) regulator reduces 500psi tank pressure to 110psi, to provide a 110psi circuit for auxiliary air components. The auxiliary regulator is located at the receiver tank and has a test point for circuit pressure setting, downstream of the regulator.

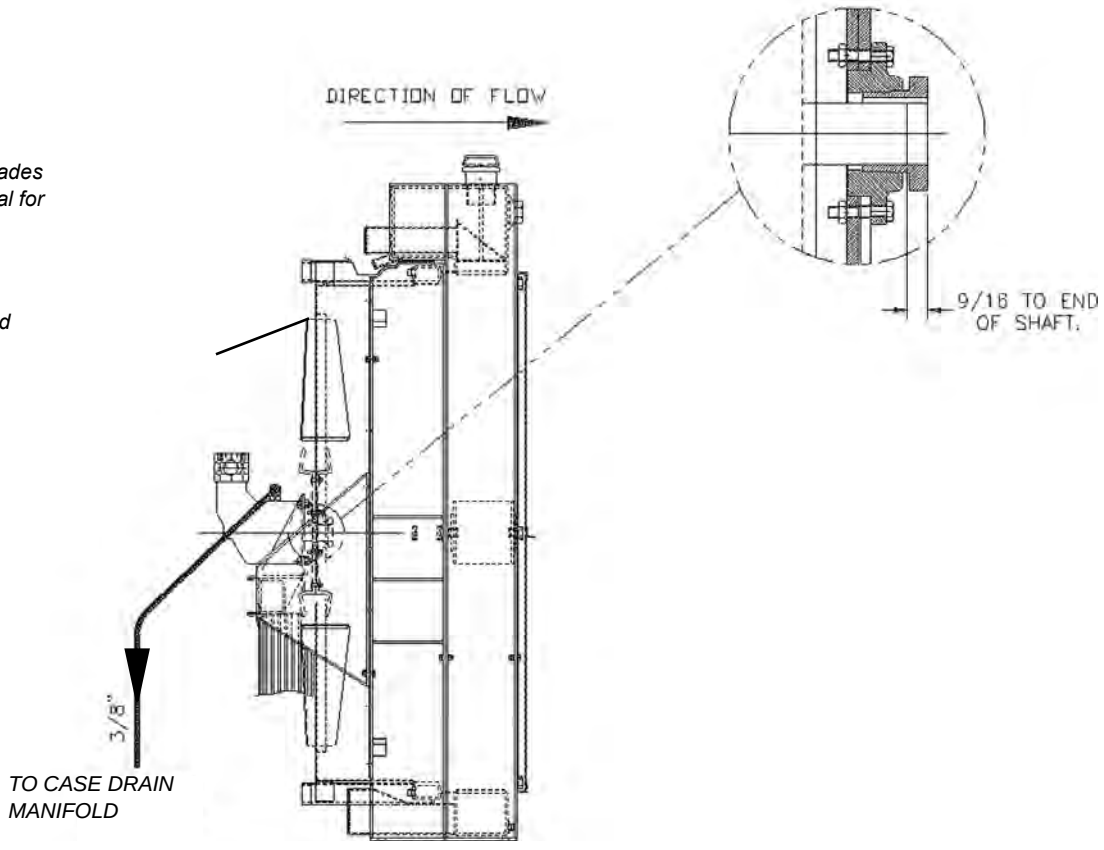
Auxiliary Regulator

Hydraulic Oil / Radiator Cooler Assembly

The Hydraulic Oil Cooler is mounted with the Radiator Cooler.

NOTE: The Hydraulic Oil Cooler is the same model as the Compressor Oil Cooler. Therefore the service manual for the Compressor Oil Cooler also applies to the Hydraulic Oil Cooler.





Position of Fan blades in cowling is critical for maximum air flow

Width of blade-end to be two thirds inside shroud

TO CASE DRAIN MANIFOLD

Hydraulic Oil / Radiator Cooler Assembly

Tube Removal

Helpful Hints:

- Clean the core prior to removing tubes.
- To avoid bending or kinking tube ends, reduce the angle of the tube as it's being pulled from the top seal.
- If the core has a centre tank, remove the top core tubes and seals first.
- If the core has an ITS (Individual Tube Support) system, mark the bars front and back before removing, to ease reassembly.
- To assist in the removal process, spray WD40 on the top end of tubes.
- If tubes are difficult to remove, try using the breaker tool and removal tool simultaneously.

Step 1.

Loosen the tube by using breaker tool, as shown in fig. 1. The breaker tool should be placed at top or bottom, not at middle when freeing tube from seal. Lightly twist the tube back and forth, to loosen tube from seals.

Fig. 1

Step 2.

After tube is free, place upper jaw of installation tool around the round portion of tube, just below the seal, see fig. 2. Squeeze handles of tool together and flattened portion. Place lower jaw on top of bottom raise tube only enough to clear bottom seal.

Fig. 2

Step 3.

Put down tool and swing tube out just far enough to allow it to be pulled down and out of its top seal, as shown in fig. 3. Remove all tubes in the row, repeating the above procedure.

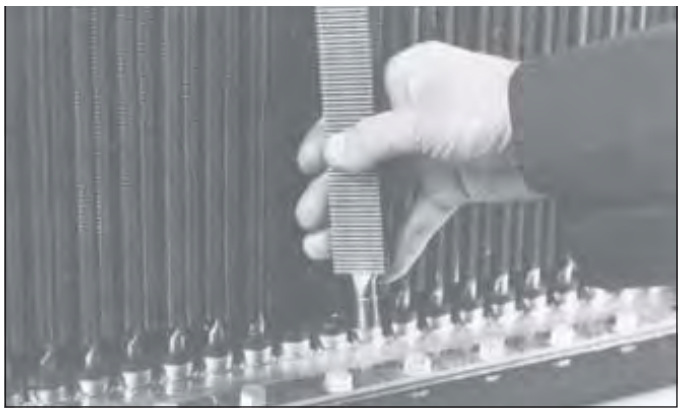


Fig. 3

If you are working with an ITS core, the tube must be raised high enough so that the interlocking tab clears the adjacent dove tail groove, as shown in fig. 4.

Fig. 4

Dust Control Systems

Three individual systems make up the complete dust control package for the drill:

1. Fully enclosed under deck area (includes the deck seal)
2. Down hole water injection.
3. Dust collector

The dust control system includes a dust curtain around the drilling platform and a blower type dust collector which acts as a vacuum to gather the dust trapped within the dust curtain. The dust control system also contains a water injection system that injects water into the main air stream to help control dust accumulation.

The general functions of the dust control subsystem units are described below.

Dust Curtains

The under deck area is fully enclosed by replaceable dust curtains, these curtains require trimming to a length that will provide the best sealing capabilities, based on the type of terrain in which the drill is being used i.e. If the terrain is generally level the curtains can be trimmed to a common length all round, but should the terrain be sloping then the curtains will need to be trimmed longer or shorter at a particular end to maximise sealing. Trim length of curtains to approximately 200mm (8”) overhang on the ground.

Underdeck Dust Curtains

Drill Deck

Excessive overhang on the ground may result in the curtains being caught and torn by larger rocks or the build up of cuttings from the drill hole.

Deck Seal

The deck seal also plays an integral part in sealing of the under deck area and requires regular inspection. This is to prevent dust and drill cuttings from entering the top of the drill deck which if left unchecked for a prolonged period, will reduce the service life of the deck bush and also create a build up of material on the deck itself.

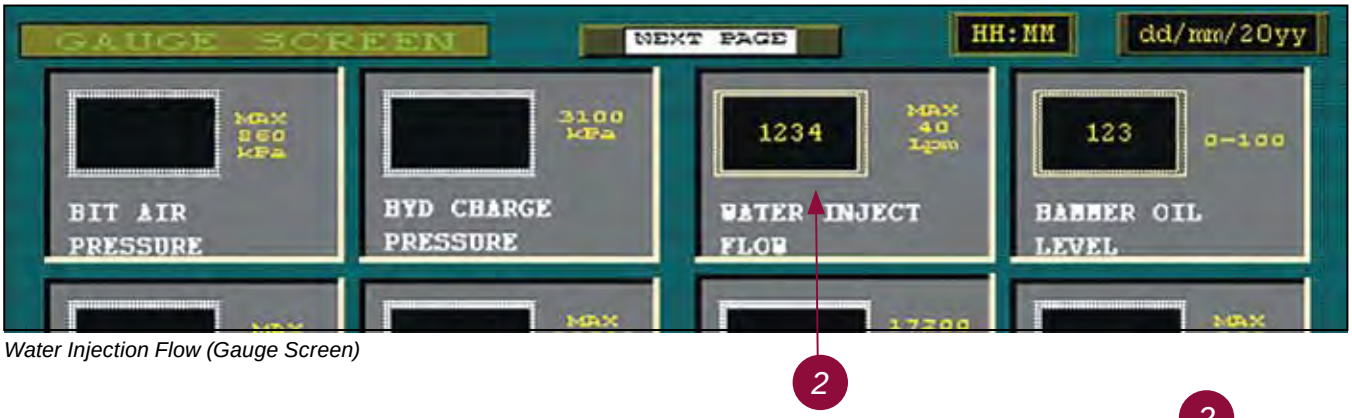
Water Injection Control

Water Controller – controls hydraulic flow to water injection pump

Water injection volume is operated with the controller in the operators cab.

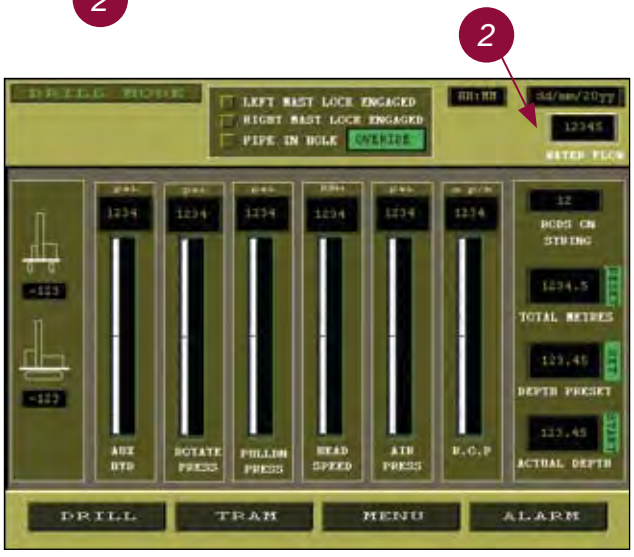
The water injection pump delivers water to the water injection solenoid which is switched on by the operator. The PLC will not switch the solenoid on until the bit air (20psi minimum) is turned on.

Water flow to the drill string is measured via a flow meter which is situated in the transducer cabinet. Water flow can be monitored on the Vigilante Gauge Screen 1, and is measured in litres/min.



Water Injection Flow (Gauge Screen)

Water Injection Flow (Transducer Cabinet)



Water Injection Flow (Drill Mode Screen)

1. *Flow meter*
2. *Water injection flow rate shown on Gauge Screen 1 and also displayed on the drill screen.*

Recommended Lubricants

Type of Service	Ambient Temperature	ISO Grade (cSt)	AGMA Number	SAE Weight	SSU Viscosity
General Service	-17.8 to 35ºC (0 to 95ºF)	100	3 • Texaco Meropa 100 • Shell Omala 100	30	550
High Ambient Temperature	35 to 48.8ºC (95 to 120ºF)	220	5 • Texaco Meropa 220 • Shell Omala 100	50	1165
Cold Ambient Temperature	-34.4 to 15.5ºC (-30 to 60ºF)	68	2 • Texaco Meropa 68 • Shell Omala 68	20	350
Frequent Start – Stop Cycles	-17.8 to 35ºC (0 to 95ºF)	150	4 • Texaco Meropa FM 150	40	775
Specialty Items: Internal Rust Inhibitor External Rust Inhibitor	• Cortec VCI 329 • Texaco Metal Protective Oil L				

Water Pump Motor Repair

Refer to Section 7 for motor repair.

Water Injection Hydraulic Control Valve Repair

Refer to Section 7 for repair and service information.

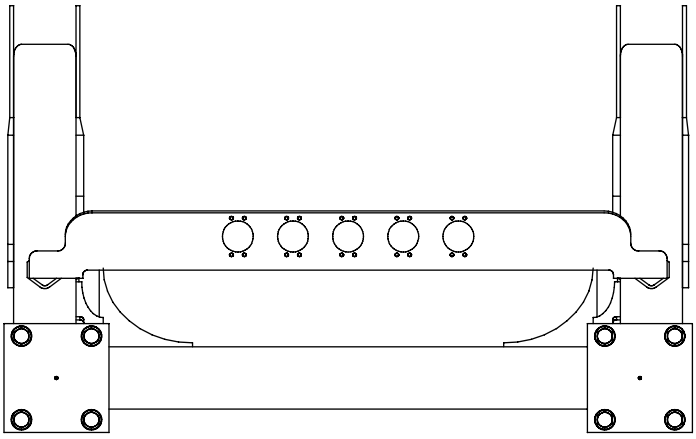
Water Pump Drive Coupling

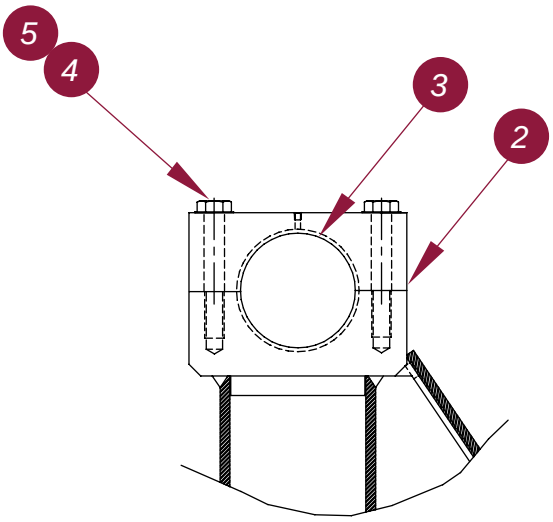
The chain drive coupling requires no maintenance, but should be checked regularly to ensure that the coupling halves are secure on the pump and motor drive shafts, also check that the chain itself is in good condition and has no excessive movement on the drive sprocket teeth.

Level and Flow Transducer

Refer to Section 8 for information.

Mast Pivot (cont.)

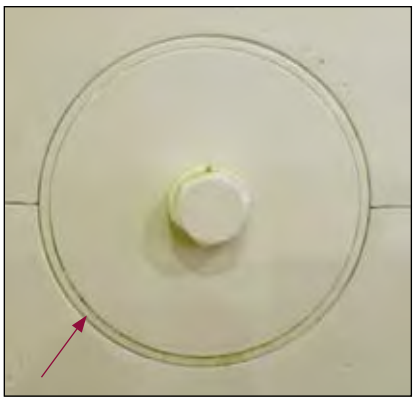




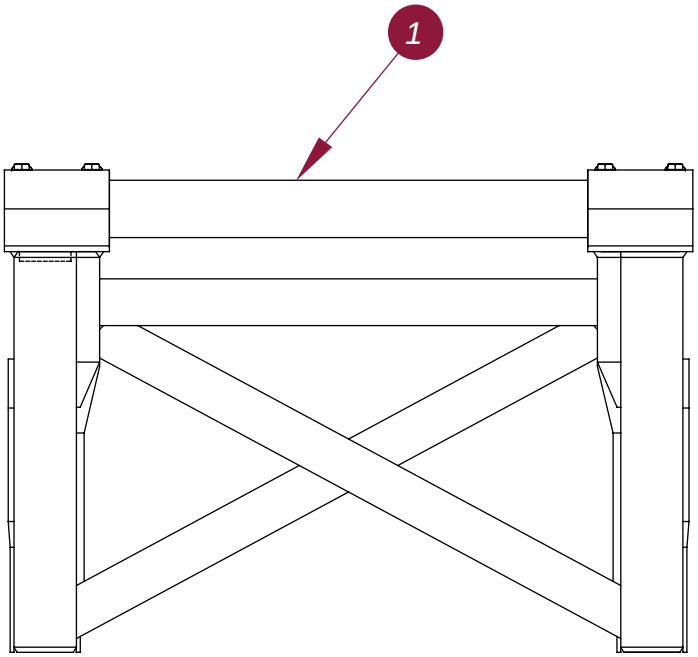
NOTE: Torque bolts x 8 A-frame cap bolts, 1368ft lb (1854.7Nm). Torque values are for lightly oiled bolts.

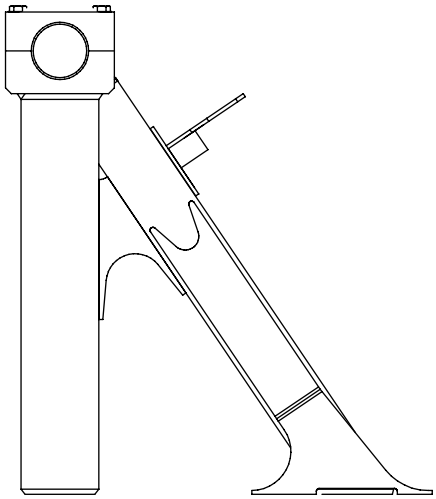
NOTE: Lubrication should be evident between the bush and the shaft.

CAUTION: Torque value must be altered if anti-seize or similar compound is used.



Grease should be evident between shaft and bush, more than bush and pivot caps





Pivot Mast A-frame

1. *Mast pivot shaft*
2. *A-frame caps*
3. *Mast pivot bush*
4. *A-frame cap bolts*
5. *Washer*

NOTE: All 16 bolts should be visually inspected as part of daily pre-start check. It is also imperative to check tension of each bolt at each service. If the bolts can be tightened when torque is being checked, the bolt is fatigued and MUST be replaced.

Replacement

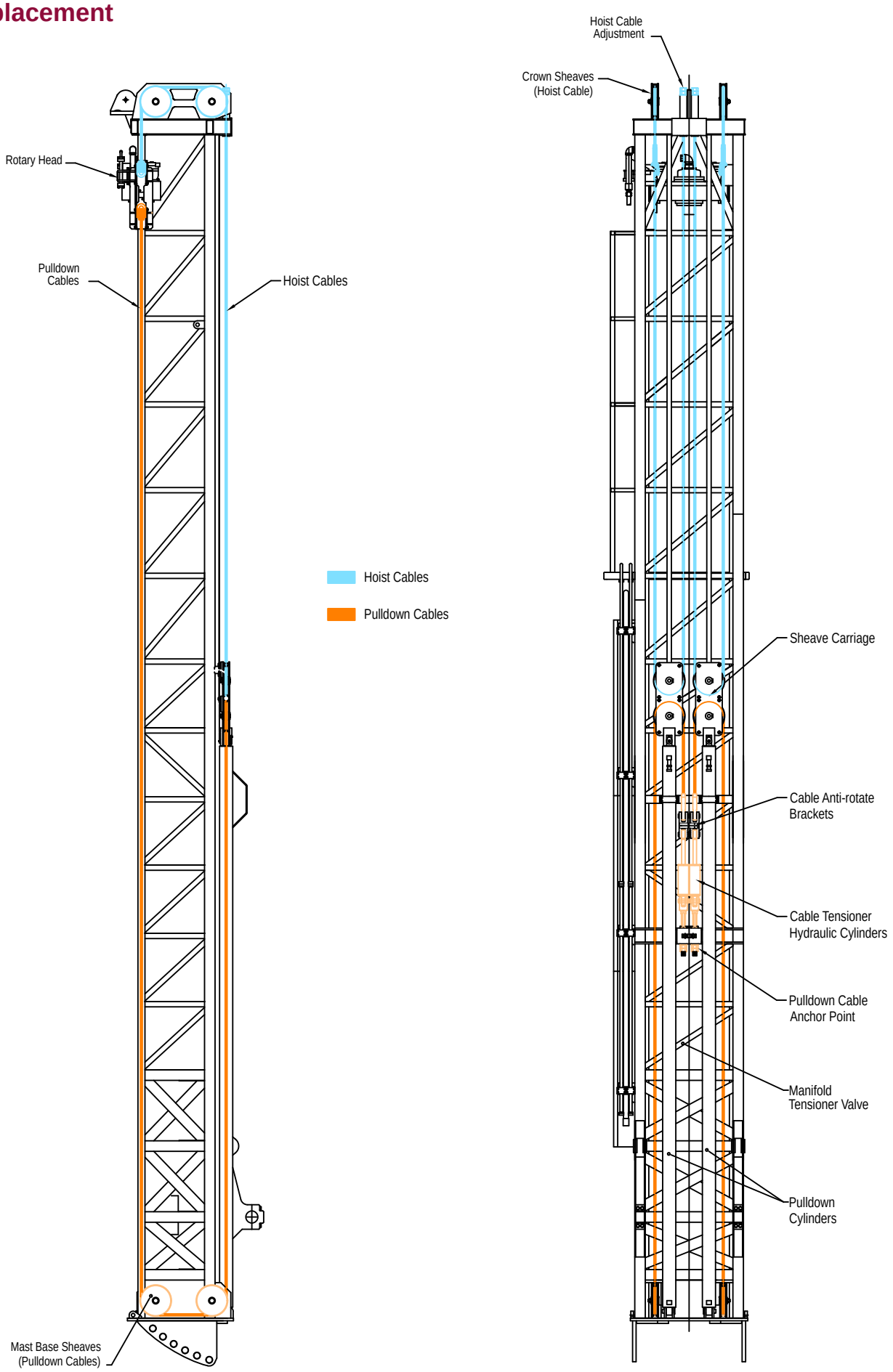


Fig. 6-11 Hoist/Pulldown Cables

Air Swivel

The rotary head uses a swivel seal assembly to seal the rotary gear case from the rock oil, water and air flowing down through the bull hose and bull shaft. The swivel seal assembly consists of two seals and a spacer that sits between them. When the seals fail, a mixture of air, water, and rock oil will be seen coming out the tell-tale hole in the top hat. The seals may need more crush, or replacing. Seal crush is achieved by placing or removing shims under the swivel adaptor plate. New seals require about 1mm (0.040”) crush (refer fig 6-16). It is extremely important that the correct amount of shim and therefore crush is placed on the swivel seals. Too much and the seals will fail, too little and seals will not seal.

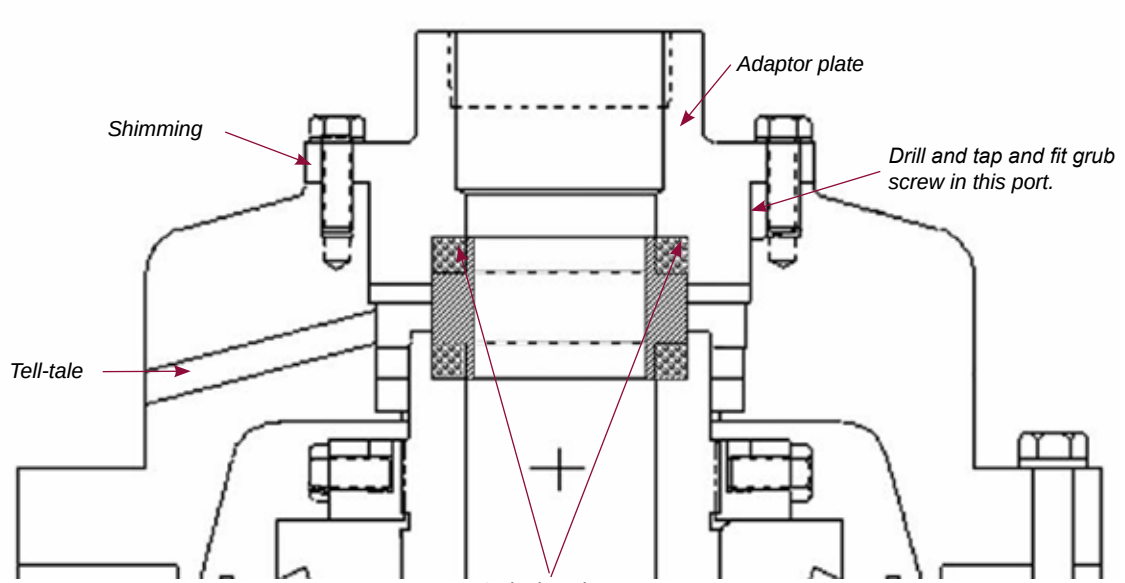
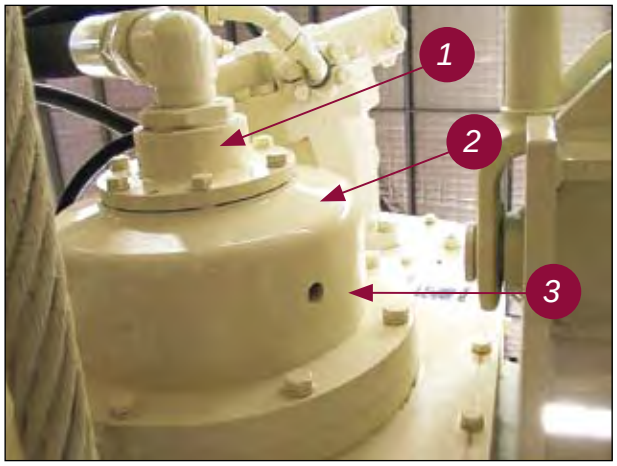


Fig 6-16 Air Swivel Seal Assembly



Rotary Head Air Swivel

1. *Shims placed under Swivel adaptor plate to achieve the correct 'crush' on swivel seals*
2. *Top hat (cover)*
3. *Tell-tale hole (if air is exhausting then swivel seals have failed or require re-shimming).*

Service

When replacing the swivel seals, ensure that all parts are thoroughly cleaned, pay particular attention to shim surfaces, seal housings and the spacer ring. Check the surface of the spacer ring for burrs, erosion and excessive grooving, discard and replace if damaged or severely worn. Lubricate seals and spacer ring liberally with clean grease before reassembly

Dual Brake System – Operation (cont.)

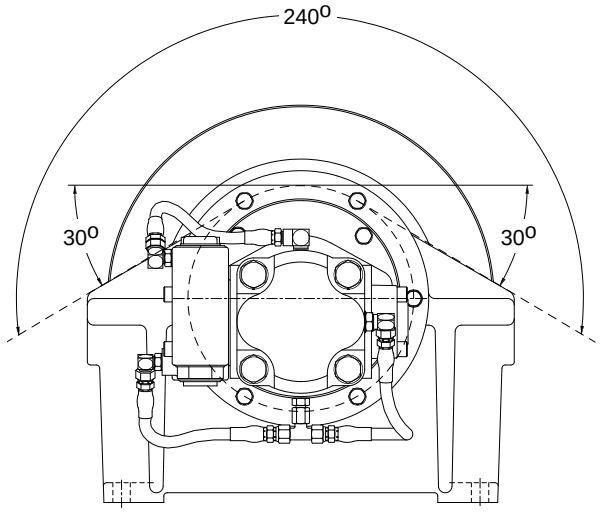
When the control valve is returned to neutral or 'hold', the pilot pressure will drop and the brake valve will close, stopping the load. The friction brake will engage and hold the load after the brake valve has closed.

When lowering a load very slowly for precise positioning, no oil flow actually occurs through the winch motor. The pressure will build up to a point where the friction brake will release sufficiently to allow the load to rotate the motor through its own internal leakage. This feature results in a very slow speed and extremely accurate positioning.

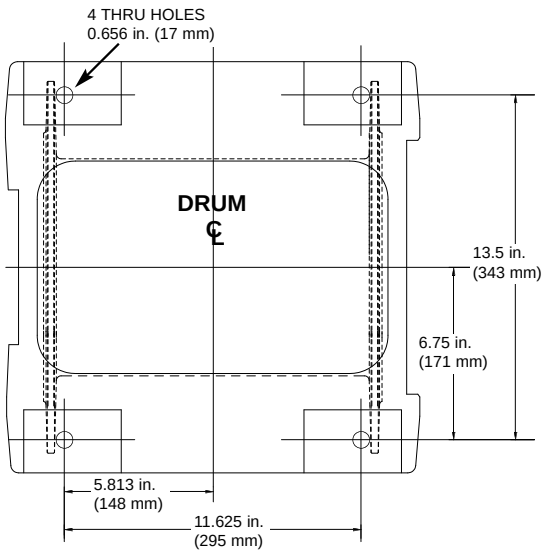
The friction brake receives very little wear in the lowering operation. All of the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be readily dissipated.

Winch Installation

1. The winch should be mounted with the centre line of the drum in a horizontal position. The mounting plane of the base may be rotated in any position around this centre line.



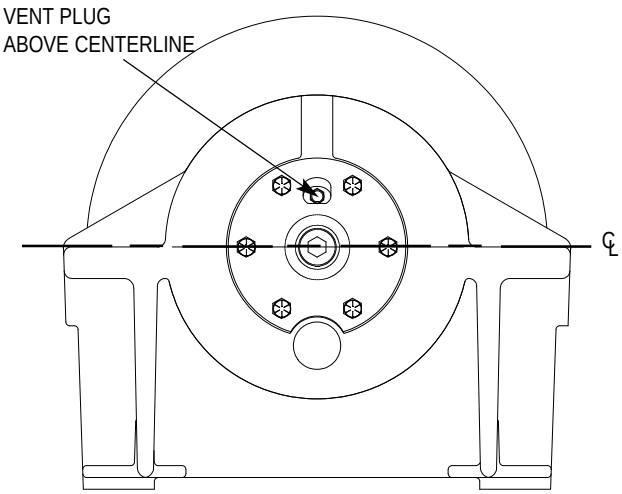
2. Because of the design of the mounting base, the direction of line pull should only be as shown in the above illustration.



   Line pulls in any other direction must be approved by Braden Engineering.

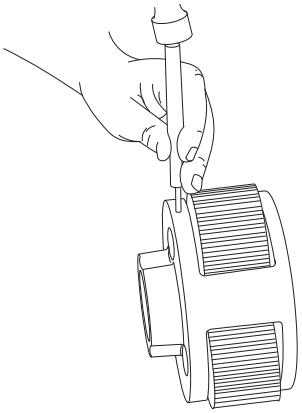
3. When mounting the winch, use all four (4) mounting holes and grade 5 (8.8) or better bolts and nuts. Tighten to recommended torque.

   It is important that the winch is mounted on a surface that will not flex when the winch is in use, and cause binding of the gear train. Binding in the gear train will result in accelerated wear and heat. Also, be sure the winch is mounted on a flat surface. If necessary, use shim stock to insure the mounting surface is flat within 0.5 mm (0.020").

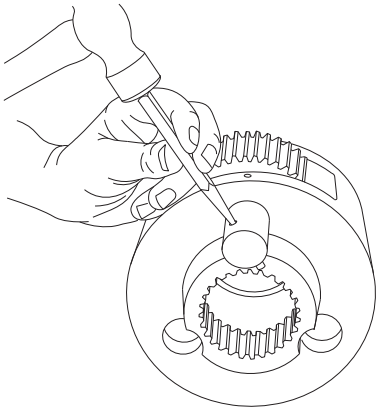


Planetary Carrier Service

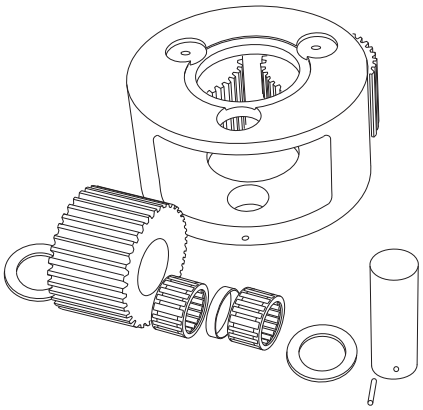
Output Planet Carrier Disassembly



1. Remove the planet gears by driving the roll pins into the centre of the planet shafts.

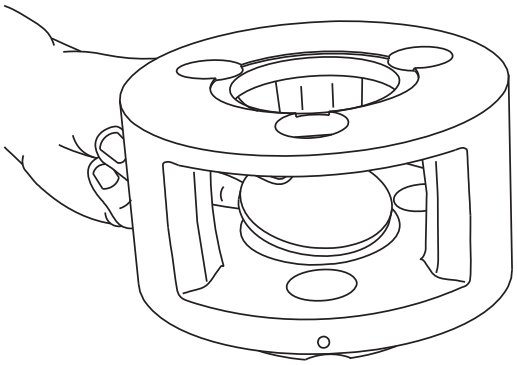


2. Use a punch to drive the roll pins from the planet shafts. Do not reuse the roll pins.

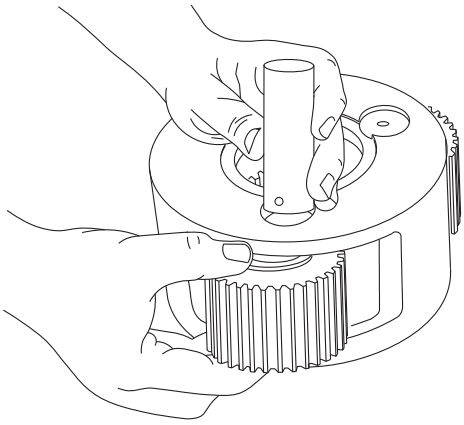


3. Now you can remove the planet shafts, bearings, spacer, thrust washers and gears. Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discolouration, material displacement or abnormal wear, the bearing should be replaced. Likewise, the cage should be inspected for unusual wear or deformation, particularly the cage bars. If there is any damage that will impair the cage's ability to separate, retain and guide the rollers properly, the bearing should be replaced. The thrust washer contact areas should be free from any surface irregularities that may cause abrasions or friction. The gears and shafts should be inspected for abnormal wear or pitting. Replace if necessary.

Output Planet Carrier Assembly



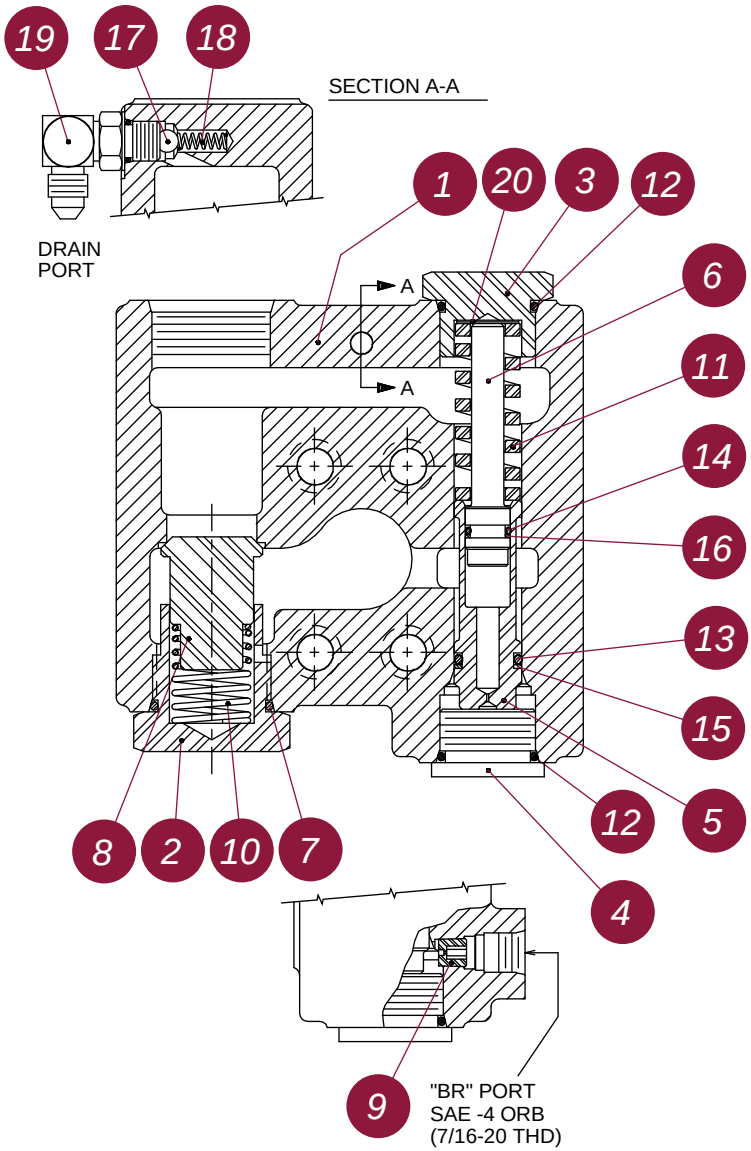
1. Place the output planet carrier on workbench with splined coupling side down. Install output thrust plate in centre of carrier.



2. Insert two (2) bearings and a bearing spacer into a gear with the spacer between the bearings. Place a thrust washer on each side of the gear and position in a carrier opening. Slide the shaft through the carrier, thrust washer, bearing gear subassembly and remaining thrust washer.

Brake Valve Service

1. *Valve housing (NSS)*
2. *Check valve retainer (NSS)*
3. *Spring retainer (NSS)*
4. *Plug (NSS)*
5. *Spool (NSS)*
6. *Damper piston (NSS)*
7. *O-ring*
8. *Check valve poppet (NSS)*
9. *Pilot orifice*
10. *Check valve spring*
11. *Spool spring*
12. *O-ring*
13. *O-ring*
14. *O-ring*
15. *Back-up ring*
16. *Back-up ring*
17. *Check ball (1/4")*
18. *Check ball spring*
19. *Elbow fitting*
20. *Shim*

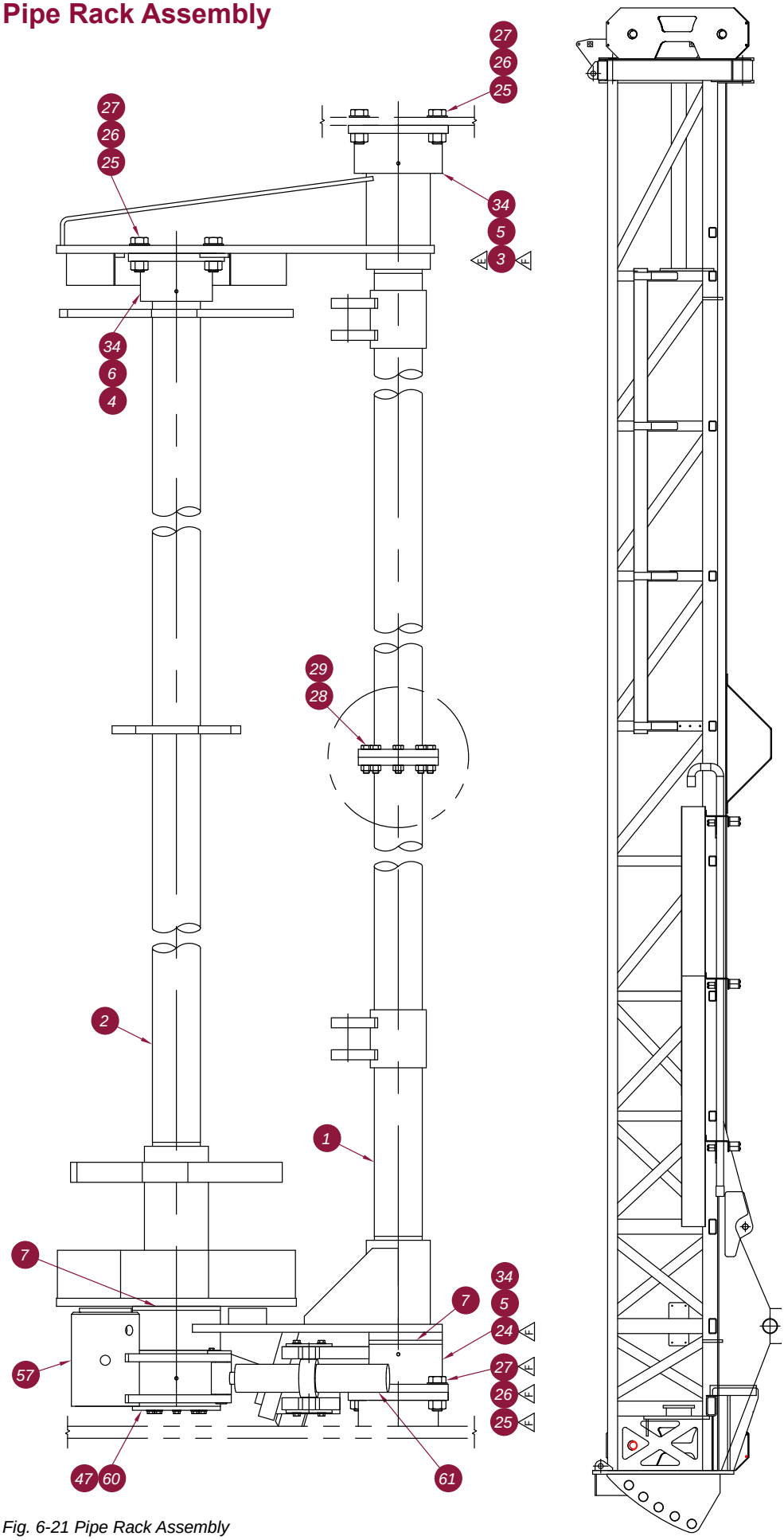


The Braden brake valve is a reliable hydraulic valve with internal components manufactured to close tolerances. Due to the close tolerances and mating of components, the valve housing, spool, piston and check poppet are not available as replacement parts.

Before disassembling the brake valve, be sure you have conducted all applicable troubleshooting operations and are certain the brake valve is causing the malfunction.

Thoroughly clean the outside surfaces of the valve and work in a clean dust free area, as cleanliness is of utmost importance when servicing hydraulic components.

Pipe Rack Assembly



1. Pipe rack support
2. Carousel mast
3. Bearing cap, support
4. Bearing cap, carousel
5. Bearing, journal
6. Bearing, journal
7. Thrust washer
24. Cap, bearing pipe rack, lower
25. Capscrew
26. Nut, hex
27. Washer, flat
28. Capscrew, hex
29. Nut, hex
34. Grease fitting
47. Shim kit
57. Index plate
60. End cap
61. Cylinder, index

Fig. 6-21 Pipe Rack Assembly

Section **7**

Hydraulic Systems

Return Hydraulic Filters

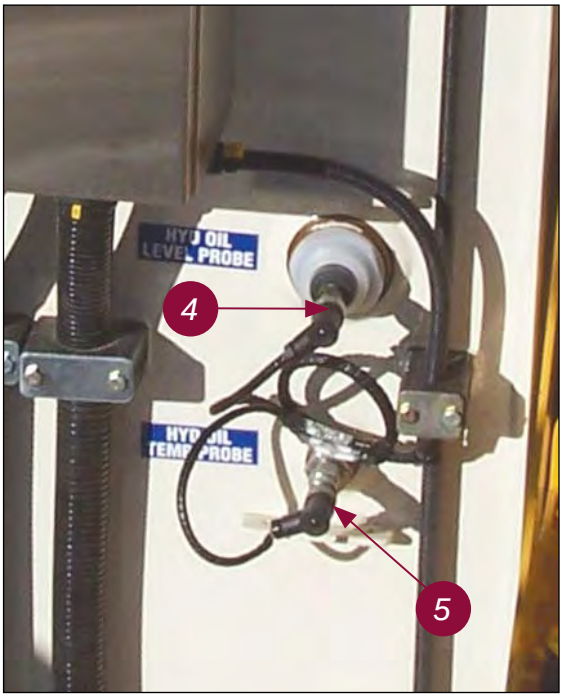
Oil returned to the hydraulic reservoir passes through three 10 micron filters. These filters are mounted on the hydraulic tank. Service indicators warn on the vigilante alarm screen if the filters become clogged.

The hydraulic tank has a level switch and a Temperature transducer located on the side of it

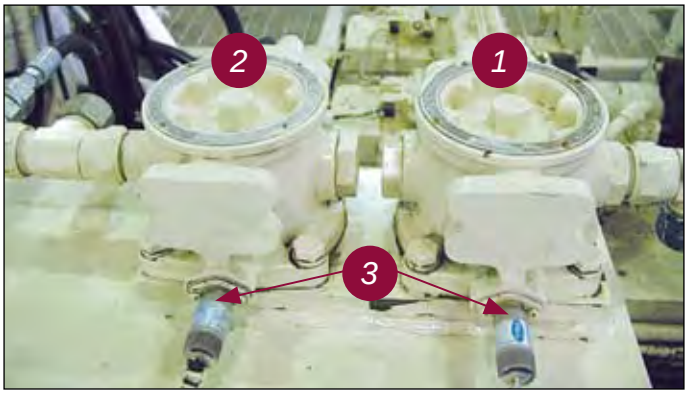
- **Hydraulic level switch** – When the oil level falls below this switch, an audible alarm will sound in the cab, (the rig will shut down after a 2 second delay, this is to allow for oil splashing away from the level switch) and the vigilante alarm screen will come up on the PLC, with the Hydraulic oil level alarm flagged (refer to Section 8 for more details).
- **Temperature transducer** – Supplies a 4-20mA signal to the PLC. When the oil temperature rises above 93ºC an audible alarm will sound in the cab, (the rig will shut down after a 20 second delay) and the vigilante alarm screen will come up on the PLC, with the Hydraulic oil temp alarm flagged. (refer to Section 8 for more details).

CAUTION: Only shut the isolation valves when the engine is stopped.

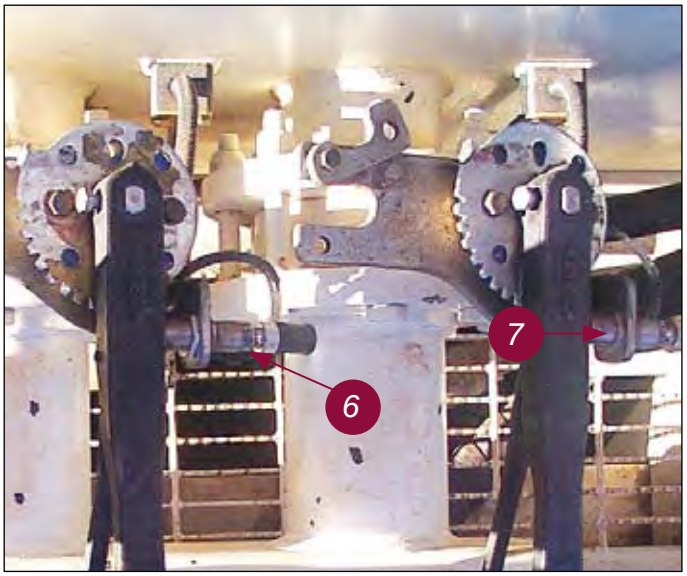
- **Proximity switch** – Tells the PLC that the valve is open allowing flow. When the valve is closed an audible alarm is sounded and the Vigilante alarm screen will show with the hydraulic valve isolated alarm flagged. The starter will not crank if the alarm is active.



Hydraulic Tank Level Switch and Transducer



Hydraulic Tank Return Filters



Hydraulic Tank Suction Isolators

1. *Main return filter*
2. *Case return filter*
3. *Differential pressure switches*
4. *Transducer*
5. *Level switch*
6. *Proximity switch*
7. *Hydraulic tank isolation valve*

Technical Data (cont.)

Start-Up Procedure

The following procedure has been developed based on experience with most types of applications, however certain applications may require a departure from or variation to this procedure.

For the start-up of new or overhauled installations.

1. If the prime mover is:

   Internal combustion engine: (Diesel, gasoline or LP)- Remove the coil wire, close the injector rack or leave the gas turned off and turn the engine over until the charge pressure reaches 50 psi or more.

   Electric Motor: Jog the starting circuit until the charge pressure reaches 50 psi or more.

2. Start the prime mover, and if possible, maintain a pump speed of approximately 750 rpm for 5 minutes. This will allow the system to be filled.

3. Listen for any abnormal noises.

4. Check for oil leaks.

5. Run prime mover to 1800 rpm. (Adjust to the design speed if less than 1800 rpm.)

6. Set charge and pilot pressure as required for the application. (Refer to circuit schematic)

7. For the HD control, bleed the pilot lines by loosening the connections at Y_1 and Y_2 and then actuate the remote control unit in both directions until oil seeps from the connections.

8. Retighten all connections.

9. Operate the control to work the hydrostatic transmission at approximately 20% of maximum speed.

10. Deaerate system by venting a bleed valve or by cracking the highest connection until fluid seeps out without bubbles.

11. Check fluid level and add fluid if necessary.

12. Continue operating transmission and gradually increase to full speed, still with no load.

13. With controls neutralized, check for creep in neutral. If evident, center the control in accordance with the instructions in the pump service manual.

14. Check that the controls are connected so that the transmission operates in the correct direction related to the control input.

15. Continue to monitor all pressure gauges and correct any irregularities.

16. Apply brakes and set high pressure relief valves (and pressure override if installed) to levels required for the application by stroking the pump to approximately 20% of maximum displacement.

17. Check security of high pressure connections.

18. Check oil level and temperature.

19. Remove and inspect high pressure filter elements, if so equipped. Replace with new elements.

20. Operate transmission under no load conditions for about 15 minutes to stabilize the temperature and remove any residual air from the fluid.

21. Again remove and inspect high pressure filter elements, if so equipped. If clean, the high pressure, bi-direction filters may be removed from the circuit. If contamination is still evident, fit new elements and continue flushing until the system is clean.

22. Replace the elements in the charge pump suction or pressure filter, whichever is installed.

23. Operate the transmission under full and normal load conditions.

24. Erratic operation may indicate there is still air trapped in the system. By working the pump control to one or both sides the remaining air can be eliminated. The system is free of air when all functions can be operated smoothly and when the oil in the reservoir is no longer aerated. (Usually less than 1 hour of operation).

Note:
If, after following the Pre-Start and Start-up procedures, the transmission does not perform correctly, refer to the relevant sections of the trouble-shooting procedures on pages 20–23.

Routine Maintenance

The AA4VG variable pumps are relatively maintenance free. Maintenance work is confined to the system, by way of oil changes and renewal of filter elements. Both of these measures promote system cleanliness. Monitoring and periodic maintenance of the system can prevent premature breakdowns and repairs. Under normal application conditions, the following maintenance intervals are suggested:

1. Renewal of Filter Elements

a. After commissioning.
b. At every 500 operating hours, or when filter indicator shows a dirty element.
c. With suction filtration, the filter element should be renewed as soon as a charge pump inlet pressure of less than -3.2 psi (0.8 bar absolute) becomes evident with the transmission in warm running condition (indicates contamination).
d. With charge flow filtration, watch for high pressure differential across the filter element (Refer to filter manufacturer's specifications).

Caution: Only filter elements capable of meeting or exceeding the fluid cleanliness level requirements (reference page 9) should be used.
Note: Paper inserts cannot be cleaned; use throwaway catridges (maintain a stock).

2. Hydraulic Oil Change

a. After 2000 operating hours (1st oil change).
b. Thereafter every 2000 operating hours or annually irrespective of operating hours achieved.

The oil change should be carried out with the system in warm running condition. Before re-filling, the reservoir should be cleaned to remove any sludge.

Caution: Rags or other threading material must not be used.

Note: The recommended interval between oil changes is based on various factors and should be carried out according to the type of fluid, the degree of aging and contamination of the fluid. The water content is also a contributory factor.

Under application conditions with a heavy occurrence of dust or severe temperature fluctuations the intervals between oil changes should be shortened accordingly.

Caution: Practical experience shows that most maintenance errors occur during an oil change due to:

a. Use of an unsuitable hydraulic oil.
b. Use of oil contaminated due to faulty storage.
c. Failure to clean reservoir.
d. Inadequate cleanliness when filling (dirty drums or containers).

3. Leakage Inspection

a. After commissioning.
b. The complete transmission (pump, motor and all pipelines, filters, valves, etc.) should be checked for leakage at regular intervals.

Caution: Leaking joints and connections must only be tighened in pressure less conditions

4. Cleanliness Inspection

The oil tank breather should be regularly cleaned of dirt and dust to prevent clogging. The cooling surfaces should be cleaned at the same time.

Caution: If hose couplings are used in the high pressure lines, it is imperative that the utmost care be taken that no foreign bodies infiltrate the oil circuit when coupling and uncoupling (danger of damage to rotary group, and even possibility of total breakdown).

5. Oil level Inspection

Inspect oil level in reservoir after commissioning, thereafter daily.

Caution: Top up only with specified oil type. Do not mix fluids.

Hydraulic Fluid

Most good quality, mineral oil based, hydraulic fluids exhibiting the following characteristics are suitable for use in a Rexroth hydrostatic transmission.

Good antiwear performance
Resistant to oxidation depredation
Protection against rust and corrosion
Resistance to foaming
Ability to separate water rapidly
Suitable for widely varying temperature conditions
good low temperature flow properties
Retains viscosity-temperature characteristics in service
Universally available

The prime consideration in the selection of hydraulic fluid is the expected oil temperature extremes that will be experienced in service. The extremes should be considered when selecting a fluid, so that the most suitable temperature-viscosity characteristics are obtained.

The fluid chosen should permit the system to operate within the following viscosity ranges.

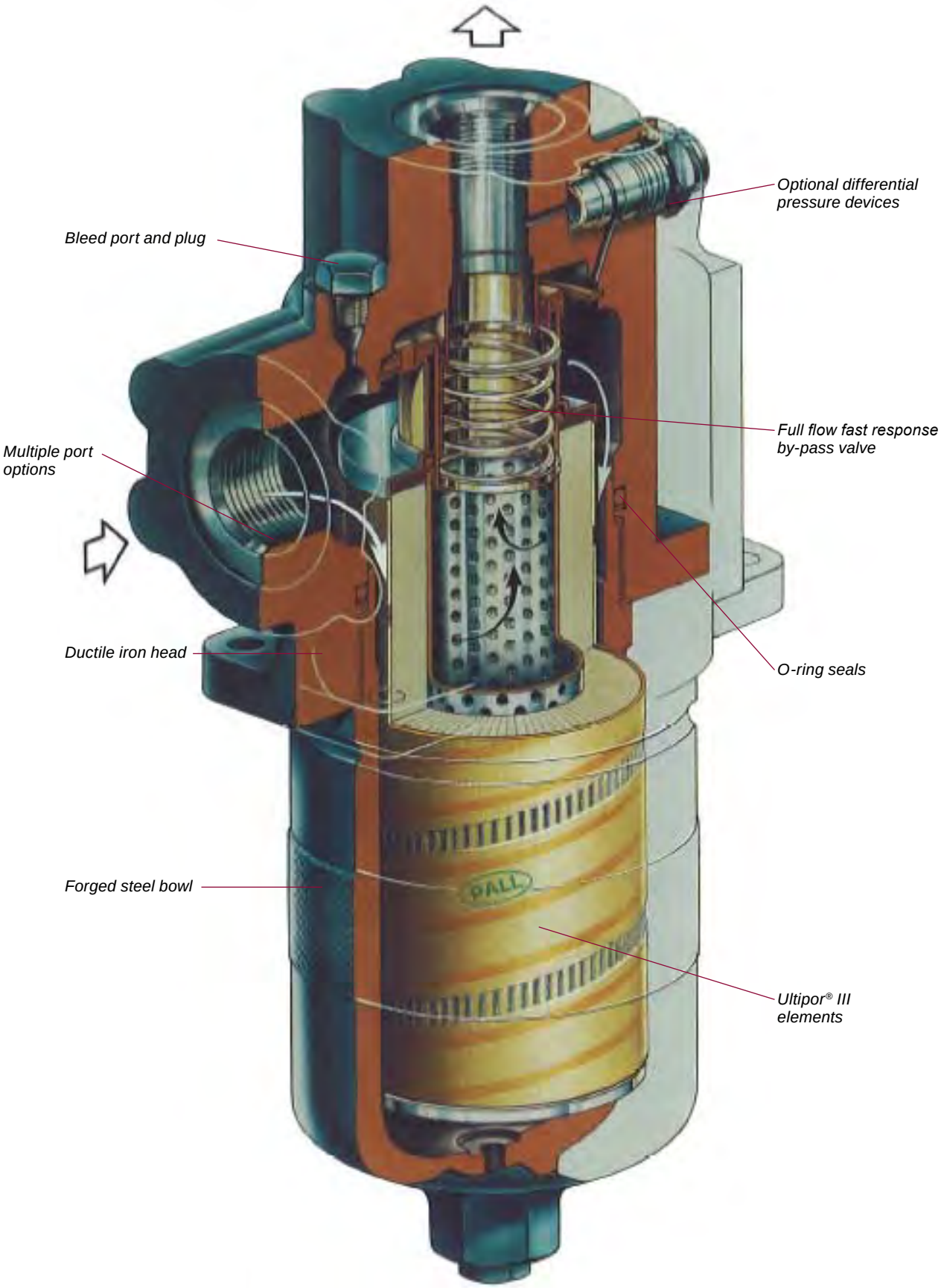
Maximum viscosity at start-up . . . . . 4600 SUS (1000 cSt)
Normal operating viscosity range . . . . 66–464 SUS (12–100 cSt)
Optimum viscosity range . . . . . 81–141 SUS (16–30 cSt)
Absolute minimum viscosity . . . . . 60 SUS (10 c St)

When the fluid viscosity is greater than 1000 SUS (216 c St) the transmission should be operated at reduced speed until the oil has been warmed to a temperature of 40°F (4.5°C).

For applications that will operate near the extremes of viscosity and/or temperature, the fluid manufacturer should be consulted for assistance in selection of the most suitable type and grade of fluid for your application.

Rexroth strongly recommends the selection and use of fluids from reputable and established suppliers.

Loop Filter Cross Section

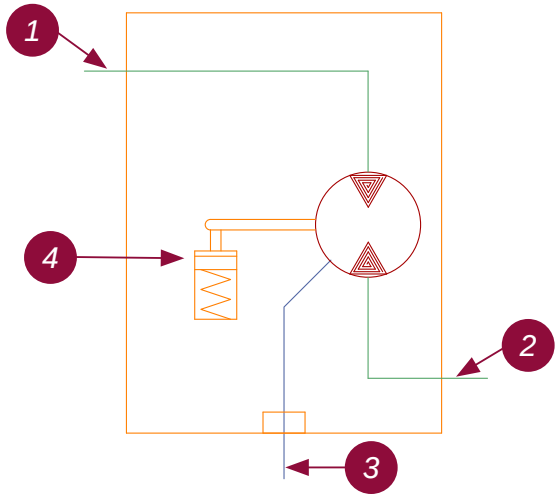


Tram Circuit

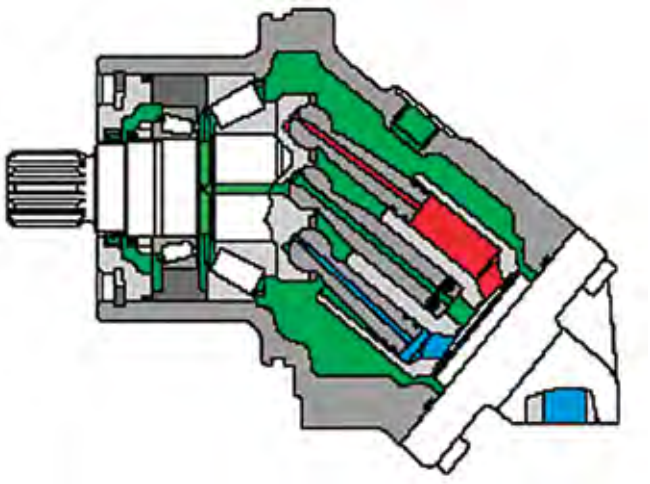
The tram circuits are closed loop circuits. The right hand tram pump is dedicated to the right hand track and the left hand tram / rotation pump powers the left hand track via a diverter valve. Each final drive has a integral brake pack which is spring applied and pressure released. The pilot pressure to release the brake is from the drill / tram select solenoid valve (V08) when the tram mode is selected (solenoid de-energised). This pilot pressure is supplied to (V08) from the drill / tram interlock solenoid (V07) which will only provide pilot pressure to (V08) when it is energised. The drill /tram interlock solenoid (V07) is energised in the tram mode when:

1. The pipe is out of the hole
2. All pipes are racked
3. The stairs are raised
4. The jacks are up

Pilot pressure is discharged from port 3 of (V08) and out through port P3 of the control manifold and on to the tram pilot valves and the brake release ports on the final drives. The Tram control valves provide controlled pilot pressure to either the Y1 or Y2 ports on each pump. This controls the stroke of the pump which governs the tram speed.

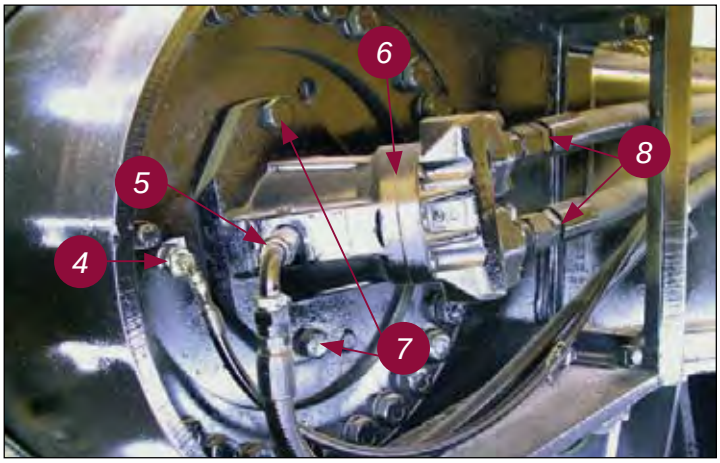


Final Drive Assembly



Tram Motor

1. *A port*
2. *B port*
3. *Case drain port*
4. *Brake release port*
5. *Case drain port*
6. *Final drive motor*
7. *Motor mounting bolts*
8. *A and B ports (forward and reverse)*



Brake Assembly

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

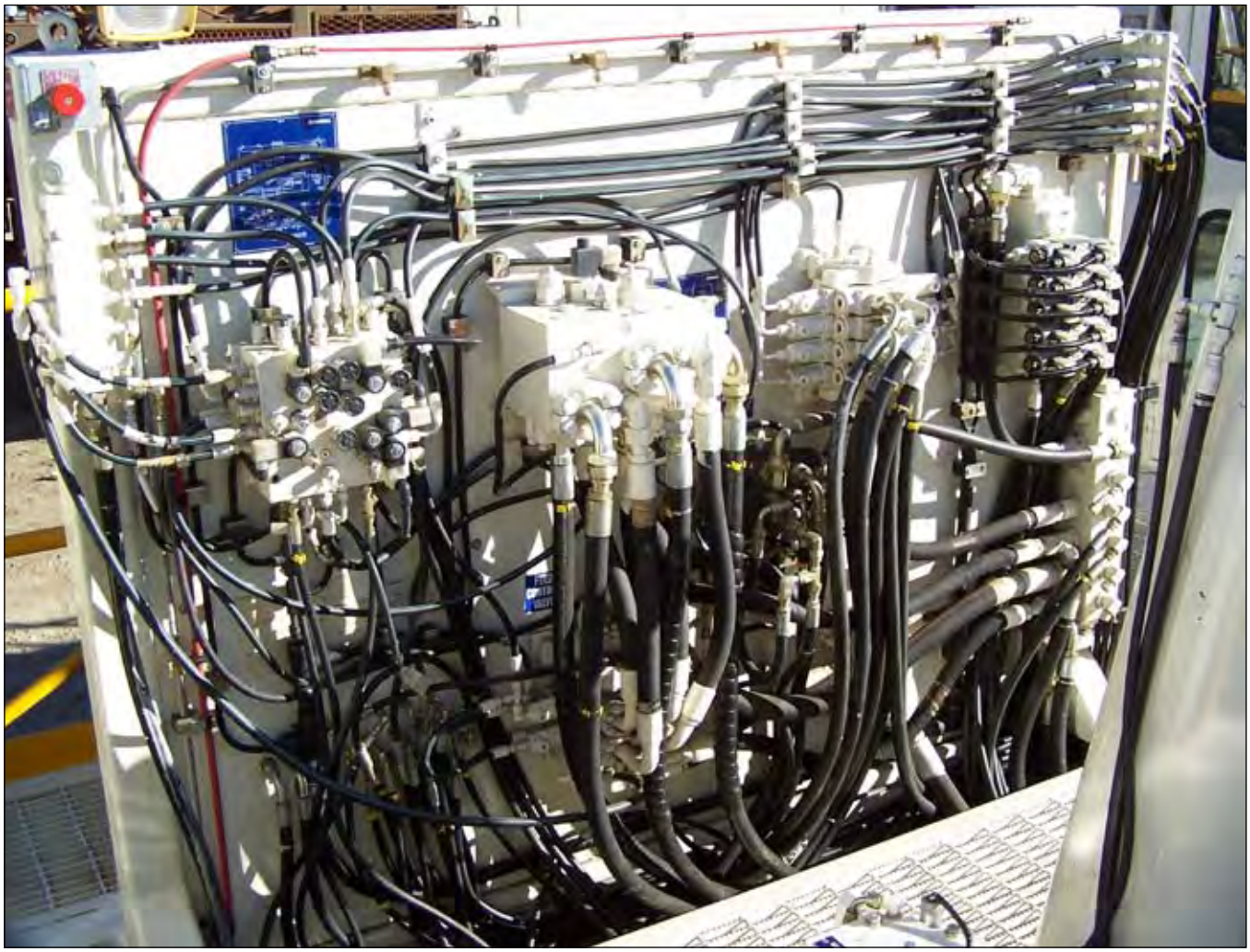
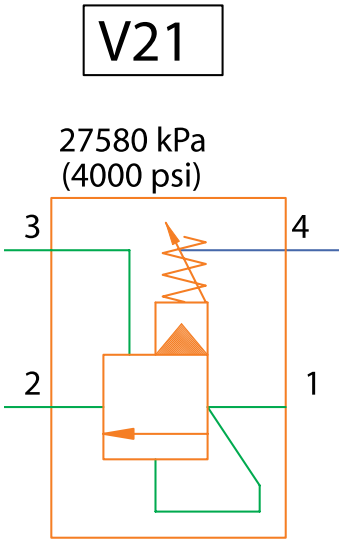


Fig. 7-16 Valve Stand Assembly



Maximum Rotation Pressure Relief

This pilot operated vented relief is set to the highest rotation pressure required to provide enough rotation torque to turn the drill bit during the drilling process. Usually set at **4000psi (275.8bar)**, this provides **80%** of pump pressure in the forward direction only, so reverse rotation pressure **(5000psi (344.7bar)** is capable of breaking out pipe joints.

Venting **Port 3** through the rotation torque control relief in the cab can remotely lower this setting. When the relief setting is reached, pressure from **Mb** on the **LH tram/rotation pump** is directed to **X3** on the servo of the **LH tram/rotation pump,** which then de-strokes the pump.

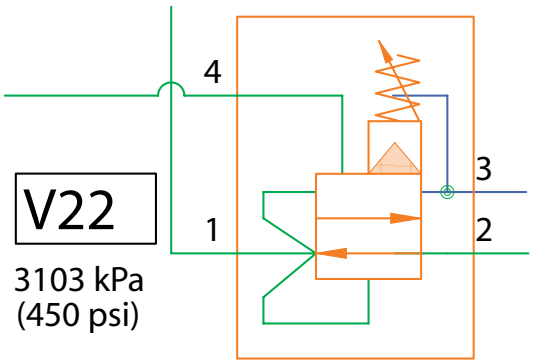
Set by engaging deck wrench on pipe flats and forward rotate. Increase remote rotation pressure control to maximum. Set V21 to show 4000psi (275.8bar) on rotation pressure gauge

Surge Protection Pressure Reducing/Relieving Valve

This valve prevents over pressure of the servo when V21 valve pressure is reached. Setting is equal to charge pressure – (450psi (31bar)), so this prevents pressure at X3 on the LH tram/rotation pump from surging higher than charge pressure, which would reverse the rotation. Flow is from Port 2 to Port 1 but is set using the relieving feature, which is from Port 1 to Port 2.

To set – fit pressure gauge to TP4. Jack the machine until the tracks are off the ground. Enable tram lockout override on vigilante touch screen and tram the LH track at full speed (engine also at full rpm) in which ever direction shows pressure at TP4.

Reduce setting until pressure begins to drop, then increase until the gauge stops rising and then increase setting by 30º. The pressure gauge should read charge pressure (450psi). If not there may be a fault with V14 or V22 cartridge or the pump is not be reaching full stroke.

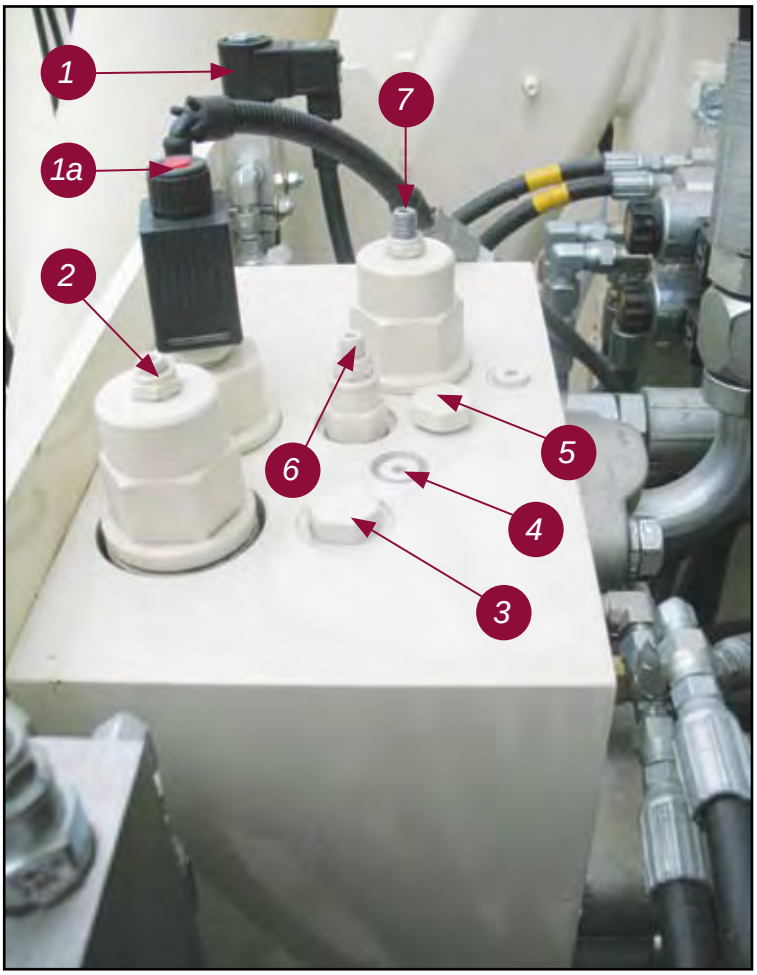


Technical Data (cont.)

Feed Control Valve

- This manifold contains rotary head counterbalance valve, regeneration for fast down, and hold-back for hammer drilling.
- (Valve 'A') Rotary head counterbalance valve.

Normal operation the valve opens from a pilot signal from the pulldown pressure. This signal is dampened by the (0.016”) orifice. This orifice allows a pressure increase in the pulldown in order for the counterbalance Valve to meter down. Please note that the tension on the counterbalance valve effects the amount of pulldown pressure required.

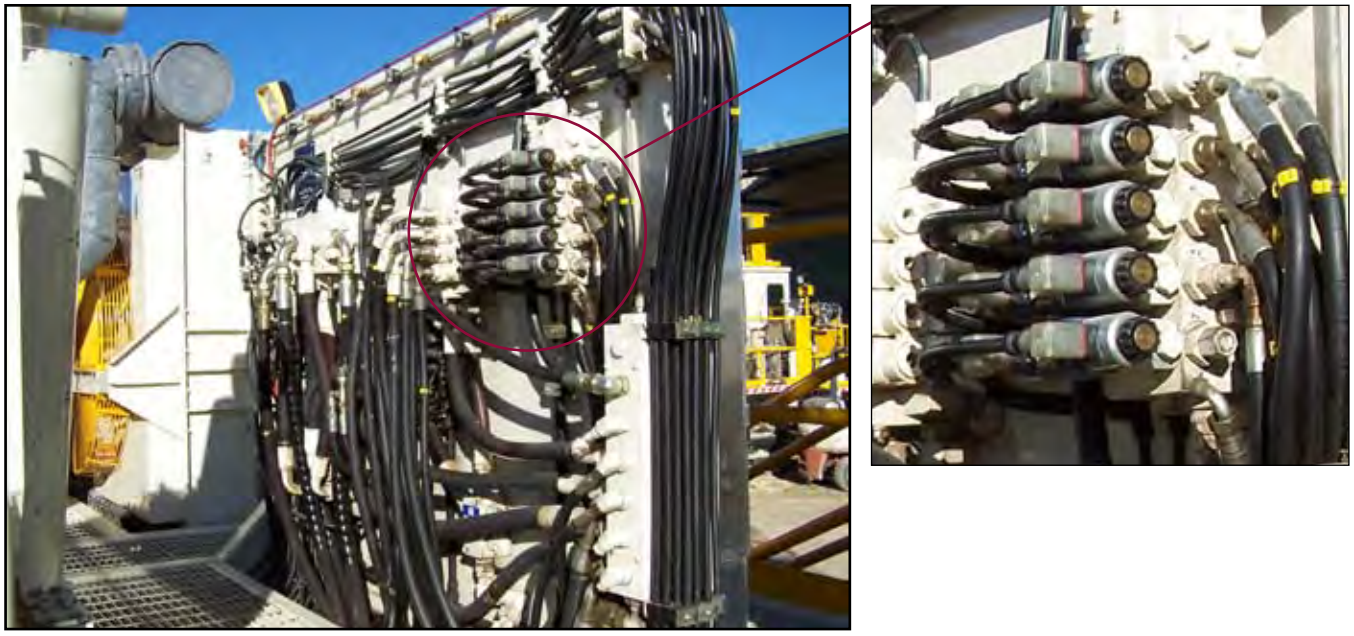


Feed Control Valve

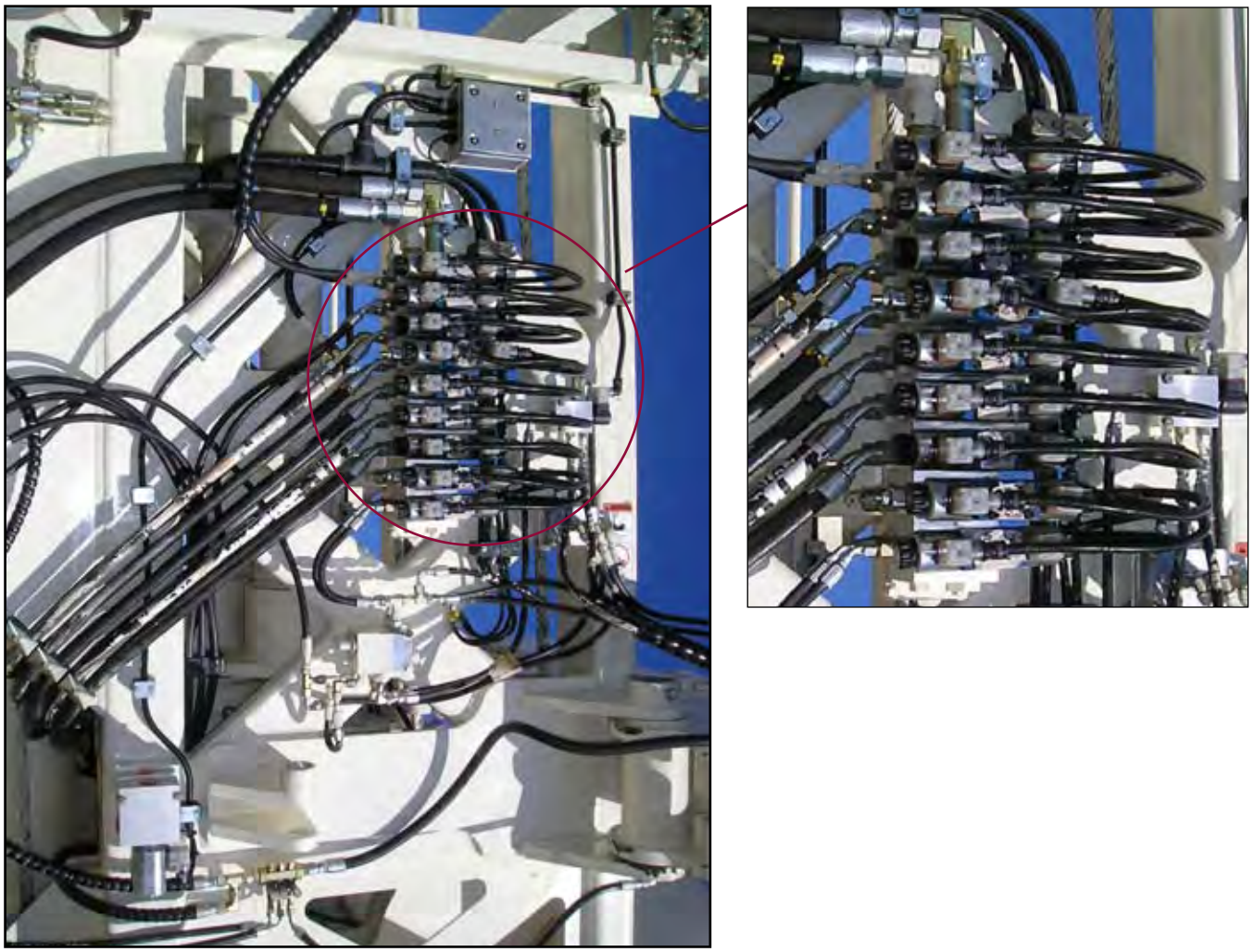
1. *Regeneration valve 'E' (NC) cartridge 'E1' (NC)*
1a. *Regeneration valve 'D' (NC) cartridge 'D1' (NO)*
2. *Counterbalance valve 'A'*
3. *Plug*
4. *Orifice .016”*
5. *Plug*
6. *Hoist control valve 'F'*
7. *Excess flow by-pass valve 'G'*

Auxiliary Valves

The 4WE6 Series 6X valves are used in two places on the SKSS machine.



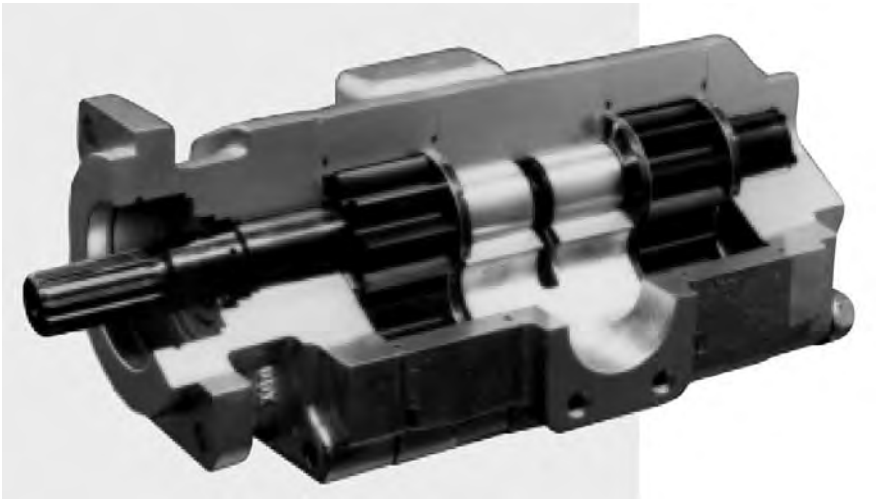
A six bank valve assembly for auxiliary functions, mounted on the valve stand.



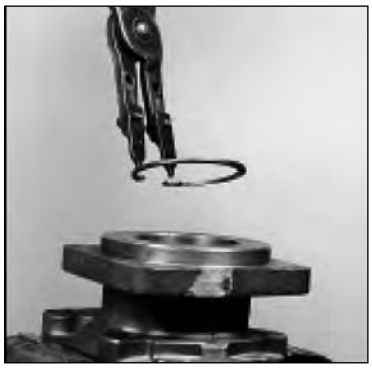
A nine bank valve assembly for pipe handling functions, mounted on the side of the mast.

Hydraulic Gear Pumps – Shaft Seal Removal and Replacement

PGP/PGM 300Series



Remove Shaft Seal



If the pump is equipped with an outboard bearing, place the shaft end cover in the vice with the mounting face up. Remove the snap ring with snap ring pliers. If a unit is equipped with a spiral-lock retaining ring, remove with a small screwdriver.

Use a bearing puller to remove the outboard bearing

Grip the shaft end in a vice with the mounting face down. Remove double lip seal by inserting the special seal removal tool into the notch between the double lip seal and the shaft end cover. Tap the seal out and discard. Remove and discard all rubber and polymer seals

Water Injection

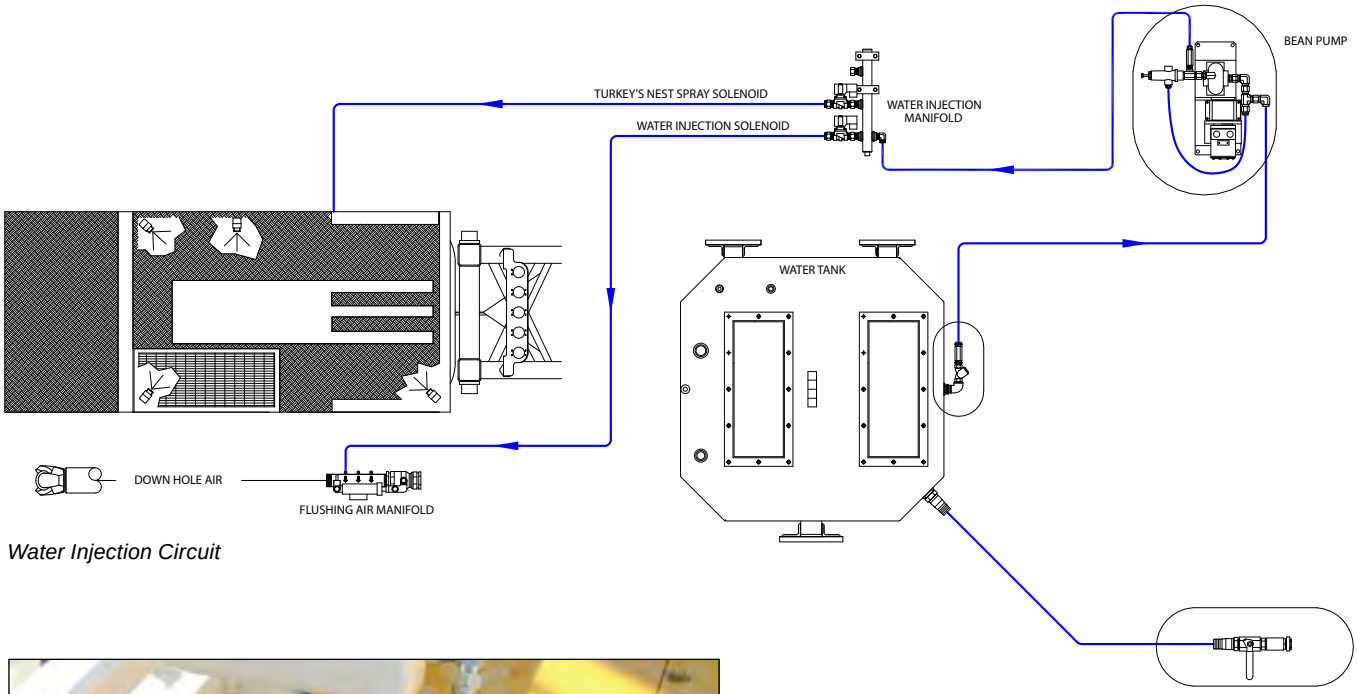
Water Injection Valve

Water Controller – controls hydraulic flow to water injection pump

Water injection volume is operated with the controller in the operators cab.

The water injection pump delivers water to the water injection solenoid which is switched on by the operator. The PLC will not switch the solenoid on until the bit air (20psi minimum) is turned on.

Water flow to the drill string is measured via a flow meter which is situated in the transducer cabinet. Water flow can be monitored on the Vigilante Gauge Screen 1, and is measured in litres/min.



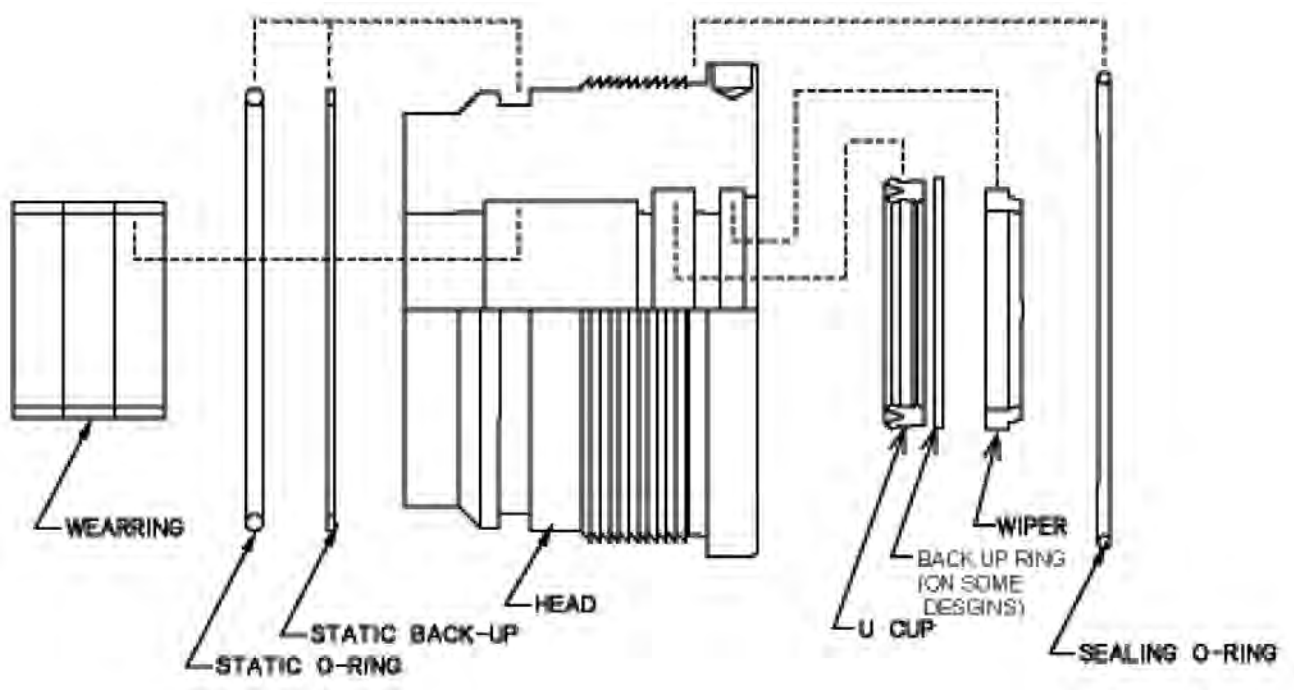
Water Injection Circuit

Water Injection / Auxiliary Functions Pump

Z Head

General

The Z series head uses ductile iron material and has a polyurethane U-cup as the primary sealing element. Cylinders rated for pressures above 3500psi (241.3bar), may have a back up ring behind the U-cup. The wiper is a standard type D polyurethane. The head is retained within the tube by means of its own buttress threads. There is a sealing O-ring that prevents contaminant from reaching the threads and provides an anti-rotation function. General procedures for teardown, inspection and rebuild are contained in the General Procedures Maintenance Manual. Contact Bucyrus if you have any questions.



Teardown

Remove the head as follows: Insert a spanner wrench into the holes provided. Turn the head counter clockwise (it is a right hand thread) to remove it. If the head is difficult to remove or moves erratically, tap the tube adjacent to the head with a brass or plastic mallet while turning it.

Rebuild

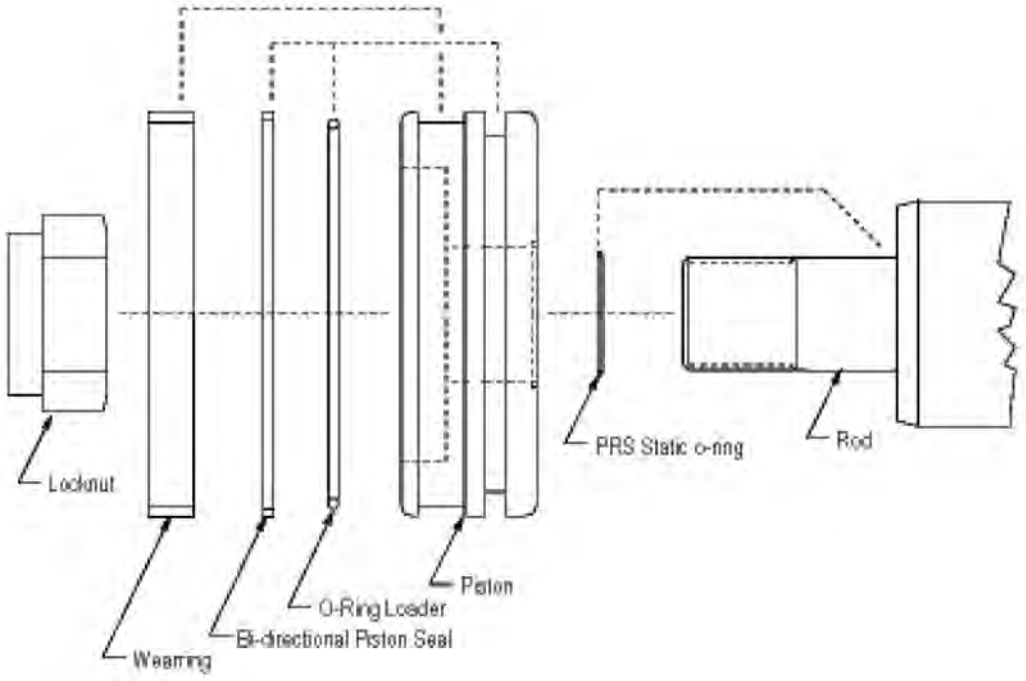
Lubricate the head and all seals with hydraulic fluid prior to installation. Using round nose pliers or special installation tools, twist the dual lip U-cup seal into a 'C' shape and allow it to snap into groove. Use a similar technique for installing the wiper. Install the static O-ring and backup into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

Slide the head into the tube and engage the threads. Turn the head counter clockwise until the first thread just passes the engagement point (the head will move noticeably) then turn the head 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.

N Piston

General

The N series piston uses aluminium material and has both an O-ring energised bidirectional seal and a close tolerance wearing. Cylinders designed for use a pressures above 3500psi may have a back-up ring on one or both sides of the bidirectional seal. See the engineering drawing to determine if your cylinder has this ring and which side of the seal it is located. A small O-ring is used to seal the static side. On some designs it is installed in a groove in the rod, for others, it fits in a groove on the edge of the piston in contact with the rod. General procedures for teardown, inspection and rebuild are contained in the General Procedures Maintenance Manual. Contact Bucyrus if you have any questions.



Teardown

After removing the piston, remove and discard the PRS static O-ring from the threaded portion of the rod. Remove the bidirectional piston 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. Remove the wear ring by spreading the ring into a 'C' shape at the split.

Rebuild

Lubricate the piston and all components with hydraulic fluid. Stretch the O-ring loader into the seal groove. Be extremely careful to avoid damaging the seal groove during installation. Scratching the groove may cause bypass leakage. Verify that the rubber O-ring is not pinched or twisted. Start one edge of the bidirectional piston seal into the seal groove. Use your thumb to push the remaining portion of the diameter over the edge of the piston and into the groove. Be very careful not to cut the OD of this seal. Spread the wear ring into a 'C' shape only enough to fit over the outside of the piston and snap it onto its groove.

Jump Starting (cont.)

Precautions

1. DO NOT smoke or use open flame near batteries.
2. DO NOT jump start if the battery fluid is frozen or slushy as the battery may explode. The battery should be warmed to at least 4.4°C (40°F) before attempting a jump start.
3. Jump start only with an external power source, having an electrical system of the same voltage, ground polarity and equipped with battery or batteries of comparable size or larger.
4. DO NOT jump start using motor generator sets, welders or other sources of DC power.
5. DO NOT jump start 24V electrical systems with two 12V batteries connected in series. The current drain will be too high on the 12V batteries possibly causing an explosion.
6. DO NOT permit metal-to-metal contact between the machine and starting vehicle and do not allow jumper cable terminal clips to contact either vehicle as arcing may result in fire or explosion.
7. Use only jumper cables that are clean, in good condition, and are heavy enough to handle the starting current.

Procedure:

1. Turn ignition switch OFF. Turn all accessories OFF.
2. Connect jumper cable to isolator box jump start receptacle on drill. Connect other end of jumper cable to jump start receptacle on source machine.
3. Stand as far away as possible from batteries before actual starting.
4. Charge batteries. The engine will not continue to run after starting if the batteries have not been charged.
5. Start engine. As soon as engine starts, remove jumper cables in reverse order of installation.

1. *Jump start receptacle*

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/touchscreen. For the touchscreen 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.

Safety Instructions and Precautions

Don’t stare into the laser beam. A prolonged period greater than 0.25ms (normal eye blink speed) can be harmful. Never point the laser beam intentionally at another person.

A warning label indicating the presence of a class 2 laser should be used and placed in a readily visible spot. The Laser is rated at IP65 and should be protected from direct water blast when washing the machine. A heat shade is recommended when operating environment exceeds 50°C.

Calibration

- Measure the full length of head travel.
- Enter the password protected Calibration area 1295 for a full calibration set up or 1057 for a partial calibration setup (as for tightening ropes) on the touchscreen.
- Type in the value on the keypad in millimetres.
- Set head right up position. Press touchscreen button to accept value.
- Set head right down position. Press touchscreen button to accept value.
- Set head halfway down (midpoint of the rods that are in the rod rack). Press touchscreen button to accept value.
- Attached bit onto head and move head to position where deck wrench can be engaged and then set deck wrench position. Press touchscreen button to accept value.
- Break bit off head and move head to position where pipe rack can be swung under head and set head clear position. Press touchscreen button to accept value.
- With first pipe and bit attached to head. Lower steel approx. 100mm below where deck wrench can be engaged and set pipe-in-hole position. Press touchscreen button to accept value.
- Move the head to a position that allows the Pipe Positioner, Centre guide, H.O.B.O enough time to move out of the way with the head coming down and set the 'Kick-out' set point if fitted. Press touchscreen button to accept value.
- Move the head up and set the 'Head up speed slow down' set point so the head will slow down before the hydraulic cylinder 'bottoms out.' Press touchscreen button to accept value.
- Record the new set-point values and forward them to Bucyrus for file updating.

Disclaimers

General

This is a generic guide in content and should not be used as a site specific manual. It is prepared to assist in the understanding of the fundamental operation of a Drill PLC System only and does not cover the operation and maintenance of the drill itself, which is contained in the Bucyrus Operation and Maintenance Manuals.

It is assumed that personnel using this guide are:

1. Trained and competent to carry out the work being performed.
2. Has completed the required approved Risk Assessments and deemed safe to perform the associated work.
3. Is familiar with the operation of the drill.
4. Has read and understood the relevant operation and maintenance manuals provided with the drill.

No Warranty is given that the information contained herein is free from error or omissions.

Accordingly, CAED Pty Ltd and/or Bucyrus disclaim liability for any act done or omission made in reliance on the information in the Guide and any consequences of any such act or omission.

Override Features

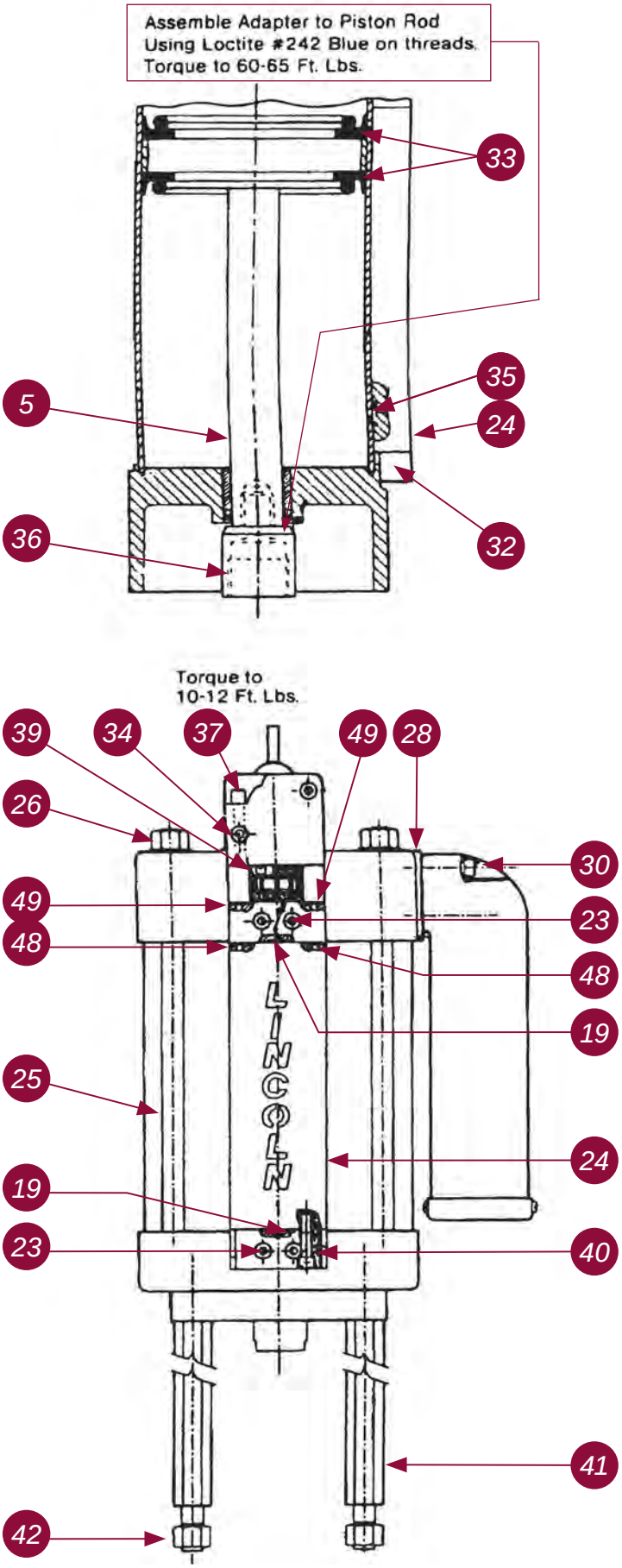
All 'override' operations and buttons are operated with the full understanding and acceptance of the system or operation to be overridden. Overriding any system has the potential for component or machine damage, this procedure must be done only after fault evaluation and with due care.

Further Information

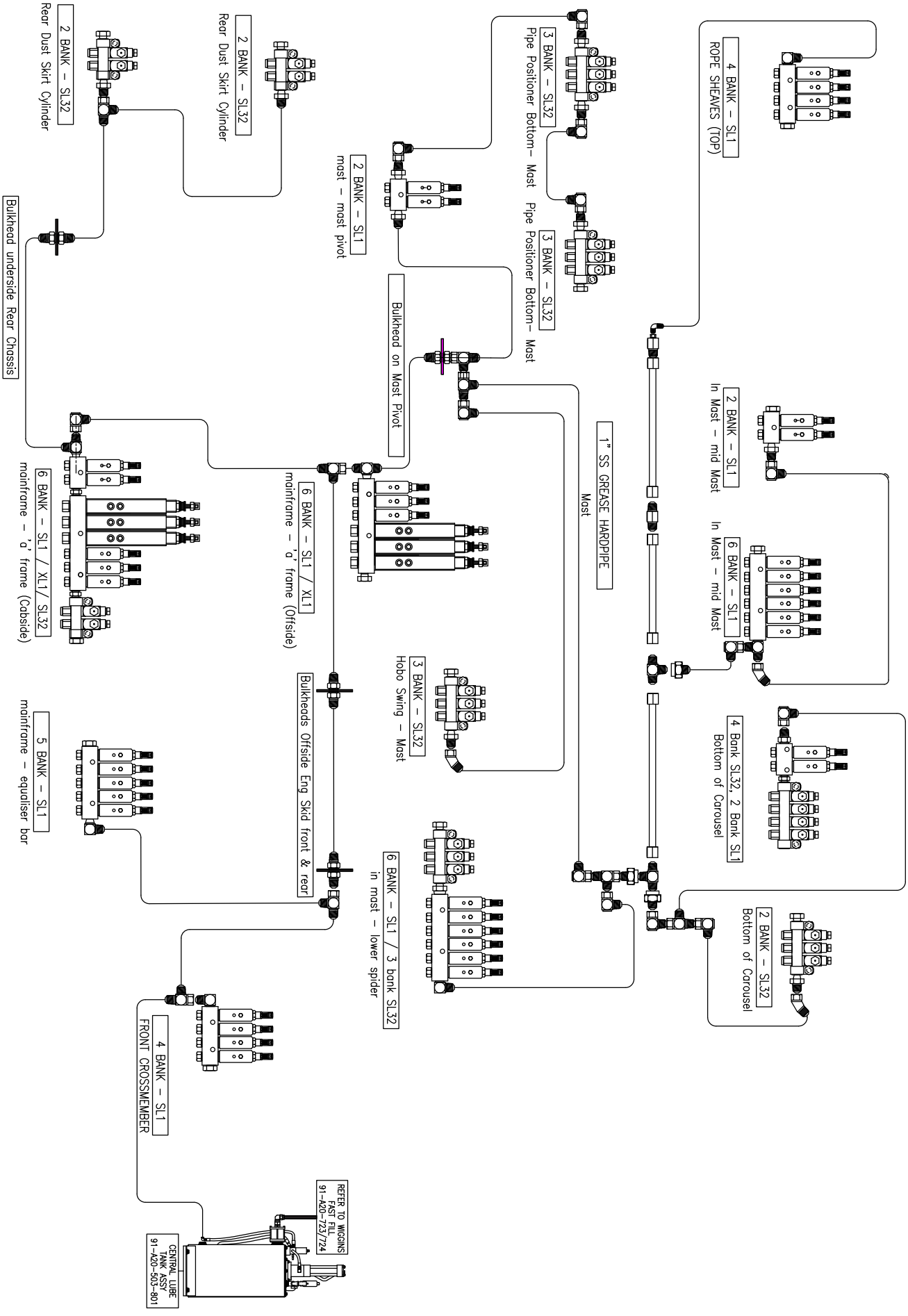
Vendor documents have been included to provide further information on device specific components used. Refer to the Bucyrus Operator and Maintenance Manual for complete and detailed as built machine operation and standards.

Auto Lube Grease Pump – Owner / Operator Manual (cont.)

1. *'U' cup (Buna-N)*
2. *Rod bearing*
3. *Seal, cylinder (Buna-N)*
4. *O-ring (Buna-N)*
5. *Piston rod assembly*
6. *Cylinder tube*
7. *Air tube*
8. *Upper casting*
9. *Bumper, valve*
10. *Cap, valve*
11. *O-ring (Buna-N)*
12. *Body, valve*
13. *Spool, valve*
14. *Cap, valve*
15. *Gasket*
16. *O-ring (Buna-N)*
17. *Relay valve*
18. *O-ring (Buna-N)*
19. *O-ring (Buna-N)*
20. *Air signal valve*
21. *O-ring piston (Buna-N)*
22. *Lower casting*
23. *Screw (1/4-20 x 7/8")*
24. *Pilot bar*
25. *Tie rod*
26. *Nut*
27. *Screw*
28. *Gasket*
29. *Muffler body*
30. *Screw (1/4-20 x 1 1/2")*
31. *Bracket, upper*
32. *Bracket, lower*
33. *Seal, piston*
34. *Screw*
35. *O-ring (Buna-N)*
36. *Adapter*
37. *Screw (1/4-20 x 2 1/4")*
38. *Coupler*
39. *Screw (6-32)*
40. *Screw (1/4-20)*
41. *Tie rod*
42. *Nut (1/2-20)*
43. *Muffler element*
44. *Nipple*
45. *End element*
46. *Muffler plate*
47. *Screw, self tapping (10-32)*
48. *O-ring (Buna-N)*
49. *O-ring (Buna-N)*
50. *Screw*



Central Lube System Circuit



10:1 Hammer Oil Pump Instructions

Symbols

Warning Symbol

⚠ WARNING

This symbol alerts you to the possibility of serious injury or death if you do not follow the instructions.

Caution Symbol

⚠ CAUTION

This symbol alerts you to the possibility of damage to or destruction of equipment if you do not follow the instructions.

⚠ WARNING

INSTRUCTIONS

EQUIPMENT MISUSE HAZARD

Equipment misuse can cause the equipment to rupture or malfunction and result in serious injury.

- This equipment is for professional use only.
- Read all instruction manuals, tags, and labels before you operate this equipment.
- Use the equipment only for its intended purpose. If you are not sure, call your Graco distributor.
- Do not alter or modify this equipment.
- Check equipment daily. Repair or replace worn or damaged parts immediately.
- Do not exceed the maximum working pressure stated on the equipment or in the **Technical Data** for your equipment. Do not exceed the maximum working pressure of the lowest rated component in your system.
- Use fluids and solvents which are compatible with the equipment wetted parts. Refer to the **Technical Data** section of all equipment manuals. Read the fluid and solvent manufacturer's warnings.
- Do not use 1,1,1–trichloroethane, methylene chloride, other halogenated hydrocarbon solvents or fluids that contain such solvents in pressurized aluminum equipment. Such use could result in a chemical reaction, with the possibility of explosion.
- Handle hoses carefully. Do not pull on hoses to move equipment.
- Route hoses away from traffic areas, sharp edges, moving parts, and hot surfaces. Do not expose Graco hoses to temperatures above 82°C (180°F) or below –40°C (–40°F).
- Do not lift pressurized equipment.
- Comply with all applicable local, state, and national fire, electrical, and safety regulations.

Air Motor and Throat Service (cont.)

12. Grease and reinstall the seal (2*) with the lips down, thread the throat bearing (36) into the air motor base (28), and torque the throat bearing to 30 to 40 ft-lb (41 to 54 N.m) using a 1 5/8-in. socket.

13. Slide the piston rod (29) down through the packing, and lower the piston assembly (27) into the air motor base (28).

14. Carefully lower the cylinder (30) straight down onto the piston assembly (27). Tighten the eight screws (3) that hold the cylinder to the base (28).

⚠ CAUTION

To avoid damaging the cylinder wall, lower the cylinder straight down onto the piston. Do not tilt the cylinder while you lower it.

15. Grip the trip rod (31) with padded pliers, screw the lift ring (24) onto the trip rod, push the lift ring down, and screw it into the top of the cylinder.

16. Install the seal (107*) with the lips up, and place the seal retainer washer (113) on the piston/valve seat (109). *Make sure the lips of the seal face up*. See Fig. 3.

17. Place the piston ball (103) in the displacement rod (29).

18. Clean the threads of the piston/valve seat (109), Apply Loctite® to the threads, and thread the assembly from Step 16 onto the displacement rod (29).

19. Clamp the flats of the piston/valve seat (109) in a vise, and torque the displacement rod (29) to the piston valve seat to 45 to 55 ft-lb (61 to 75 N.m).

20. Clamp the air motor base (28) in a vise horizontally by closing the vise jaws on the flange

21. Thread piston assembly tool (A) (included in repair kit 238751) onto the threads of the displacement pump cylinder (110). See Fig. 5.

22. Insert the piston assembly (B) into the displacement pump cylinder.

23. Unscrew the piston assembly tool from the displacement pump cylinder. Clip the piston assembly tool with a diagonal cutter (C), and discard it.

NOTE: Be careful that you do not scratch the rod.

24. Use a strap wrench to screw the displacement pump cylinder (110) to the air motor base (28). See Fig. 3.

25. Before you remount the pump, connect an air hose and run the air motor slowly, starting with just enough air pressure to make the air motor run, and make sure that it operates smoothly.

26. Reconnect the ground wire before regular operation of the pump.

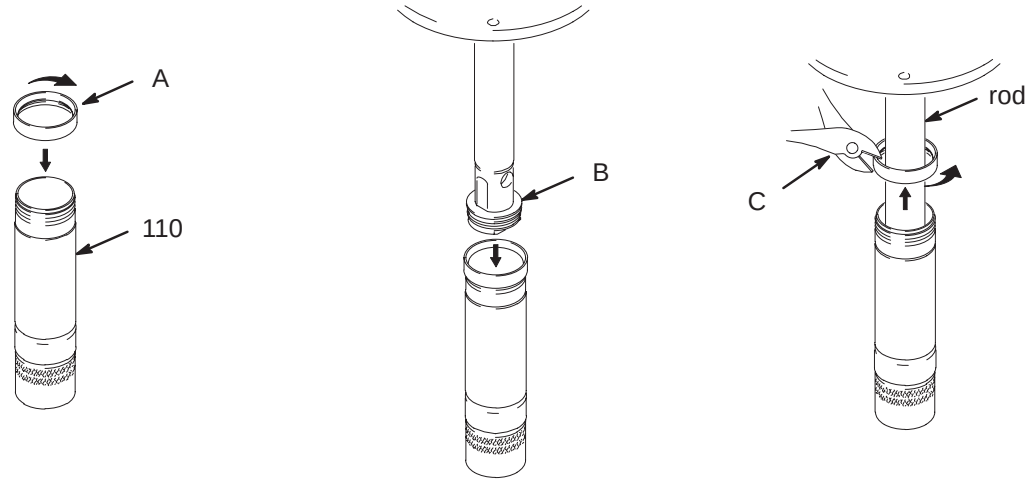
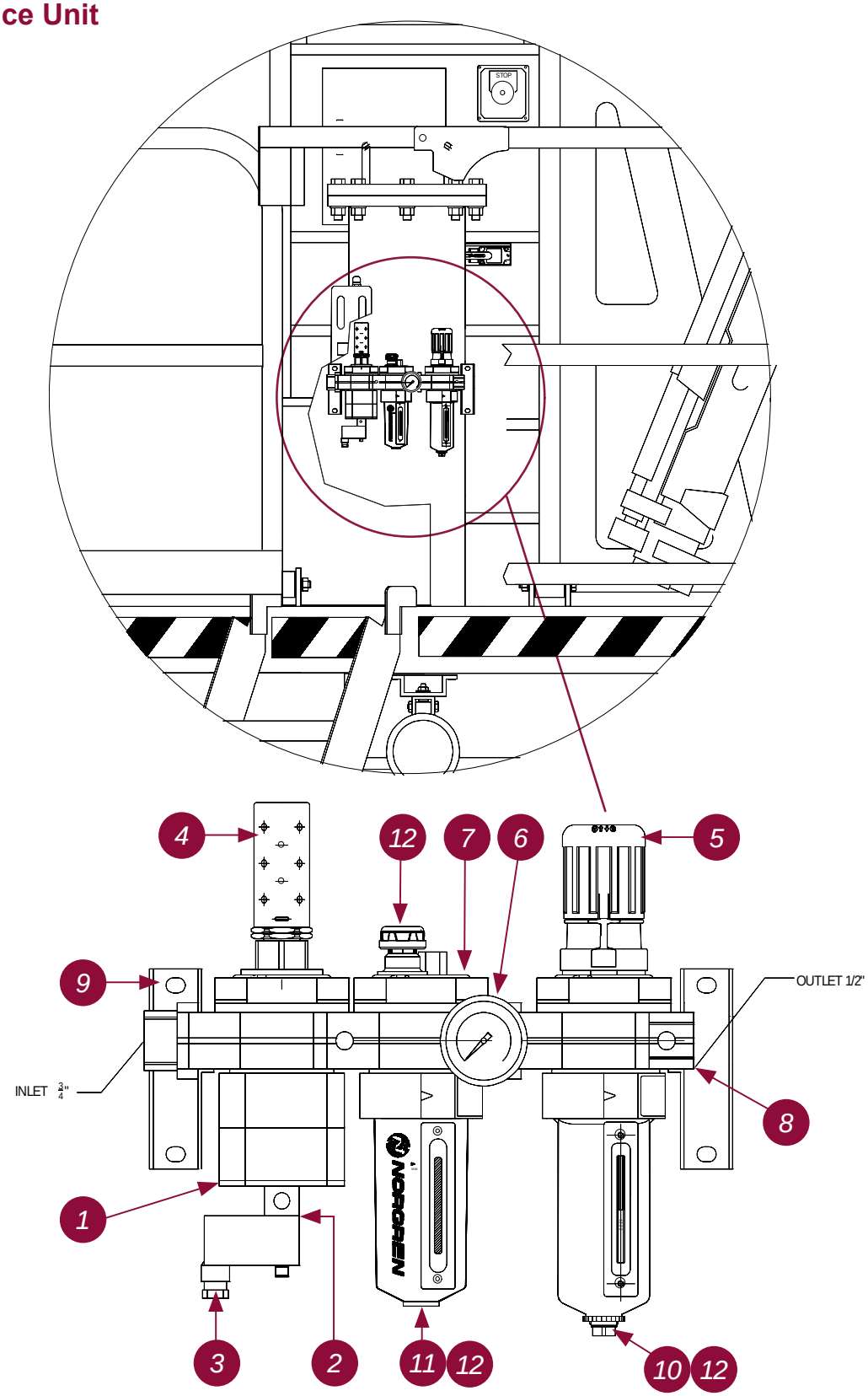


Fig. 5

Air Service Unit

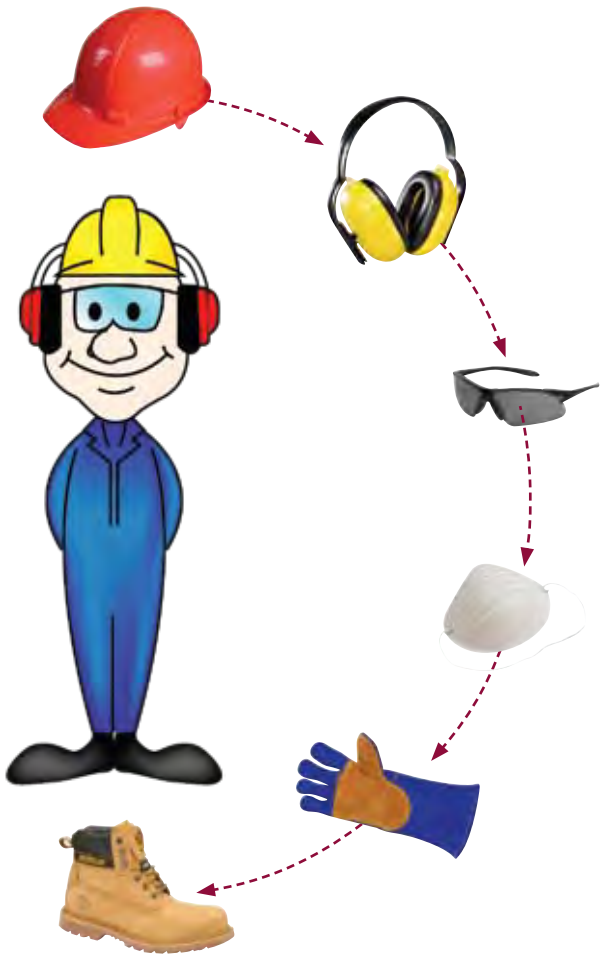


1. *64 smooth start valve SOL OP*
2. *Webbe stem SDMO 2W*
3. *Coil 24V DC, 6W*
4. *Quitaire silencer 1/2" BSM male*
5. *Bas fil/reg 40m AD REL 10bar*
6. *50mm gauge 1/8" CB 1-10bar*
7. *Bas micro fog lubricator*
8. *3/4" triple yoke*
9. *Oly 64 bracket kit*
10. *Metal bowl assembly*
11. *Metal bowl assembly*
12. *O-ring sight dome assembly*
13. *Thread grease air service unit*

General Lubrication

Maintenance and day to day lubrication is essential to smooth running, and will ensure that the drill will perform to it's full potential. This section will cover the points on the drill that will require daily/250/500/1000 and 2000hr lubrication and servicing. These service intervals are set out to give optimal component life and to keep the drill in excellent working condition.

CAUTION: Ensure the correct personal protective equipment is worn when performing any service or maintenance tasks.



Equipment Lubrication

Determination of when oil changes are made, filters and filter elements are to be cleaned and/or replaced and lubrication of equipment is required, should be based on the severity of operation.

CAUTION: Recommended lubrication instructions provided herein are based upon normal operation, and should be varied in accordance with other than normal operating conditions.

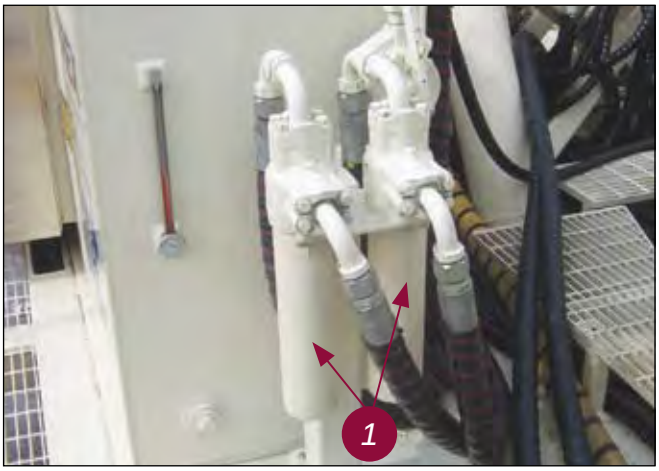
Equipment photo's and charts have been included to show the general location of points and equipment which require scheduled and periodic lubrication. The lubrication charts list the various lube and check points, filters and filter elements, and provides data such as quantities, types of lubricants recommended, and the recommended frequency of lubrication.

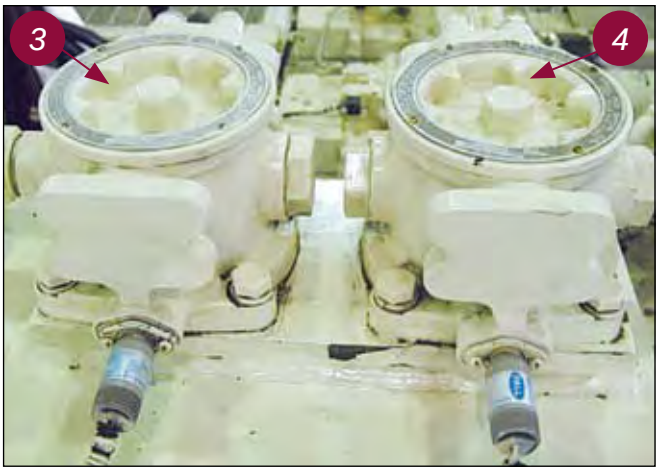
NOTE: For additional lubrication information, refer to vendor manuals provided with the drill.

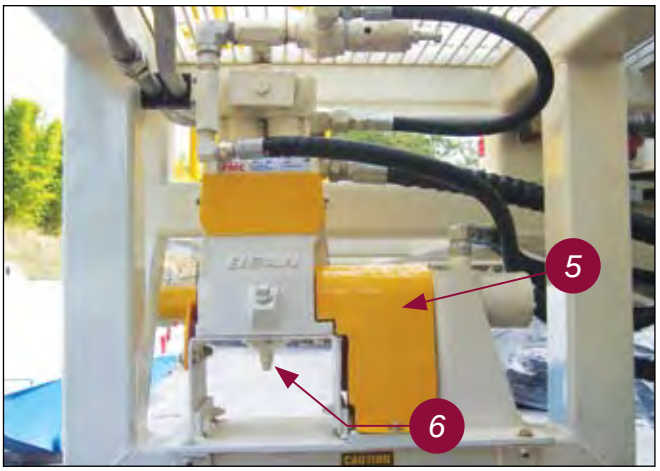
Care of Lubrication Points

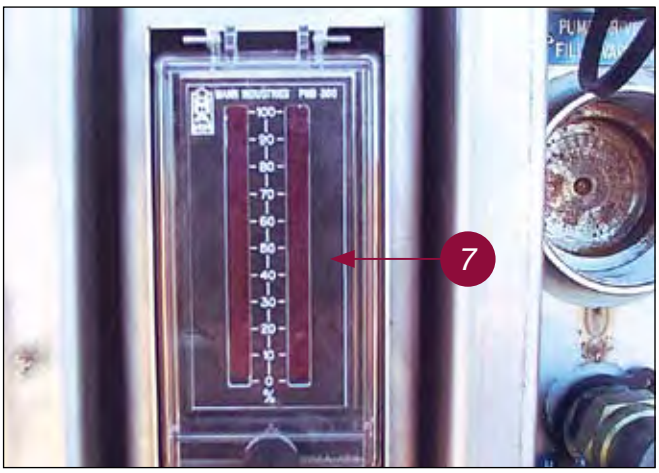
Before lubricating, or filling hydraulic fluids, the fittings, caps, and filler plugs should be thoroughly cleaned to prevent contamination.

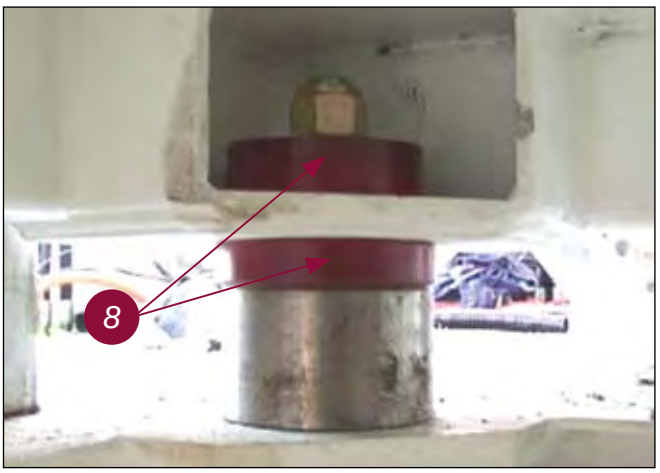
WARNING: After lubrication and filling, remove excess spills. Always keep fittings, caps and fill plugs clean of foreign matter.

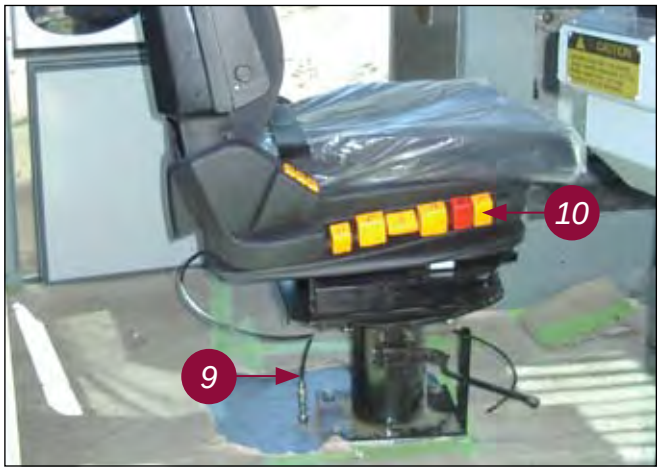








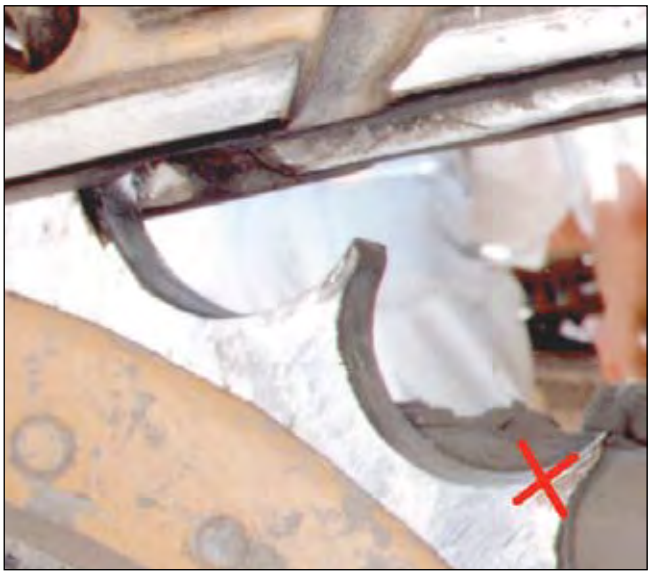




1. *Loop Filters (4)*
2. *Charge filters (2)*
3. *Case return filter*
4. *Main return filter*
5. *Drive coupling*
6. *Drain point*
7. *Water level indicator*
8. *Cab mounts*
9. *Seat air supply*
10. *Seat controls*

Sprocket Wear Patterns (cont.)

Wear on Reverse Drive Side



Normal wear during forward and reverse travel.

Causes:

- Wear caused by accumulation of abrasive soils in the sprocket on the reverse side.
- Increased wear caused by bushing rotation in the sprocket during load when driving in reverse direction. Wear caused by kinematics during transverse motion between bushing and sprocket during turning manoeuvres.
- High surface pressure between bushing and sprocket when sprocket with mud reliefs is used.
- Small sprockets and idler diameters lead to extensive articulation movements which increased the amount of rotation of the bushing in the sprocket.
- Bushings move closer to the tooth tip because of internal chain wear. As a result, increased surface loads and increasing distance to the tooth bottom.

Effects:

- Tooth tip is weakened.
- Higher tooth space clearance increases impact loads when machine changes directions.
- In case of excessive wear, bushing may jump over the sprocket teeth.

Remedies:

- Normal wear is inevitable.
- Use of lubricated track chains eliminates pitch extension which reduces the chance of bushings jumping over the tooth tip.
- Use the largest sprocket and idler diameters possible in order to achieve smaller articulation angles.
- Use proper track chain tension in order to prevent sag between the sprocket and last roller.

Item	Task	Comments and Initials
	14. RECORD the down hole water pump pressure.	
	15. RECORD the cleaning pump pressure.	
	16.CHECK the rotary drive preload. **Procedure** 1. Place an 8” x 8” wood block under the rotary head. 2. Load the pulldown to 1500psi on the pulldown pressure gauge. 3. There should be no visible movement. **Procedure to adjust the Rotary Drive preload to eliminate visible movement.** 1. Place an 8” x 8” wood block under the rotary head. 2. Load the pulldown to 1500psi on the pulldown pressure gauge. 3. Turn the locknut until it contacts the bearing cone, and then turn another 15º. 4. Tighten the screws evenly and opposite to one another, gradually increasing the torque. Do not tighten the screws prior to assembling the locknut to the shaft. 5. Install Loctite 515 Master Gasket at all split lines unless a shim or gasket is used. Replace seals back to back.	

Functional Checks – Machine Not Isolated
WARNING The machine must not be isolated and a commissioning and testing tag placed as detailed in the isolation regulations. • The task SHALL be completed using the appropriate safe work procedure. • Maintainers who have achieved the required competencies can perform functional CHECKS. 1. Park the machine on a level surface. 2. The observer be visible to the machine operator at all times. 3. All other maintainers should remain clear of the machine during operational tests. 4. The engine is running to perform these checks. With the assistance of an observer CHECK the following.

Item	Task	Comments and Initials
1	1. Operating controls – CHECK all functions.	
	2. CHECK the PLC screen for any alarms.	
	3. CHECK operation of reserve oil system LED in the operators cab when the engine is running.	
	4. CHECK all lights.	
	5. Compressor, CHECK main control regulator pressure. Adjust only if required. • High Pressure (Approximately) 500psi, 3447 kPa • Medium Pressure (Approximately) 350psi, 2413 kPa • Low Pressure (Approximately) 190psi, 1310 kPa	
	6. Compressor, CHECK pilot control regulator pressure 50psi, 344 kPa. CHECK at port 2 on the inlet valve and adjust only if required.	
	7. Compressor, CHECK pressure reducing regulator pressure, 80psi, 552 kPa. CHECK at port 1 on the inlet valve when pressure is reducing from medium to low mode, adjust only if required.	
	8. Water pump pressure High pressure units (approximately) 500psi, 3447 kPa. Plumb gauge into the pump discharge, set at position 4 on the water injection control in the cab and CHECK pressure.	
	9. Air conditioner – CHECK operation.	
	10. Auto-lube system – CHECK all pivot points and bushes.	
	11. CHECK air cleaner restriction indicator for the engine and compressor.	
	12. CHECK the operator’s seat for correct function and control.	
	13. RECORD the down hole water pump pressure.	

Additional Job Details		
Details of Additional Work Including Parts Requirements (Please include a copy of the parts page indicating the parts required).	Work Order Originator	Work Order Number

Service Kit 2000 Hours
Bucyrus Part #:
Stock #:

Qty	Description
4	Filter, engine oil
1	Element, primary fuel filter
2	Filter, fuel/water separator
4	Element, engine air cleaner (outer) only change on condition / alarm
4	Element, engine air cleaner (safety) Element, compressor air cleaner (safety)
3	Element, hydraulic return oil filter
5	Element, hydraulic loop filter
2	Element, hydrostatic charge circuit filter
1	Element, compressor lubrication filter
1	Air con – return air media
1	Air con filter element
4	O-rings loop filter assembly
2	O-rings charge filter assembly
1	Compressor filter O-ring
2	Case and return filter O-ring
2	PTO tank / hydraulic tank breather
4	B/U ring loop filter
1	O-rings compressor hydraulic filter
2	O-rings lower cover return filters
2	Engine coolant filter
1	Seperator element
1	Pump drive box filter
1	Hydraulic tank filter
1	Element, hammer oil tank
4	Auto lube cartridge

N.B: For filter part numbers please refer to Parts Manual.