February 2012
BI006782

Service Manual

MD6240 and MD6290 Rotary Blasthole Drill

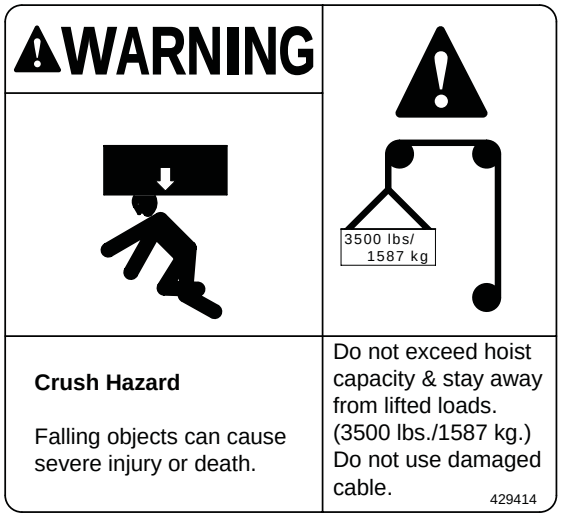
417199 Rev. 06

Section 1

Safety

Maximum Wind Speed = 75 MPH (120.8 Km/h) at which time drilling must be stopped, mast lowered and machine shutdown.

Safety Signs



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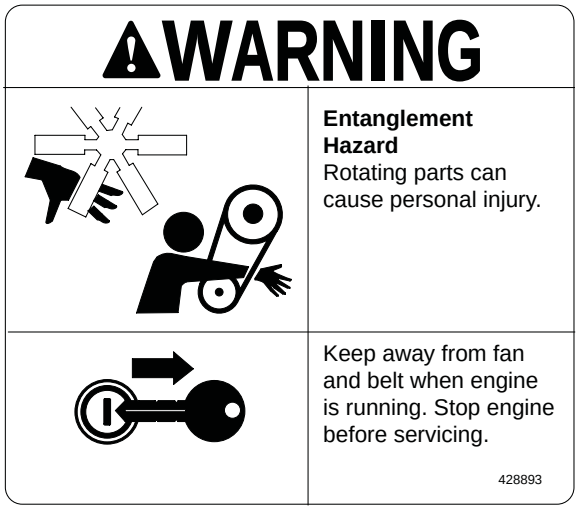

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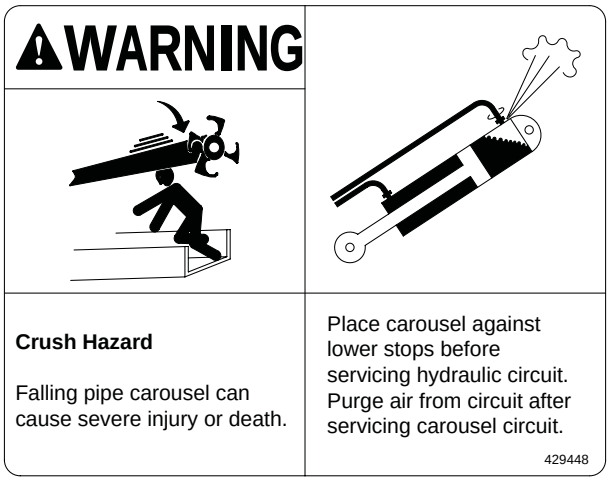

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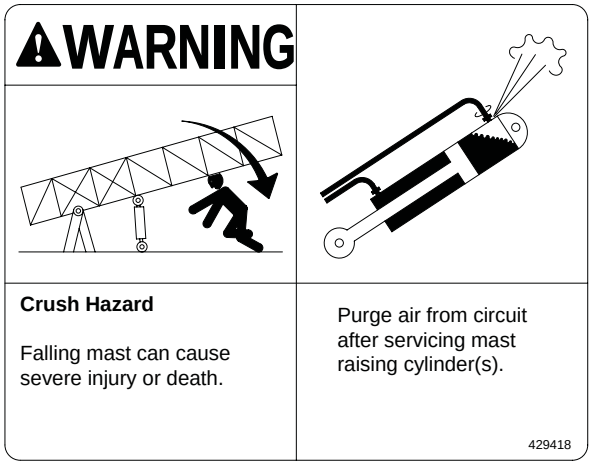

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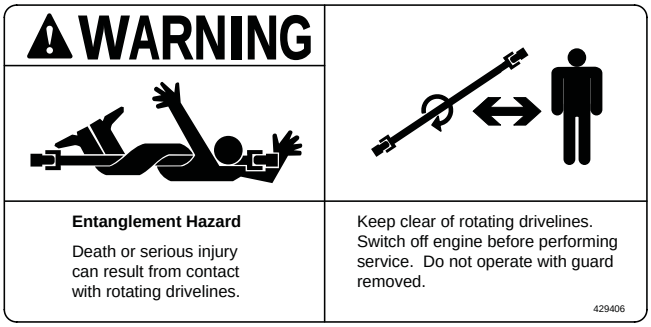

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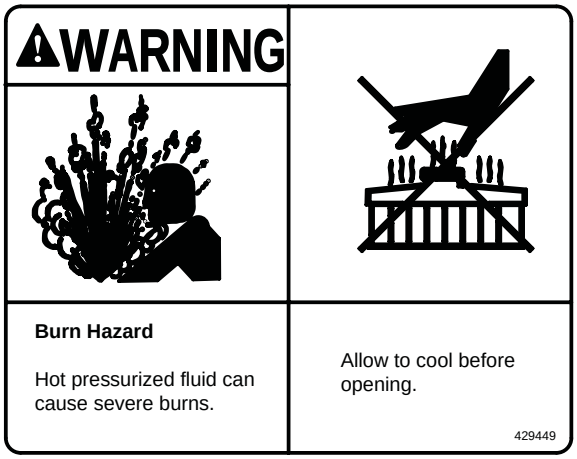

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Operator Control Panel (standard)

4. Mast Lever

Controls the lowering and raising of the mast.
- Pull lever to raise mast.
- Push lever to lower mast.

DO NOT raise mast close to power lines. See Section 1 for Clearances from High Voltage Lines.

5. Propel Levers - Hydraulic pilot operated

Control the speed and the direction of the tracks.
- Push levers to propel forward (radiator end).
- Pull levers to propel in reverse (cab end).

5a. Right Track Lever

5b. Left Track Lever

6. Rotation Lever - Hydraulic pilot operated

Controls rotary head speed and direction.
- Push lever for forward rotation.
- Pull lever for reverse rotation.

7. Hoist/Pulldown System Lever - Hydraulic pilot operated

Controls the raising and lowering of the rotary head.
- Push lever to raise the rotary head.
- Pull lever to lower the rotary head.

8. Engine Diagnostic Lamp

Light flashes to indicate engine fault.
Refer to engine manual for fault codes and remedy.

9. Remote Pulldown Relief

Controls the pressure to the feed system to increase or decrease the weight on bit.
- Turn control clockwise to increase pressure.
- Turn counterclockwise to decrease pressure.

9a. Holdback System Pressure Control

This valve is used on high pressure machines using down the hole hammers and is used in conjunction with the **Holdback System Switch** (see switch panel detail) which activates the solenoid valve. Normally this valve is wide open (all the way out, counterclockwise) when drilling begins. As pipe sections are added, the weight on the bit increases. To avoid too much pressure on the bit turn valve IN (clockwise) to increase oil restriction from pulldown cylinder to tank.
- Turn control clockwise to decrease pressure on bit.
- Turn counterclockwise to increase pressure on bit.

10. Compressor Start-Run Valve–not shown (cold weather option)

Low Pressure Machines:

When starting machine, valve should be in the "Start" position so compressor is unloaded or in low pressure mode. When machine is warmed up, turn valve to "Run" position.

High Pressure Machines:

When starting machine, valve should be in the "Low" position. When machine is warmed up, turn valve to "High" position.

NOTE **Machines without cold weather package do not use this valve.**

Switch Panel (standard)

30. Hydraulically Operated Break-Out Wrench (HOBO) - Swing

The break-out wrench is used to undo tight thread connections. This switch is used to swing the break-out wrench into or away from the drill pipe.

- Push and hold switch up to swing break-out wrench out.
- Push and hold switch down to swing break-out wrench in.

31. Hydraulically Operated Break-Out Wrench (HOBO) - Clamp

The break-out wrench is used to undo tight thread connections. This switch is used to clamp and unclamp the break-out wrench and to turn the wrench.

- Push and hold switch right to disengage (open) break-out and unclamp wrench.
- Push and hold switch left to clamp wrench and engage (close) break-out.

32. Drill Pipe Loader - Interlock

This switch is connected to a proximity switch in the mast. If the pipe rack moves off its stop inside the mast the proximity switch will activate and stop the pulldown, rotation and auto feed. This is to prevent the rotary head from hitting the pipe rack. When this happens, use the pipe loader swing switch (40) to swing pipe rack back against stop, then drilling can resume. When adding drill pipe however, use pulldown and rotation with the pipe loader out. To do this, place the switch in the OVERRIDE position (towards the UNLOCK symbol). This will allow the rotation and pulldown functions to work when the pipe loader is out.

33. Drill Stem Thread Lube

- Push and hold switch down to activate grease pump to lubricate drill pipe threads.

34. Air Line Lubricator

- Push switch down to activate lubricator pump to provide lubrication for "In The Hole Hammers" used on high pressure machines.

35. Water Injection / Dust Collector

This switch is used to engage the water injection or dust collector systems to control drilling dust.

- Push switch up to engage water injection system.
- Push switch down to engage dust collector system.

36. Drill Pipe Support

The drill pipe support is used to support the drill pipe in the center of the mast when using the drill pipe loader for multiple pass drilling.

- Push and hold switch up to engage drill pipe support.
- Push and hold switch down to disengage drill pipe support.

37. Dust Curtain

Switch is used to raise or lower the dust curtain at the rear of the machine.

- Push and hold switch up to lift dust curtain.
- Push and hold switch down to lower dust curtain.

DO NOT brush fins of coil with wire brush or irreparable damage will occur. If fins are bent, use a correct coil fin comb to realign them.

Servicing

Condenser Coil - When the cover is removed the condenser coil is exposed, and thus readily available for examination and cleaning. If cleaning is required, wash with low pressure water in the reverse direction to air flow.

Condenser Fan Motor - Inspection of the motor is carried out by lifting the cover and removing the motor from its mounting bracket. The brushes are accessible by removing the brush cover screws. Inspect brushes for wear and replace if necessary. The motor case should be cleaned using only moisture free compressed air.

Condenser Fan Blade - If any part appears to be damaged or worn excessively, DO NOT REPAIR, but replace the fan blade.

Compressor - The compressor is equipped with either pad type or Rotalock suction and discharge service valves mounted on the cylinder head. The pad type valves and the Rotalock valves are not interchangeable.

Oil Charge - The system is charged with a R-134a compatible oil.

Compressor Oil Level - It is not necessary to frequently check or change the compressor oil. However, it may be necessary to replenish or replace the compressor oil in the following cases:

1. Whenever the compressor, evaporator, condenser or receiver-drier is replaced.
2. Whenever the refrigerant has leaked from the system.
3. Whenever the refrigerant is suddenly released from the cooling cycle.
4. Whenever any oil-related problems occur in the cooling cycle.

Follow the component manufacturer's recommended procedures for repairs or replacements to the system.

Operator's Seat

ISRINGHAUSEN ISRI®

Model 1000, 6000, & 6500

Operator's Instructions

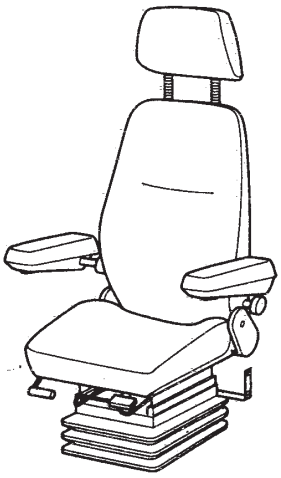
These ergonomicaly designed seats offer a variety of options that insure the users comfort and safety throughout extended operating periods.

To enjoy the greatest degree of comfort and safety:

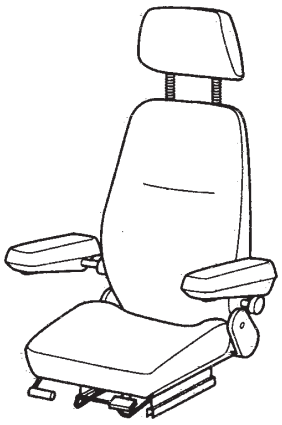
you must read and understand these instructions and become familiar with all applicable controls and their functions.

you must perform the recommended maintenance.

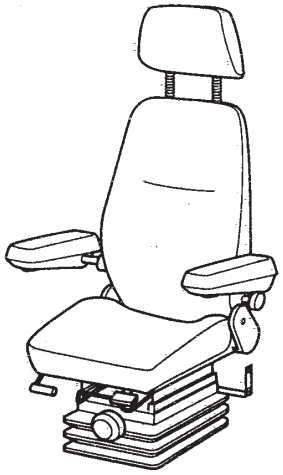
you must order and use the correct replacement parts.



MODEL 6500



MODEL 1000



MODEL 6000

Operator Inspection and Maintenance

Daily

Inspect seat belts; they must be in place and work properly. Inspect tether belts; they must be in place and adjusted properly. Replace worn or faulty seat and tether belts.

Inspect all controls; they must be in place and function properly.

Inspect moving components; they must move freely. However, excessive free play indicates worn components. Repair or replace all worn components.

Weekly

Inspect all fasteners; they must be in place and tight. Be sure all mounting fasteners are torqued properly.

Inspect upholstery for cracks, cuts, tears, or breaks; replace if needed. Clean upholstery when needed.

Inspect suspension boot; it must be in place and free from cuts and cracks.

If a change in suspension performance is noticed replacing the shock absorber may be required.

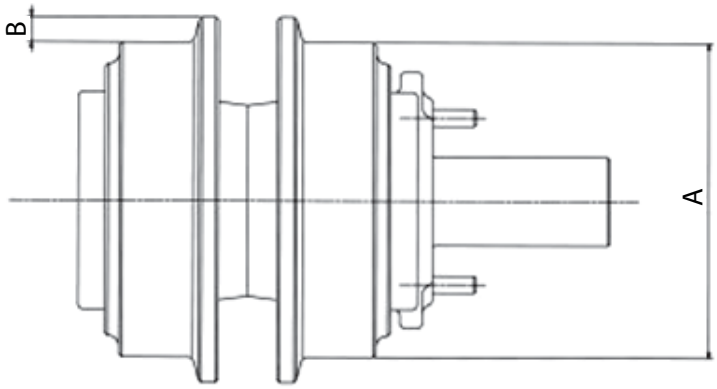
⚠ WARNING

Breaking these rules could cause serious or fatal injury to yourself and others:

- Read and understand operator's instructions before using seat.
- Do not use damaged or faulty seat.
- Do not adjust seat while traveling.
- Always use seat belts.
- With seat properly adjusted and at maximum suspension height, you must have 50.8 mm (2.00 in.) min of head room.

Crawler Wear Limits

Track Rollers



CALIPER METHOD

New A	10%	20%	25%	30%	40%	50%	60%	70%	75%	80%	90%	100%
180	179.2	178.2	177.6	177.1	175.9	174.7	173.4	171.9	171.2	170.4	168.7	167

DEPTH GAUGE METHOD

New B	10%	20%	25%	30%	40%	50%	60%	70%	75%	80%	90%	100%
15	15.4	15.9	16.2	16.5	17	17.7	18.3	19	19.4	19.8	20.7	21.5

CARRY ROLLER POSITION

X1	X2

2. Operating and Service Instructions

2.1. General Maintenance Instructions

2.1.1 Handling hydraulic substances and lubricants

The relevant applicable safety regulations for the respective products must be observed when handling oil, grease or other chemical substances.
Suitable safety measures must be taken to avoid scalding and burning when the machine has warmed up (i.e. at operating temperature), as operating media are then at least the same temperature.
Do not smoke if handling combustible fluids.
Caution with fire and naked flames. Not only fuel but also other operating media often have a low flash point and ignite easily.
Lubricants that are not being reused must be disposed of in an environmentally friendly way.

2.1.2 Conversions or changes to the undercarriage

Unauthorized conversions or changes are not permitted for safety reasons. The rated pressure of connected pressure relief valves and pressure tanks must not be altered.

Seals on units must not be removed.

2.1.3 Before starting up

Before starting up:

- Lubricate all lubrication points
- Check all oil levels and adjust if necessary
- Check function of all repaired components
- Carry out visual inspection of all components

3.1.7 Compact transmission with drive motor

Connecting the locating flange of the side frame as well as the sprocket is achieved using adequately dimensioned bolt connections. Transmission of torque is achieved by frictional locking.

Remove the protective caps when connecting the hydraulic hoses. Attention must be paid that no dirt gets into the supply lines during the assembly process.

All prescribed parameters such as:

- Hydraulic pressure limits,
- maximum and minimum volume flow rates,
- allowance for oil leakage,
- brake air pressure monitoring,

must be observed when using the undercarriage hydraulic system. Please contact the manufacturer where necessary for permitted values.

3.1.8 Parking brake

The multi-disc brake incorporated into the transmission is a parking brake that is kept constantly closed by pressure springs. The maintenance-free brake is designed as a separate compact unit and should only be removed from the transmission and exchanged as a complete unit. This design protects all individual components such as discs, springs, sealing elements etc. against outside influences. Any repair work should only be carried out by a specialist workshop.

Feeding hydraulic oil either direct or via the drive brake valve and a connecting line to the brake connection of the compact unit opens the brake.

Pressure ranges within which the brakes can be vented must be observed. Only completely vented brakes allow wear-free and fault free operation of the complete drive.

Use of a separate hydraulic circuit for supplying the brakes is recommended if operating without parking brake valve.

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The following applies for all spring units:

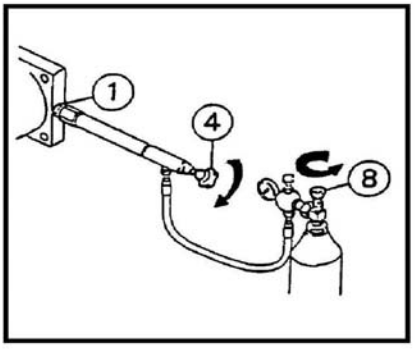
All spring units can either be bolted, inserted or fastened onto the front idler yoke.
This ensures easy fitting and removal. The pre-tensioned spring in the frame is an exception.

This spring is tensioned first when in the undercarriage frame and then secured with a locking system.

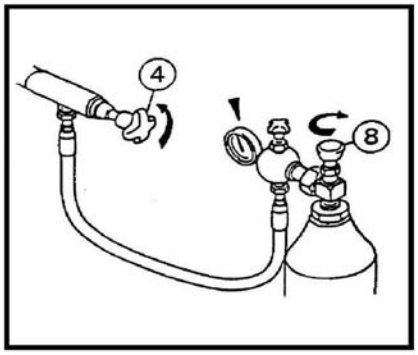
Dismantling the spring units may only be carried out by a specialist workshop. The following applies to all spring units: Replace the complete unit if a repair is necessary.

Repairing spring units involves extensive safety measures and should only be carried out by a specialist workshop.

Turn hand wheel on filling valve (4) to right (**clockwise**) so that the gas valve (1) opens.
Open nitrogen filling canister (8) **(Turn anti-clockwise)**:



Check filling pressure on the pressure gauge (6). When pressure level has been reached – settling time min. 5 minutes – close filling canister (8) again. Turn hand wheel back to left. Gas valve closes automatically.



Repeat individual work stages in reverse order and protect the gas valve with a protection cap. Replace brass cap and copper ring.
IMPORTANT!
Make absolutely sure that no dirt particles get into the gas valve.

Inter tractor
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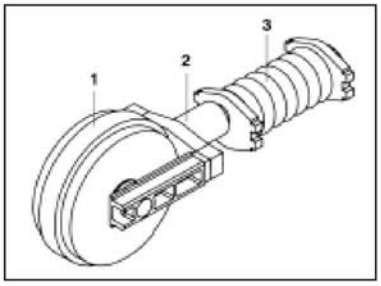
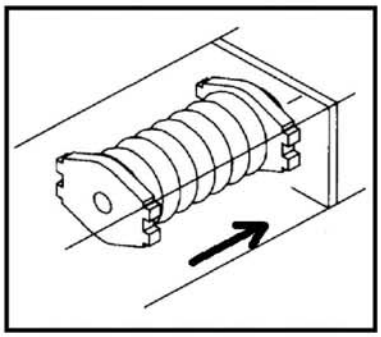
4.2.3 Front idler unit plug-in unit

The design consists of:

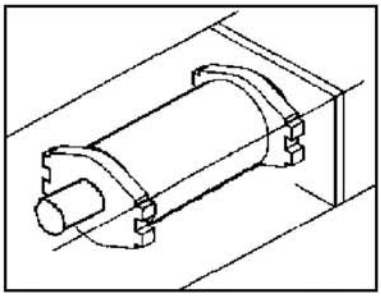
- Front idler comp. with yoke (1)
- Track tensioner (2)
  screwed onto the yoke
- Spring unit (3)



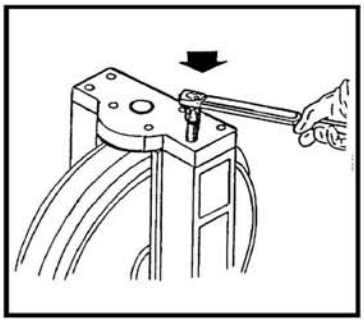
If the spring has been designed as a plug-in unit, lift carefully into the greased guide rails of the frame using appropriate lifting gear.



Alternative illustration of a plug-in unit as fluid spring element (e.g. nitrogen or elastomer)



Place yoke on sliding blocks and tighten with bolts.



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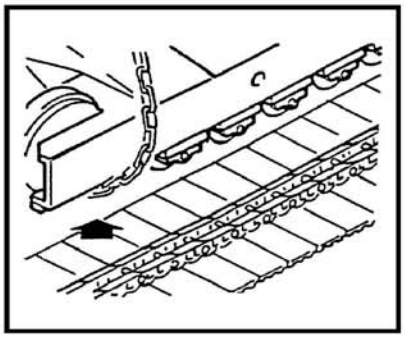
6.2. Track rollers – Fitting and removal

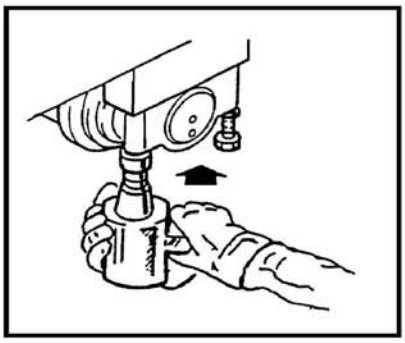
If necessary, slacken off track and undo track fastener (see "Track" chapter).

Raise the track undercarriage using a lifting device and clean dirt off of all parts.



Undo the bolts of the faulty track roller, remove and dispose.

If track guide is fitted, it will have to be removed first at the appropriate points before dismantling.



Fit new roller using new bolts and fasten in place. Re-join track again as described in the following chapter.

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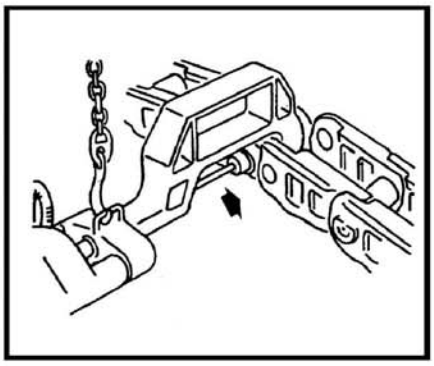
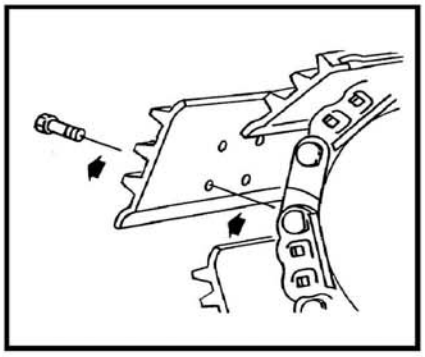
Tightening torque for track bolts [ft lb]

[ft lb] Bolt	Strength class 11.9		Strength class 12.9		Strength class 13.9	
	Torque procedure	Turning angle procedure	Torque procedure	Turning angle procedure	Torque procedure	Turning angle procedure
M10 x 1	65 ± 4	20 ± 1	70 ± 4	25 ± 1	75 ± 4	25 ± 1
M12 x 1	120 ± 7	35 ± 2	125 ± 7	40 ± 2	130 ± 7	45 ± 2
M14 x 1.5	175 ± 10	60 ± 3	190 ± 10	65 ± 3	200 ± 10	65 ± 3
M16 x 1.5	275 ± 15	130 ± 5	290 ± 15	140 ± 5	300 ± 15	145 ± 5
M18 x 1.5	400 ± 20	190 ± 10	420 ± 20	200 ± 10	440 ± 20	210 ± 10
M19 x 1.5	480 ± 25	235 ± 10	510 ± 25	250 ± 10	530 ± 30	265 ± 15
M20 x 1.5	550 ± 25	250 ± 10	590 ± 30	260 ± 10	610 ± 30	280 ± 15
M22 x 1.5	740 ± 35	280 ± 15	790 ± 35	295 ± 15	825 ± 40	310 ± 15
M22 x 2					800 ± 40	
M24 x 1.5	975 ± 50	320 ± 15	1040 ± 50	340 ± 15	1085 ± 55	360 ± 20
M27 x 1.5	1420 ± 70	460 ± 20	1510 ± 75	490 ± 20	1575 ± 80	520 ± 25
M30 x 2	1900 ±95	620 ± 30	2035 ± 100	670 ± 40	2120 ± 100	700 ± 35
M32 x 2	2290 ± 110	740 ± 40	2440 ± 120	790 ± 40	2550 ± 125	820 ± 40
M36 x 2	3360 ± 170	1675 ± 80	3585 ± 180	1790 ± 90	3740 ± 190	1870 ± 90
[ft lb] Bolt	Strength class 11.9		Strength class 12.9		Strength class 13.9	
	Torque procedure	Turning angle procedure	Torque procedure	Turning angle procedure	Torque procedure	Turning angle procedure
7/16 – 20 UNF	85 ± 4	30 ± 2	90 ± 4	32 ± 1	95 ± 4	35 ± 1
½ – 20 UNF	130 ± 7	45 ± 2	140 ± 7	48 ± 2	150 ± 7	50 ± 2
9/16 – 18 UNF	190 ± 10	65 ± 3	200 ± 10	70 ± 3	215 ± 10	75 ± 3
5/8 – 18 UNF	265 ± 15	130 ± 5	285 ± 15	140 ± 5	300 ± 15	150 ± 5
¾ – 16 UNF	465 ± 20	240 ± 10	500 ± 25	250 ± 10	520 ± 25	265 ± 15
7/8 – 14 UNF	745 ± 35	260 ± 10	800 ± 40	270 ± 10	830 ± 40	285 ± 15
1 – 14 UNS	1140 ± 60	380 ± 20	1220 ± 60	410 ± 20	1270 ± 65	430 ± 20
1 1/8 - 12 UNF	1660 ± 80	560 ± 30	1770 ± 90	600 ± 30	1850 ± 90	625 ± 30

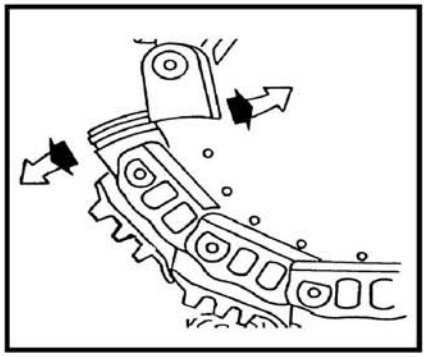
For larger tracks, press the master pin out using a hydraulic pin remover.



Design with master links
Drive track to sprocket until the master link and sprocket centre are at the same height.
Secure track against rolling off front idler.
Remove shoe over master link.



Knock the pin end of the master link towards the drive middle or press the bushing end out of the pin end using a rod or crowbar until the track has been opened.



Important for K-LOC designs!
Only the bushing end can be opened outwards. Open out the end of the track.

There are various designs of master links that are not shown here in detail.

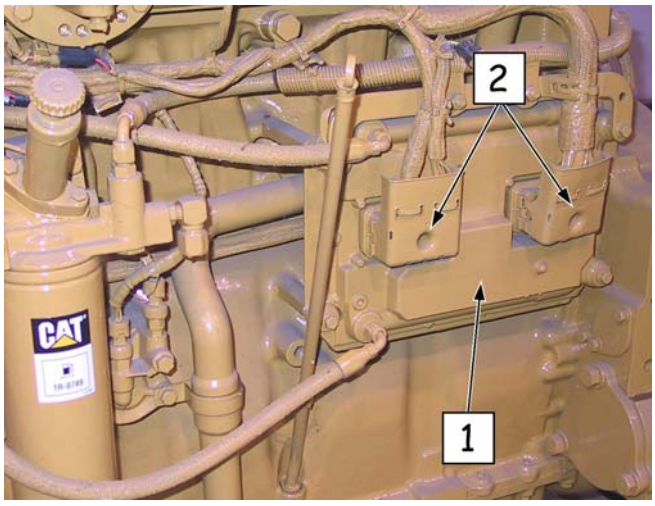


Fig. 4-0 Electronic Control Module - Caterpillar C-15 Electronic Engine
1. Electronic Control Module (ECM)
2. Plug-Ins - Disconnect from ECM BEFORE welding.

Drivetrain / Compressor

CAUTION:
DO NOT weld on any part of the machine without first disconnecting the negative battery cable or place the battery disconnect switch in the open position. On machines equipped with electronic engine, disconnect the connections to the Electronic Control Module (ECM) on the engine before welding.

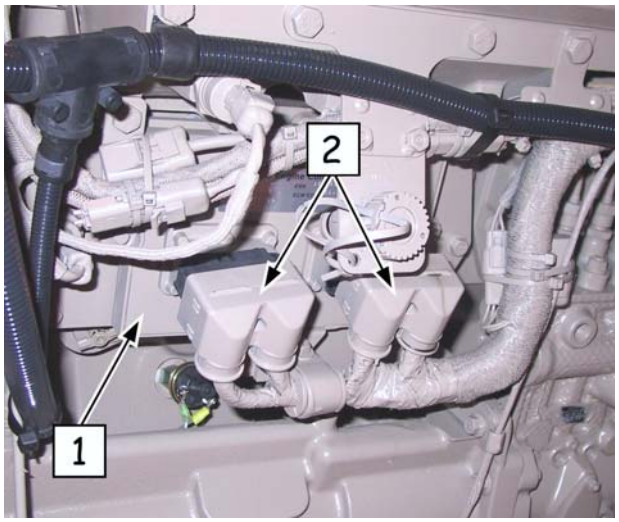


Fig. 4-0a Electronic Control Module - Cummins QST30- Left Side
1. Electronic Control Module (ECM)
2. Plug-Ins - Disconnect from ECM BEFORE welding.

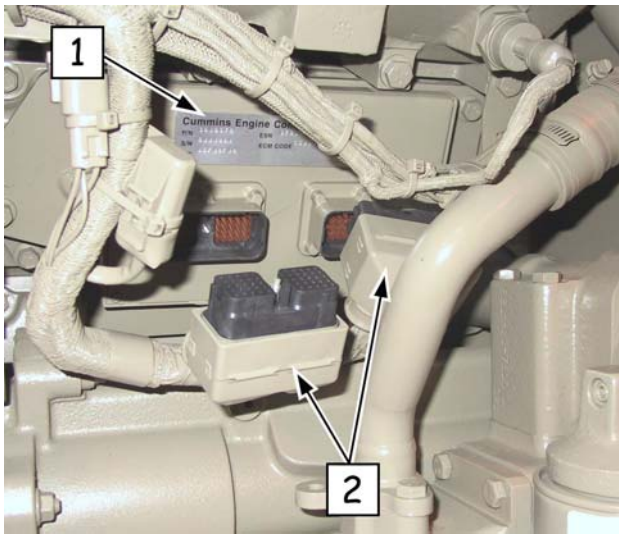


Fig. 4-0b Electronic Control Module - Cummins QST30- Right Side
1. Electronic Control Module (ECM)
2. Plug-Ins - Disconnect from ECM BEFORE welding.

Pump Drive Gearbox - Repair

Disassembly (refer to fig. 4-6):

1. After removing pump drive from machine as outlined previously, place unit on a workbench so that pump adapter pads are facing up.
2. Remove nuts from studs (or capscrews) that secure pump mounting pads to gearbox.
3. Lift the driven gears and their bearings from the gearbox.
4. Turn gearbox over so input adapter is facing up. Remove the capscrews that hold the input adapter to the gearbox housing. Lift up the input adapter with input shaft, bearings and gear.

Inspection and Repair:

1. Check gears and bearings for damage, look for metal particles or flaking from bearings.
2. Check splines on output shafts for excessive wear.
3. Check bearing bores, the O.D. of the ball bearings are a slip fit. If there is excessive play, the bearing bores will have to be built up and re-machined
4. Check condition of input shaft oil seal. Its always a good idea to replace seals when overhauling the unit.
5. Clean mounting surfaces of old sealant, clean and remove any debris from inside of gearcase.

Assembly:

1. Assembly is basically the reverse of disassembly procedure. Remember to follow the notes with the assembly drawing.
2. If bearings need to be replaced, press them onto both sides of gears as far as they will go. There is no bearing pre-load, as the O.D. of the bearings are a slip fit.
3. Apply anti-seize compound or a good grade of wheel bearing grease to the splines of the output shafts.
4. Apply silicone sealant to mounting flanges of pump adapter plates and input adapter.
5. Apply medium strength adhesive to input adapter and pump adapter plate capscrews and studs.
6. Pump adapter studs or capscrews should not be reused. Install new ones and torque to 150 ft. lbs. (204 Nm). Torque nuts on studs to 150 ft. lbs. (204 Nm).

Installation:

1. Refer to "Removal & Replacement" procedures as outlined previously.

Lubrication:

1. After installing pumps, fill gearbox with proper lubricant (see Section 9). Oil level should be to bottom of plug on side of gearbox or to FULL mark on dipstick. Oil volume is 6 3/4 quarts (6.8 liters) .DO NOT OVERFILL, this will result in overheating and possible malfunction of the unit.
2. Maximum operating oil temperature is 225° F (107.2° C).

Linde	HPR-02 Installation and Start-Up Instructions	Document No: 1012
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Initial Start-Up:

1. Start the prime mover (leave at low idle) and allow the HPR-02 to rotate for 10 seconds.
2. Stop the prime mover and wait 1 minute.
3. Repeat steps #1 and #2 four more times.
4. Start the prime mover and set it to low idle, then slowly actuate a function 3 times to allow the HPR-02 to increase to maximum displacement. Leave the function fully actuated for 30 seconds each time.
5. Warm the system up by steadily increasing the prime mover speed and pressure so as to allow any air to be purged from the fluid.
6. Check the HPR-02 stand-by pressure, load sense margin pressure, pressure compensator setting (if applicable), VD3 performance valve setting (if applicable), and maximum flow setting when the hydraulic oil reaches its normal operating temperature.
7. Check the oil level in the reservoir and fill with filtered oil if necessary before delivery of the machine.

Routine Maintenance:

- Maintenance of the hydraulic system is limited to changing the hydraulic fluid and system filtration.
- In order to gaurantee the proper function and efficiency of the HPR-02, the purity of the hydraulic oil over the entire operating period must comply to at least class 18/13 according to ISO 4406.
- With modern filtration technology, however, much better values can be achieved which contributes significantly to extending the life and durability of the HPR-02 and the complete system.

Changing the Filters:

- It is recommended that the filters be changed after the initial start-up or at least 100 hours from the initial operation. Additional filter changes should be made after 500 hours of operation from the previous filter change.

Date: 1/23/06

New or Rebuilt Hydraulic Pump - Startup

Startup Procedure

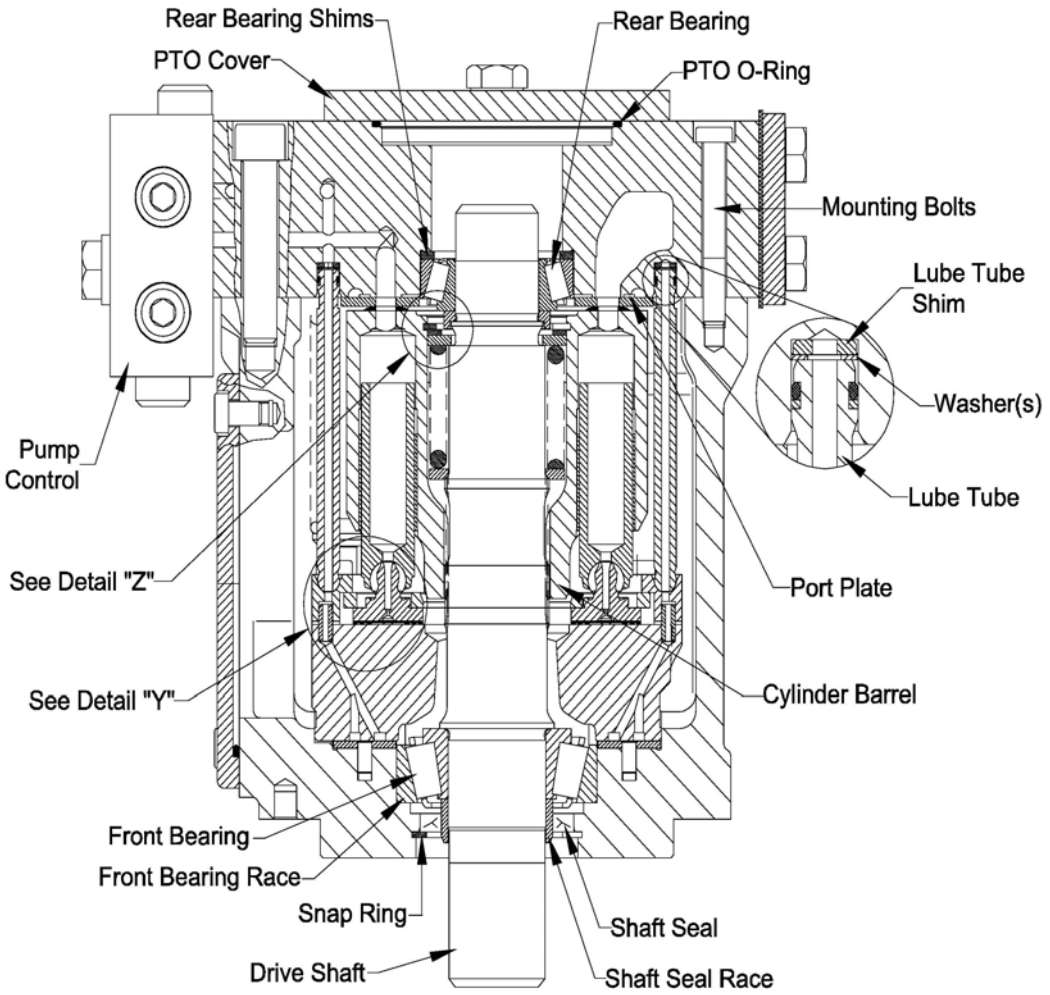
The following procedure has been developed based on experience with most types of applications, however certain applications may require a departure from or variation to this procedure.
For the startup of new or overhauled installations:

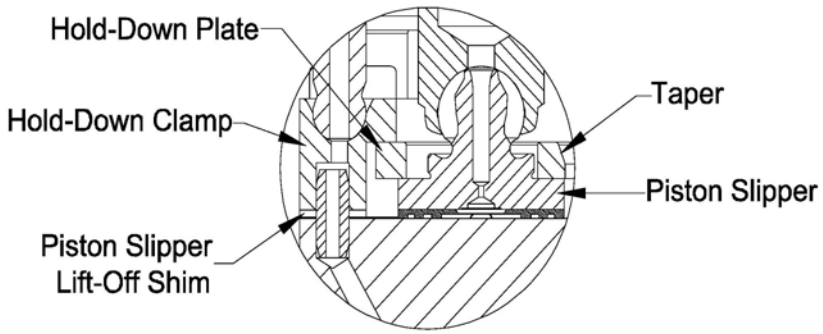
1. If the prime mover is:

   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 (3.5 bar) or more.

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

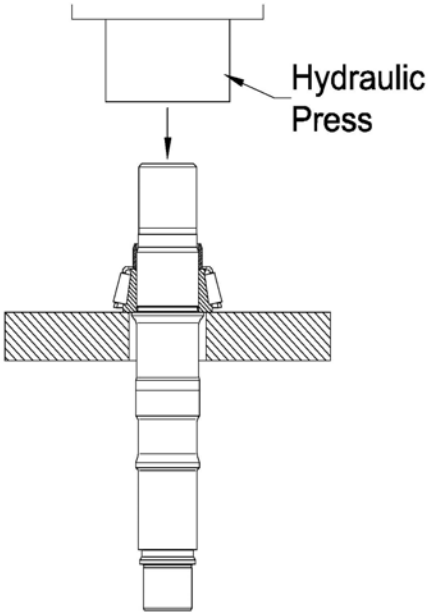
2. Start the prime mover, and if possible, maintain a pump speed of approximately 750 rpm for 5 minutes. This will allow the system to be filled.
3. Listen for any abnormal noises.
4. Check for oil leaks.
5. Run prime mover to 1800 rpm. (Adjust to the design speed if less than 1800 rpm.)
6. Set charge and pilot pressure as required for the application (refer to circuit schematic).
7. Retighten all connections.
8. Operate the control to work the hydrostatic transmission at approximately 20% of maximum speed.
9. Deaerate system by venting a bleed valve or by cracking the highest connection until fluid seeps out without bubbles.
10. Check fluid level and add fluid if necessary.
11. Continue operating transmission and gradually increase to full speed, still with no load.
12. With controls neutralized, check for creep in neutral. If evident, center the control in accordance with the instructions in the pump service manual.
13. Check that the controls are connected so that the transmission operates in the correct direction related to the control input.
14. Continue to monitor all pressure gauges and correct any irregularities.
15. Apply brakes and set high pressure relief valves (and pressure override if installed) to level required for the application by stroking the pump to approximately 20% of maximum displacement.
16. Check security of high pressure connections.
17. Check oil level and temperature.
18. Remove and inspect high pressure filter elements, if so equipped. Replace with new elements.
19. Operate transmission under no load conditions for about 15 minutes to stabilize the temperature and remove any residual air from the fluid.
20. 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.


Rear Bearing Shims
Rear Bearing
PTO Cover
PTO O-Ring
Mounting Bolts
Lube Tube Shim
Washer(s)
Pump Control
Lube Tube
See Detail "Z"
Port Plate
See Detail "Y"
Cylinder Barrel
Front Bearing
Front Bearing Race
Snap Ring
Shaft Seal
Drive Shaft
Shaft Seal Race


Hold-Down Plate
Taper
Hold-Down Clamp
Piston Slipper
Piston Slipper Lift-Off Shim

Detail "Y"

Hydraulic Pump Repair - Linde



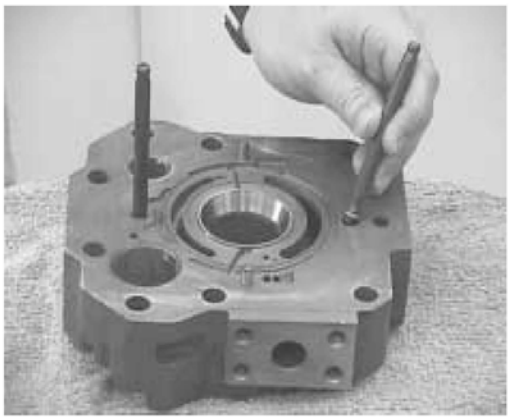
33. Position the drive shaft on a vertical press as illustrated to the left. Press the Front bearing and Shaft Seal Race off of the Drive Shaft.

34. As illustrated, remove the Piston Rings from the two Actuator Pistons.

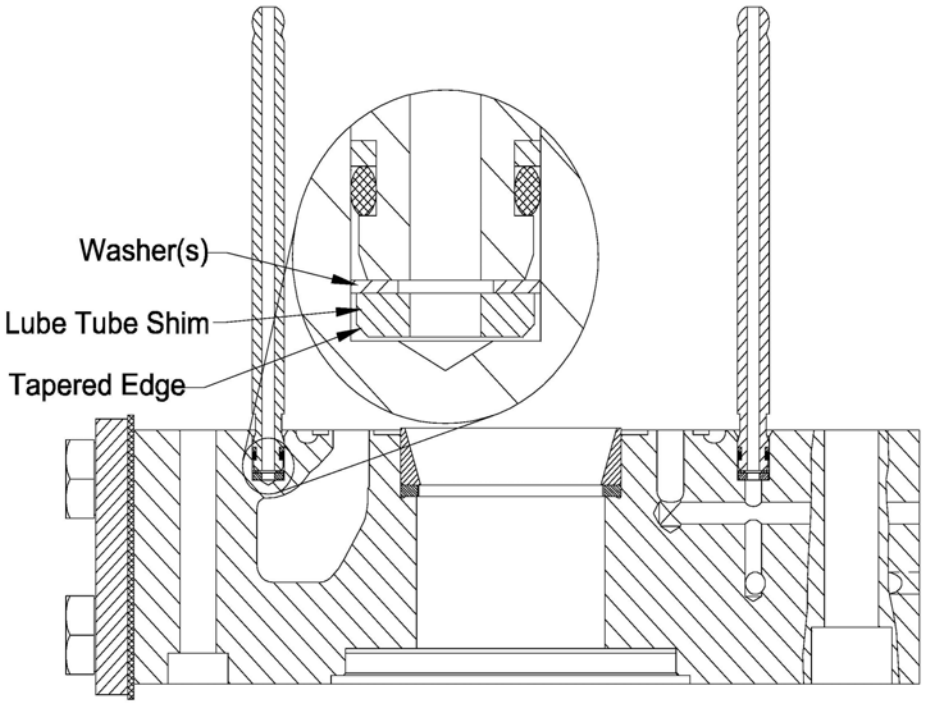
This concludes the disassembly portion of this manual. At this point, all components of the HPR-02 pump should have been completely disassembled. Careful inspection of all parts is absolutely critical. Any parts showing signs of wear or damage should be discarded and replaced with genuine Linde parts. It is also strongly recommended that all sealant-type parts (o-rings, seal nuts, and shaft seal) be discarded and replaced with new genuine Linde parts.

All parts that are going to be reused must be thoroughly cleaned and flushed free of all contaminants. Any remaining sealant material on the rear head and pump housing must be scraped clean. The mounting surfaces of the pump housing and rear head should be cleaned and deburred with a sanding stone and solvent.

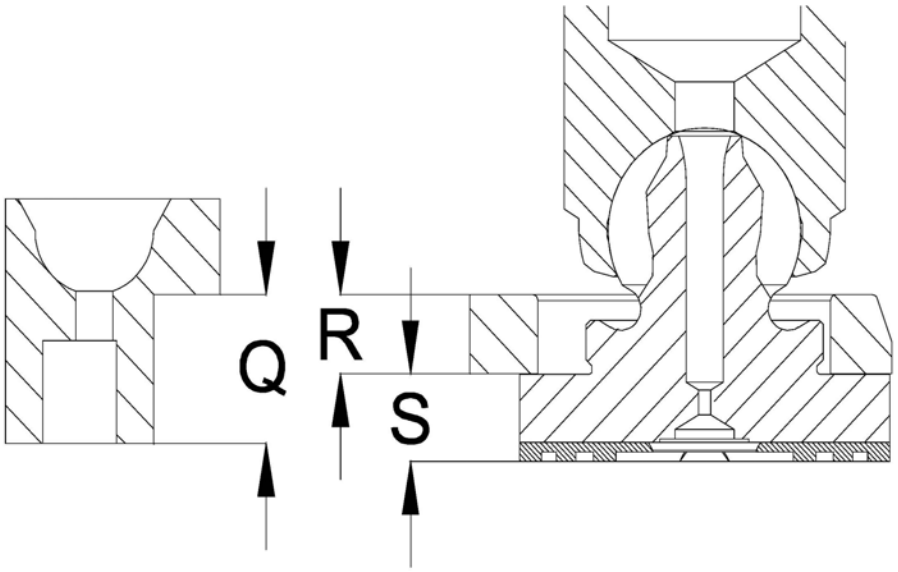
35. Insert the rotating group from Step #33 into the pump housing. Follow all steps outlined in Appendix "E" (located at the end of this repair manual) to measure for and select the proper Lube Tube Shims. *It is absolutely critical that this measurement be done correctly.* After the measurements have been done and the proper shims are selected, make sure that the Lube Tubes and Shims are properly labeled as to ensure that they are installed into the proper cavity in the Rear Head.



36. Insert the two Lube Tube and Shims into the Rear Head. Make sure that they are inserted into the correct cavities in the Rear Head. When inserting the Lube Tube Shims, make sure that the tapered edge faces away from the Lube Tube as illustrated below.



Linde Repair Manual	Appendix "B": Procedure to Shim For Piston Slipper Lift-Off	Appendix "B" Rev. 1, 8-13-02 Page 2 of 3



2. Do the following calculation and record the value below to the nearest 0.01mm:

   Dimension "Y" = (Dimension "R") + (Dimension "S")

   Dimension "Y" = _____ mm

3. Do the following calculation and record the value below to the nearest 0.01mm:

   Dimension "Z" = (Dimension "Y") – (Dimension "Q")

   Dimension "Z" = _____ mm

4. Based on the value for Dimension "Z", select the proper *Shims* to acquire a **clearance** of 0.01mm to 0.03mm. Refer to the example below.

5. Repeat steps #1 through #4 for the *Hold-Down Clamp* on the other side of the pump.

IMPORTANT:
There are two *Hold-Down Clamps* on each pump. The two *Hold-Down Clamps* are different from each other. Likewise, the *Shims* beneath them are different from each other. It is critical that each *Hold-Down Clamp* be measured and shimmed separately.

Linde Repair Manual	Appendix "E": Procedure to Shim Lube Tubes	Appendix "E" Rev. 0 Page 2 of 5

3. Orient the *Cylinder Barrel Compression Plate* with the male pilot facing away from the cylinder barrel. Set the *Cylinder Barrel Compression Plate* on top of the unit housing. Match up the threaded holes in the unit housing with the four *S.H.C.S.* on the plate for alignment purposes.

   IMPORTANT:
   Make sure to use the four *Washers* with the *S.H.C.S.* to avoid bottoming the *S.H.C.S.* in the threaded holes in the unit housing.

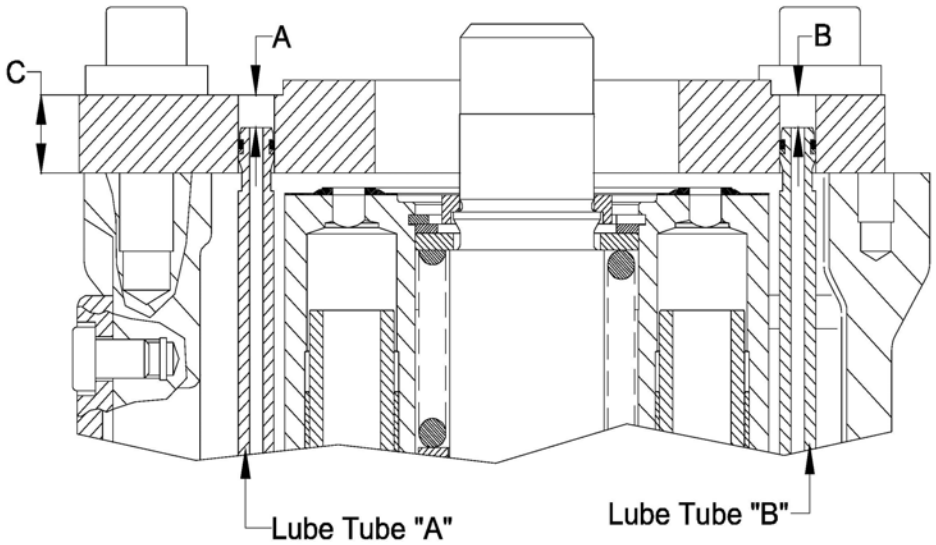
4. Fasten the *Cylinder Barrel Compression Plate* to the unit housing by tightening the four *S.H.C.S.* **with a hand tool**.

5. Center the swash plate (to the position of zero displacement) by moving the two actuator pistons. For best results, the swash plate should be at its zero displacement position.

   As illustrated below, use depth micrometers to measure dimensions "A" and "B". Measure dimensions "A" and "B" to the nearest 0.01mm and record the values below:

   Dimension "A" = _____ mm Dimension "B" = _____ mm

   Please note that there are two *Lube Tubes* designated *Lube Tube "A"* and *Lube Tube "B"*. Make sure to keep each *Lube Tube* properly labeled to avoid mixing them up. Also make sure that dimension "A" corresponds with *Lube Tube "A"* (and the same for dimension "B" and *Lube Tube "B"*)

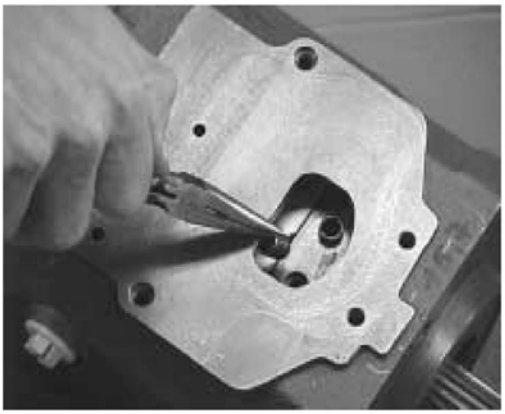


14. Use a sharp edge tool, sanding stone, and solvent to remove any remaining sealant from the sealing area of the pump housing.

15. Follow all steps in Linde Conversion Bulletin "VARIABLE-PLATE" to remove the Rear Bearing from the Drive Shaft.

16. Set the Rear Bearing aside.

17. Remove the Bearing Support Ring from the Drive Shaft.



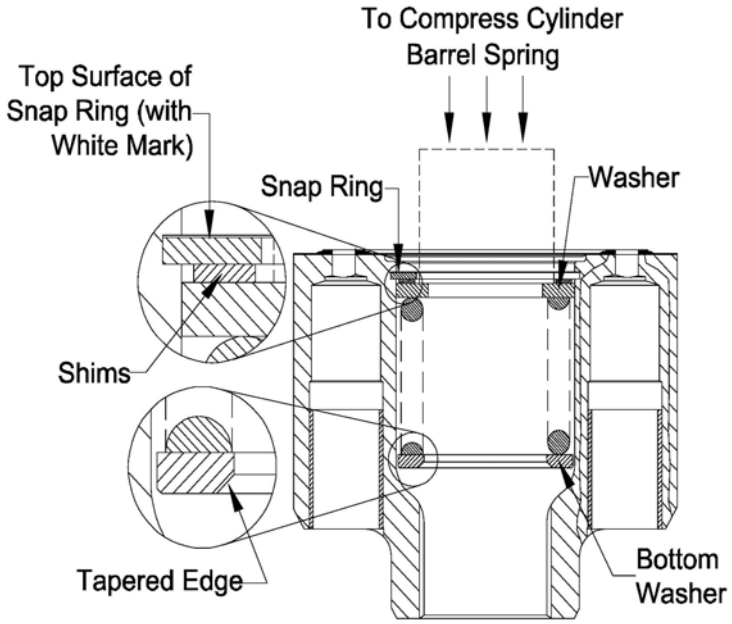
18. Remove the two metal split pins from the swash plate.

18. Using the proper race driver tool, drive the Rear Bearing Race into the Rear Head.

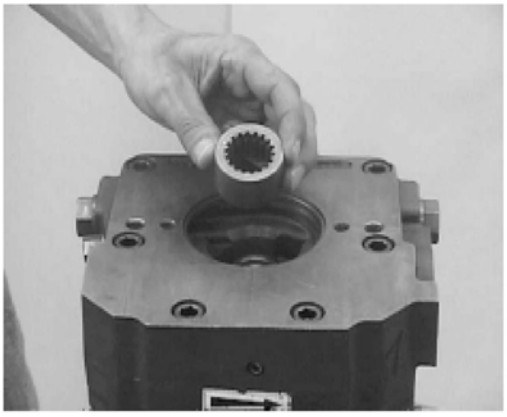
19. Install the Snap Ring and Washer into the Cylinder Barrel. Do NOT install the Bottom Washer, Cylinder Barrel Spring, or Cylinder Barrel Shims at this time. When installing the Snap Ring, make sure to orient it so that the white mark is facing towards the bronze surface of the Cylinder Barrel. If using a new Snap Ring without a white mark, apply a white mark with paint on the snap ring and make sure to orient the Snap Ring as just described.

20. Follow all steps outlined in Appendix "A" (located at the end of this repair manual) to measure the Cylinder Barrel lift-off and for proper shim selection.

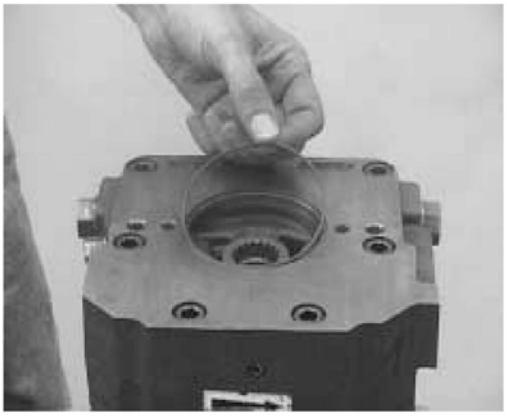
21. Assemble the Cylinder Barrel as illustrated below. Make sure that the tapered edge of the Bottom Washer is facing away from the Cylinder Barrel Spring. Addtionally, make sure the the Snap Ring is positioned with the white mark as illustrated.



Hydraulic Pump Repair - Linde



54. Install the Charge Pump Coupling onto the Drive Shaft.



55. Apply some petroleum jelly to the o-ring and place it in the o-ring groove in the Rear Head.

56. Apply some petroleum jelly to the o-ring and place it in the o-ring groove in the Charge Pump.

Linde Repair Manual	Appendix "B": Procedure to Shim For Piston Slipper Lift-Off	Appendix "B" Rev. 1, 8-13-02 Page 3 of 3

Example: HPV105-02 Pump

Part #1: (For the first *Hold-Down Clamp*)
Dimension "Q" = 10.39mm
Dimension "R" = 5.50mm
Dimension "S" = 5.99mm

Dimension "Y" = (5.50mm) + (5.99mm) = 11.49mm

Dimension "Z" = (11.49mm) – (10.39mm) = 1.10mm

You must calculate a range for the *Shims*:

(maximum clearance) = (1.10mm) + (0.03mm) = 1.13mm

(minimum clearance) = (1.10mm) + (0.01mm) = 1.11mm

Select a *Shim* (or combination of *Shims*) that is between 1.11mm and 1.13mm for the first *Hold-Down Clamp*. To compensate for measuring errors, it is recommended that you select a shim between the two extreme values – 1.12mm.

Part #2: (For the second *Hold-Down Clamp*)
Dimension "Q" = 10.42mm
Dimension "R" = 5.50mm (same value as in Part #1)
Dimension "S" = 5.99mm (same value as in Part #1)

Dimension "Y" = (5.50mm) + (5.99mm) = 11.49mm

Dimension "Z" = (11.49mm) – (10.42mm) = 1.07mm

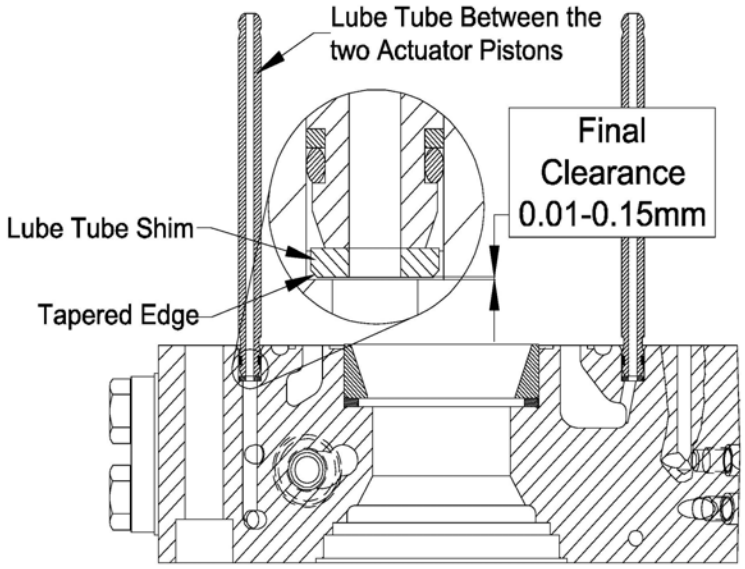
You must calculate a range for the *Shims*:

(maximum clearance) = (1.07mm) + (0.03mm) = 1.10mm

(minimum clearance) = (1.07mm) + (0.01mm) = 1.08mm

Select a *Shim* (or combination of *Shims*) that is between 1.09mm and 1.10mm for the second *Hold-Down Clamp*. To compensate for measuring errors, it is recommended that you select a shim between the two extreme values – 1.09mm.

Linde Repair Manual	Appendix "E": Procedure to Shim Lube Tubes	Appendix "E" Rev. 0 Page 5 of 5



Example: HPV105-02 Pump

Dimension "A" = 34.88mm
Dimension "B" = 34.93mm

Dimension "C" = 11.51mm
Dimension "D" = 11.53mm

Dimension "E" = (11.51mm) – (34.88mm) + (25.00mm) = 1.63mm
Dimension "F" = (11.53mm) – (34.93mm) + (25.00mm) = 1.60mm

You must calculate a shim range for each Lube Tube:

- For the Lube Tube between the two Actuator Pistons: (reference Dimension "E")

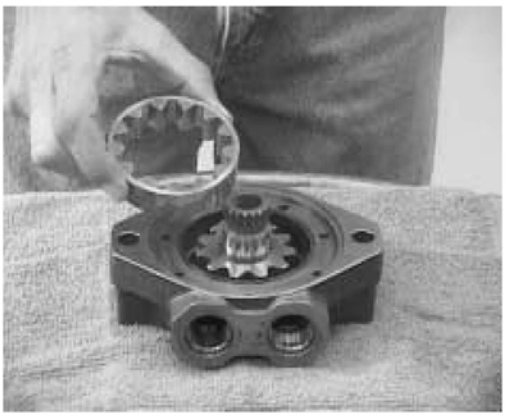
  (maximum clearance) = (1.63mm) – (0.15mm) = 1.48mm
  (minimum clearance) = (1.63mm) – (0.01mm) = 1.62mm

  Select a Lube Tube Shim between 1.48mm and 1.62mm thick

- For the other Lube Tube: (reference Dimension "F")

  (maximum clearance) = (1.60mm) – (0.15mm) = 1.45mm
  (minimum clearance) = (1.60mm) – (0.01mm) = 1.59mm

  Select a Lube Tube Shim between 1.45mm and 1.59mm thick



7. Install the Outer Gear into the Charge Pump Housing.

   IMPORTANT:
   The Outer Gear has a sharp, flat edge on one side and a small taper on the other side. The edge with the small taper must be facing downward (as illustrated to the left) when installed. Failure to install the Outer Gear as described will lead to improper operation of the Charge Pump and/or permanent damage to the Charge Pump.

8. Apply some petroleum jelly to the O-Ring, then install the O-Ring into the Charge Pump housing.

9. (If reusing the original Needle Bearing in the Port Plate, then skip this step) Apply a thin, uniform layer of Green Loctite No. 270 to the outer race of the new Needle Bearing.

   The orientation of the Needle Bearing is important. On one face of the Needle Bearing, there will be some stamping (bearing manufacturer's name, etc.) and the other side will be blank. The side of the Needle Bearing **with** the stamping must be facing **away** from the Port Plate when installed. Install the new Needle Bearing into the Port Plate and wipe away any excess Loctite.

Auxiliary Pump

CAUTION:

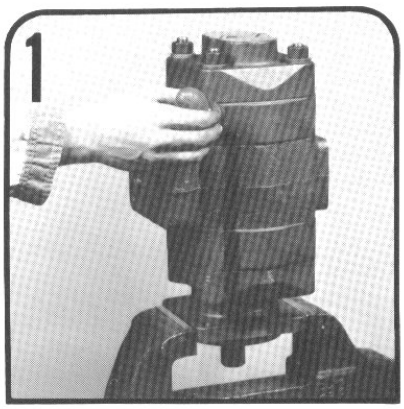
1. If prying off sections becomes necessary, take extreme care not to mar or damage machined surfaces. Excessive force while prying can result in misalignment and seriously damage parts.

2. If parts are difficult to fit during assembly, tap gently with a soft hammer (never use an iron hammer).

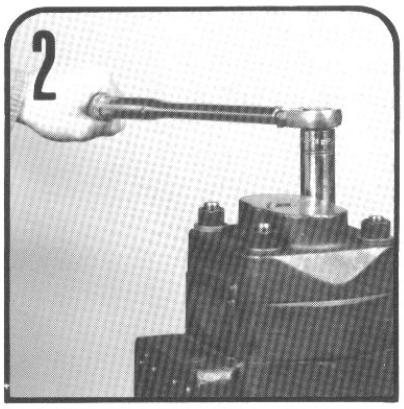
3. Gears are closely matched, therefore they must be kept together as sets when removed from a unit. Handle with care to avoid damage to the journals or teeth. Avoid touching gear journals.

4. Never hammer bushings into bores, use an arbor press.

start disassembly here



Place the pump in a vise with the drive shaft pointing down. Caution: DO NOT GRIP ON OR NEAR ANY MACHINED SURFACES DURING ASSEMBLY OR DISASSEMBLY. Match-mark all sections. Be sure to align these marks when reassembling.



Use a socket wrench to remove the 4 cap screws on single units or the 4 hex nuts, studs and washers of multiple units.

Lift off the port end cover. If prying is necessary, be careful not to damage the machined surfaces. Dowel pins will remain in either port end cover or gear housing. **Do not remove.**

Remove the thrust plate. Examine and replace if necessary. See wear guide page 12.

recommended test procedure

Be sure there is an adequate supply of oil for the pump, at least one gallon of oil for each gpm of pump capacity.

If one section of a tandem pump is being tested, make sure that all other sections not being tested are adequately supplied with oil. If any of the other sections run dry, or if plugs are left in ports, serious and permanent damage will result.

The oil should be a good quality hydraulic oil rated at 150 SSU at 100° F., with the oil temperature held at 120° F. plus or minus 5° F. (Test procedures are described in detail in SAE handbooks; see Hydraulic Power Pump Test Procedure, SAE J745c.)

The feed line must be of adequate size with no more than 5" mercury vacuum adjacent to the pump inlet. As a rule, the feed line must provide a feed flow velocity not in excess of 8 feet per second.

Feeding hot oil into a cold pump may cause the pump to seize. Jog the pump by momentarily starting the driving engine or motor to gradually equalize pump and oil temperatures.

Run the pump at least two minutes at no load and moderate speed (not over 1500 rpm). If the pump becomes excessively hot, shut down immediately and locate the problem source.

Gradually increase pressure on pump, in 500 psi increments until the desired test pressure has been reached. This should take about five minutes.

Delivery should run close to rated catalog performance figures which are averaged from testing several pumps. Something like a 5% lower reading may be used as a rated minimum if new or relatively new parts have been used. When rebuilding the pump with parts from the original pump, which, while worn, appear satisfactory for reuse, a 10% or 15% lower reading may be permitted, depending on the performance expected from the equipment. One's own experience will prove the best guide here.

Many repairmen measure the output at normal operating speed and at zero pressure, then again at 1000 psi (or the operating pressure of the equipment) and allow a volume decrease approximating the listing below. It is a suggested reference only which makes allowance for reused parts.

GPM DELIVERY at 1800 rpm	GPM DROP OFF AT...		
100 psi	1000 psi/70 bar	2000 psi/140 bar	3000 psi/210 bar
10-30	$1\frac{1}{2}$-3	2-$3\frac{1}{2}$	$2\frac{1}{2}$-4
30-50	2-3	$2\frac{1}{2}$-4	3-$4\frac{1}{2}$
50-70	$2\frac{1}{2}$-$3\frac{1}{2}$	3-5	$3\frac{1}{2}$-$5\frac{1}{2}$

At test speeds other than 1800 rpm, gpm delivery will vary almost proportionately, but the same (drop-off) figures should be used.

Be sure to run the pump in the direction for which it was designed and built. Driving pump in the wrong direction will build up pressure behind shaft seal, damaging it and necessitating replacement.

After completing testing procedures, pump is ready for installation and immediate duty operation on equipment. Again, it must be remembered that to prevent seizure, hot oil must not be fed into a cold pump.

The physical and functional aspects of the compressed air system are described briefly in the following paragraphs. However, you should refer to the parts manual for installation details and to the Sullair manual for technical information and troubleshooting.

Compressed Air Subsystem Components (low pressure)

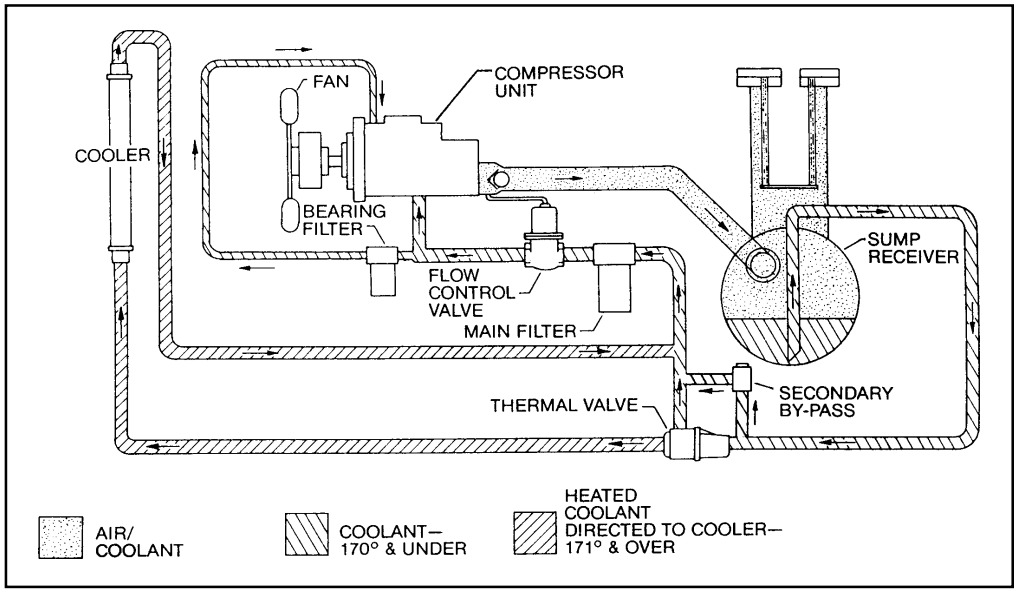


Fig. 4-12 Low Pressure Compressor Cooling and Lubrication System Functional Diagram.

The compressed air subsystem consists of an engine driven air compressor, a separator tank, and the miscellaneous control and plumbing elements required to control the operation of the subsystem and to direct the air flow as desired. Figure 4-12 illustrates the compressor lubrication and cooling functions. Although the following topics briefly describe the functions of the compressor and separator tank, you should refer to the Sullair manual for functional details of these units.

1. **Air Compressor** - A single-stage, positive-displacement, oil-flood-lubricated type air compressor is located behind the engine. The compressor operates in association with the separator tank to provide compressed air at a given CFM to the rotary drill and to other air operated components as required. The air compressor is engine driven by means of a torsional drive coupling.

   In operation, the compressor unit receives oil from the separator tank sump. Besides acting as a coolant for the compressor, the oil seals the leakage paths between the rotor and stator and between the rotor meshes. Forming a lubricating film between the rotors, the oil allows one rotor to directly drive the other. As the air is compressed, it becomes mixed with oil which must be separated out before the air is used.

2. **Separator Tank** - The separator tank is both a sump for the compressor oil and a reservoir for the compressed air. The tank serves to separate the cooling and lubricating oil from the air in the air/oil mixture delivered by the compressor. A built-in filter in the separator tank filters the oil from the air, and the recovered oil is returned to the compressor. A sight gauge in the return line enables the operator to see that oil is flowing in the line. A blow-down valve is located in a common line between the compressor and tank.

Compressor Oil Filter

Changing Filter Elements (continued)

4. DO NOT run the system without a filter element (5) installed. Check that the o-ring (2) on the head assembly (7) is not damaged. Use replacement filter element part number called for on the element change label or in the parts book.
5. Lubricate element o-ring (2) with clean system fluid and push open end of filter element (5) straight onto the nipple in the head assembly (7). Clean out filter bowl (6) and lightly lubricate threads of filter cover assembly with clean system fluid. Screw cover assembly onto head assembly until it bottoms. O-ring sealing in not improved by overtightening.

> **CAUTION:**
> **DO NOT use pipe wrench, hammer, or any other tool to tighten bowl.**

6. Bleed the system and check for leaks. To bleed filter, open bleed plug, if fitted, one and one half turns. Jog system and fill filter until all air bleeds through plug, then tighten plug. Pressurize system fully and check for leaks; if leaks occur, check o-rings and sealing surfaces.
7. After element change, ensure differential pressure device is reset by pushing in the button; electrical switches reset automatically. When system reaches normal operating temperature, check that the electrical switch has not actuated and/or the visual warning button has remained depressed. If visual indicator rises due to a cold start condition, reset again as outlined in "Routine Maintenance".

ders, or maintain or troubleshoot these systems only in well–ventilated areas away from heat, open flame or sparks. **DO NOT** install, store or otherwise expose ether cylinders to temperatures above 160°F (71°C). Remove ether cylinder from the compressor when operating in ambient temperatures above 60°F (16°C).

P. DO NOT attempt to use ether as a starting aid in gasoline engines or diesel engines with glow plugs as serious personnel injury or property damage may result.

Q. DO NOT spray ether into compressor air filter or into an air filter that serves both the engine and the compressor as serious damage to the compressor or personal injury may result.

R. Antifreeze compound used in air line anti–icer systems contains methanol which is flammable. Use systems and refill with compound only in well–ventilated areas away from heat, open flames or sparks. **DO NOT** expose any part of these systems or the antifreeze compound to temperatures above 150°F (66°C). Vapors from the antifreeze compound are heavier than air. **DO NOT** store compound or discharge treated air in confined or unventilated areas. **DO NOT** store containers or antifreeze compound in direct sunlight.

S. Store flammable fluids and materials away from your work area. Know where fire extinguishers are and how to use them, and for what type of fire they are intended. Check readiness of fire suppression systems and detectors if so equipped.

1.5 MOVING PARTS

A. Keep hands, arms and other parts of the body and also clothing away from belts, pulleys and other moving parts.

B. DO NOT attempt to operate the compressor with the fan or other guards removed.

C. Wear snug–fitting clothing and confine long hair when working around this compressor, especially when exposed to hot or moving parts inside the enclosure.

D. Keep access doors closed except when making repairs or adjustments, performing service or when starting or stopping the compressor.

E. Make sure all personnel are out of and clear of the compressor prior to attempting to start or operate it.

F. Shut off engine before adding fuel, fluid, coolant lubricants, air line antifreeze compound or battery electrolyte, or before replacing ether starting aid cylinders.

G. Disconnect the grounded negative battery connection to prevent accidental engine operation prior to attempting repairs or adjustments. Tag the battery connection so others will not unexpectedly reconnect it.

H. When adjusting the controls, it may require operation of the equipment during adjustment. **DO NOT** come in contact with any moving parts while adjusting the control regulator and setting the engine RPM. Make all other adjustments with the engine shut off. When necessary, make adjustment, other than setting control regulator and engine RPM, with the engine shut off. If necessary, start the engine and check adjustment. If adjustment is incorrect, shut engine off, readjust, then restart the engine to recheck adjustment.

I. Keep hands, feet, floors, controls and walking surfaces clean and free of fluid, water, antifreeze or other liquids to minimize possibility of slips and falls.

1.6 HOT SURFACES, SHARP EDGES AND SHARP CORNERS

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.

1.7 TOXIC AND IRRITATING SUBSTANCES

A. DO NOT use air from this compressor for respiration (breathing) except in full compliance with OSHA Standards 29 CFR 1920 and any other Federal, State or Local codes or regulations.

⚠ 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.

B. DO NOT use air line anti–icer systems in air lines supplying respirators or other breathing air utilization equipment and **DO NOT** discharge air from these systems into unventilated or other confined areas.

C. Operate the compressor only in open or well–ventilated areas.

D. If the compressor is operated indoors, discharge engine exhaust fumes outdoors.

E. 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.

SPECIFICATIONS

MODULE

DIMENSIONAL:

MODEL	LENGTH		WIDTH		HEIGHT		WEIGHT	
	in.	mm	in.	mm	in.	mm	lb.	kg.
250 (w/ receiver mtd.)	71	1803	34	864	30.5	775	980	445
330	39	991	36	914	32	813	1050	476
375	39	991	36	914	32	813	1050	476
500	39	991	36	914	32	813	1050	476
750	51	1295	43	1092	40	1016	1500	680
900	51	1295	43	1092	40	1016	1500	680

RECEIVER/SUMP TANK

MODEL	SUMP LENGTH		SUMP DIAMETER		SUMP HEIGHT		DISCHARGE PIPE SIZE	WEIGHT	
	in.	mm	in.	mm	in.	mm	m.n. p.t.	lb.	kg
250 (vert. tank)	--	--	12	305	34	864	1 1/2"	95	43
330 ("T" tank)	36	914	18	457	50	1270	21/2" No Thrd.	520	236
375 ("T" tank)	36	914	18	457	50	1270	21/2" No Thrd.	520	236
500 ("T" tank)	48	1219	24	610	51	1473	3"	520	236
750 ("T" tank)	48	1220	24	610	51	1473	3"	520	236
900 ("T" tank)	48	1220	24	610	51	1473	3"	520	236

POWER REQUIREMENTS (FOR COMPRESSOR UNIT ONLY):*

	330	375	500	750	900
Rated Speed.	2100 RPM	2100 RPM	2100 RPM	2100 RPM	2100 RPM
BHP Required at 100PSIG (6.9 bar)	86 (64.16KW)	97 (72.33KW)	120 (89.49KW)	176 (131.99KW)	208 (155.10KW)
BHP Required at 80PSIG (5.5 bar)	78 (58.16KW)	87 (64.87KW)	105 (78.30KW)	155 (115.59KW)	182 (135.72KW)
Max. Torque Required	213 ft/lb (289.7Nm)	240 ft/lb (326.4Nm)	300 ft/lb (408Nm)	443 ft/lb (602.5Nm)	520 ft/lb (707.2Nm)

* For 1050,1250 and 1600 machines, consult factory for specifications.

NOTE

Sullair recommends 1200 MINIMUM RPM for start–up, warm–up and idle modes. Maximum RPM is shown on the compressor serial nameplate of the drill compressor package.

TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
MACHINE SHUTS DOWN WITH AIR DEMAND PRESENT	No Fuel	Check fuel gauge and add fuel if necessary.
	Compressor Discharge Temperature Switch Is Open	Cooling air flow is insufficient; clean cooler and check for proper ventilation.
		Low oil sump level; add oil.
		Dirty oil; change oil
		Clogged oil filter; change element.
		The temperature regulating section of the fluid control center is not functioning properly; change the thermostat element.
		Defective discharge temperature switch; check for a short or open circuit to the engine fuel rack solenoid. Should this check out normally, it could be possible that the temperature switch itself is defective.
	Defective Engine Oil Pressure Switch	Check continuity and replace if necessary.
	Blown Fuse In Wiring Harness	Check continuity and replace if necessary.
MACHINE WILL NOT BUILD UP FULL DISCHARGE PRESSURE.	Air demand too great	Check service lines for leaks or open valves.
	Dirty air filter	Check filter indicator and change or clean element if required.
	Pressure regulator out of adjustment	Adjust regulator according to control adjustment instructions in the Maintenance section
	Defective pressure regulator	Check diaphragms and replace if necessary (kit available).
	Defective minimum pressure valve	Check that piston is moving freely.
	Pilot valve out of adjustment	Adjust pilot valve according to control adjustment i instructions.
	Start/Run valve	Check to see if it is in run position
IMPROPER UNLOADING WITH AN EXCESSIVE PRESSURE BUILD–UP CAUSING PRESSURE RELIEF VALVE	Pressure Regulating Valve Is Set Too High	Readjust.
	Leak In Control System Causing Loss Of	Check control lines.
		Defective diaphragms in the Sullicon Control; re place diaphragms (kit available)
		Defective pressure regulating valve, repair valve (kit available).
	Inlet Valve Jammed	Free or replace valve.
	Defective Pressure Relief Valve	Replace pressure relief valve.
	Pilot Valve Out Of Adjustment	Adjust pilot valve according to control adjustment instructions.
INSUFFICIENT AIR DELIVERY	Plugged Air Filter	Clear or replace.
	Plugged Air/Oil Separator	Replace separator element and also change con pressor oil and oil filter at this time.
	Defective Pressure Regulator	Adjust or repair
	Power Source Speed Too Low	Readjust engine speed.
	Pilot Valve Out Of Adjustment	Adjust pilot valve according to control adjustment instructions.
EXCESSIVE COMPRESSOR OIL CONSUMPTION	Clogged Return Line	Clear orifice
	Separator Element Damaged Or Not Functioning Properly	Change separator element.
	Leak In The Lubricating System	Check all pipes, connections, and components.
	Defective Blowdown Valve Diaphragm	Replace diaphragm.
COMPRESSOR OVERHEATING	Dirty Oil Cooler Core	Clean core thoroughly.
	Faulty Thermostat In Thermal Valve	Change thermostat element.
	Plugged Oil Cooler Tubes (Internal)	Clean tubes thoroughly.
	Low Sump Oil Levels	Fill.
	Plugged Compressor Oil Filter	Change Element.
	Plugged Oil Return Line	Clean orifice.

ders, or maintain or troubleshoot these systems only in well–ventilated areas away from heat, open flame or sparks. **DO NOT** install, store or otherwise expose ether cylinders to temperatures above 160°F (71°C). Remove ether cylinder from the compressor when operating in ambient temperatures above 60°F (16°C).

P. DO NOT attempt to use ether as a starting aid in gasoline engines or diesel engines with glow plugs as serious personnel injury or property damage may result.

Q. DO NOT spray ether into compressor air filter or into an air filter that serves both the engine and the compressor as serious damage to the compressor or personal injury may result.

R. Antifreeze compound used in air line anti–icer systems contains methanol which is flammable. Use systems and refill with compound only in well–ventilated areas away from heat, open flames or sparks. **DO NOT** expose any part of these systems or the antifreeze compound to temperatures above 150°F (66°C). Vapors from the antifreeze compound are heavier than air. **DO NOT** store compound or discharge treated air in confined or unventilated areas. **DO NOT** store containers or antifreeze compound in direct sunlight.

S. Store flammable fluids and materials away from your work area. Know where fire extinguishers are and how to use them, and for what type of fire they are intended. Check readiness of fire suppression systems and detectors if so equipped.

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D. Keep access doors closed except when making repairs or adjustments, performing service or when starting or stopping the compressor.

E. Make sure all personnel are out of and clear of the compressor prior to attempting to start or operate it.

F. Shut off engine before adding fuel, fluid, coolant lubricants, air line antifreeze compound or battery electrolyte, or before replacing ether starting aid cylinders.

G. Disconnect the grounded negative battery connection to prevent accidental engine operation prior to attempting repairs or adjustments. Tag the battery connection so others will not unexpectedly reconnect it.

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D. If the compressor is operated indoors, discharge engine exhaust fumes outdoors.

E. 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.

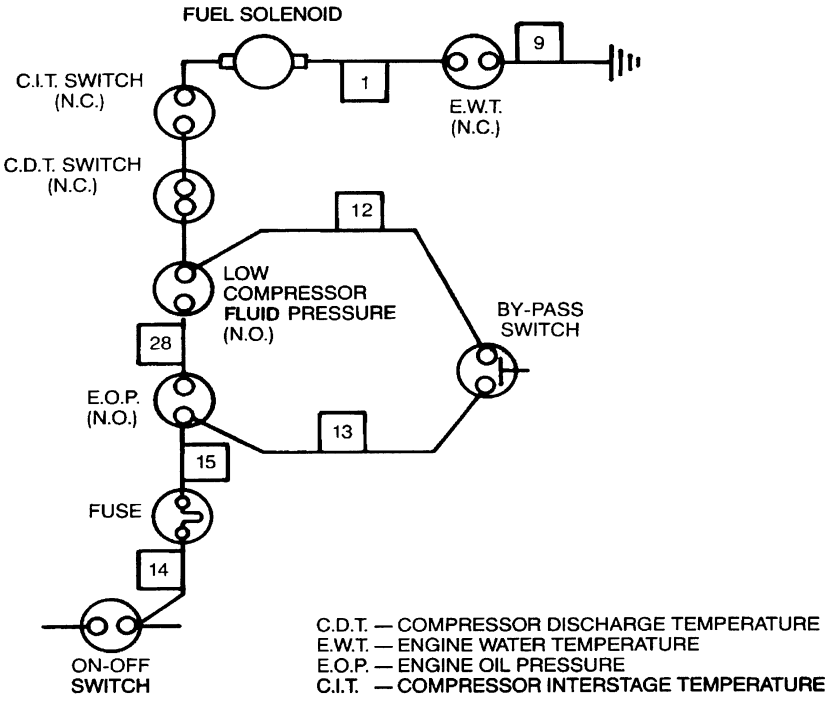
Figure 2–7 Mininum Discharge Temperature Before Condensation

250psig	INLET TEMPERATURE						
RH	60	70	80	90	100	110	120
60	138	153	167	181	195	209	224
80	150	165	179	194	209	224	240
100	159	174	189	205	230	235	252
300psig							
RH	60	70	80	90	100	110	120
80	146	160	174	189	203	218	233
80	157	172	187	202	218	234	249
100	167	182	197	214	229	245	262
350psig							
RH	60	70	80	90	100	110	120
60	151	166	181	196	211	225	241
80	163	179	194	210	226	241	257
100	173	189	205	222	238	253	271

400psig							
RH	60	70	80	90	100	110	120
60	157	172	187	202	218	240	248
80	169	184	200	216	232	256	266
100	179	195	212	228	244	262	279
450psig							
RH	60	70	80	90	100	110	120
80	161	177	192	207	224	240	256
80	174	190	206	222	238	256	272
100	184	200	218	234	252	268	286
500psig							
RH	60	70	80	90	100	110	120
60	166	181	197	212	228	244	262
80	178	194	212	228	244	262	278
100	189	206	222	240	258	274	292

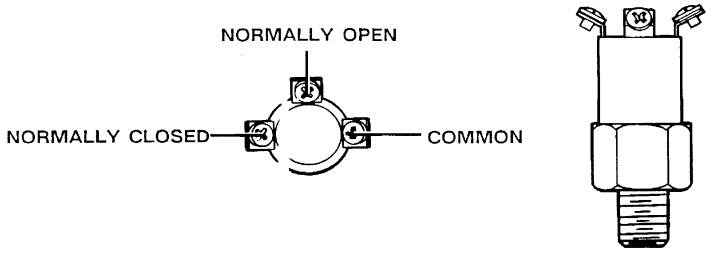
Figure 2–12 Typical Wiring Diagram (Diagram Shown Below is "Energized to Run" Fuel Solenoid)

(A)



FALLING COMPRESSOR FLUID PRESSURE SWITCH

(B) (B)



NOTE: Switch to be wired opposite than the system of power (i.e. normally closed system – use open and common terminals; normally open system, use normally closed and common terminals).

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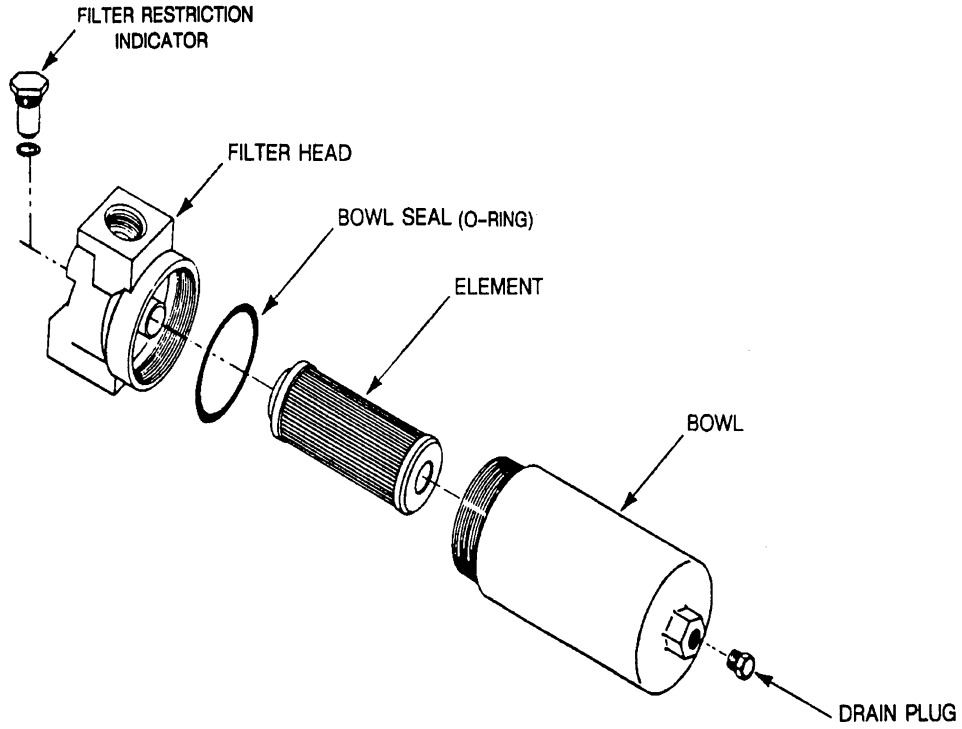
5.5 MAINTENANCE EVERY 1000 HOURS

Perform the following after every 1000 hours of operation:

1. Clean the return line orifice and strainer.
2. Service the minimum pressure valve (see Section 5.6 under Servicing the Minimum Pressure Valve).

Figure 5–1 Full–Flow Fluid Filter



5.6 PARTS REPLACEMENT AND ADJUSTMENT PROCEDURES

SERVICING THE FULL–FLOW FLUID FILTER

Refer to Figure 5–1. The full–flow fluid filter is located schematically in the coolant line between the receiver/sump and the compressor unit. The full–flow filter element is replaceable. For installation of filter element and o–ring kit , follow the procedure explained below.

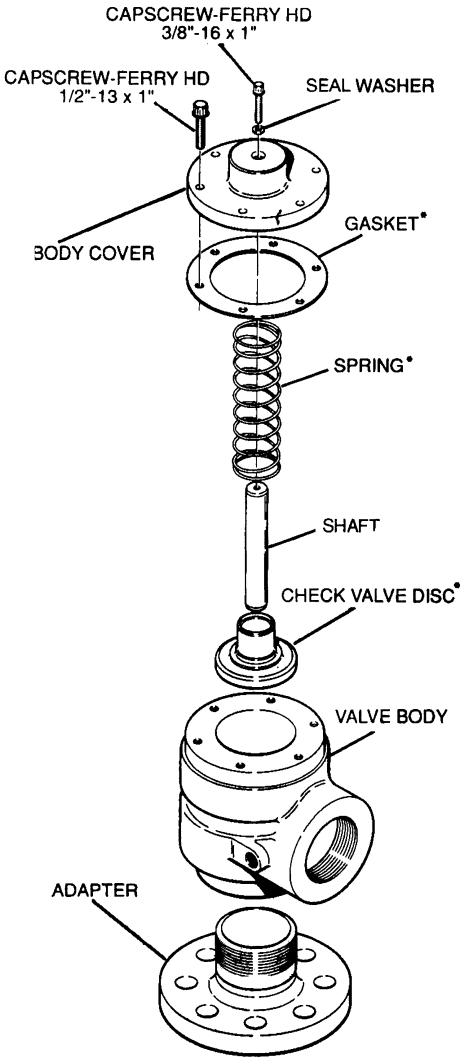
1. The compressor must be shut off and the system pressure must be relieved.
2. Remove drain plug and drain fluid from the bowl.
3. Rotate the bowl counterclockwise (looking from the bottom) and remove.
4. Inspect and clean the inside of the bowl and bottom of filter head.
5. Replace bowl seal.

NOTE

The large diameter end of the spring should contact the new element.

6. Place new clean element in housing, centering it on location in the filter head.
7. Replace bowl, rotate clockwise (looking from bottom) and hand tighten.
8. Replace drain plug.

Figure 5–14 3" Discharge Check Valve



Repair kit (Consult Factory)

6. Place spring onto the hub of the disc bearing assembly.
7. Place new gasket on the valve body.
8. Install cover/shaft assembly centering shaft into spring and disc with bearing.
9. Install the six cover capscrews and torque to 80 ft.–lbs. (108 Nm).

DISCHARGE CHECK VALVE MAINTENANCE FOR 3" VALVE

(1) Body
(2) Cover
(3) Shaft
(4) Gasket
(5) Spring
(6) Washer
⅜" capscrew
½" capscrew
½" plug
(7) Disc with Bearing

Refer to Figure 5–14.

1. Remove the six (6) capscrews from the valve body cover and remove the cover/shaft assembly.
2. Remove gasket and spring from valve body.
3. Remove disc/bearing assembly from valve body.
4. Clean cover and valve body gasket surfaces.
5. Install new disc/bearing assembly (9) into valve housing (1).
6. Place spring (7) onto disc/bearing assembly shaft.
7. Place gasket (6) on valve body.
8. Install cover (2)/shaft (5) assembly centering shaft into spring.
9. Install the six cover capscrews and torque to 80 ft.–lbs. (108 Nm).

FLEXIBLE PIPE COUPLING MAINTENANCE

Refer to Figure 5–15.
COUPLER INSTALLATION

1. Install both couplings as shown, encompassing the retainer, gasket and sleeve. **DO NOT** tighten either coupling until the entire joint has been assembled.
2. Tighten the nuts to the torque value shown in Table 2. **RECOMMENDED ASSEMBLY TORQUE MUST BE MAINTAINED.** Retightening of the coupler will be necessary if leakage occurs.

SPECIAL NOTES

1. Assembly of the gaskets can be made easier by dipping the gaskets in water or the fluid to be sealed. **DO NOT USE THE RUBBER LUBRICANTS.**
2. Flexible joints are not intended to support end loads caused by internal pressure or other forces causing pipe separation.

DRIVE COUPLING MAINTENANCE

Refer to Figure 5–16. Drive coupling maintenance is normally not necessary on Sullair Drill compressors. In the event that your coupling needs repair, follow the procedure explained below for disassembly.

1. Remove all interconnecting piping to the compressor and any other which may interfere with lifting of the compressor from the frame.
2. Using an overhead lift with a minimum 2 ton capacity, connect a chain of sufficient length and size along with a lifting strap to the compressor

6.2 RECOMMENDED SPARE PARTS LISTING FOR ALL MODELS

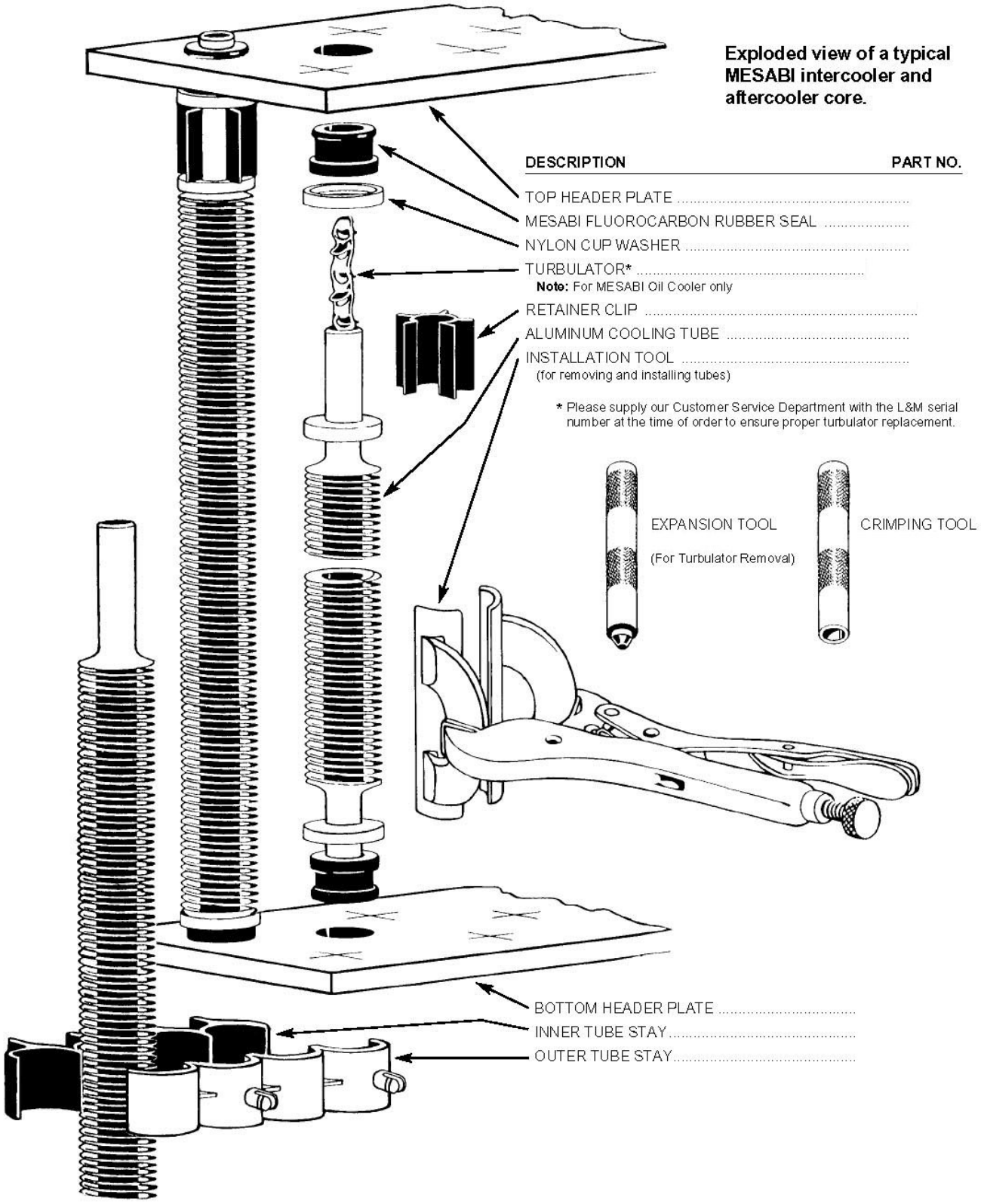
DESCRIPTION	QTY
SPARE PARTS LIST FOR 20/12 COMPRESSOR AIR END(500-1350SCFM) 350 PSIG	
*REPAIR KIT FOR 3" DIAMETER SHAFT SEAL – FRONT	1
*REPAIR KIT FOR 1 1/4" DIAMETER SHAFT SEAL – BACK	1
RELIEF VALVE – GEARCASE	1
REPAIR KIT FOR 3 ½" FLEXMASTER – 2 REQ.	2
DISCHARGE TEMPERATURE SWITCH 265F NC	1
INTERSTAGE TEMPERATURE SWITCH 250F NC	1
FLUID PRESSURE SWITCH 90# FALLING	1
FLUID STOP VALVE:	
2" SAE CODE 61	1
1 ½" NPT	1
	1
DISCHARGE CHECK VALVE:	
2 ½" (M85)	1
2 ½" (NPT)	1
2 ½" (4BSF)	1
3" (NPT)	1
INLET BUTTERFLY VALVE 6"	1
INLET BUTTERFLY VALVE 8"	1
INLET BUTTERFLY VALVE 8" WITH 0.625 ORIFICE	1
INLET VALVE PNEUMATIC CYLINDER	
SEAL	1
SHAFT	1
REPAIR KIT FOR INLET POPPET VALVE 6" WITH SPRINGS	1
REPAIR KIT FOR INLET POPPET VALVE 6" LESS SPRINGS	1
REPAIR KIT FOR INLET POPPET VALVE 8" WITH SPRINGS	1
REPAIR KIT FOR INLET POPPET VALVE 8" LESS SPRINGS	1
SPARE PARTS LIST FOR 20/12 COMPRESSOR AIR END (700-1350SCFM) 500 PSIG	
*REPAIR KIT FOR 3" DIAMETER SHAFT SEAL – MAIN	1
*REPAIR KIT FOR 1 1/4" DIAMETER SHAFT SEAL – AUXILIARY	1
RELIEF VALVE – GEARCASE	1
REPAIR KIT FOR 3 ½" FLEXMASTER – 2 REQ.	2
DISCHARGE TEMPERATURE SWITCH 300F NC	1
INTERSTAGE TEMPERATURE SWITCH 280F NC	1
FLUID PRESSURE SWITCH 90# FALLING	1
FLUID STOP VALVE:	
2" SAE CODE 61	1
	1
DISCHARGE CHECK VALVE	
2 ½" (M85)	1
2 ½" (NPT)	1
2 ½" (4BSF)	1
3" (NPT)	1
INLET BUTTERFLY VALVE 6" WITH 0.625 ORIFICE	1
INLET BUTTERFLY VALVE 8" WITH 0.625 ORIFICE	1
INLET VALVE PNEUMATIC CYLINDER	
SEAL	1
SHAFT	1
REPAIR KIT FOR INLET POPPET VALVE 6" WITH SPRINGS	1
REPAIR KIT FOR INLET POPPET VALVE 6" LESS SPRINGS	1
REPAIR KIT FOR INLET POPPET VALVE 8" WITH SPRINGS	1
REPAIR KIT FOR INLET POPPET VALVE 8" LESS SPRINGS	1
SPARE PARTS LISTS FOR 20/12 MODULE (500-1000 SCFM 350 PSIG)	
*REPAIR KIT FOR FLUID FILTER	8
FLUID FILTER DIFF. PRESSURE INDICATOR (FILTER MOUNTED)	1
FLUID FILTER DIFF. PRESSURE INDICATOR (LOCAL MOUNTED)	1
REPAIR KIT FOR THERMAL/BYPASS VALVE	1
REPAIR KIT FOR THERMAL VALVE ELEMENT	

SERVICE MANUAL

RADIATORS & CORES

Please read and follow instructions carefully before proceeding with any service work and/or repairs. Consult factory before proceeding with any possible warranty claims.

MESABI® Aluminum Tube Air to Oil Cooler – Standard Parts



Tube Removal (continued)

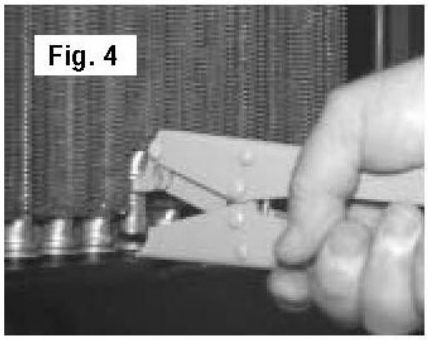


Fig. 4

STEP 4. Reposition tool, so the upper jaw is between the upset on the tube and the copper washer as shown in **Fig. 4.** Raise tube until bottom end clears the rubber seal.

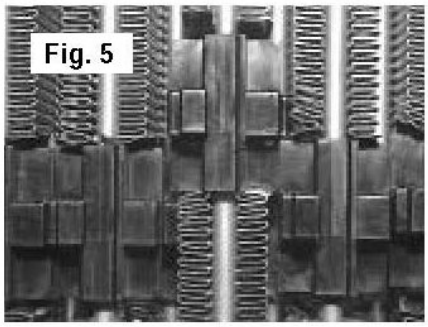


Fig. 5

If you are working with an ITS core, the tube should be raised high enough so that the interlocking tab clears the adjacent dovetail groove as shown in **Fig. 5.**

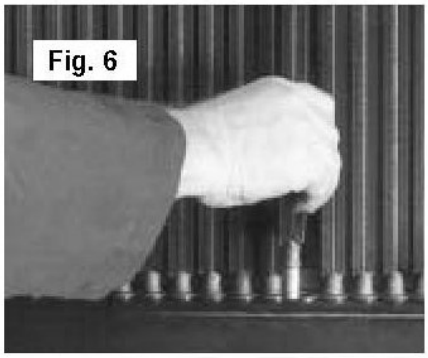


Fig. 6

STEP 5. With a minimum of angle, swing tube out, just far enough to allow it to be pulled down and out of its top seal, as shown in **Fig. 6.**

Cleaning Tube Ends

Before the original tubes are reinstalled, the tube ends must be clean of foreign material. L&M recommends polishing the tube ends with a polishing wheel (Grainger #5A725 - use Qty. 5 together) and a copper polishing compound (Grainger #3W769).

If the debris cannot be removed by polishing, L&M recommends using a piece of fine grit emery cloth or steel wool. If there is a lot of debris on the tube ends, use a 6" or 8" diameter wire wheel brush with a wire size of .006 or .008. Larger diameter wire sizes could damage the tube ends. Try installing a tube. If it does not slide easily into the top and bottom seals, try polishing the tube ends as per above.

Seal Installation

HELPFUL HINTS:

- L&M recommends installing new MESABI seals when tubes are removed.
- After removing the old seals, clean the plate holes of any foreign debris. We recommend a McMaster Carr Chuck Grip with 3/4" brush #63505T65 (L&M P/N 64092).
- Clean out inside of tanks and blow out plate holes with air.
- Install new seals in clean dry holes.
- If the core has a center tank, do not install seals at the bottom of the top core until all the tubes are installed in the bottom core.

With your thumb start the new MESABI seals into the holes and push them part way in. Care must be taken not to install seals too far into the header plate. A properly installed seal has a crowned or convex top surface, and the tube hole is slightly flared at the opening. A seal that is installed too far into the header has a concave top surface and the tube hole is noticeably smaller in diameter as shown in **Fig. 7**. Over installed seals will make tube installation more difficult and are much more likely to be damaged during tube installation.

The use of a hammer directly on the seal can easily cause seals to be installed too far into the header plate. L&M recommends the use of a flat plate 3/8" x 3" x 6" placed over the seals and hitting with a rubber mallet will allow the seals to be properly installed.

Fig. 7

ON THE LEFT: Properly installed seal.

RIGHT: seal installed too far into header.

Lubrication

Use #10 hydraulic oil as a lubricant. Using a 1/2" diameter tube brush with fiberglass bristles (L&M P/N 63451), coat the inner hole of each seal.

The oil can be brushed onto the tube ends using a paint brush. Make sure seal holes and both tube ends are completely lubricated.

Compressed Air Supply

The compressed air supply is used to back blow the filter elements to clean the filter material. The outside section of the top of the dust collector is a compressed air reservoir. This air tank is connected directly to the impulse valves which supply the air pulse to clean the filter. The lines should be drained daily using the petcock next to the timer (fig. 5-8).

Air Regulator/Filter

Adjust the air regulator/filter to 40 PSI (2.8 bar). Lift up the cap and turn to adjust, then push back down to lock. If air pressure is too high the filter elements will be damaged. The air regulator/filter is located on the side of the dust collector opposite the timer (fig. 5-7). The air regulator/filter is equipped with a water separator which automatically drains the water off as it accumulates in the bowl.

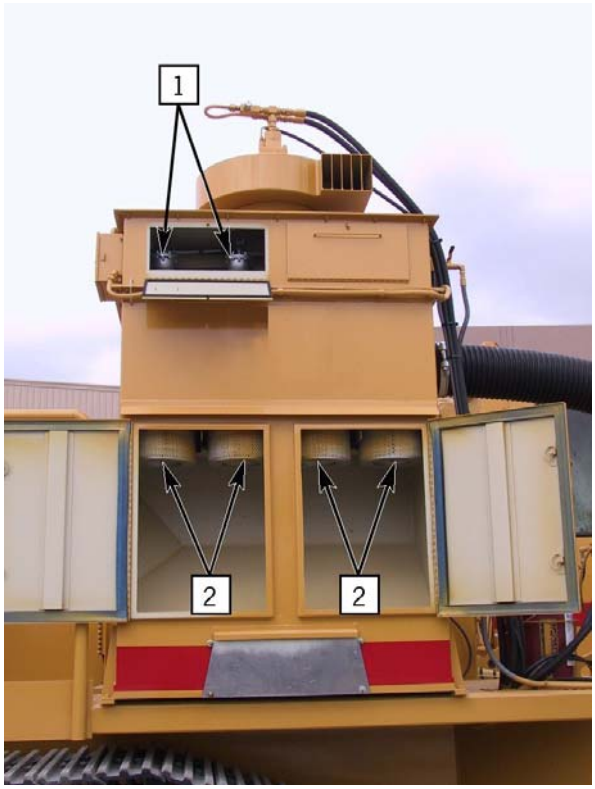


Fig. 5-6 FC3000 Dust Collector
1. Air Impulse Valves (4)
2. Filters (4)

Fig. 5-7 Air Regulator/Filter

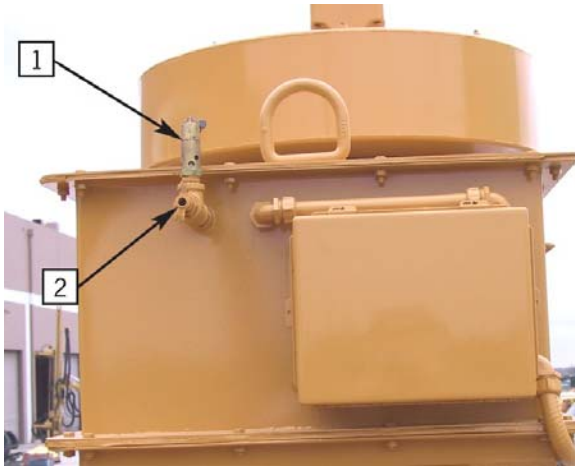


Fig. 5-8 FC3000 Dust Collector
1. Relief Valve
2. Water Drain Petcock

Water Pump (vertical)

Pump Specifications

Stroke	– 1"	Oil Capacity	– 1 quart
Oil Type	– SAE 30	GPM	– 9
Direction of Rotation	– either	Maximum Pressure	– 550 PSI
Number of Pistons	– 2	RPM	– 500
Crankcase Material	– Cast iron		

Torque Requirements

Valve Chamber Studs	– 15 ft. lb.	Conn Rod Nuts	– 7 ft. lb.
Rear Cover HHCS	– 15 ft. lb.	Packing Assembly Nut	– 10 ft. lb.

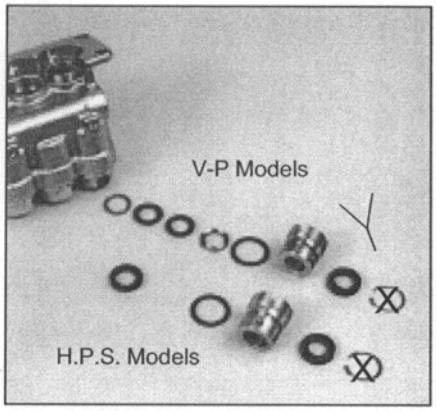
Reassembling Valve Parts

NOTE **Valve seats are used with the thin seating area pointing toward the valve disc.**

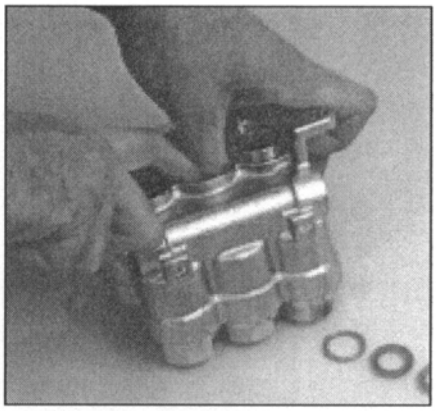
1. With the o-ring (4) in place on each valve seat (7), place a few drops of light oil on the ring and seat and place each squarely in the bottom of the recess in the valve chamber.
2. Place the valve cages (6) on the valve seats (7) and the spring and disc (5) inside each cage.
3. Repeat steps 1 and 2 to install the outer discharge valve parts.
4. Place the valve covers (3) (with o-rings on bottom groove) over each valve assembly.
5. Replace clamp bar (2) and capscrew (1), tightening capscrew (1) only snugly. Overtightening capscrew (1) can damage valve parts. Torque to 30 ft. lbs.

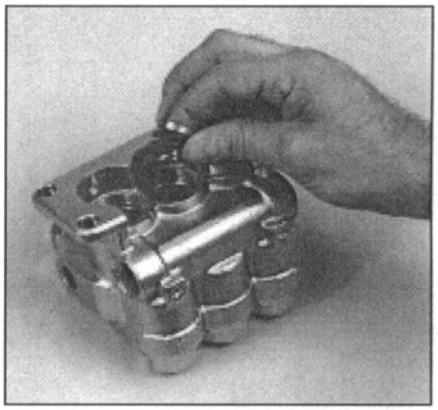
Servicing the Crankshaft

1. Remove pipe plug (38) and drain oil from pump case.
2. Disconnect piping and remove pump from mounting.
3. Remove capscrews (37), cup washers (36) and mounting base (35) carefully to protect gasket (34).
4. Remove capscrews from rod assemblies (25). Use a center punch or other suitable instrument to mark caps and rods for proper rematching when they are reassembled.
5. Remove oil slinger (29) from the crankshaft (30).
6. Push the connecting rods and crosshead assemblies into the pump case to clear the crankshaft (30).
7. Remove the driven sheave from the crankshaft extension.
8. Remove the snap rings (33).



Seal and V-Packing Arrangement


Installation of Male Adapter


Order of Packings [MA, VP, FA]

SERVICING THE SEALS

Disassembly

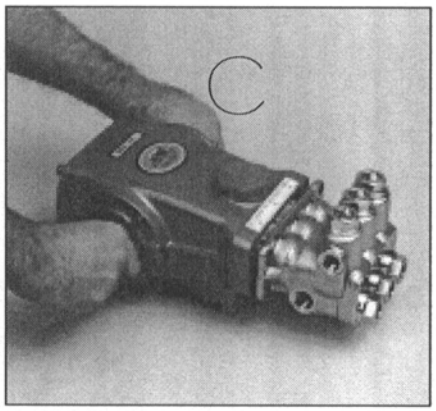
1. Remove the Manifold Head as described in SERVICING THE PLUNGERS section.
2. Place Manifold Head on work surface **with crankcase side up**.
3. On 5PFR and 7PFR plunger pumps prior to May of 1989, remove Snap Ring and Lo-Pressure Seal from each Seal Case. Discard Snap Rings (refer to Tech Bulletin 054).
4. On 5PFR and 7PFR plunger pumps after May of 1989, remove Lo-Pressure Seal from each Seal Case.
5. On 15PFR plunger pumps, remove Snap Ring and Lo-Pressure Seal from each Seal Case.
6. Remove Seal Case from each seal chamber. Remove O-Ring from outside diameter of Seal Case.
7. **Hi-Pressure Seal Models:** The Hi-Pressure Seal is generally easily removed from the manifold without any tools. If extremely worn a reverse pliers may be used.
8. **V-Packing Models:** The Female Adapter, V-Packings and Male Adapter are easily removed from manifold without any tools. If extremely worn a reverse pliers may be used.

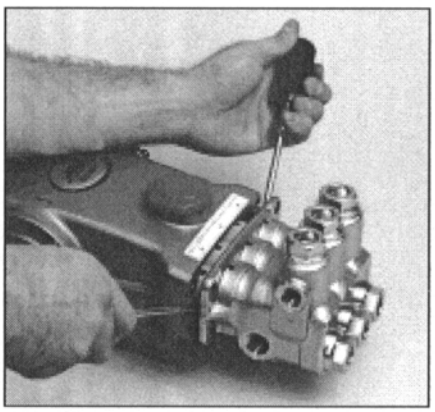
Reassembly

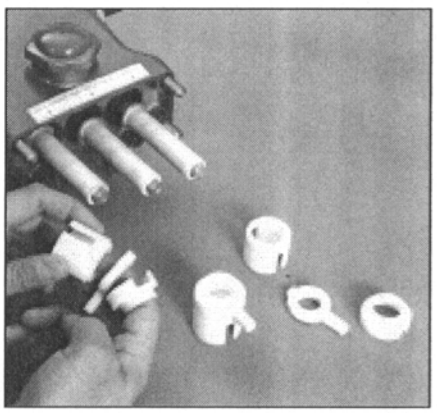
V-Packing Models:

1. Lubricate seal chamber in the manifold.

   NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces (refer to Tech Bulletin 053).
2. Insert Male Adapter **with notches down and "v" side up** and press completely into chamber by hand.
3. Lubricate V-Packings and install one at a time with **grooved side down**.
4. Install Female Adapter with **grooved side down.**
5. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Rings before installing.
6. Thread Seal Case into manifold and tighten with special seal case tool. Torque per chart.


Separating Manifold Head from Crankcase


Removal of Manifold Head from Crankcase


Removal of Seal Retainers and Wicks

Reassembly

Check all mating surfaces. Replace any parts that have scratches or burrs that could cause leakage. Clean all metal parts in clean solvent. Blow dry with air. Do not wipe dry with cloth or paper towel because lint or other matter can get in the hydraulic system and cause damage. Do not use a coarse grit or try to file or grind these parts. Check around the keyway and chamfered area of the shaft for burrs, nicks or sharp edges that can damage the seals when reassembling the bearing housing.

Note: Lubricate all seals (prior to installation) with petroleum jelly such as Vaseline. Use new seals when reassembling this motor. Refer to parts list (6-129) for proper seal kit number.

21 Use a press to install exclusion seal in outer bore of bearing housing. Lip of seal must face outward. See Figure 11. If a press is not available use a plastic or rubber hammer, being careful not to damage or cock seal in the bore.

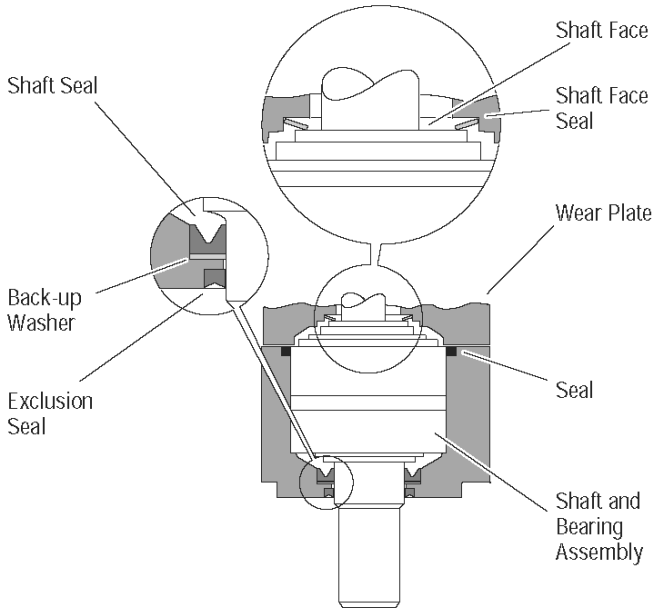


Figure 11

22 Place back-up washer into seal bore. Place shaft seal onto installation tool (600496) and press seal into seal bore of the housing.

23 Clamp housing in vise, see Figure 1.

24 Place protective bullet (see note below) over shaft. Apply petroleum jelly to inside diameter of dust and shaft seal. You may need a press to install shaft and bearing assembly. Do not distort shaft seal. Damage to this seal will cause leakage.

Note: Bullet (600465), for 1inch dia. shafts, available— by special order. Use tape over other shafts to prevent cutting the seals.

25 Apply petroleum jelly to the 76,0 [3.00] diameter seal. Install seal into the bearing housing.

26 Alignment studs can be very helpful in reassembly of the motor. See special tool listing page 2. If you use studs, install 2 studs diagonally opposed in the bearing housing.

27 Install the shaft face seal in the wear plate as shown in Figure 11. Do not distort seal.

28 Install the wear plate, see Figure 11.

29 Apply a light film of petroleum jelly to the 76,0 [3.00] diameter seal and install seal in the wear plate.

30 Install the drive into the output shaft.

31 Align the notch on the outside of the Geroler with the notch on the wear plate. Install the Geroler against the wear plate. Be sure to retain the rollers in the outer ring if they are loose.

32 Install the valve drive in the Geroler.

Note: Installation at this time involves 3 steps in the timing of the motor. Timing determines the direction of rotation of the output shaft. Timing parts include:

1. Geroler
2. Valve Drive
3. Valve Plate
4. Valve

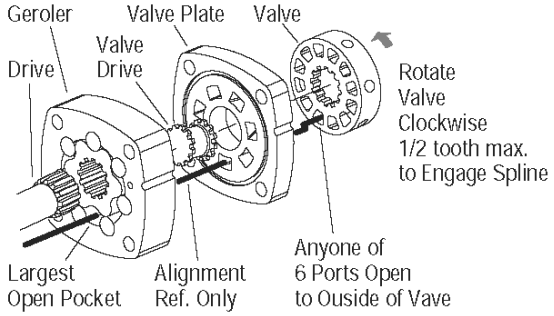


Figure 12 Timing Alignment

Timing Step # 1 — Locate the largest open pocket in the Geroler and mark it on the outside edge of the Geroler.

33 Apply a light film of petroleum jelly to the 76,0 [3.00] diameter seal. Install seal in groove of valve plate.

Feed Cylinder

General Information

This section describes those teardown and rebuild practices that are common to all standard Texas Hydraulics cylinder designs. Specific practices are available based on the component to be rebuilt.

Standard Texas Hydraulics cylinders are designed to operate with fluids per MIL-L-2104 or equivalent. Fluid cleanliness should be maintained at an ISO 18/15 for maximum life.

Teardown

1. Remove the cylinder and drain hydraulic fluid. Clean away all dirt or other foreign substance from openings, particularly at the head.

NOTE **If excessive wear due to side-loads or binding is a possibility, mark or note the piston and head relationship to the rod and tube. This condition will usually show up as a highly polished surface on the piston and head 90° to the pin rotation axis.**

2. Remove the head retaining device. See specific procedure for your head design.
3. Extend the rod until the piston bottoms out on the head. Gently tap the piston against the head to drive the rod assembly out. Place the rod assembly on a surface that will not damage the chrome. Remove the piston locknut and separate the piston from the rod. Slide the head off the rod from the piston end.
4. Discard all old seals.

Auto Tensioning (optional) - Operating Principle

The auto tensioning system consists of hydraulic cylinders anchored to the feed cylinder and attached to a slider block with guide grooves that cable sheaves move up and down in (fig. 6-5). A separate cylinder is used for each sheave. Cable stretch is taken up at a 2 : 1 ratio, i.e. for every unit of cylinder movement, two units of cable stretch are taken up.

Hydraulic valves are used to limit cable tension maximum and minimum values. The system operates in balanced tension, so that, if one cable wears or stretches more than another there will still be equal tension on all cables.

The hydraulic valve logic uses a shuttle valve to allow for multiple pressure sources. The valve logic also incorporates a pressure reducing valve to lower pressure from an external source of higher pressure. This pressure is adjustable through a predetermined range this is appropriate for the system, and it's setting determines the minimum cable tension value. The area of the hydraulic cylinder pistons is also predetermined in conjunction with the system pressure to produce the appropriate forces in the system.

The valve logic also uses a check valve, with an orifice, in series with the pressure reducing valve to prevent reverse flow, effectively locking the cylinder in position and locking the minimum value of tension in the feed cables. This also provides "power off" load locking, and the orifice controls the cylinder speed. Down stream of the check valve, is a relief valve which prevents oil from flowing directly to tank and determines the maximum system pressure. A second relief valve, installed at the retract ports of the pulldown side cylinder determines the maximum value of tension in the feed cables. The second relief also provides a means of adjustment of the maximum tension and will relieve at a predetermined value, should an overload occur from system impulse loads, or excessive take-up of the unloaded set of cables during momentary deflections in the mast structure.

During a hoisting load cycle (removal of drill pipe and bit, after completion of drilling) the mast will deflect under this loading. The set of pulldown cables may be unloaded, or at a reduced tension load during this operation, and the tensioning system will take up slack as the mast deflects. Once the hoisting load is removed and the mast attempts to return to its original undeflected position, the feed cable could be over tensioned. The second relief, which is exposed to externally induced changes in cylinder pressure, will open and limit additional tension to the appropriate maximum level.

A check valve with 30 psi cracking pressure, is downstream of the relief to prevent oil in the valve and cylinder from draining to tank due to gravity head, but allows flow to tank above 30 psi. The system relief valve should be preset to 3000 psi on the bench, by use of a hand pump or other suitable pressure source and a gauge installed in port "GB" of the tensioner manifold. The overload relief is also preset to 3000 psi.

Two check valves are used at the hoisting side of the tensioning cylinder retract ports, allowing free flow into the cylinders, and locking oil in the cylinders, such that oil can not be exchanged between the two hoist side cylinders. An additional check valve is used at the pulldown side of the tensioning cylinder retract ports, allowing free flow into the cylinders, and locking oil in the cylinders, such that oil cannot be exchanged between the pulldown side cylinders and the hoist side cylinders.

7. After successful installation in housings, wait a few minutes for the alcohol to completely evaporate, before assembling. The alcohol is necessary as a lubricant during the installation process, but for assembly the area must be clean and dry in order for the load ring to properly "crush" into its final position.

> **WARNING:**
> **Never install seals with oil, grease or any solvent that can leave a residue.**

Assembly Instructions

1. After both seal halves have been installed in the case and seal plate housings and just prior to assembly, thoroughly clean the faces with denatured alcohol. Apply a thin film of oil (the same oil that will be used in the drive unit) to the faces of the seal rings with a clean lint free cloth. **Be careful not to get oil on the load rings.**
2. Pick up the seal plate (with the half seal installed) with both hands and turn it over using your fingers to hold the seal ring in place, while it is inverted. Line the plate up over the shaft and slide on until the case seal face come in contact with your fingers. Slowly slide your fingers out at the gap and let the faces come together.
3. Place both hands on the seal plate and apply even pressure to the top of it to make sure that the seal is completely seated in the housings. Turn the plate slightly in both directions while applying pressure. At this time it is not important to line up the bolt holes.
4. Visually inspect the gap between the plate and the case to see that it is the same size all of the way around the circumference. If it is not, repeat step 3. If further adjustments are necessary, remove the seal plate and the seal halves from their housings and repeat the installation procedure again starting with step 1 (cleaning process).
5. Line up the bolt holes, and slowly and evenly draw the plate down to the case using the specified torque.

Run-In Period

The run-in period is the amount of running time necessary for the faces to mate to each other to form a perfect seal. One hour in each direction is normally sufficient. It is common for seals to "weep" a little during this period. Continuous dripping and/or running oil is a signal that something is wrong.

Maintenance

For trouble free function of the seal, adequate lubrication of the sealing faces is necessary at all times. A small amount of oil may be visible on the outer diameter of the seal when it is working. This is not a leak, but only the seal faces being properly lubricated. If a seal is removed or the faces are separated after it has been run-in, it should be replaced with a new set.

Cotta Service	Repair Manual	Cotta Service

CONVERSION TABLE

UNIT	X	CONV. FACTOR	=	TO GET
INCH	X	25.4	=	MILLIMETER
INCH	X	2.54	=	CENTIMETER
FOOT	X	0.305	=	METER
QUART	X	0.946	=	LITER
GALLON	X	3.79	=	LITER
OUNCE	X	28.3	=	GRAM
POUND	X	0.454	=	KILOGRAM
INCH POUND	X	0.113	=	NEWTON METER
FOOT POUND	X	1.36	=	NEWTONMETER
PSI	X	0.069	=	BAR
HORSE POWER	X	0.746	=	KILOWATT
°F	=	(°C x 1.8) + 32		

0.5

Cotta Service	Repair Manual	Cotta Service

Fig.17

Carefully move the input shaft assembly upward far enough to allow the removal of the intermediate shaft assembly.

Fig.18

Remove Intermediate shaft assembly from gearbox.

Fig.19

Remove bearing cone from Intermediate shaft. Repeat process on other side.

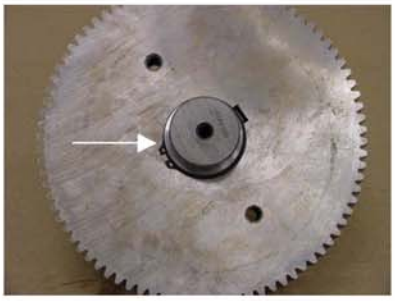


Fig.20

Remove snap ring.

Cotta Service	Repair Manual	Cotta Service

Fig. 29

Wet set screws with sealing compound
(Loctite no. 242)
Tighten set screws in locknuts to 50 ft-lb min. Tighten screws evenly & opposite to one another. Gradually increasing the torque.

⚠ **Do not tighten screws prior to assembling locknut to shaft.**

Fig. 30

Install 2nd locknut and tighten firmly against 1st locknut.

Fig. 31

Wet set screws with sealing compound
(Loctite no. 242)
Install set screws and repeat tightening procedure. (fig. 29)

Fig.32

Input shaft Assembly:

Wet outside of ball bearing with oil and install onto input shaft until contact is obtained with shoulder of the shaft.

2.8

Rotary Drive Gearbox Repair

Cotta Service	Repair Manual	Cotta Service

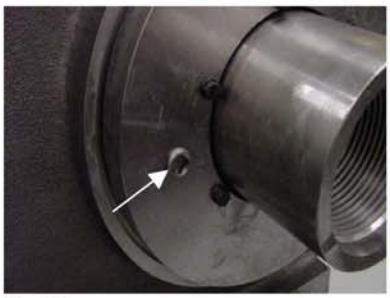


Fig. 66

Wet threads of plug with sealing compound.
(Loctite no. 545)
Install plug in bearing cover and tighten firmly.

Note: this is a magnetic plug!

Fig. 67

Install plug in Gearbox cover and tighten firmly.

Note: this is a magnetic plug!

Technical Data

Speed, Displacement, Pressure, Torque

Diagram 1

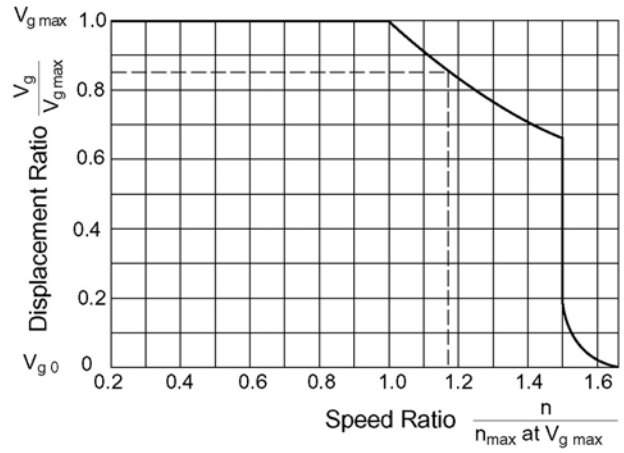
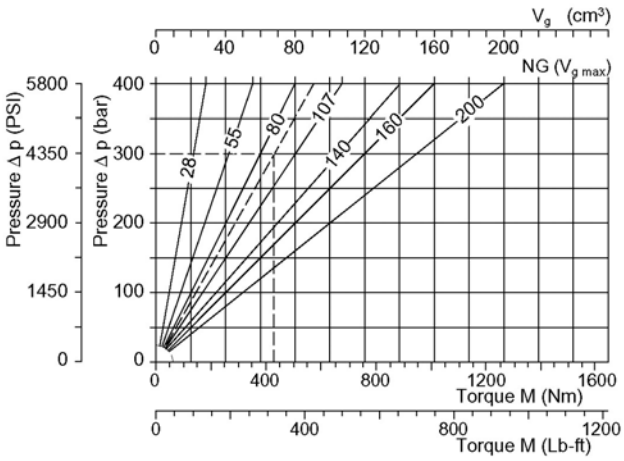


Diagram 2



Example

Given:
- Size 107
- Speed n = 3860 rpm
- n_{max} at $V_{g\,max}$ (see table of values)
- Pressure Δp = 4350 psi (300 bar)

Required:
- Max. perm. displacement
- Torque

Solution:
Speed ratio

$$\frac{n}{n_{max}\text{ at }V_{g\,max}} = \frac{3860}{3300} = 1.17$$

From diagram 1:
Displacement ratio

$$\frac{V_g}{V_{g\,max}} = 0.85$$

Therefore displacement $V_g = 0.85 \cdot V_{g\,max}$
$= 0.85 \cdot 107\ cm^3 = 91\ cm^3$

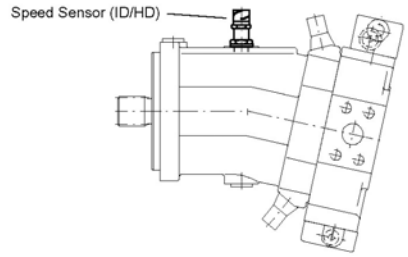
From diagram 2 displacement Vg = 91 cm³ at pressure Dp = 4350 psi (300 bar) gives a torque of approximate. 320 lb-ft (435 Nm) (theoretical values, without considering efficiency).

Speed Sensor (D)

Version A6VM. . . D ("with provisions for speed sensor") includes toothed collar on the rotary group.
A speed-proportional signal is produced by means of the rotating, toothed rotary group which can be picked up by a suitable sensor and fed back for evaluation.
The speed sensor can be screwed into the upper drain port. An additional adapter piece is necessary for the drain ports in order to install the speed sensors (M18 x 1.5).

Size	28	55	80	107	140	160	200
No. of teeth	42	54	58	67	72	75	80
length of thread (mm)	19.9	19.9	19.9	19.9	31.9	31.9	31.9

The speed sensor is not included in standard supply;
Suitable sensors: ***order separately!***
- Inductive impulse detector ID (see RA 95038)
- Hall effect speed sensor HD (see RA 95042)



Reference Formulas

Input Flow $Q = \frac{V_g \bullet n}{231 \bullet \eta_v} \quad \left(Q = \frac{V_g \bullet n}{1000 \bullet \eta_v}\right)$

Output Torque $M = \frac{V_g \bullet \Delta p \bullet \eta_{mh}}{24 \bullet \pi} \quad \left(M = \frac{1.59 \bullet V_g \bullet \Delta p \bullet \eta_{mh}}{100}\right)$

Output Power $P = \frac{M \bullet n}{5252} = \frac{Q \bullet \Delta p \bullet \eta_t}{1714} \quad \left(P = \frac{2\pi \bullet M \bullet n}{60000} = \frac{M \bullet n}{9549} = \frac{Q \bullet \Delta p \bullet \eta_t}{600}\right)$

Output Speed $n = \frac{Q \bullet 231 \bullet \eta_v}{V_g} \quad \left(n = \frac{Q \bullet 1000 \bullet \eta_v}{V_g}\right)$

V_g = Geo. displacement - in³ (cm³)
M = Torque - lb-ft (Nm)
Δp = Pressure drop - psi (bar)
n = Speed - rpm
η_v = Volumetric Efficiency
η_{mh} = Mechanical hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{mh}$)
Q = Flow - gpm (L/min)
P = Drive Power - hp (kW)

Begin of Stroke Adjustment, Gauge Method

Adjustment Procedure for the HD Control

1. Lock or load motors and then bring pump on stroke until at least 600 psi loop pressure is developed. Or supply pressure to the G port with an external pressure sorce. **Caution:** Do not allow oil to flow over the high pressure relief valves for long periods of time, as excessive heat can be generated in the pump.
2. Apply a variable low pressure pilot signal at the gauged X port, either with the charge pump or an external source, eg. remote pilot controller or pressure reducing valve.
3. Gradually increase the pilot pressure at the X port while watching the stroking pressure on the M1 gauge. When the M1 pressure is approximatly 1/2 of G note the pilot pressure on the X gauge. This is the begin of stroke set point. The begin of control adjustment setting ranges from 29-290 psi on HD1 control and 72.5-725 psi on the HD2 control.
4. To change the begin of stroke set point turn the adjustment screw in (clockwise) to lower the setting and out (counter-clockwise) to increase the begin point setting.
5. Repeat steps 1 through 4 until the required begin of control set point is achieved and stable.
6. When the correct setting is reached, lock adjustment screw in place and adjust the pilot pressure above and below the begin point to check motor operation.
7. After obtaining the desired setting shut down the system, remove gauges, reinstall plugs and reconnect pilot line as it was originally.

Adjustment Procedure for the HA Control

1. Lock or load motors to accept pressure from either side of the loop. Gradually increase the loop pressure while watching stroking pressure on the M pressure gauge. This can be done with the main hydrostatic pump. Or by suppling pressure to the G port with an external pressure sorce. **Caution:** Do not allow oil to flow over the high pressure relief valves for long periods of time, as excessive heat can be generated to the pump.
2. When the M1 pressure is approximatly 1/2 of G note the loop pressure on the G gauge. This is the begin of stroke set point.
3. To change the setting turn the adjustment screw in (clockwise) to lower the begin point setting and out (counter clockwise) to increase the begin point setting.
4. Repeat steps 1 through 5 until the required begin of control set point is achieved and stable. The G port may require bleeding each time due to trapped pressure.
5. **Note:** The begin of control can be selected between 1160 and 5075 psi for HA1 control and HA2 control.
6. After obtaining the desired setting lock begin of stroke adjustment screw into place. Shutdown system, remove gauges, reinstall plugs in ports M1 and G. **Caution:** Port G may contain trapped pressure.
7. **Note:** If motor has control override option (T code) port X must be vented to tank during adjustment procedure i.e. X port must be free of any trapped pressure.

Adjustment Procedure for the EP Control

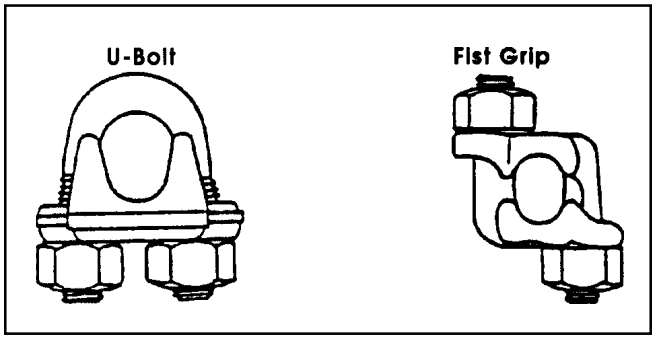
1. Lock or load motors to accept pressure from either side of the loop.and then bring pump on stroke until at least 600 psi loop pressure is developed. Or supply pressure to the G port with an external pressure sorce. **Caution:** Do not allow oil to flow over high pressure relief valves for long periods of time as excessive heat can be generated in the pump.
2. Gradually increase the amperage to the solenoid while watching the stroking pressure on the M1 gauge. When the M1 pressure is approximatly 1/2 of G read the ammeter. This is the begin of stroke set point.
3. If the setting is different from the amperage rating shown in the table on page 8, readjust the setting by turning the adjustment screw in (clockwise) to lower the setting and out (counter clockwise) to increase the begin point setting
4. Repeat steps 1 through 3 until the required begin of control set point is achieved and stable.
5. When the correct setting is achieved, lock the adjustment screw in place, shut down the system. Remove gauges and ammeter reinstall plugs and solenoid connector.

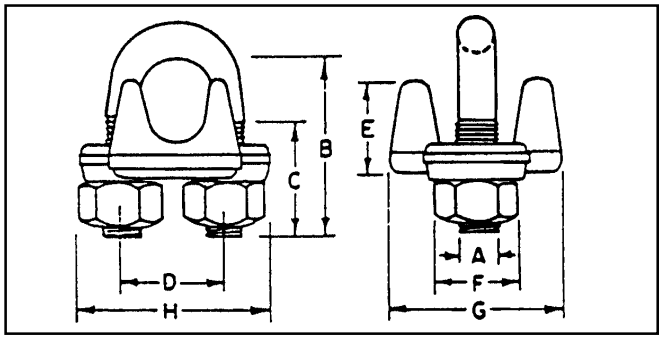
How to Apply Wire Rope Clips (continued)

A termination made in accordance with the above instructions, and using the number of clips shown has an approximate 80% efficiency rating. This rating is based upon the catalog breaking strength of wire rope. If a pulley is used in place of a thimble for turning back the rope, add one additional clip.

The number of clips shown is based upon using right regular or long lay wire rope, 6 x 19 class, or 6 x 37 class, fiber core or IWRC, IPS, or XIPS. If Seale construction or similar large outer wire type construction in the 6 x 19 class is to be used for sized 1 in. (25.4 mm) and larger, add one additional clip. The number of clips shown also applies to right regular lay wire rope, 8 x 19 class, fiber core, IPS, sizes 1 1/2 in. (38.1mm) and smaller; and right regular lay wire rope, 18 x 7 class, fiber core, IPS or XIPS, sizes 1 3/4 in. (44.5mm) and smaller.

For other classes of wire rope not mentioned above, it may be necessary to add additional clips to the number shown. If a greater number of clips is used than shown in the table, the amount of rope turnback should be increased proportionately.





Clip Size	A	B	C	D	E	F	G	H	Min. no of clips	Amount of rope to turn back	Torque in lb-ft	Weight lb/100
1 1/8	.22	.72	.44	.47	.41	.38	.81	.94	2	3 1/4	4.5	5
3/16	.25	.97	.56	.59	.50	.44	.94	1.16	2	3 3/4	7.5	9
1/4	.31	1.03	.50	.75	.66	.56	1.19	1.44	2	4 3/4	15	18
5/16	.38	1.38	.75	.88	.72	.69	1.31	1.69	2	5 1/4	30	30
3/8	.44	1.50	.75	1.00	.91	.75	1.63	1.94	2	6 1/2	45	42
7/16	.50	1.88	1.00	1.19	1.03	.88	1.81	2.28	2	7	65	70
1/2	.50	1.88	1.00	1.19	1.13	.88	1.91	2.28	3	11 1/2	65	75
9/16	.56	2.25	1.25	1.31	1.22	.94	2.06	2.50	3	12	95	100
5/8	.56	2.38	1.25	1.31	1.34	.94	2.06	2.50	3	12	95	100
3/4	.63	2.75	1.44	1.50	1.41	1.06	2.25	2.84	4	18	130	150
7/8	.75	3.13	1.63	1.75	1.59	1.25	2.44	3.16	4	19	225	240
1	.75	3.50	1.81	1.88	1.78	1.25	2.63	3.47	5	26	225	250
1 1/8	.75	3.88	2.00	2.00	1.91	1.25	2.81	3.59	6	34	225	310
1 1/4	.88	4.25	2.13	2.31	2.19	1.44	3.13	4.13	6	37	360	460
1 3/8	.88	4.63	2.31	2.38	2.31	1.44	3.13	4.19	7	44	360	520
1 1/2	.88	4.94	2.39	2.59	2.53	1.44	3.41	4.44	7	48	360	590
1 5/8	1.00	5.31	2.63	2.75	2.66	1.63	3.63	4.75	7	51	430	730
1 3/4	1.13	5.75	2.75	3.06	2.94	1.81	3.81	5.28	7	53	590	980
2	1.25	6.44	3.00	3.38	3.28	2.00	4.44	5.88	8	71	750	1340
2 1/4	1.25	7.13	3.19	3.88	3.94	2.00	4.56	6.38	8	73	750	1570
2 1/2	1.25	7.69	3.44	4.13	4.44	2.00	4.69	6.63	9	84	780	1790
2 3/4	1.25	8.31	3.56	4.38	4.88	2.00	5.00	6.88	10	100	750	2200
3	1.50	9.19	3.88	4.75	5.34	2.38	5.31	7.63	10	106	1200	3200

GENERAL SAFETY RECOMMENDATIONS

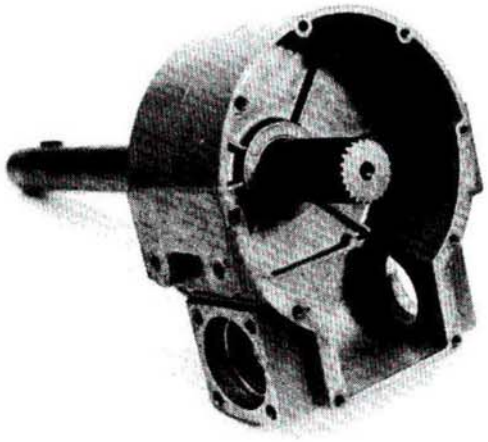
Safety for operators and ground personnel is of prime concern. Always take the necessary precautions to ensure safety to others as well as yourself. To ensure safety, the prime mover and winch must be operated with care and concern by the operator for the equipment and a thorough knowledge of the machine's performance capabilities. The following recommendations are offered as a general safety guide. Local rules and regulations will also apply.

⚠ WARNING

Failure to obey the following safety recommendations may result in property damage, personal injury or death.

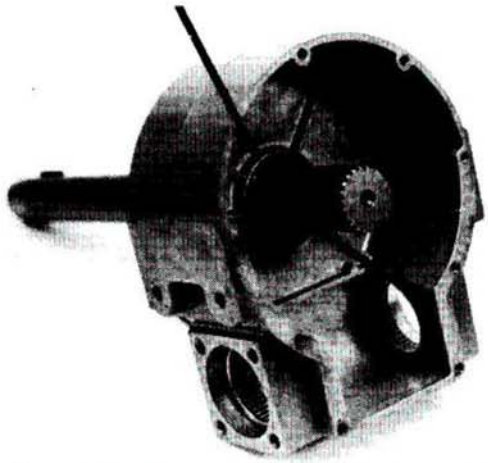
1. Read all warning tag information and become familiar with all controls before operating winch.
2. Never attempt to clean, oil or perform any maintenance on a machine with the engine running, unless instructed to do so in the service manual.
3. Never operate winch controls unless you are properly seated at the operators station on the prime mover and you are sure personnel are clear of the work area.
4. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.
5. Ground personnel should stay in view of the prime mover operator and clear of winch drum. Do not allow ground personnel near winch line under tension. A safe distance of at least 1½ times the length of the cable should be maintained.
6. On machines having hydraulically, mechanically and/or cable controlled equipment, be certain the equipment is either lowered to the ground or blocked securely before servicing, adjusting and/or repairing the winch. Always apply the prime mover parking brakes before dismounting the prime mover.
7. Keep equipment in good operating condition. Perform scheduled servicing and adjustments listed in the "Preventive Maintenance" section of this manual.
8. The winch drum clutch may disengage and drop or lose control of a load if not fully engaged at the beginning of a lift or pull. The winch operator must **visually** determine that the clutch is **fully** engaged before lifting or pulling a load.
9. The winches described herein are neither designed nor intended for use or application to equipment used in the lifting or moving of persons.
10. The cable clamps alone on winches described herein are not designed to hold rated loads. A minimum of 5 wraps of cable must be left on the drum barrel to achieve rated load. Do not use knots to secure or attach winch cable. We suggest that the last 5 wraps of cable be painted bright red to serve as a visual warning.
11. Operate winch at line speeds to match job conditions.
12. Leather gloves should be used when handling winch cable.
13. Never attempt to handle winch cable when the hood end is not free.
14. When winding winch cable on the winch drum, never attempt to maintain tension by allowing winch cable to slip through hands. Always use "hand-over-hand" technique.
15. Never use winch cable with broken strands. Replace winch cable.
16. Do not weld on any part of the winch.
17. Do not use knots to secure or attach winch cable.
18. Use recommended gear lubricant.
19. Install guarding to prevent personnel from getting any part of body or clothing caught at a point where the cable is wrapped onto the drum or drawn through guide rollers.
20. Install switches or valves which will shut off power to the winch in locations where they can be reached by anyone entangled in the cable before being drawn into the winch or any "pinch-point".
21. "Deadman" controls, which automatically shut off power to the winch whenever the operator leaves his station, should be installed whenever practicable.
22. Never allow anyone to stand under a suspended load.
23. Avoid sudden "shock" loads or attempting to "jerk" load free. This type of operation may cause heavy loads, in excess of rated capacity, which may result in failure of cable and winch.
24. The pull should be lined up as straight as possible. Severe-angle pulls put excessive stress on the winch, guide and even the vehicle frame.
25. Always check your wire rope before a winching operation. Look for flat spots, frays, kinks and rust spots; any of these will weaken the rope and may cause failure under load.
26. Use caution when operating a winch. Use a remote control and stand clear of the winch and rope.
27. You can aid the winch by trying to drive a stuck vehicle out, but don't overrun the wire rope. In case the rope does go slack, stop the winch immediately and let the winched vehicle come to a stop. Remove the slack from the rope before continuing the operation.
28. Always respool the rope onto the Drum after a winching operation. This will decrease the chance of developing flat spots or kinks in the rope.
29. Wire ropes that have flat spots, kinks or frays should not be used, as they severely reduce the tensile strength of the rope.
30. Never loop the rope and hook it to itself, as the hook could cut the rope. Use a sling or choker chain.
31. Avoid hooking onto the bumper of a vehicle. Instead, attach the sling to an axle or frame member to avoid damage.
32. Never use the winch rope as a tow line, as this could damage the winch severely.
33. Don't leave the winch in gear when not in use. The winch could be damaged if the motor or PTO is accidentally energized.
34. Never allow anyone to operate your winch who is not familiar with it.

7.



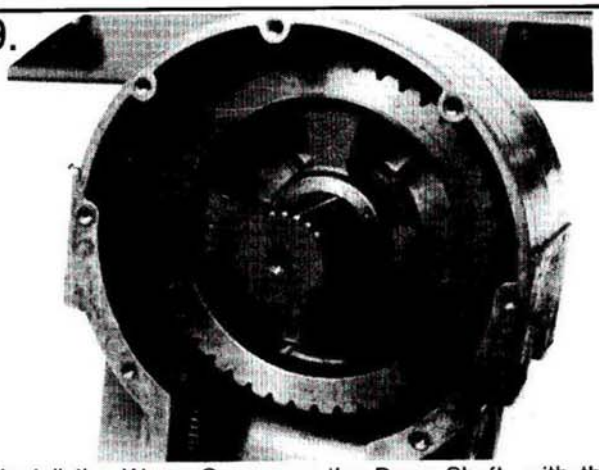
Install the Worm Housing over the end of the Drum Shaft with the Oil Seal against the Thrust Washer.

8.



Install a Thrust Washer over the end of the Drum Shaft, allowing it to rest on the housing boss.

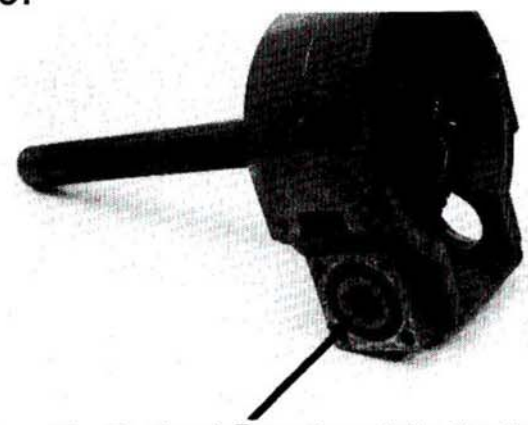
9.



Install the Worm Gear over the Drum Shaft, with the "long hub" end turned inward.

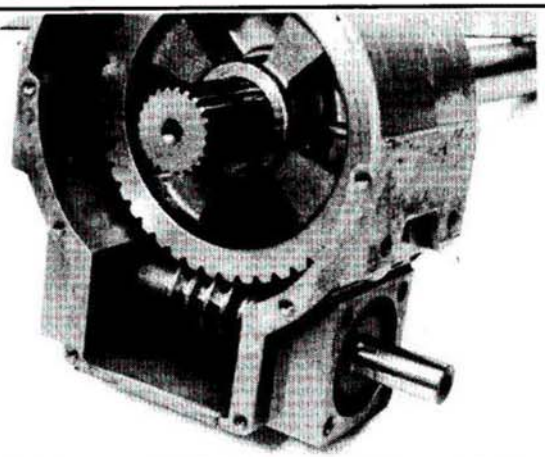
Push the Worm Gear in until it rests against the Thrust Washer.

10.



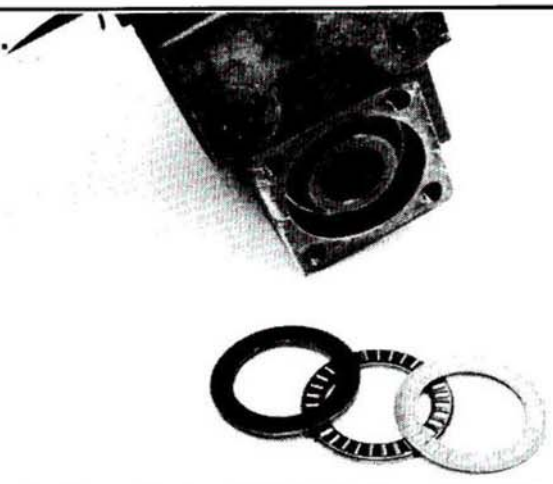
Insert the Bearing Adapter through the Needle Bearing in the end opposite the input end of the Worm Housing (see page 8-#24), with the small end turned outward.

11.



Insert the Worm, small end first, through the Needle Bearing in the input end of the Worm Housing, threading it past the Worm Gear into the Bearing Adapter.

12.



Install a Thrust Washer (1/8″ thick), then a Thrust Bearing, then another Thrust Washer (1/16″ thick) over the small end of the Bearing Adapter.

Carousel Pipe Rack

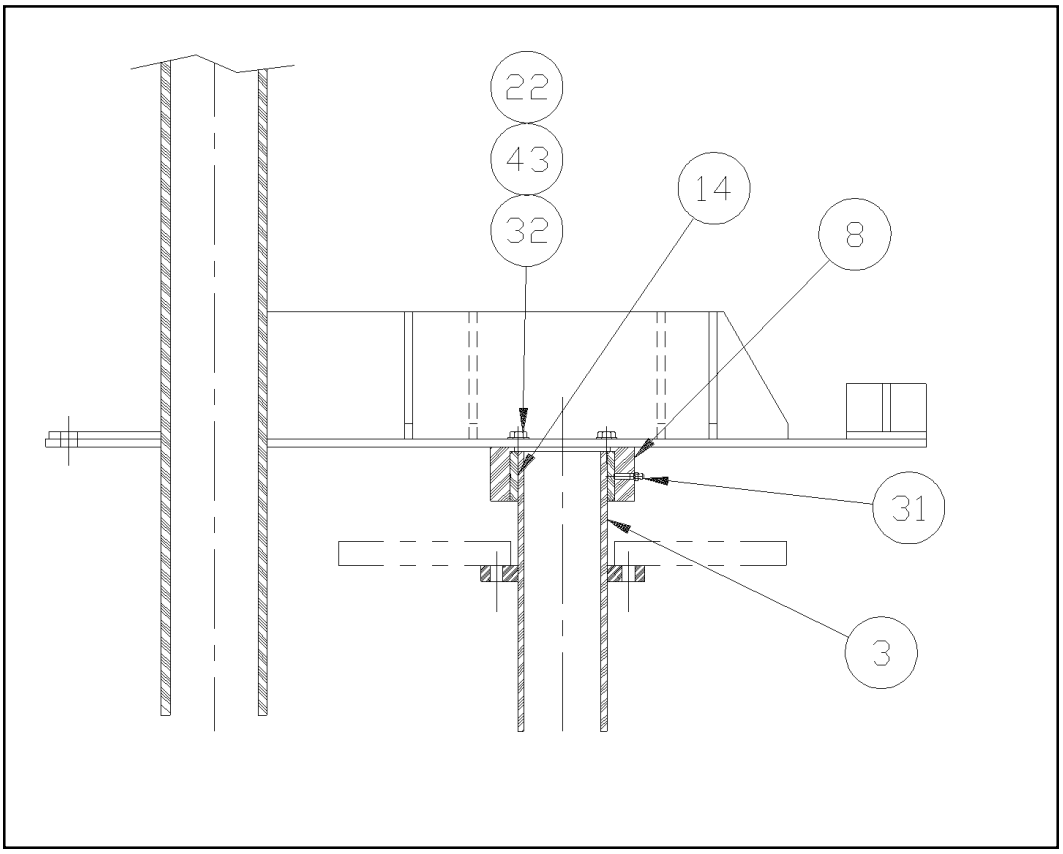


Fig. 6-21 Upper Carousel Support Bearing
3. Top Tube
8. End Cap
14. Journal Bearing
22. Safety Wire
31. Grease Fitting
32. Capscrew (4)
43. Flat Washer (4)

Disassembly

Cleanliness is extremely important when repairing a hydraulic motor. Work in a clean area. Before disconnecting the lines, clean the port area of the motor thoroughly. Use a wire brush to remove foreign material and debris from around the exterior joints of the motor. Check the shaft and key slot, remove all nicks, burrs or sharp edges that might damage the bearing housing seals when installing the shaft and bearing assembly. Before starting the disassembly procedures, drain the oil from inside the motor.

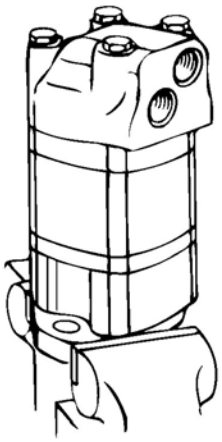


Figure 1

1 Place the motor in a vise with the output shaft down. Clamp across the mounting flange of the motor not the housing. Excessive clamping pressure will cause distortion. When clamping, use some protective device on the vise, such as special soft jaws, pieces of hard rubber or board.

Although not all drawings show the motor in a vise, we recommend that you keep the motor in the vise during disassembly and reassembly. Follow the clamping procedures explained throughout the manual.

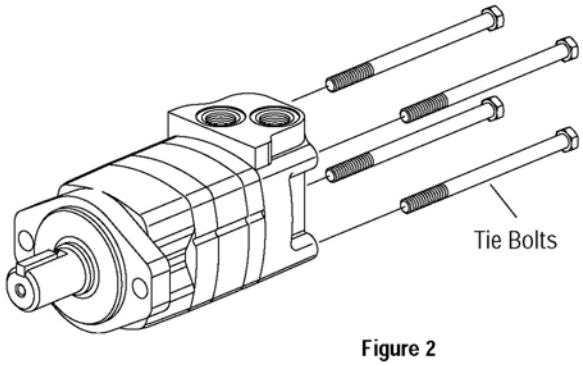


Figure 2

2 Remove 4 bolts from motor.

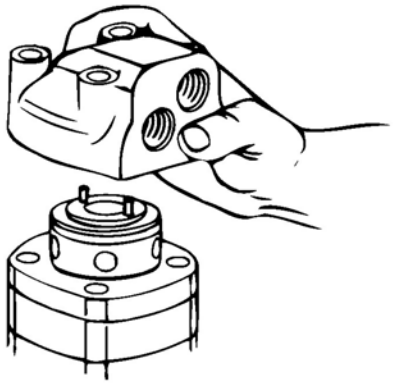


Figure 3

3 Lift valve housing straight up. If done carefully the pins, springs, balance ring assembly, and valve will remain on the valve plate.

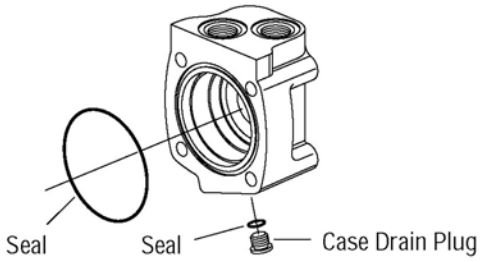


Figure 4

4 Carefully remove 76,0 [3.00] diameter seal from valve housing.

5 Remove case drain plug—with seal, from valve housing.

6 Remove 2 pins and 2 springs from balance ring assembly, see Figure 5.

Pressure Setting Sequence

The following sequence is recommended for checking and setting pressures. Be sure to relieve all pressure in system prior to installing gauges. If machine is equipped with a hydraulic pressure test station (see fig's.7-1a,b & c) it will not be necessary to install gauges. The pressure setting procedures and locations are described fully in this section.

FUNCTION	PRESSURE	PAGE
HYDRAULIC SYSTEM		
1. Charge Pressure	450 PSI (31 bar)	7-13
2. RH / LH Tram		
Pressure Override (P.O.R.)	5000 PSI (345 bar)	7-13
Crossover (High Pressure)	5500 PSI (380 bar)	7-15
3. Auxiliary Pump		
Standby	500 PSI (35 bar)	7-17
Main Pressure	3000 PSI (207 bar)	7-17
Auxiliary Pressure Relief Valve	2500 PSI (172 bar)	7-17
Pulldown Relief Valve	2500 PSI (172 bar)	7-23
4. Cooler Fan Speed	*2000 - 3000 PSI (138 - 207 bar)	7-30
5. Dust Collector/Water Injection	2000 PSI (138 bar)	5-21 (Section 5)
6. Jack Relief	2800 PSI (193 bar)	7-34

* Depends of fan size and cooler package. Consult factory.

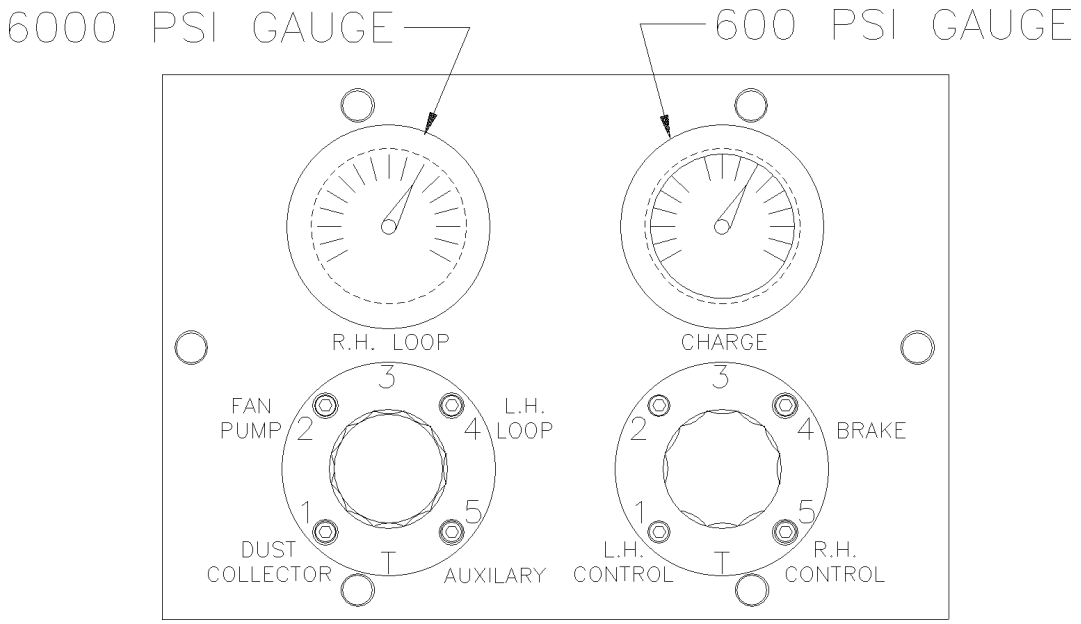


Fig. 7-1b Hydraulic Pressure Test Station Detail
See fig. 7-1c on following page for isolator valve hose connections.

Right Track, Left Track/Rotation Pumps

WARNING:
Relieve pressure on hydraulic and pneumatic systems before loosening connections or parts.
BE SURE machine is on level ground and block tracks before removing brake lines.

1. Set Charge Pressure - 450 PSI (31 bar)

1. Shutdown machine and relieve standing pressure.
2. Install a 600 PSI (41 bar) gauge in the relief valve test port (item 2, fig. 7-7c) or if machine is equipped with a hydraulic pressure test station, turn knob to CHARGE position.
3. Start machine and allow time to warm up. Correct charge pressure is 450 PSI (31 bar). If adjustment is required, loosen locknut and turn relief valve adjustment screw to obtain correct pressure. Tighten locknut.

2. Set Pressure Override (P.O.R.) - 5000 PSI (345 bar)

Function of Pressure Override

The pressure override valve varies the swashplate angle, as required to limit the maximum pressure at port A or B. The override valve prevents continuous dumping of excessive flow at load pressure through the cross port relief valves. This eliminates unnecessary heating of the oil and protects the pump and motor from heavy-handed operators or if the drive stalls, causing the pump to deadhead.

The pressure override is adjusted 500 PSI (35 bar) less than the high pressure crossover relief valves.

Adjustment Procedure

1. Shutdown machine and relieve standing pressure.
2. Install a 6000 PSI (414 bar) gauge in ports M_A and M_B or if machine is equipped with a hydraulic pressure test station, turn knob to R.H. LOOP or L.H. LOOP position. Remove and plug the track brake release line at the tee connection (fig. 7-6a).
3. Be sure the pump control is in neutral. Loosen P.O.R. valve locknut with a 13mm wrench and back out the P.O.R. adjusting screw all the way with a 4mm allen wrench.
4. Start machine and allow time to warm up.
5. With machine in PROPEL mode, slowly move the right or left tram lever (depending upon which pump you are setting) to full forward or reverse position, noting the pressure reading on the gauge. Turn screw in (clockwise) until you get a reading of 5000 PSI (345 bar).

NOTE **One turn of the screw equals 1200 PSI (83 bar).**

6. Now move the tram lever in the opposite direction and note the pressure reading on the gauge. It should be the same on both sides of center. When pressure setting is correct, tighten the locknut.
7. Leave gauges installed for setting of the high pressure crossover relief valves (following page).

Hydraulic Feed Circuit

NOTE **All part numbers on drawings and in text in this section are for reference only. Always order parts from the parts manual for your specific machine serial number.**

Hoist/Pulldown Control Valve 410665 (fig. 7-10)

- Control valve operates in a Load Sensed mode as described previously.
- Both “P” ports are connected to the pressure manifold that sees stand-by pressure (approx. 500 PSI [35 bar]).
- Load sense port is connected to the shuttle at “X” port on Auxiliary Pump.
- Directional pilots are connected together such that the signal from the Hoist/Pulldown controllers shift both spools simultaneously.
- “C” ports are connected to Max. Pulldown Relief Valve 411774 (item 7, fig. 7-15) This relief is set at 2500 PSI (172 bar). Max. pulldown relief is a vented relief that is controlled by the remote pulldown relief valve 57319 located in the cab (item 1, fig. 7-14).
- Remote pulldown relief 57319 (item 1, fig. 7-14) is infinitely variable from 0-2500 PSI (0-172 bar).

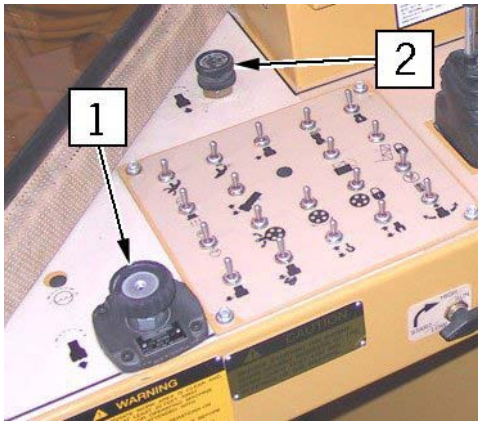


Fig. 7-14 Operator's Control Console - Left Side
1. Remote Pulldown Relief 57319
2. Holdback Valve 342638

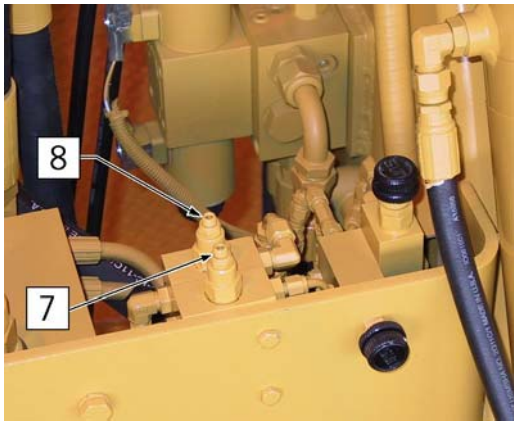


Fig. 7-15 Mast "A" Frame - Engine Side
7. Max. Pulldown Relief Valve 411774
8. Pulldown Counterbalance Valve "C" 414867

Set Max. Pulldown Relief Valve - 2500 PSI (172 bar)

Read pressure from gauge installed in "G" port of feed and auxiliary pump, or if machine is equipped with a hydraulic pressure test station; turn knob to AUXILIARY.

1. Allow system to warm up and place auxiliary pump switch on switch panel to PUMP LOADED position.
2. If no pipe is attached to rotary head, lower rotary head until feed cylinder is bottomed out and leave pulldown lever in LOWER position. If pipe is attached, lower pipe to ground or bottom of hole and leave pulldown lever in LOWER position. Activate pulldown system (auto feed) by pushing switch on switch panel DOWN to engage pulldown system.
3. Loosen locknut using a 9/16 box end wrench and adjust set screw with 9/32 allen wrench until pressure reads 2500 PSI (172 bar). Tighten locknut. Place pulldown system (auto feed) switch in UP position to disengage pulldown system. Return pulldown lever to neutral position.

Jack and Mast Elevate Circuit

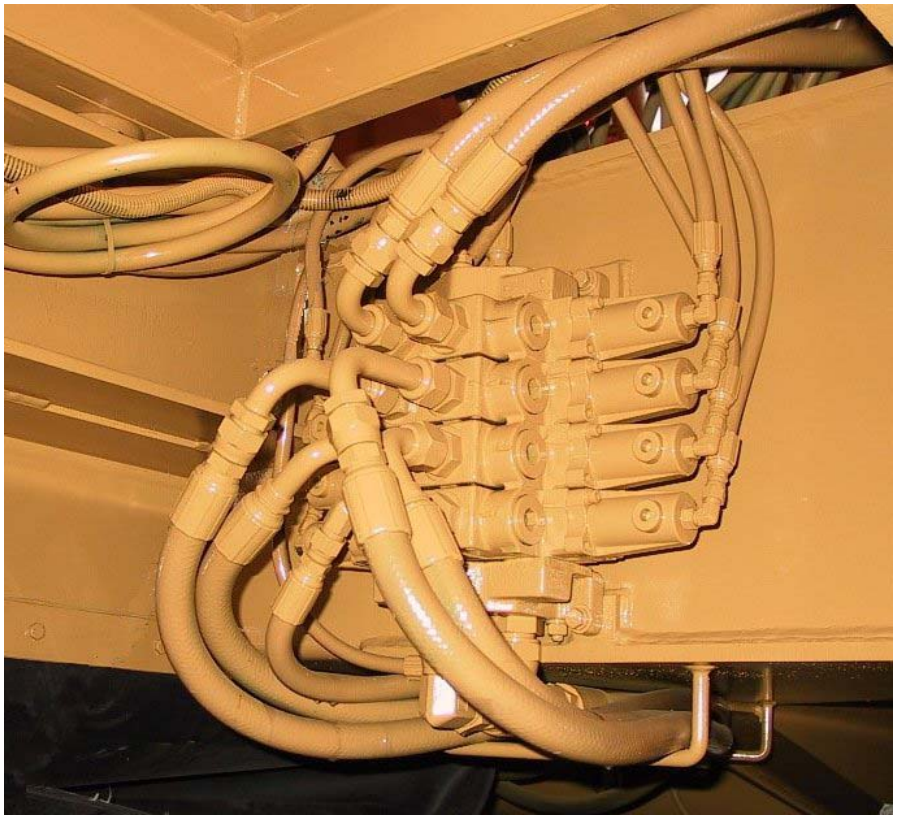


Fig. 7-20 Mast Elevate & Jack Control Valve 410091 (mounted under operator's cab)

Joystick Adjustments (electric)

GENERAL DESCRIPTION, ADJUSTMENT PROCEDURES & TROUBLESHOOTING

Printed Circuit Board (P.C. Board) Terminal Board Connections (All terminals may not be present on your P.C. Board)

(+) Positive voltage 12VDC or 24VDC depending on the controller ordered.

(-) Negative side of the supply voltage.

(X) Auxiliary output: Supply voltage is present whenever the controller is turned on. Output current should not exceed 3 amps.

(A) Output terminal to proportional coil when the control handle is moved in the "A" direction.

(B) Output terminal to proportional coil when the controller handle is moved in the "B" direction.

(C) Common return when high current P.C. Boards are used. The coil's ground or (-) connection must be return to the P.C. Board "C" terminal, not to ground.

(R) Range terminal: See Dual Range Option.

Most P.C. Boards have LEDs (Light Emitting Diodes) which can be used for troubleshooting, or simply as an indication of output at a specific terminal. LEDs are located near the (A) and (B) terminals.

Standard Coil Connections:

Dual Coil: Two coils or solenoids, with each coil having at least 2 connections. One is connected to the P.C. Board (A) terminal, the other is connected to the negative (-) side of the supply voltage. The other coil is connected to the (B) terminal and the negative (-) side of the supply voltage. Two or more P.C. Boards can be paralleled to operate the same coil.

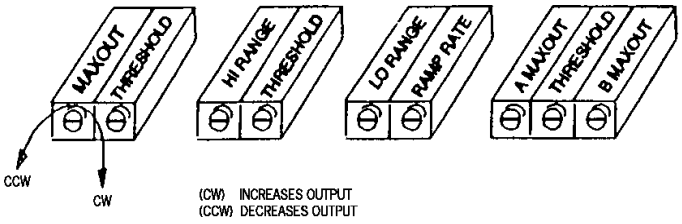


Fig. 7-33 Adjustment Detail and Dual Coil Connections

Adjustment Procedures:

Adjustments are made by turning a trimpot adjustment screw. It may be necessary to turn the adjustment screw several turns (5 or more) to observe a change in output.

Clockwise (CW) adjustment of the trimpot increases the output.

Counterclockwise (CCW) adjustment of the trimpot decreases the output.

Adjustment affects output current and voltage to the coil. The minimum and maximum output current is preset at the factory. However, for optimum performance, they must be adjusted while the equipment is operating.

Counterbalance Valve Adjustment

Counterbalance Valve Adjustments

CAUTION:
Overadjustment of a counterbalance valve, i.e. turning the adjusting screw in too far, could result in uncontrolled descent of the mast assembly.

NOTE **Adjustment of the counterbalance valves is directly opposite of relief valves in this system, in that clockwise adjustment of relief valves increases pressure, whereas clockwise adjustment of the counterbalance valves decreases pressure. This must be remembered when performing any adjustments to the system.**

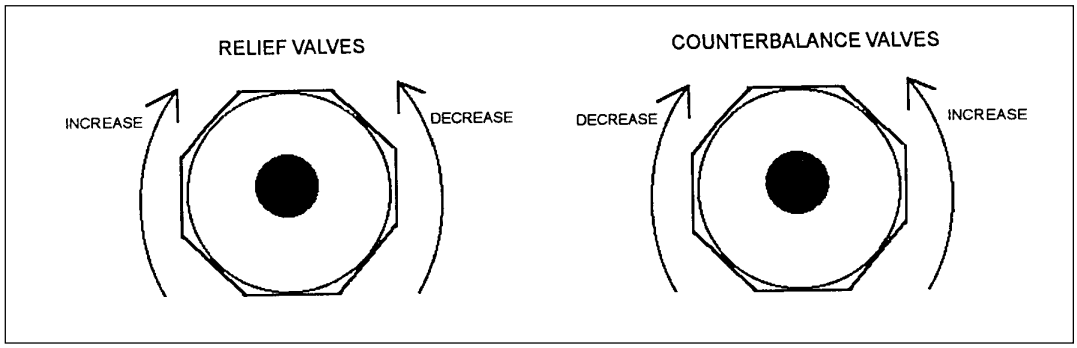


Fig. 7-39 Relief Valve vs. Counterbalance Valve Adjustment

Main Return and Case Drain Filters

Routine Maintenance

Main Return and Case Drain filters do not normally require special attention except for periodic monitoring of the differential pressure warning device. Schedule replacement of filter element every 500 hours, and have ample supply of spare elements available.

1. If external leaking is noted, replace o-ring at leak. For cover seal (4) and reservoir to head seal (6) leaks, replace o-rings. If leakage persists, check sealing surfaces for scratches or cracks; replace any defective parts.
2. Differential pressure devices actuate when the element needs changing or because of high fluid viscosity in "cold start" conditions. If visual indicator is fitted and actuates during "cold start", reset by depressing the rubber button when the normal operating temperature is reached. If indicator actuates after resetting, replace element.

Changing Filter Elements

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

1. Turn off and depressurize the system. Open bleed plug (if fitted) 1 1/2 turns.
2. Unscrew and remove filter cover assembly (2) from head assembly (1), counterclockwise when viewed from above. It may be necessary to use a correct sized wrench on the hexagon on the filter cover assembly (2) to loosen the cover initially.
3. Remove filter element (7) 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.

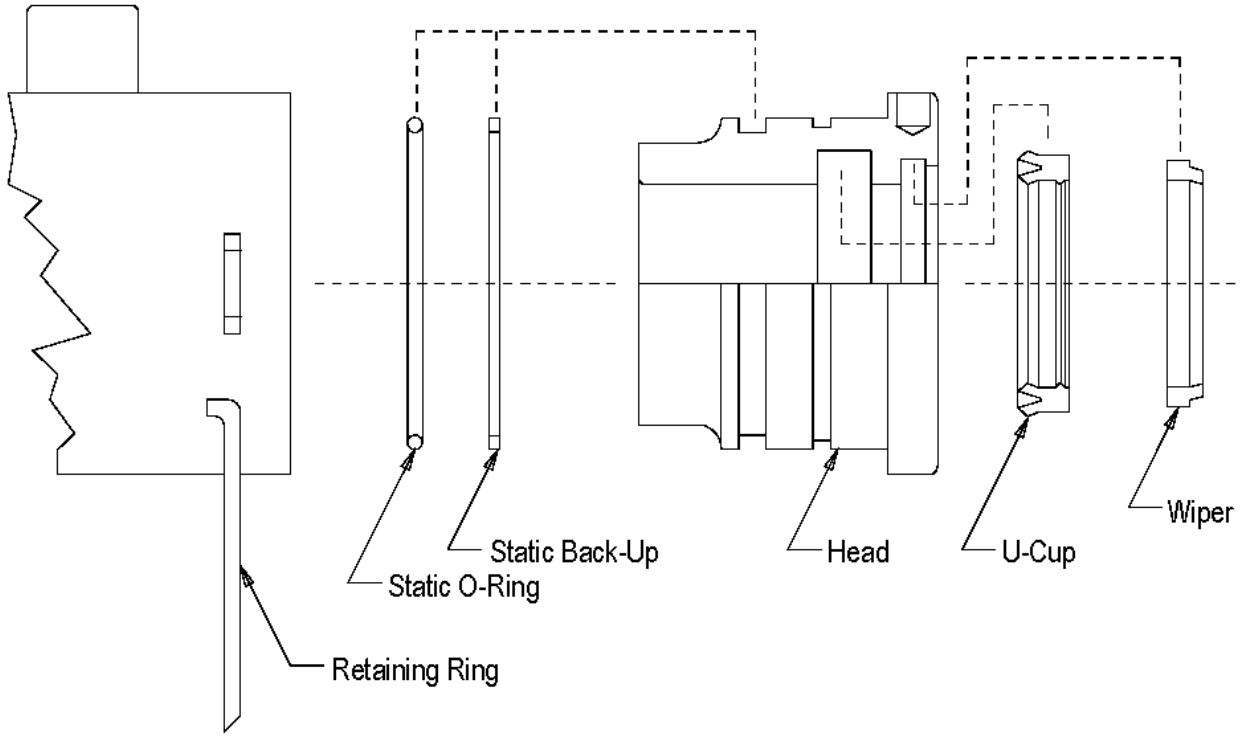
CAUTION:
DO NOT attempt to clean or reuse element.

Hydraulic Cylinder Repair

K Head

General

The K series head uses aluminum material and has a polyurethane u-cup as the primary sealing element. The wiper is a standard type D polyurethane. The head is retained within the tube by means of a square retaining ring, half of which is engaged by the head and the other half by the tube. General procedures for teardown, inspection, and rebuild are contained in the General Procedures Maintenance Manual. See your Texas Hydraulics Sales Engineer if you have any questions.



Teardown

Remove the head retaining device as follows: Insert a spanner wrench into the holes provided. Rotate the head clockwise until the edge of the retaining ring appears in the milled opening of the tube. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counter-clockwise until the retaining ring is completely removed.

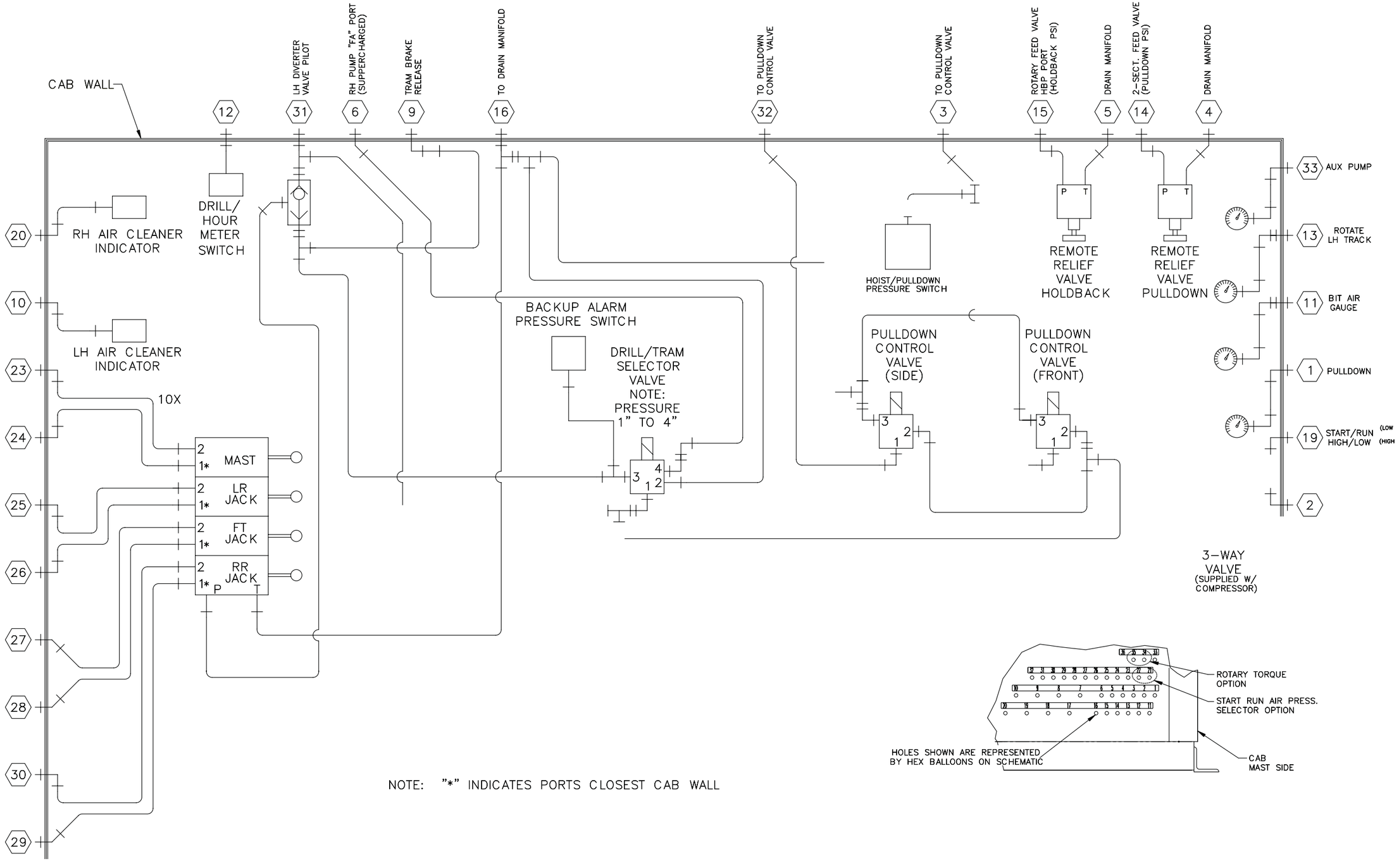
Rebuild

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 retaining ring groove. If possible, the head/seal assembly should sit for at least one hour to allow the seals to elastically restore.

> NOTE: When installing the head, pay careful attention to the retaining ring hole to insure that the static seal on the head does not extrude into the slot.

Insert the spanner wrench into the holes provided and rotate the head until the retaining ring hole is visible through the slot milled in the tube. Insert the retaining ring hook into the hole and rotate the head 1-1/4 turns until the retaining ring is completely pulled into the tube and the ends are covered.

Hydraulic Piping - SKF Cab Controls



NOTE: "*" INDICATES PORTS CLOSEST CAB WALL

(Ref. 426061 rev 23)

Batteries and Circuit Breakers

Batteries

1. Acid burn, fire and explosion hazards exist when working around drill and vehicle batteries. Sulfuric acid in batteries will cause severe burns. Batteries emit hydrogen gas, which will burn or explode if sparks or flame are present.
2. Always add battery water before starting up, not after shutting down. Keep batteries filled and charged. A discharged battery will freeze at much higher temperatures than a fully charged battery.
3. Wear protective clothing, gloves, an acid-resistant apron and a face shield when servicing batteries.
4. Always loosen vent caps from the weak batteries and cover with a cloth before charging.
5. DO NOT short across battery terminals. The spark can ignite gases.
6. Be sure battery fluid is at the proper level.
7. When charging batteries, always disconnect battery charger from its power source or turn it off before connecting or disconnecting charger leads to battery terminals.
8. When removing a battery, disconnect ground (-) terminal FIRST.
9. When installing a battery, connect ground (-) terminal LAST.

Circuit Breakers

Circuit breakers are located in the operator's cab on the side of the control console. They are disabled by pulling out on the knob and reset by pushing in on the knob. Before working on an electrical system, disable it at the circuit breaker or remove the positive battery terminal connector. Place an OUT OF SERVICE tag on the ignition switch and on the breaker or battery to keep machine from being accidently started while someone is performing service work.

Fig. 8-2 Drill Control Console
1. Circuit Breaker Panel
2. Circuit Breakers for Air Conditioner

Auxiliary Pump & Water/DC Valve Wiring

WIRING, AUX. PRESSURE PUMP
(SEE SCHEMATIC #426455)

ITEM NO.	PART NO.	QTY	WIRE COLOR CODE	WIRE GA.	DESCRIPTION AND/OR FUNCTION	TERMINAL NUMBER
51	17818	30'	BLACK	16	GND	N/A
61	99345	15'	PINK/ORANGE	16	AUX. PRESS. PUMP	61
62						
63						
64						
65						
66						
67						
68						
69						
70	54430	15'	N/A	N/A	CONDUIT, 1/2"	N/A
71	56719	2	N/A	N/A	CONNECTOR, CONDUIT, 1/2" STR	N/A
72	350477	1	N/A	N/A	CONNECTOR, CROUSE HINDE	N/A
73	347037	1	N/A	N/A	WELD STUD, 3/8-16UNC X 1" LG	N/A
74	46103	1	N/A	N/A	CLAMP, TUBING, 1"	N/A
75	45259	3	N/A	N/A	TERMINAL, SPADE, 3/16" STUD, 16/14	N/A
76	45261	2	N/A	N/A	TERMINAL, BUTT, 16/14	N/A
77	95129	1	N/A	N/A	CONNECTOR, 2-WAY, MALE	N/A
78	95128	1	N/A	N/A	CONNECTOR, 2-WAY, FEMALE	N/A

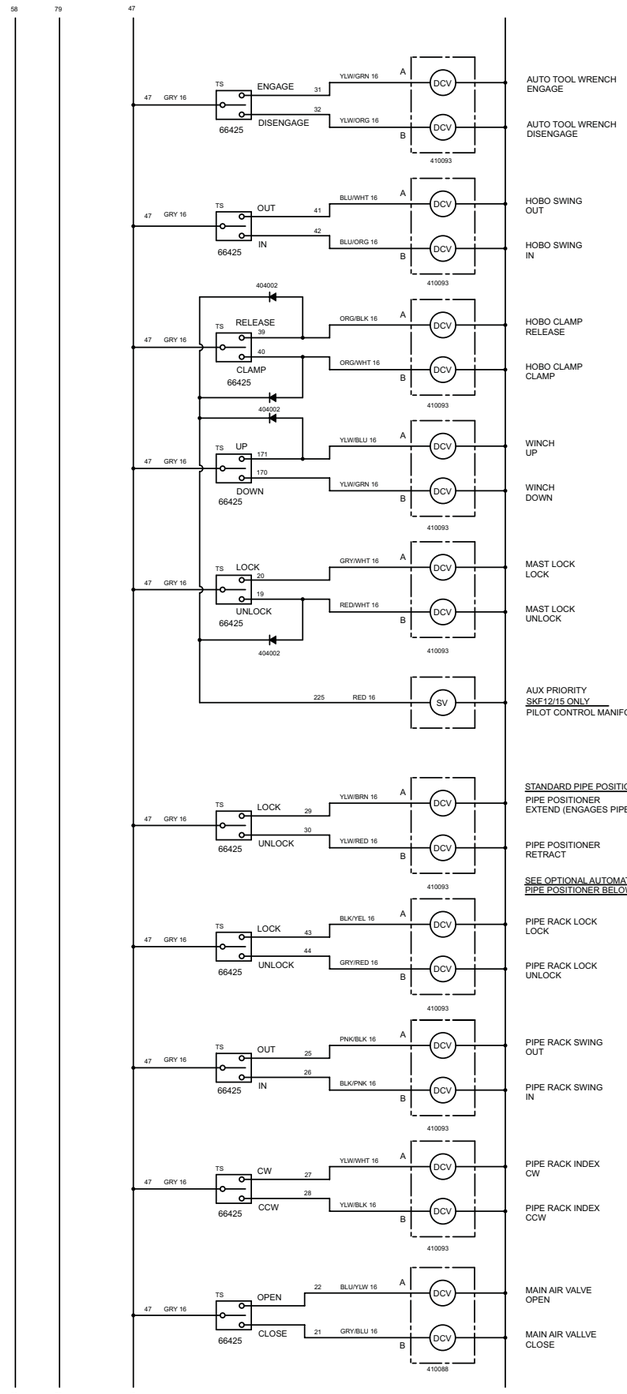
Fig. 8-11 Auxiliary Pressure Pump Wiring (ref. 426525)

WATER & DUST COLLECTOR VALVE WIRING 410089
(SEE SCHEMATIC #426455)

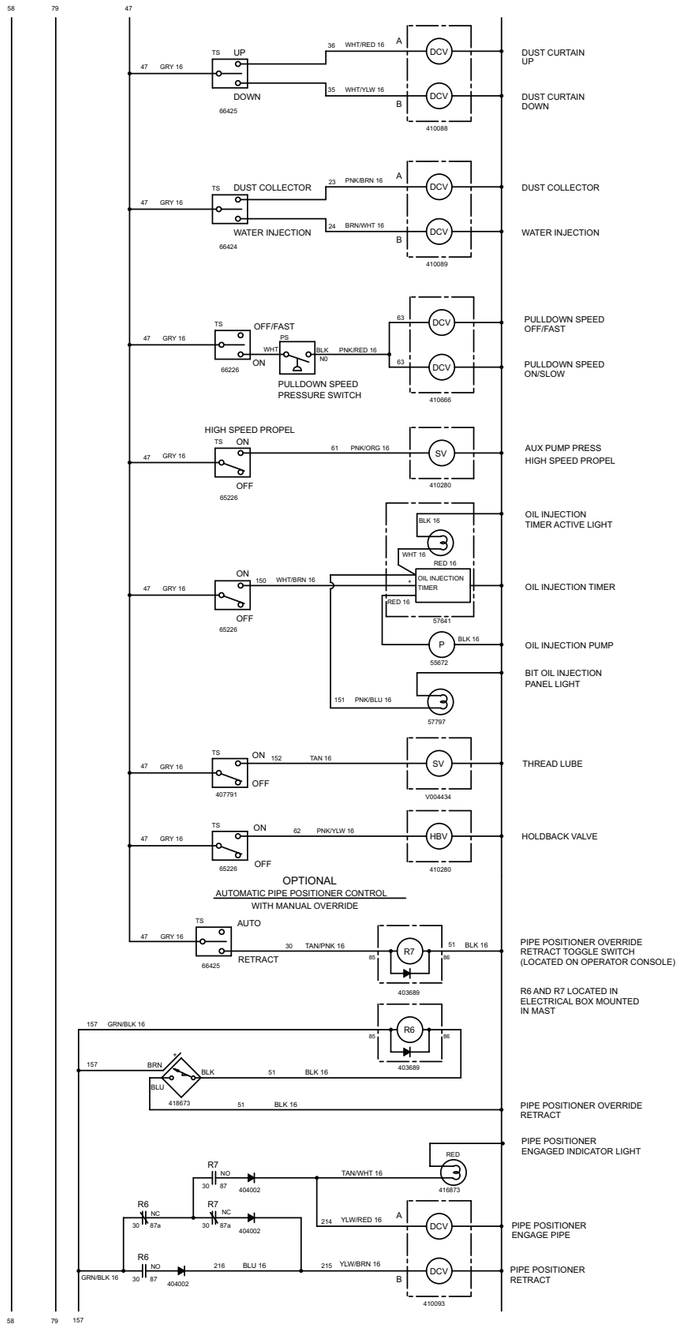
ITEM NO.	PART NO.	QTY	WIRE COLOR CODE	WIRE GA.	DESCRIPTION AND/OR FUNCTION	TERMINAL NUMBER
23	99341	15'	PINK/BROWN	16	DUST COLLECTOR	23
24	99361	15'	BROWN/WHITE	16	WATER INJECTION	24
51	17818	30'	BLACK	16	GND	N/A
52						
53						
54						
55						
56						
57						
58						
59						
60	54430	15'	N/A	N/A	CONDUIT, 1/2"	N/A
61	56719	2	N/A	N/A	CONNECTOR, CONDUIT, 1/2" STR	N/A
62	350477	2	N/A	N/A	CONNECTOR, CROUSE HINDE	N/A
63	45254	2	N/A	N/A	TERMINAL, 3/8" STUD, 16/14	N/A
64	45259	6	N/A	N/A	TERMINAL, SPADE, 3/16" STUD	N/A
65	320354	2	N/A	N/A	CLAMP, TUBING, 1"	N/A
66	347037	1	N/A	N/A	WELD STUD, 3/8-16UNC X 1" LG	N/A
67	95129	2	N/A	N/A	CONNECTOR, 2-WAY, MALE	N/A
68	95128	2	N/A	N/A	CONNECTOR, 2-WAY, FEMALE	N/A
69	344929	8'	N/A	N/A	LOOM 1/4" SPLIT	N/A
70	323194	1	N/A	N/A	CONNECTOR, CONDUIT, STR., 1/4" I.D.	N/A

Fig. 8-12 Water and Dust Collector Valve Wiring (ref. 426526 rev. A)

Electrical Schematic–SKF/SKFX

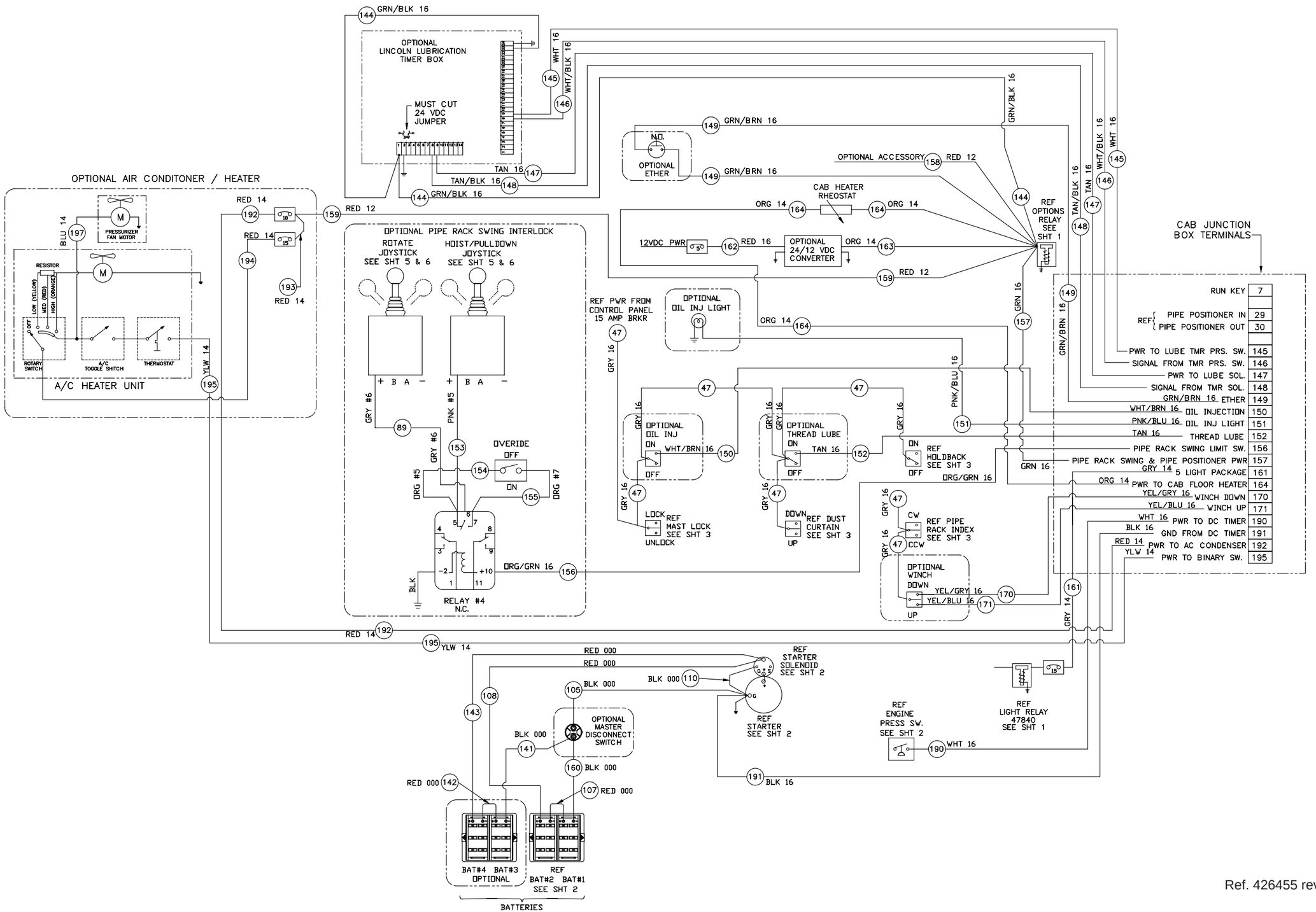


ABBREVIATION DEFINITIONS: DCS - DUST COLLECTOR SIDE
CS - CAB SIDE
DE - DRILLING END
NDE - NON DRILLING END



Ref. 433752 rev. 06 (3 of 6)

Electrical Schematic–SKF (Cat)



Ref. 426455 rev. 06 (7 of 12)

Section 9

Lubrication and Preventative Maintenance

NOTE **This section contains recommended procedures and instructions which personnel will need in order to properly perform necessary lubrication and preventive maintenance. This information should be considered as the manufacturer's recommendations only and are based upon normal operation. For severe or unusual conditions the recommended lubrication instructions should be varied in accordance with extended hours of operation, climate and drilling conditions.**

Lubrication and Maintenance Chart

C/A = Check/Add if required				
Interval	**Service Point**	**Service Required**	**Lubricant Required** [5]	**Capacity**
500 Hrs	Hydraulic Fluid	Initial Change, then every 1000 hrs	Chevron AW MV ISO 32 [3]	223.5 gal. (846 L)
	Hydraulic Filters	Replace	– – – – –	– – – – –
	Engine Air Filter (safety)	Replace	– – – – –	– – – – –
	Engine Crankcase Breather	Check/Clean	– – – – –	– – – – –
	Comp. Control Air Filter	Replace	– – – – –	– – – – –
	Comp. Air Filter (safety)	Replace	– – – – –	– – – – –
	Air Filter Housings	Clean	– – – – –	– – – – –
	Pump Drive Gearbox	Drain/Replace Oil	80W-90 Gear Oil	6.75 gal. (6.4 L)
	Water Pump (vertical)	Change Oil (every 3 months)	80W-90 Gear Oil	1 qt. (.95 L)
	Water Injection Pump Strainer	Replace	– – – – –	– – – – –
	Dust Collector	Check Timer Cycle (3.2 sec. between pulses)	– – – – –	– – – – –
		Check air pressure (approx. 40 psi [2.8 bar])	– – – – –	– – – – –
	Air Conditioner Filter	Replace	– – – – –	– – – – –
	Winch	Drain Gear Oil/Replace	80W-90 Gear Oil	4 pints (1.9 L)
	Rotary Drive Spindle	Check–adjust as necessary	– – – – –	– – – – –
	PLUS ALL ITEMS LISTED IN DAILY/150–250/300 HRS			
1000 Hrs or Yearly	Track Final Drive Gearbox [6]	Drain/Replace	80W-90 Gear Oil	see daily
	Hydraulic Tank	Drain, Clean, Replace Oil	Chevron AW MV ISO 32	223.5 gal. (846 L)
	PLUS ALL ITEMS LISTED IN DAILY/150–250/300/500 HRS			
2000 **Hrs or Two Years**	Comp. T-Tank Separator	Replace	– – – – –	– – – – –
	Comp. Return Strainer	Replace	– – – – –	– – – – –
	Engine Coolant	Drain/Flush/Replace	Water/Anti-freeze 50/50	see daily
	All Pump Pressure Settings	Check/Adjust per Service Manual	– – – – –	– – – – –
	All Valve/Other Settings	Check/Adjust per Service Manual	– – – – –	– – – – –
	PLUS ALL ITEMS IN DAILY/150–250/300/500/1000 HRS			

NOTES:

1. No. 1-D or No. 2-D diesel fuels as listed in ASTM D975 are acceptable fuels.
2. Distilled water or deionized water is recommended for use in engine cooling systems. Do not use hard water, softened water that has been conditioned with salt or sea water. Use a 1:1 mixture of water/glycol for optimum performance.
3. Chevron AW MV ISO 32 is the standard factory fill for hydraulic fluid. Other fluids may be used if they meet the specifications listed in this section.
4. Indicators may show change or by-pass when fluid is cold; reset and check again.
5. For severe operating conditions (extreme cold or tropical), use appropriate viscosity of lubricants or use fully synthetic lubricants as shown on the Cold Weather Lubricants chart is this section..
6. Tropical conditions require initial change at 50 hours then every 250 hours.
7. Optional for use with down-the-hole hammer.
8. See compressor oil lubrication chart for alternate oils and change intervals.
9. Lithium Base with 3% Molydbenum Disulfide.

Hydraulic System Maintenance

The hydraulic components of the drill are built for many years of trouble-free operation. Only one preventive maintenance step is necessary to ensure the expected life of the system—CLEANLINESS. When dirty filters are indicated, change the filter as follows:

- Clean the area around the filter covers to prevent dirt entering the filter housings.
- Pull filters from the housings. Install new filter and install the covers making sure the cover O-ring is in place.

Sight gauges are provided on the sides of the tank for checking oil levels.

- Oil level should be at the halfway point of the sight gauge when all cylinders are extended.
- A temperature gauge is also provided on the sight gauge.

CLEANLINESS cannot be overstressed:

- Use new oil only from previously unopened containers.
- Clean all tank openings.
- Fill tank through return filter.

Fig. 9-11 Return Filters Mounted on Hydraulic Tank

Compressor Lubrication Procedure

- Drain Receiver Condensate

  In periods of cold weather and/or high humidity, crack receiver drain valve prior to start-up to remove water. Close when oil appears.

- Check Oil Level

  The oil level is checked at the sight glass with machine level at each shift. The machine must be shut down long enough to permit oil foam to settle or check before start-up at the beginning of the shift. Oil level should be at the center of the sight glass.

- Change Oil

  Every 300 hours or as specified in compressor lubrication chart. Use Dexron III ATF or consult factory for specific recommendations if extremely severe duty is encountered. Change oil filter element.

- Lubricate control and linkage. Clean oil return line strainer.

Compressor Oil Filter

- Blocked filter indicator will pop up red if the element needs changing.
- If the filter bowl is leaking, the O-ring needs to be changed. Flogging up the tabbed locking nut will not stop the leak.

Fig. 9-12 Compressor Oil Filter

Preventive Maintenance–Bolted Joints

- **Vibratory Overload**

Abusive, unusual or unforeseen loads can cause bolted joint separation. This can result in the loosening of bolts, which in turn can cause bolt fatigue failure. Bolt fatigue will generally result in a fracture surface and ultimately failure at the first engaged thread of the bolt or sometimes in the fillet under the bolt head. Loose bolts can also fail quickly in fatigue. As an example, tests conducted by a bolt manufacturer indicated that a bolt tightened to 1420 lb tension and stressed cyclically to 9215 lb failed after 5960 load cycles. Identical bolts tightened to 8420 lb and stressed to the same 9215 lb survived 4.65 million cycles before failure. If the bolts had been tightened beyond 9215 lb, it would have been impractical to cycle them to failure.

- **Thermal Relaxation**

Bolted joints exposed to high temperatures or thermal cycling have a tendency relax or lose bolt tension over time, due to stress creep. Since pre-loading stretches bolts, and only stretches them a few thousandths of an inch. It is easy to imagine that a bolt heated to the operating temperature limits of an air compressor could increase the plasticity of the bolt material, allowing it to lose some of its initial loading. Bolted joints of a new machine that are subjected to high heat should be checked and re-torqued to specification after the first 500 hours of operation.

Critical Bolted Joint Maintenance

Critical bolted joints are those joints which hold major structures together or hold overhead loads. Failure of these joints could endanger personnel or seriously damage equipment. As stated earlier, these are identified in the drawing “Critical Fastener ID & Inspection Schedule. We recommend that critical bolted joints of drills should be ***checked for proper torque*** every ***120 days or 2000 operating hours*** for machines that have ***less than 10,000*** operating hours, and every ***90 days or 1500 operating hours*** for machines that have ***greater than 10,000 operating hours.***

If a bolt is found to be loose (less than 90% of specified torque value), it should be removed and replaced. If the joint contains more than one bolt, all bolts in the joint should be replaced. The joint mating surfaces and bolts should be inspected for signs of corrosion, surface degradation, and the presence of hardened washers or Nordlock washers. Joints with Nordlock washers require the replacement of the washers as well. Hardened washers can generally be reused as long as the washer is undamaged. The new bolts should be lubricated with NLGI2 molycoat grease and torqued to the proper specification. Bolts should be replaced with the same grade bolt that was originally in the assembly. These drills primarily use SAE Grade 5 and Grade 8 bolts. These are identified by the markings on the head of the bolt. Chart #1 of the drawing for each machine titled “Critical Fastener Torque Values” graphically depicts the standard indentifying bolt markings.

Bolts in critical joints should also be removed and ***visually inspected for corrosion and re-lubricate every 2.5 years or 15,000 hours of operation***. If bolts are not damaged, they maybe re-installed and returned to service. Any damaged or corroded bolts should be discarded and replaced. In addition, bolts in critical joint should be ***replaced every 5 years or 30,000 hours of operation***, regardless of apparent condition.

Other Bolt Maintenance

All bolts contained in these drills are subject to the same topics described above, but generally do not have the same degree of risk involved should a bolt failure occur. Every machine should have a “walk-around” inspection performed at the beginning of each operating shift, which includes looking for loose hardware. Other significant bolted joints include all pressurized fittings, flange connections and all bolted pin retainer/keeper plate bolts. All machine bolts should be inspected for proper torque specification annually at a minimum.

Maintenance Record

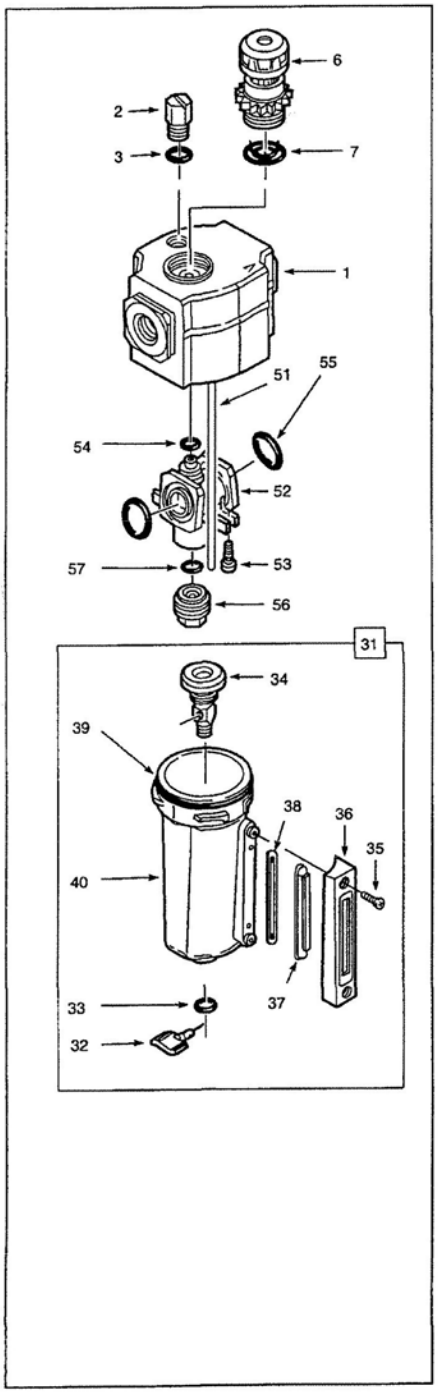
DATE	HOUR METER	MAINTENANCE PERFORMED	WORK PERFORMED BY	WORK AUTHORIZED BY

Lube Pump Air Motor

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	SOLUTION
Airmotor is not working and air is coming from exhaust.	Restricted or inadequate air supply.	Check air supply and adjust to minimum recommended level. Check air supply hose diameter and change it to minimum recommended size (see specifications). Check size of FRL and Quick disconnect coupling. Replace if small size or restricted.
Erratic or accelerated operation with short stroking.	Dirty or damaged Relay Valve (Item 17) or Air Signal Valve (Item 20).	Check valves and clean if necessary. Replace any damaged seals or worn parts.

Lubricator Maintenance and Repair



TECHNICAL DATA
Fluid: Compressed air
Maximum pressure: 250 psig (17 bar)
Operating temperature: 0° to +175°F (-20° to +79°C)*

* Air supply must be dry enough to avoid ice formation at temperatures below 35°F (2°C).

Main ports: 1/2" PTF
Start point (i.e., minimum flow required for lubricator operation): 3.5 scfm (1.7 dm³/s) at 90 psig (6.3 bar) inlet pressure
Approximate flow at 90 psig (6.3 bar) inlet pressure and 7 psid (0.5 bar) pressure drop: 144 scfm (68 dm³/s)
Nominal reservoir size: 7 fluid oz (0.2 liter)
Materials:
Body: Aluminum
Reservoir: Aluminum
Liquid level indicator lens: Transparent nylon
Sight feed dome: Transparent nylon
Elastomers: Neoprene and nitrile

REPLACEMENT ITEMS
Service kit (3, 7, 39)
Liquid level lens kit (35, 37, 38, 39)
Manual drain (32, 33, 34)
Sight feed dome (6, 7)

INSTALLATION
1. Install lubricator vertically in air line -
   - downstream of filters and regulators,
   - upstream of cycling valves,
   - with air flow in direction of arrow on body,
   - as close as possible to the device being lubricated.
2. Connect piping to proper ports using pipe thread sealant on male threads only. Do not allow sealant to enter interior of unit.
3. Fill reservoir with a good quality, light, misting type oil for compressed air tools. Oil level must always be visible in lens (37). **DO NOT OVERFILL.**
4. Turn reservoir fully clockwise into body before pressurizing.
5. Manual drain is ported 7/16-24 UNS male for 1/4" tube nut and ferrule.

REFILL RESERVOIR WITH OIL
Shut off inlet pressure and reduce pressure in reservoir to zero. Remove fill plug (2), add oil, and reinstall fill plug. ***Do not remove the fill plug when the reservoir is pressurized, as oil will blow out the fill plug hole.***

ADJUSTMENT
1. Turn on system pressure.
2. Adjust lubricator drip rate only when there is a constant rate of air flow thru the lubricator. Monitor drip rate thru sight feed dome (6).
3. Determine the average rate of flow thru the lubricator. Turn adjusting knob (6) to obtain the recommended drops per minute. See ***Drip Rate Chart.*** Turn knob counterclockwise to increase and clockwise to decrease the drip rate. Push red locking on adjusting knob down to lock drip rate setting. Pull lockring up to release.
4. Monitor the device being lubricated for a few days following initial adjustment. Adjust the drip rate if the oil delivery at the device appears either excessive or low.

DRIP RATE CHART

Flow - scfm (dm³/s)	Drops per Minute
5 (2.4)	10
10 (5)	11
20 (9)	13
30 (14)	15
40 (19)	17
50 (24)	19
60 (28)	22
70 (34)	24
80 (38)	26
90 (43)	28
100 (48	30

DISASSEMBLY
1. Shut off inlet pressure. Reduce pressure in inlet and outlet lines to zero. Loosen fill plug (2).
2. Remove reservoir - push into body and turn counterclockwise.
3. Disassemble in general accordance with the item numbers on exploded view. Disassemble and replace drain (32, 33, 34) only if it malfunctions. Do not remove items 51 thru 57

CLEANING
1. Clean all parts using warm water and soap.
2. Rinse and dry parts. Blow out internal passages in body with clean, dry compressed air
3. Inspect parts. Replace parts found to be damaged.

ASSEMBLY
1. Lubricate seals, o-rings, and stem of drain valve (32) with o-ring grease
2. Assemble lubricator as shown on exploded view.
3. Torque Table

	Inch-Pounds (N-m)
6 (dome)	20 to 25 (2 3 to 2 8)
35 (screw)	13 to 16 (1 5 to 1 8)
53 (screw)	8 to 10 (0.9 to 1.1)

4. Turn reservoir (40) fully clockwise into body

WARNING
These products are intended for use in industrial compressed air systems only. Do not use these products where pressures and temperatures can exceed those listed under ***Technical Data.***

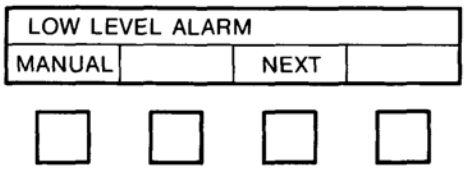
In lubrication applications some oil mist may escape from the point of use to the surrounding atmosphere. Users are referred to OSHA safety and health standards for limiting oil mist contamination and utilization of protecting equipment.

Do not use these products with fluids other than air, for nonindustrial applications, or for life-support systems.

ALARM MESSAGES:

The following alarm messages can appear if an alarm condition occurs.

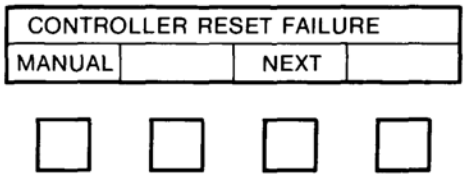
Indicates that the system reservoir needs to be replenished.



MANUAL - Will appear if programmed. Pressing the corresponding button will initiate a lube cycle.

NEXT - Indicates that there is more than one alarm message. Pressing the corresponding button will display the next alarm message.

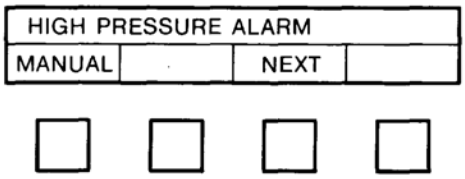
Indicates that the system pressure switch (Centro-Matic) or cycle switch (Modular Lube) has failed to activate within the alarm time setting that was programmed in setup.



MANUAL - Will appear if programmed. Pressing the corresponding button will initiate a lube cycle.

NEXT - Indicates that there is more than one alarm message. Pressing the corresponding button will display the next alarm message.

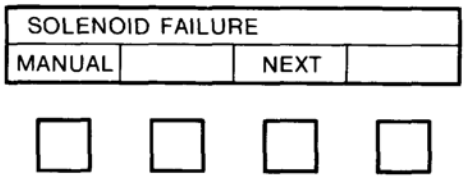
Indicates that excessive system pressure has developed in Lube system. Modular Lube only.



MANUAL - Will appear if programmed. Pressing the corresponding button will initiate a lube cycle.

NEXT - Indicates that there is more than one alarm message. Pressing the corresponding button will display the next alarm message.

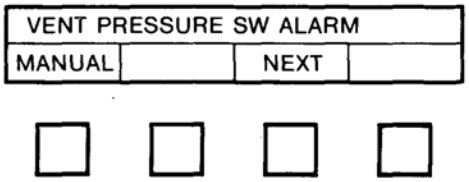
This alarm would indicate that the system dispensed lubricant during the period between lube cycles. Modular Lube only.



MANUAL - Will appear if programmed. Pressing the corresponding button will initiate a lube cycle.

NEXT - Indicates that there is more than one alarm message. Pressing the corresponding button will display the next alarm message.

The supply line failed to vent below the setting of the vent pressure switch, therefore the injectors did not recharge. Centro-Matic only.



MANUAL - Will appear if programmed. Pressing the corresponding button will initiate a lube cycle.

NEXT - Indicates that there is more than one alarm message. Pressing the corresponding button will display the next alarm message.

3-Way Air Valve
"CF" Solenoid with Junction Box

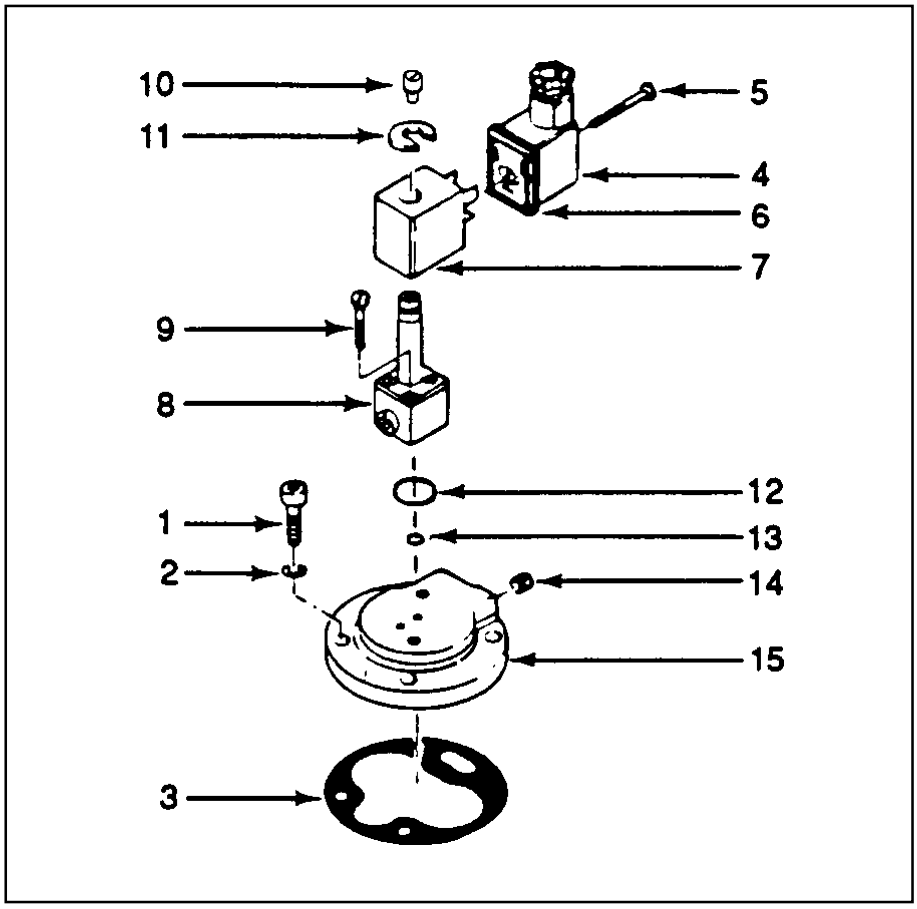


Fig. 10-11h "CF" Solenoid with Junction Box (ref. no. 330617)

1. Screw (4)
2. Lockwasher (4)
3. Gasket
4. Connector (includes 4-6)
5. Screw
6. Gasket
7. Coil, 24VDC
8. Solenoid Base
9. Screw (2)
10. Diffuser
11. Coil Retaining Clip
12. O Ring (large)
13. O Ring (small)
14. Pipe Plug
15. Base

See parts manual for repair part numbers.

DEI + LOGGER –
Drilling Efficiency Indicator
Installation and Operations Guide

Thunderbird
Mining Systems

Chapter 1
Introducing the DEI + LOGGER

The **DEI + LOGGER** is an instrument that is installed on the drills in a mining, water well, exploration, or construction operation. It helps the drill operator know, at every moment, what is occurring in the drill hole by providing information that is not normally available.

The **DEI + LOGGER** eliminates the need for manual drill reports and provides all of the data required to monitor the performance of a single drill or an entire drill fleet. Manual data is entered into the **DEI + LOGGER** using the buttons below the display. Data is retrieved from the **DEI + LOGGER** using a PDA and connecting cable and transferred to the office PC using a USB cradle.

Thunderbird provides a sample suite of Windows-based reporting software to convert the logged data. These reports are used by operations and maintenance personnel to assess the performance and productivity of the drill fleet and drill operators. Reports provide information about the drillability of the patterns, the drilling consumables replaced and replenished, and the delay code operating hours – thus allowing asset utilization to be readily evaluated.

The **DEI + LOGGER** is the newest generation of Drilling Efficiency Indicators. Earlier **DEI** instruments have been installed on nearly all makes and models of drills. Today they are operating on hundreds of drills in mines throughout the world. Whether installed in a coal, metal, quarry, or other operation, the **DEI** has proven that it will increase productivity by reducing overall drilling costs and improving the blasting efficiency.

The **DEI + LOGGER** provides all the capabilities of its predecessors, PLUS:

- Even more information about the current drilling operation, instantaneously, on a much larger and easier-to-read display.
- Drilling statistics about the previous three holes, the current shift, the three previous shifts, and a production period you define.
- Features that allow you to set up the system, check the status of system elements, and do troubleshooting procedures. For example, the **DEI + LOGGER** leads you through the calibration procedure in a sequence of interactive screens.

The rest of this chapter gives you an overview of the information and system management features available on the **DEI + LOGGER**.

Chapter 2
Installing the DEI + LOGGER

Unpacking the Components

Before you begin the installation, make sure you have all the components you need for your system. The table that follows lists the most commonly used of components used for **DEI + LOGGER** installation and gives their part numbers and the conditions under which you need each one.

Component	Part Number	Conditions for Use
DEI + LOGGER	6523-109-001	Unit required on all systems.
Display mounting system	3142500	
Air pressure switch (See note in "Laying Out and Tracking the Components")	3700-030-001 3700-031-001 3700-032-001 3700-033-001	Standard, 12 - 150 psi. Optional, 20 - 350 psi. Optional, 50 - 450 psi. Optional, 60 - 650 psi.
Optical shaft encoder	4500630	40-pulse, standard, for most drills.
Encoder mounting kit	6041-018-001 6041-018-002	For **indirect** connection to the pulldown system. For **direct** connection to the pulldown system.
Encoder drive kit		For **indirect** connection to pulldown system:
	9001-097-002	ANSI 40 sprocket drive.
	9001-097-003	ANSI 35 sprocket drive.
	9001-116-001	ANSI 35 6.32" split sprocket drive.
	9001-116-002	ANSI 35 5.002" ID sprocket drive.
	9001-117-001	ANSI 40 5.50" split sprocket drive.
	9001-117-002	ANSI 40 4.88" split sprocket drive.
	9001-117-003	ANSI 40 5.125" split sprocket drive.
	9001-117-004	ANSI 40 6.50" split sprocket drive.
	9001-117-005	ANSI 40 5.25" split sprocket drive.
	9001-117-00X	ANSI 40 split sprocket drive (special order only).
	9001-119-002	Torque reel drive.
Cables:		
DC input power	7070-191-xxx	For systems connecting to a 21 to 30 VDC power source.
Air switch signal	7070-189-xxx	For all systems.
Encoder sensor	7060-190-xxx	For all systems.
	xxx = Cable length in feet (for example, 025 = 25 feet).	

8. Using the ANSI 40 roller chain, connect the two instrumentation sprockets. Remove links as necessary to tighten the chain.
9. Slide the encoder bracket (with the encoder on it) as necessary until the chain is ***snug but not overtight***, and secure the brackets.
10. Connect the 7-socket end of the encoder cable assembly (7060-190-xxx) to the port on the encoder.
11 Route the cable away from moving equipment. Use tie wraps to secure any excess cable.
12. Make the sure power to the **DEI + LOGGER** is turned off.
13. Connect the 7-pin end of the encoder cable assembly to the **ENCODER** port on the rear panel of the **DEI + LOGGER**.

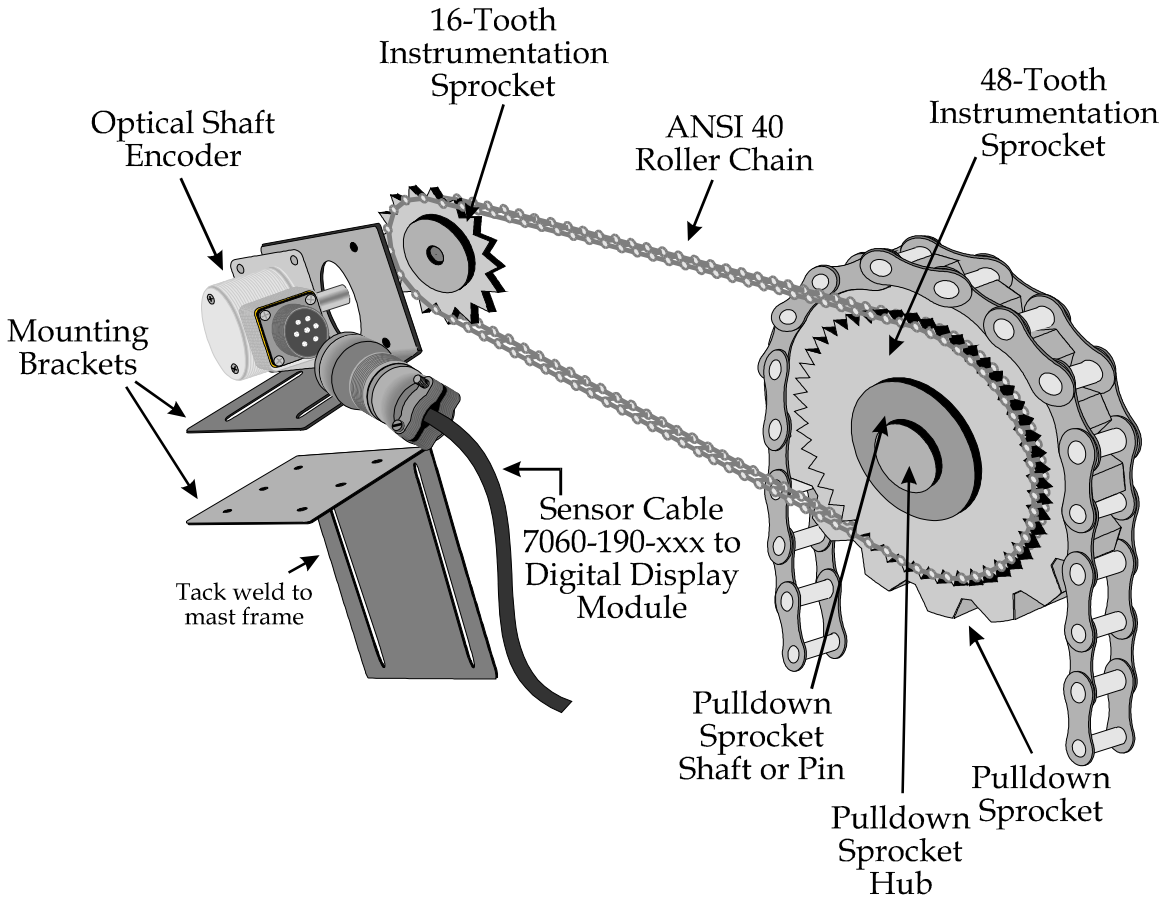
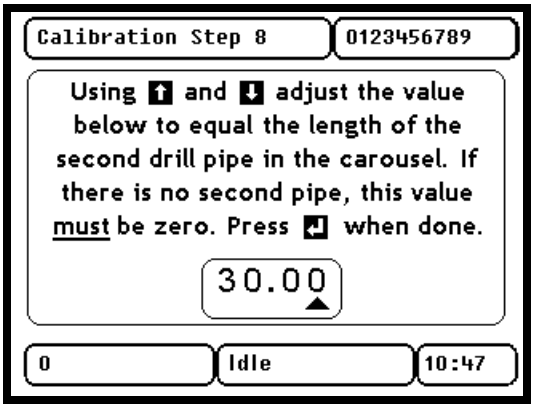
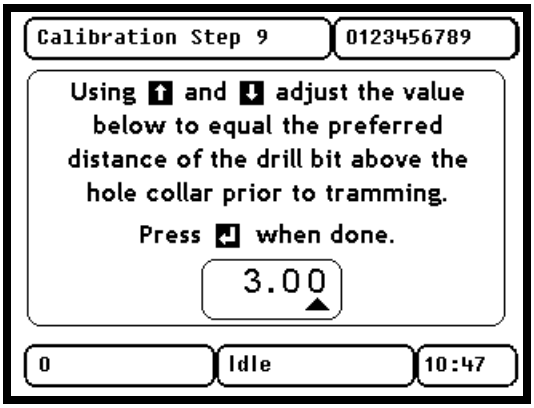


Figure 10. Installing the Encoder — Indirect Sprocket Drive Method



This is the length of pipe in the rack, not the first pipe with bits, sub, stabilizers, and other components.

NOTE: In cases where the drill stems in the pipe rack or carousel vary in length by 0.5 feet (15 cm) or more, set the length to "0.00". If the hole depth reading is inaccurate during hole reaming or cleaning or during excessive on-and-off cycling of the bailing air, contact Thunderbird Mining Systems. You may need to install a manual air switch.



This offset is the distance the bit must be raised **above** the collar of the hole for the **DEI + LOGGER** to consider the pipe out of the hole and turn off the PIPE (pipe-in-hole) notification. A normal value for this offset is ½ the distance between the bottom of the bit and the ground when the drill is on the level and the jacks and power head are fully retracted. You can adjust this value to increase or decrease the sensitivity of the PIPE alarm function.

The PIPE notification turns off only when drilling resumes or after the distance from the bottom of the hole is equal to the hole depth plus this offset.

PIPE

When the drill is moving downward, this area is blank.

When the ROP display is showing the "Distance From Bottom, and there is a Pipe-In-Hole condition, the word "PIPE" flashes in this area of the display to alert the operator to the condition. This features helps you prevent damage to equipment often caused by retracting the jacks or moving the drill when pipe is still in the hole.

The Pipe-In-Hole alert occurs whenever the following three conditions are met:

- Drilling air is turned off.
- Drill feed direction is reversed relative to the normal drilling direction (as indicated by encoder data).
- The distance from bottom value is greater than 85% of the hole depth.

TIME TO COMPLETE

The estimated time remaining to finish drilling the current hole is based on the distance remaining and the current rate of penetration. The value is calculated as the difference between the target depth and the current depth, divided by the current ROP. This value is displayed after 5% of the hole has been drilled.

Graphic Display

Right and left arrows on the graph show the current depth. A dark line shows the target depth.

Note: You can change the minimum and maximum values on the scale through the Graphic Scaling system screen.

Button Usage

	**Enter**	No function on this screen.
	**Left**	Displays the Shift Screen: Current Shift.
	**Up**	Displays the Production Screen.
	**Down**	Displays the Statistics Screen: 1st Previous Hole.
	**Right**	Displays the ROP Graphics Screen: Current Hole.

Shift Screens

There are four shift screens. Each one displays cumulative statistical data for all holes worked on during the selected shift — current shift or one of the three previous shifts. Starting and ending times for shifts are set up on the Shift Times system screens.

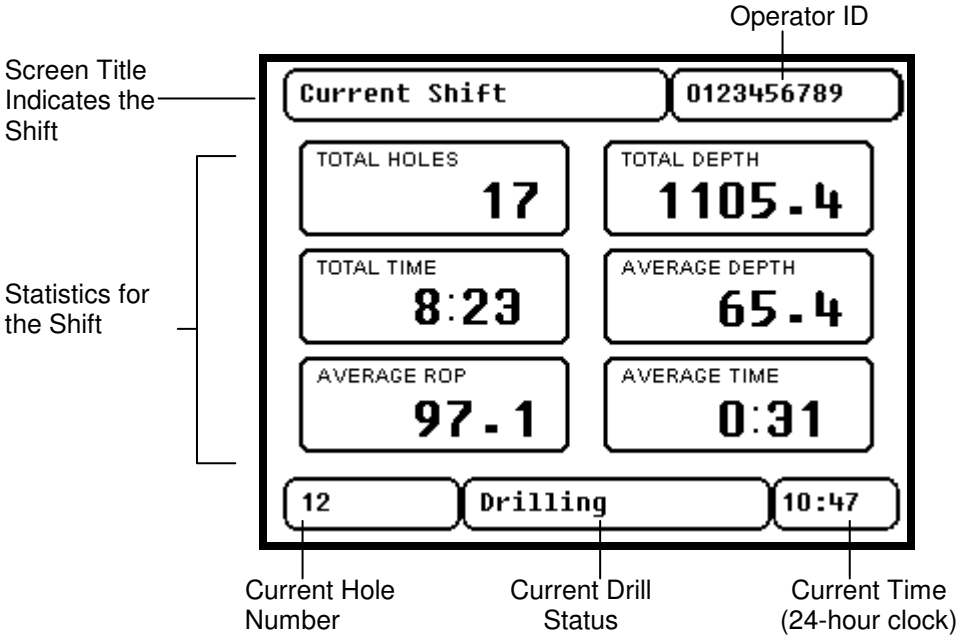
To display one of the shift screens:

1. Press the **Statistics** button to display the default statistics screen — Statistics: Current Hole.
2. Press the **Left** arrow button to display the shift screen for the current shift.
3. Press the **Left** arrow button to display the screen for a different shift (once for the previous shift, twice for the 2nd previous, or three times for the 3rd previous shift).

You can move through the four shift screens by pressing the **Right** arrow button to move to a screen for a more recent shift and by pressing the **Left** arrow button to move to a screen for a previous shift.

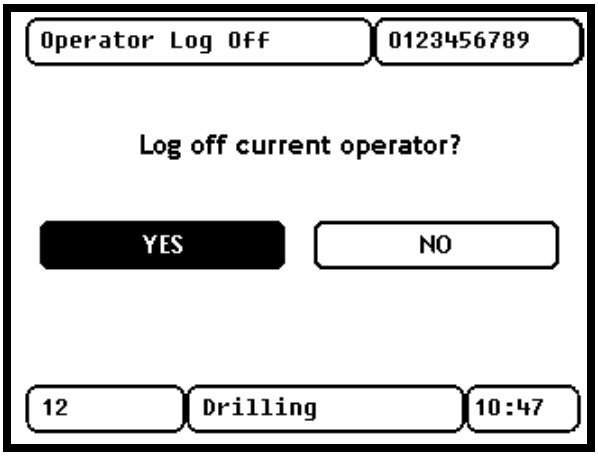
Sample Screen

A sample screen for the current shift is shown and explained below.



If your system is **not** set up for auto-logoff, at the end of your shift, a screen appears asking if you want to log off.

- To log off, press the **Enter** button.
- Or, to remain logged on, press the **Right** arrow button to highlight "No", and then press the **Enter** button.



Drilling Conditions Screen

Whenever the drilling conditions change, use this screen to select the current drilling conditions. The list of conditions on this screen comes from the PDA system setup.

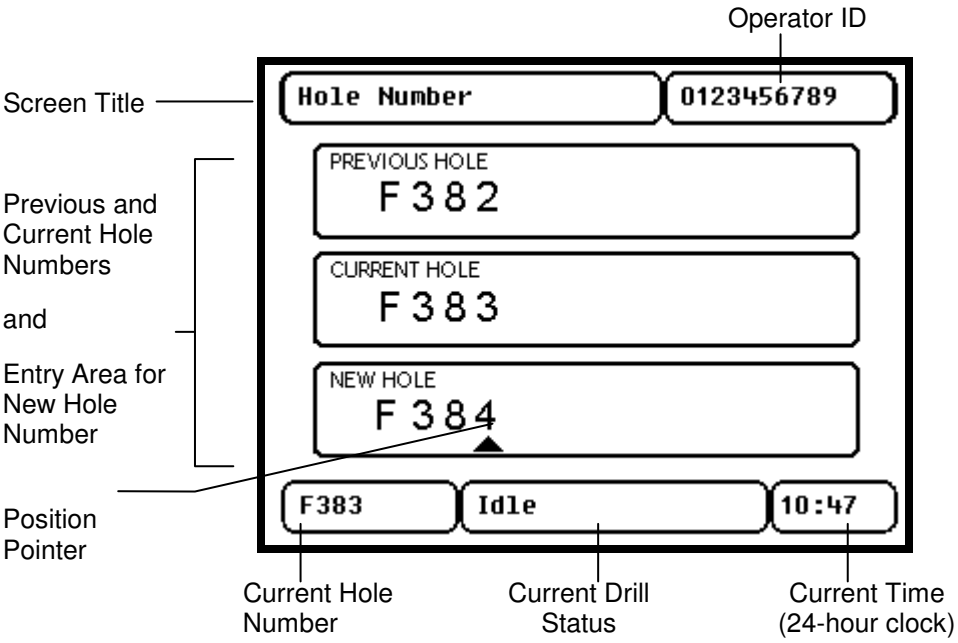
Note: The drill condition selected on this screen is canceled each time you press the **Zero Hole Depth** button and the drilling statistics will indicate "unknown drilling conditions" if you do not select the condition from this screen.

To display the Drilling Conditions screen:

1. Press the **Data Entry** button to display the Data Entry Menu.
2. Use the arrow buttons (**Left, Up, Down, Right)** to move the highlight to "Drill Conditions". Then press the **Enter** button.

To return to the Data Entry Menu, press the **Data Entry** button.

Sample Screen



Using the Screen

When the screen first appears, the previous and current hole numbers appear in the top two boxes, and the current hole number appears in the bottom box. To change the **New Hole** number:

1. Use the **Left** and **Right** arrow buttons to move the pointer in the **New Hole** box to each digit you want to change.
2. At each position, use the **Up** or **Down** arrow buttons to increase or decrease (respectively) the letter or number in the selected position. Blanks appear between "Z" and zero and between "9" and "A".
3. Press **Enter** to apply the new setting.

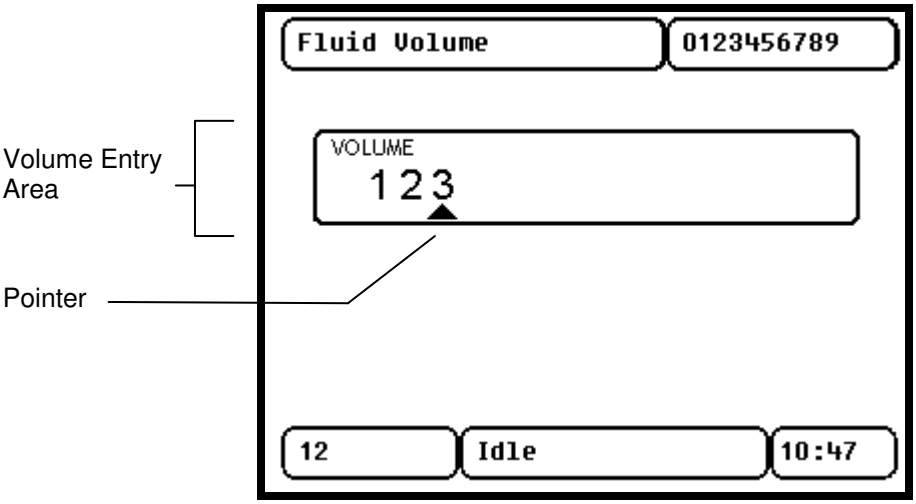
Button Usage

	**Enter**	Displays the Volume screen.
	**Left**	Moves the selector to the left column.
	**Up**	Moves the selector up one row.
	**Down**	Moves the selector down one row.
	**Right**	Moves the selector to the right column.

Fluid: Fluid Volume Screen

After you select the fluid that was replenished in the drill, use this screen to record the amount that was added.

Sample Screen



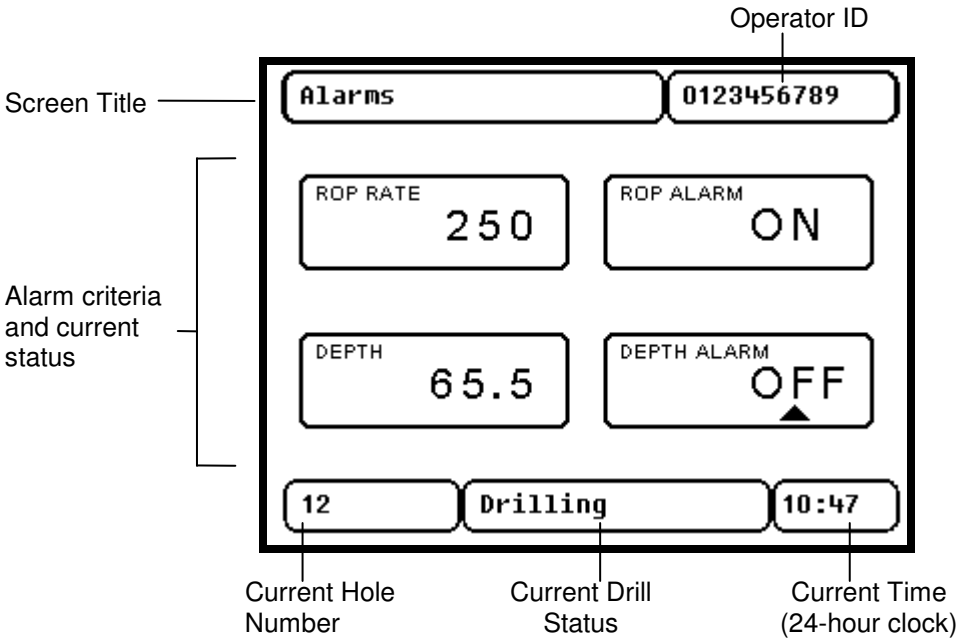
To enter the volume of the fluid added:

1. Use the **Left** and **Right** arrow buttons to move the pointer to each position you need to change in the **Volume** box.
2. At each position, use the **Up** and **Down** arrow keys to scroll through the numbers and letters until you reach the correct one. Blanks appear between "9" and "0".
3. Once the **Volume** is correct, press the **Enter** button to return to the Data Entry Menu.

To display the Alarms screen:

1. Press the **System** button to display the System Menu.
2. Use the arrow buttons (**Left, Up, Down, Right)** to move the highlight to "Alarms". Then press the **Enter** button.

Sample Screen



Using the Screen

When the screen first appears, the current criteria and state is displayed for both alarms.

To change the alarm criteria or the state:

1. Use the **Left** and **Right** arrow buttons to move the pointer to the element you want to change — either the maximum ROP rate or hole depth or the on/off state of one of the alarms.
2. Use the **Up** or **Down** arrow buttons to increase or decrease (respectively) the value of the selected digit or to alternate the state between "ON" and "OFF".
3. Repeat steps 1 and 2 until both the values and states on the screen are as you currently require.
4. Press **Enter** to apply the new settings.

A confirmation screen appears for 3 seconds, then the System Menu reappears.

System Status: Display Test Screens

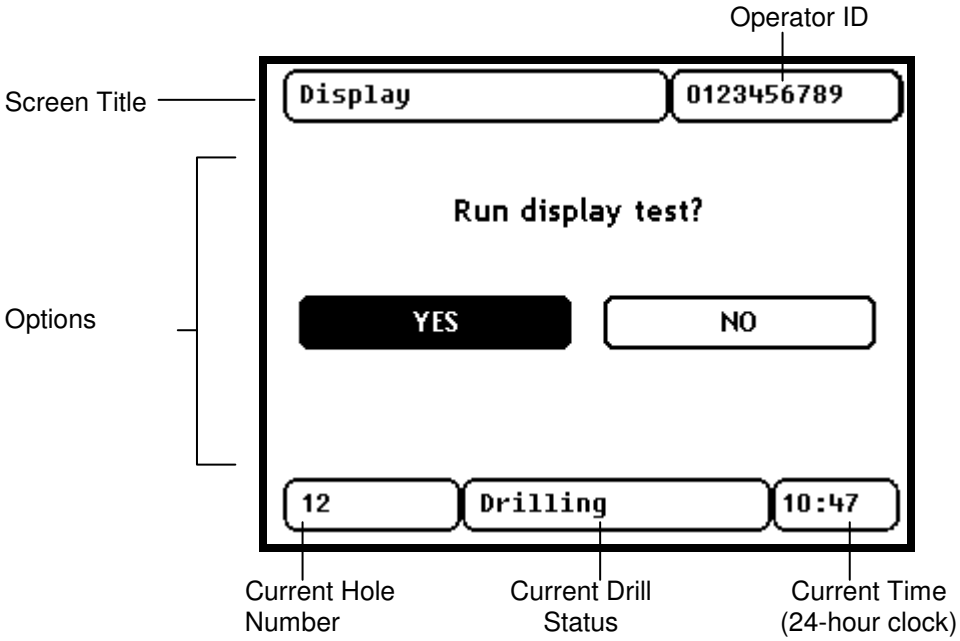
If segments are missing in the display, or if the display appears wrong in some other way, run the display test.

To display the Display Test screen:

1. Press the **System** button to display the System Menu.
2. Use the arrow buttons (**Left, Up, Down, Right)** to move the highlight to "Diagnostics". Then press the **Enter** button to display the Diagnostics menu.
3. Use the **Up** and **Down** arrow buttons to move the highlight to "Detailed System Status". Then press the **Enter** button to display the Detailed System Status menu.
4. Use the arrow buttons to move the highlight to "Display". Then press the **Enter** button.

To return to the Detailed System Status menu, highlight "No" and press the **Enter** button. To return to the System Menu, press the **System** button.

Initial Screen



Using the Screen

To run the display test:

1. If necessary, on the Display Test screen, use the **Left** arrow to highlight "Yes".

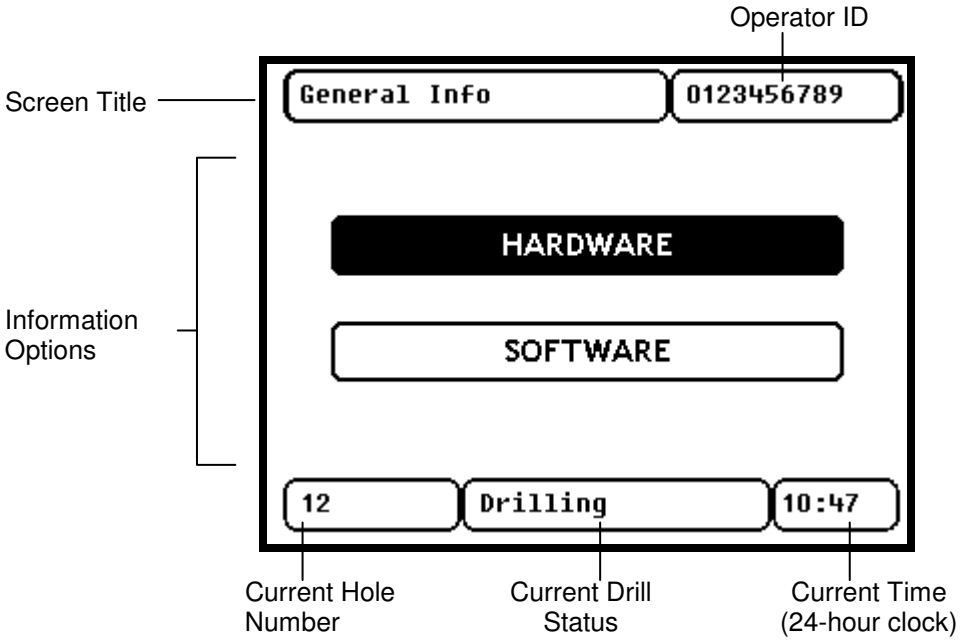
General Info Menu

This screen provides two options for viewing information about the **DEI + LOGGER** hardware and software.

To display the General Info Menu:

1. Press the **System** button to display the System Menu.
2. Use the arrow buttons (**Left, Up, Down, Right)** to move the highlight to "General Info". Then press the **Enter** button to display the General Info menu.

Screen



Using the Screen

Use the **Up** or **Down** arrow buttons to highlight the option you want. Then press the **Enter** button. The two options are:

- **Hardware.** A series of screens listing hardware-related information for the **DEI + LOGGER,** such as current hardware version number, **DEI + LOGGER** connector configuration, **DEI + LOGGER** and drill system part numbers, and descriptions as setup through the PDA.
- **Software**. A screen showing the software version currently in use on the **DEI + LOGGER**.