BI014158
JULY 2012
Service Manual Part No.: 91-A13-035
Rev.04

Service Manual

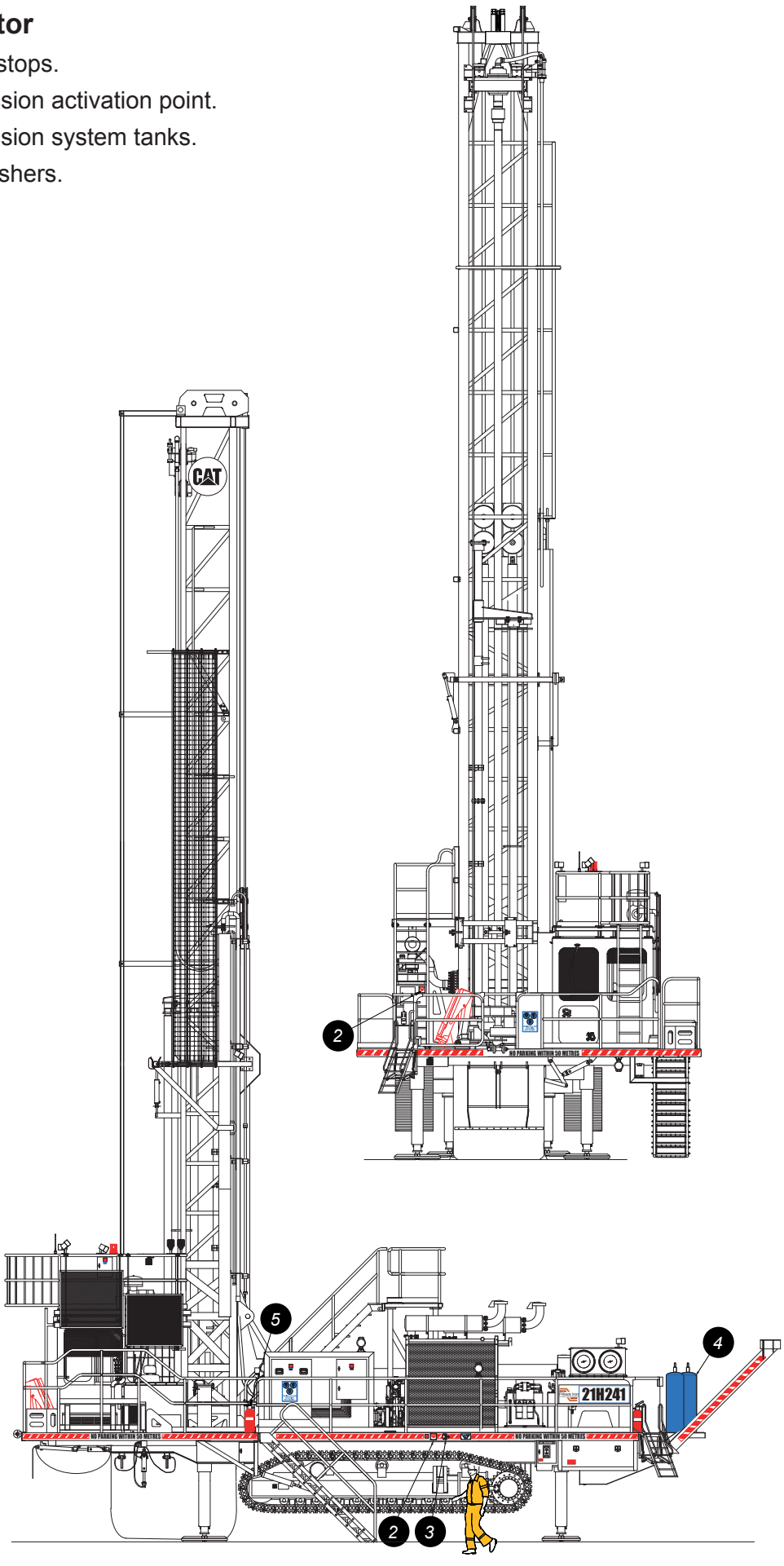
MD6420 Rotary Blasthole Drill

Caterpillar Serial Number: 2E67F21

Safety

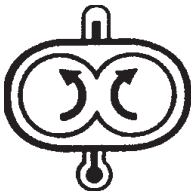
Safety Locator

2. Emergency stops.
3. Fire suppression activation point.
4. Fire suppression system tanks.
5. Fire extinguishers.



Graphic Symbol Legend

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



Compressor Discharge Temperature

Engine Coolant Temperature

DRILL (Drill/Propel Switch)

Drill Hourmeter

Drilling Air Pressure

Dust Collector

Engine START

Engine Hourmeter

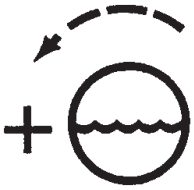
Engine RPM

Engine Oil Pressure

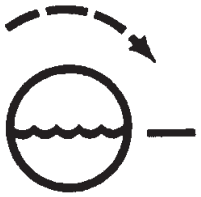
Ether Injection

Engine STOP (also By-Pass)

Water Injection



Water Injection Flow Control – INCREASE



Water Injection Flow Control – DECREASE

Voltage (Battery Charging)

Drill Stem Thread Lube

Dust Curtain

Operating System Help Table Icons

	Busload
	Indicates pipe catcher is up (interlocks feed)
	Indicates pipe catcher is down
	Indicates critical engine coolant level
	Indicates fast tram speed if rabbit is green Indicates slow tram speed if turtle is green
	Indicates fast speed in general
	Indicates slow speed in general
	Engine hour meter
	Indicates activated output
	Indicates voltage on an inactivated digital output
	Indicates low current on an activated PWM output (cable break)
	Indicates no feedback from an activated digital output
	Indicates high current on an inactivated PWM output
	Indicates inactivated output
	Indicates good input from edge detection laser
	Indicates missing input from edge detection laser

Login Screen

Dashboard

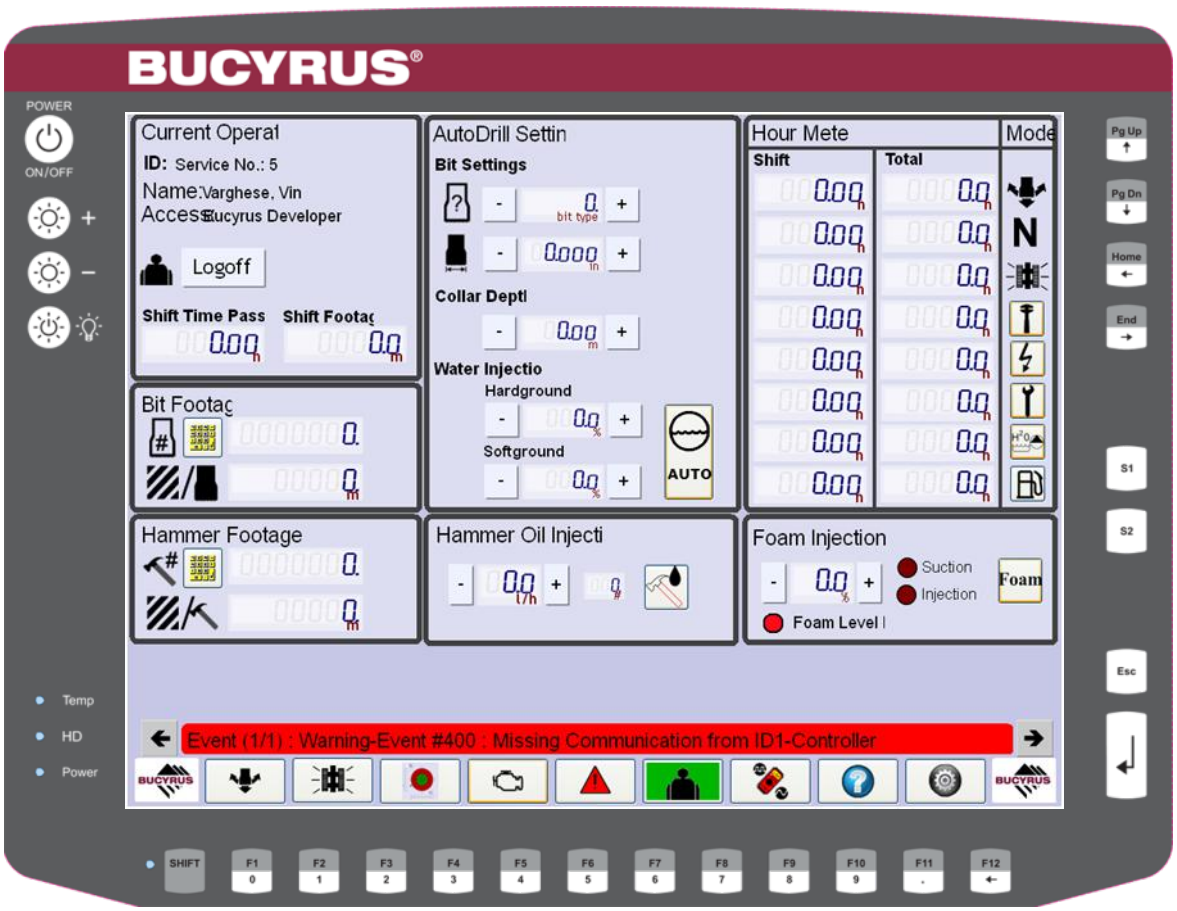
The Dashboard is the main interface for drill operation, service and trouble shooting. The program is started automatically once the operational system is running. The start screen of the Dashboard is the “ Login Screen”. The access level of the user determines which screens are accessible.

Without login it is possible to switch to the Help and Engine Screen. This allows the access of onboard documentation like manuals and schematics as well as checking engine hours and engine fault codes.

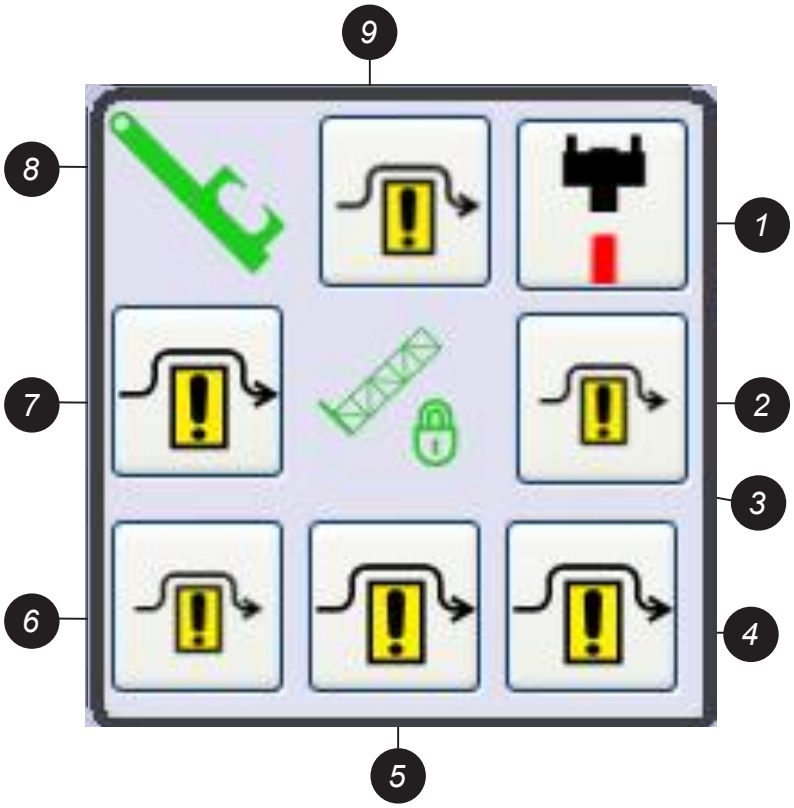
Login Screen

The Login Screen is the start screen of the Dashboard. Beside the login function, the screen provides information about bit life, drill, tram, service and refill hours. In addition to the general machine hour meter the passed shift time and the shift footage is captured and displayed.

Bit settings may be made if Auto Drill or bit life capturing is required.



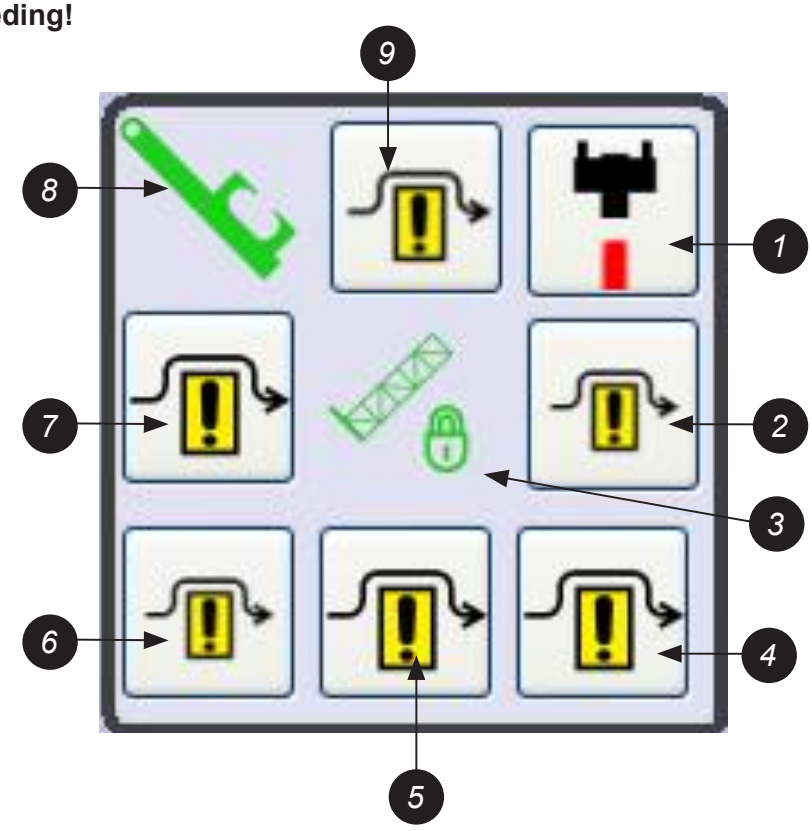
Drill Status and Override Updates (cont.)



1. *Drill pipe coupled status*
2. *Drill water tank non operational*
3. *Mast locks engaged*
4. *Pipe in hole*
5. *Carousel not parked (out position)*
6. *Head not clear*
7. *Not ready to drill*
8. *Pipe positioner engaged on the drill pipe*
9. *Pipe safety arm not closed*

Note: Drill Pipe Coupled / Uncoupled status Icon is an indicator that can be manually changed by the operator from coupled to uncoupled status and vice versa by touching the icon. In the event you are unsure as to the status of your drill pipes and as with all good drilling practices you must visually check before proceeding!

1. *Pipe uncoupled status*
2. *Water tank status overridden*
3. *Mast locks engaged*
4. *Pipe in hole overridden*
5. *Carousel position overridden*
6. *Rotary head (head clear) position overridden*
7. *Ready to drill status overridden*
8. *Pipe positioner in (clear) or drilling position*
9. *Pipe safety arm overridden*



Level Screen

The Level screen displays four distinct sections; the level gauge, the jacking interlocks, the Auto level and Auto Retract buttons and the access stairs up and down buttons.

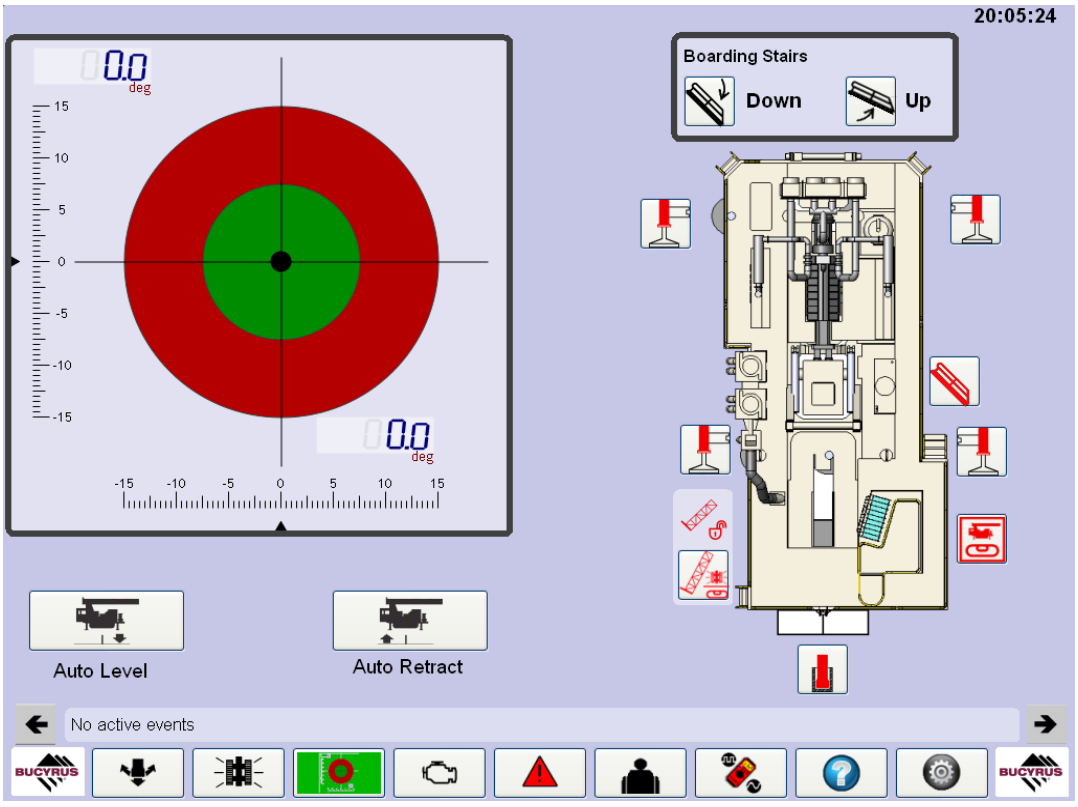
The level gauge in the upper left corner displays a digital readout of the angle and an analogue bubble gauge to display the machine angle.

The Interlock panel displays the functions that will prevent the jacks from being raised or lowered, such as stairs down, pipe in hole, mast locks, dust curtain position and the inclination override button.

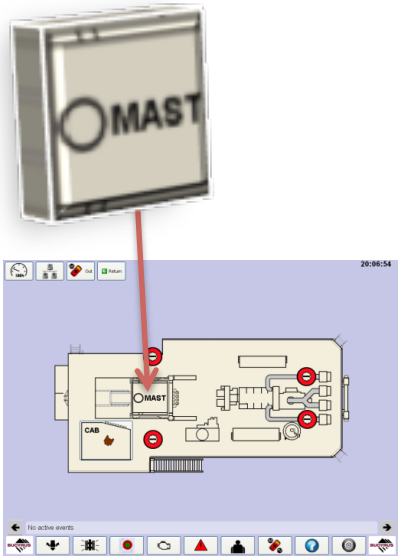
The Auto level button will automatically level the machine from gradients less then 6° providing the interlocks are not active. Any gradient greater than 6° will require manual levelling of the drill.

The Auto retract when activated, will retract all four jacks to the fully raised position, for this to happen, all interlock indicators must be green.

NOTE: Machine stability limit alarms and interlocks are active when jacking the drill.



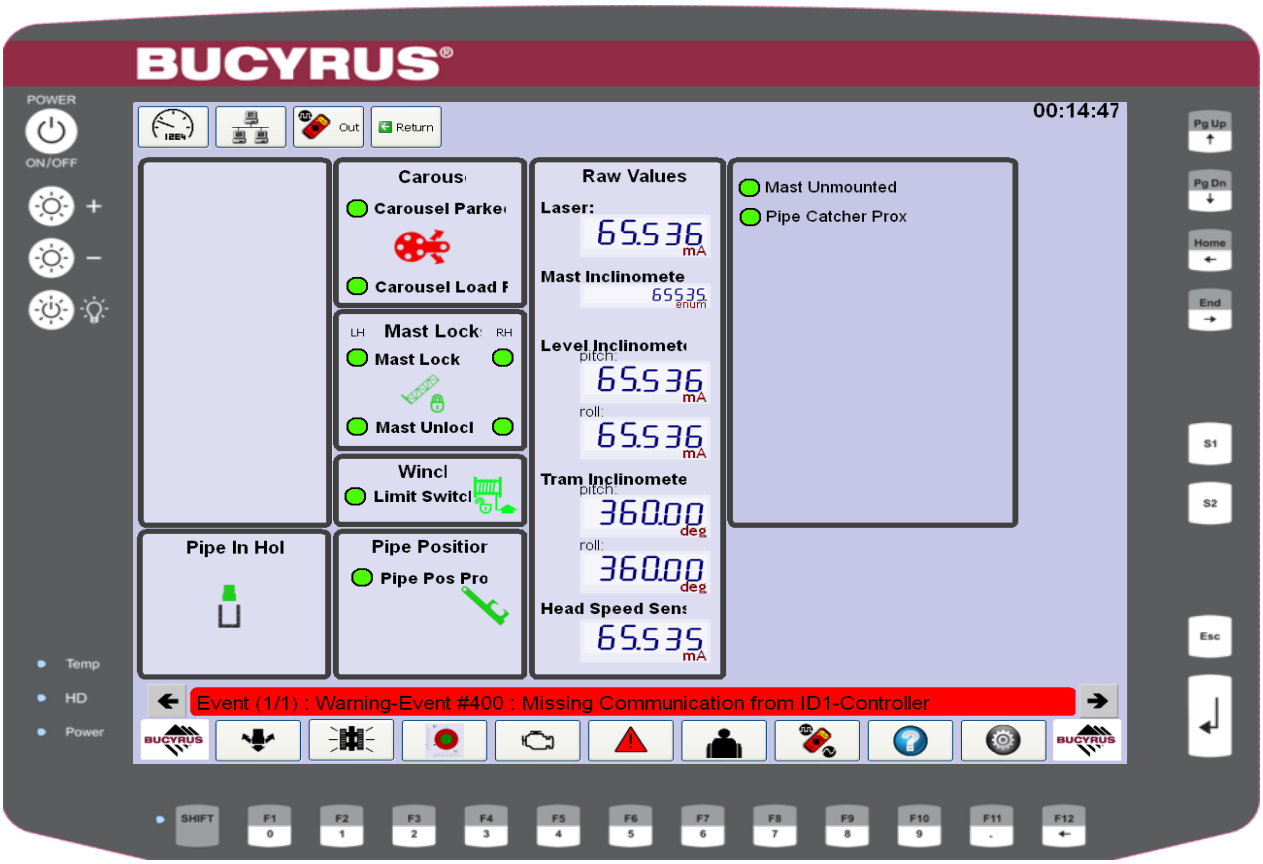
Status Sub Screen - Mast Input



If the MAST INPUT screen is selected from the screen at left, the screen below will appear.

- This screen displays the status of all of the inputs from the mast.
- **Green indication circles** indicate actual inputs generally proximity switches.
- **Raw values** box shows the actual sensor values from these sensors.
- Other symbols show interlock status for Carousel, mast locks, pipe positioner, winch up interlock and pipe in hole.

Note: Mast un-mounted is a switch in the main junction box which needs to be turned on if mast is removed for maintenance or transport. This will remove the mast from the PLC system.



New Machine Procedure

NOTE: Required for new equipment only

- The mast must be lowered to the horizontal position.
- Initial monitoring of the roller and idler temperatures must be recorded over a 500 metre tramming distance for new machines.
- The machine should be trammed for 250 metres in the forward direction and 250 metres in the reverse direction in either order with the temperatures continually monitored.
- If temperatures over 90ºC (194ºF) are recorded the machine must be stopped until the rollers or idlers have cooled below 60ºC (140ºF).
- As a minimum the following detail must be recorded, the temperatures prior to starting, two intermediate temperatures and the finished temperatures over the 500m distance.

General Maintenance Checks While Tramming

- If the drill is required to walk more than 500 metres, maintenance personnel will be expected to monitor the roller temperatures.
- Were possible while tramming it is favoured that the load rollers, carrier rollers and idler temperatures are continually monitored while the machine is tramming. It is acknowledged that the machine may be trammed through areas that will not allow people to move around the moving machine or this practice may not be permitted under normal site operations.
- If the temperatures cannot be continually monitored the machine should be stopped at 20 minute intervals during tramming and the temperatures must be checked and recorded.
- If any of the roller or the idler temperatures exceeds 90ºC (194ºF) but is less than 100ºC (212ºF) the following is recommended:
  - Machines without two speed tramming; should have the engine reduced to the low idle speed, recommence tramming and recheck the roller temps after 10 minutes.
  - Machines with two speed tramming; the low speed tram setting should be selected, recommence tramming and recheck the roller temps after 10 minutes.

CAUTION: If the drill continues to walk with any of the rollers or the idler temperatures above 90ºC (194ºF), the roller seals may distort, causing the lubricant to leak out and the roller will fail.

- If temperatures are recorded above 100ºC (212ºF) they must be allowed to cool naturally to under 90ºC (194ºF) before tramming is recommenced.
- Record all required temperatures on the 'Temperature and Condition Record' chart provided and file the information for machine history.

NOTE: For full operations tramming procedure refer to the operators manual.

Section 1.0 Technical Data and Control Settings (cont.)

1.3 Performance Specifications

1.3.1 Cooling

Cooling capacity:	8.0 kW
Evaporator air on temperature:	29ºC DB/19ºC WB
Suction temperature:	-2ºC
Ambient temperature:	46ºC
Supply Airflow:	325 l/s (nominal)
Refrigerant:	R134a

1.3.2 Heating (using hot water) (TFC8Bx1)

Heating capacity:	10.0 kW
Coil air on temperature:	21ºC
Water flow rate:	9 l/min
Water temperature:	90ºC

1.3.3 Heating (using electrical elements) (TFC8Bx2)

Heating capacity:	6.0 kW

1.3.4 Pressuriser

Airflow:	50 l/s (nominal)
Pressure (in cabin):	62 Pa (nominal)

NOTE: Pressure is dependant on filter cleanliness and degree of cabin sealing.

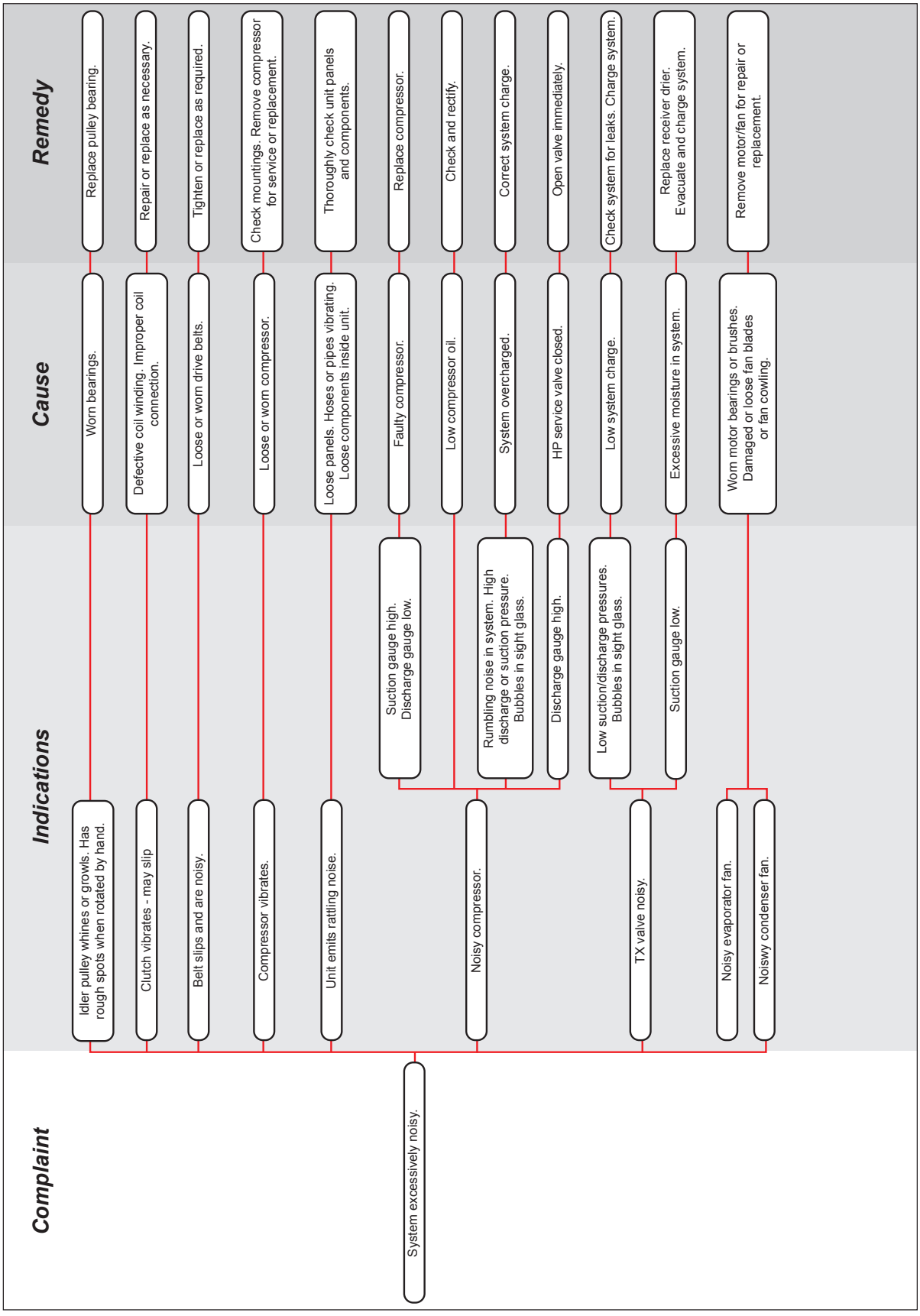
1.4 Unit Mass (Kg)

Unit	TFC8	TCF8	Pressuriser
Mass (kg)	70	50	8

Section 4.0 Fault Diagnosis (cont.)

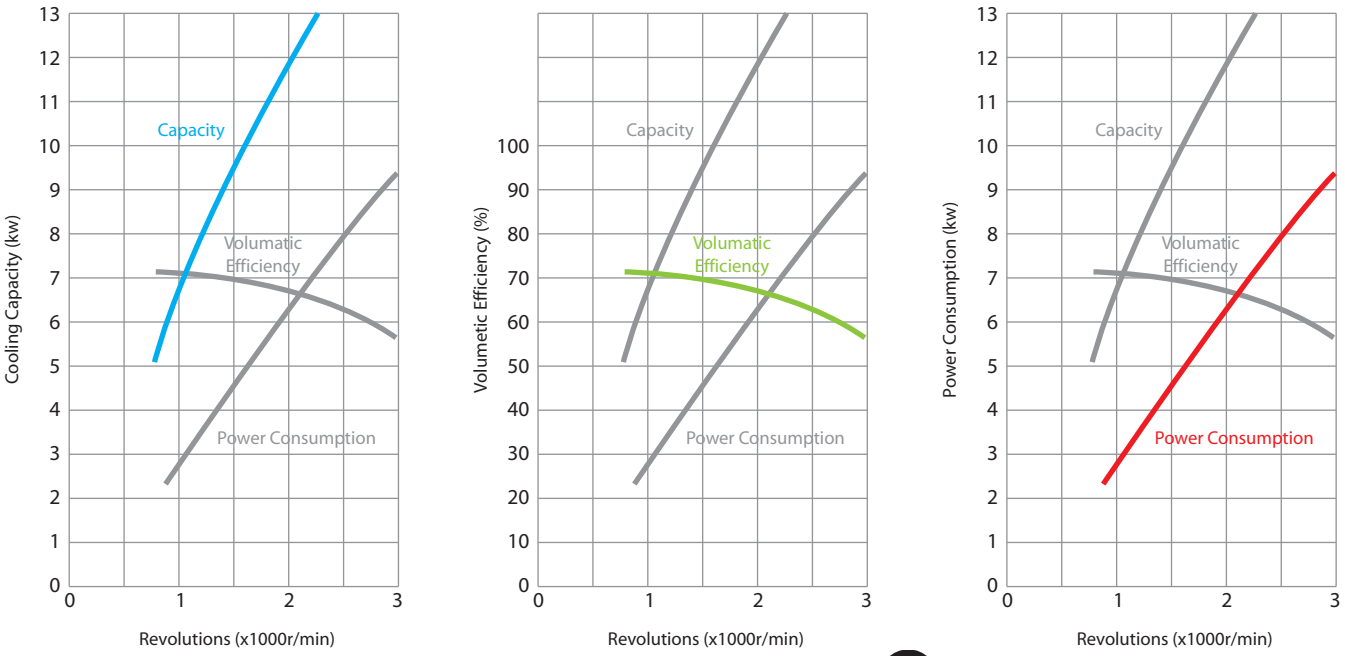
4.1 Fault Analysis Charts (cont.)

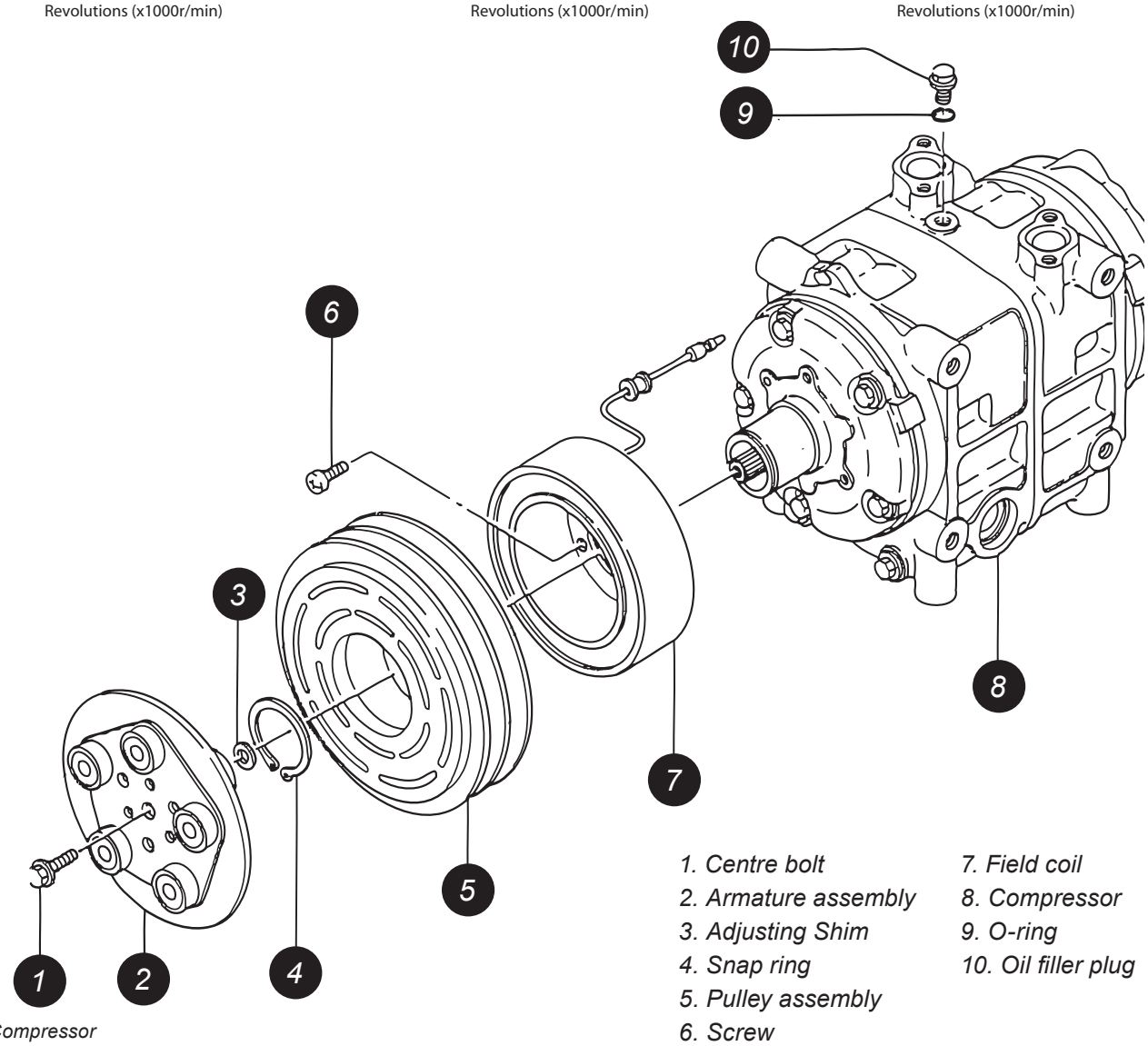
System Excessively Noisy



Section 5.0 Reference Drawings (cont.)

5.4 Performance Curve





DKS32 Compressor

1. *Centre bolt*
2. *Armature assembly*
3. *Adjusting Shim*
4. *Snap ring*
5. *Pulley assembly*
6. *Screw*
7. *Field coil*
8. *Compressor*
9. *O-ring*
10. *Oil filler plug*

Sy-Klone International Powered Precleaners

LIMITED LIFETIME WARRANTY:

Sy-Klone International warrants that its Gideon® Technology Powered Precleaners, its RESPA® Powered Precleaner & Filtration Systems and the Power-KLONE Powered Precleaners ("Sy-Klone Powered Precleaner") to be free from defects in material and workmanship. If a Sy-Klone Powered Precleaner fails because of a manufacturing or workmanship defect within the limited warranty period, Sy-Klone will replace the defective part or refund the purchase price, subject to the following conditions:

Warranty Period:

The Sy-Klone Powered Precleaner housings are warranted to be free of defects in material and workmanship for the operating life of the machine upon which the precleaner is initially installed. The motor and fan are warranted for a period of two (2) years or 5,000 operational hours, which ever expires first, from initial installation. Service parts are covered for a period of one (1) year from date of purchase.

What is covered:

This limited warranty covers the Sy-Klone Powered Precleaners.

What is not covered:

This limited warranty DOES NOT COVER –

- Failures resulting from incorrect application.
- Damage caused by improper installation, improper or abnormal use, misuse, neglect or accident or unauthorized repair.
- Failures resulting from parts not sold or approved by Sy-Klone.
- Damage to parts, fixtures, housings, attachments and accessory items that are not part of the air precleaner.
- Incidental or consequential losses.

We are proud of the fact that Sy-Klone's products are built to last!

This limited warranty is VOID if the Sy-Klone Powered Precleaner is altered or modified in any way including unauthorized repair efforts or the use of any service or repair parts other than those supplied by Sy-Klone.

Sy-Klone's responsibilities:

If a defect in material or workmanship not caused by an excluded failure is found in the Sy-Klone Powered Precleaner during the warranty period, Sy-Klone will provide, at Sy-Klone's option, new parts or Sy-Klone approved repair parts or assembled components needed to correct the defect. Sy-Klone reserves the right to provide a refund of the purchase price in lieu of replacement or repair at Sy-Klone's option. The replacement or repaired product will be sent to you freight prepaid or made available to you for pick up at a local dealer designated by Sy-Klone. Items replaced under this warranty become the property of Sy-Klone and shall be returned to Sy-Klone upon request.

User's responsibilities:

Report your issue to Sy-Klone's Technical Services Department at 1-800-351-8265 or by fax to 904-448-6626 immediately. After contacting Sy-Klone you may be required to deliver or send the air precleaner properly packaged, freight prepaid, to Sy-Klone. The user is responsible for the cost of shipping and packing.

Exclusions and Limitations on Damages and Remedies:

THIS LIMITED WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, WRITTEN OR ORAL, WHETHER EXPRESSED BY AFFIRMATION, PROMISE, DESCRIPTION, DRAWING, MODEL OR SAMPLE. ANY AND ALL WARRANTIES OTHER THAN THIS ONE, WHETHER EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

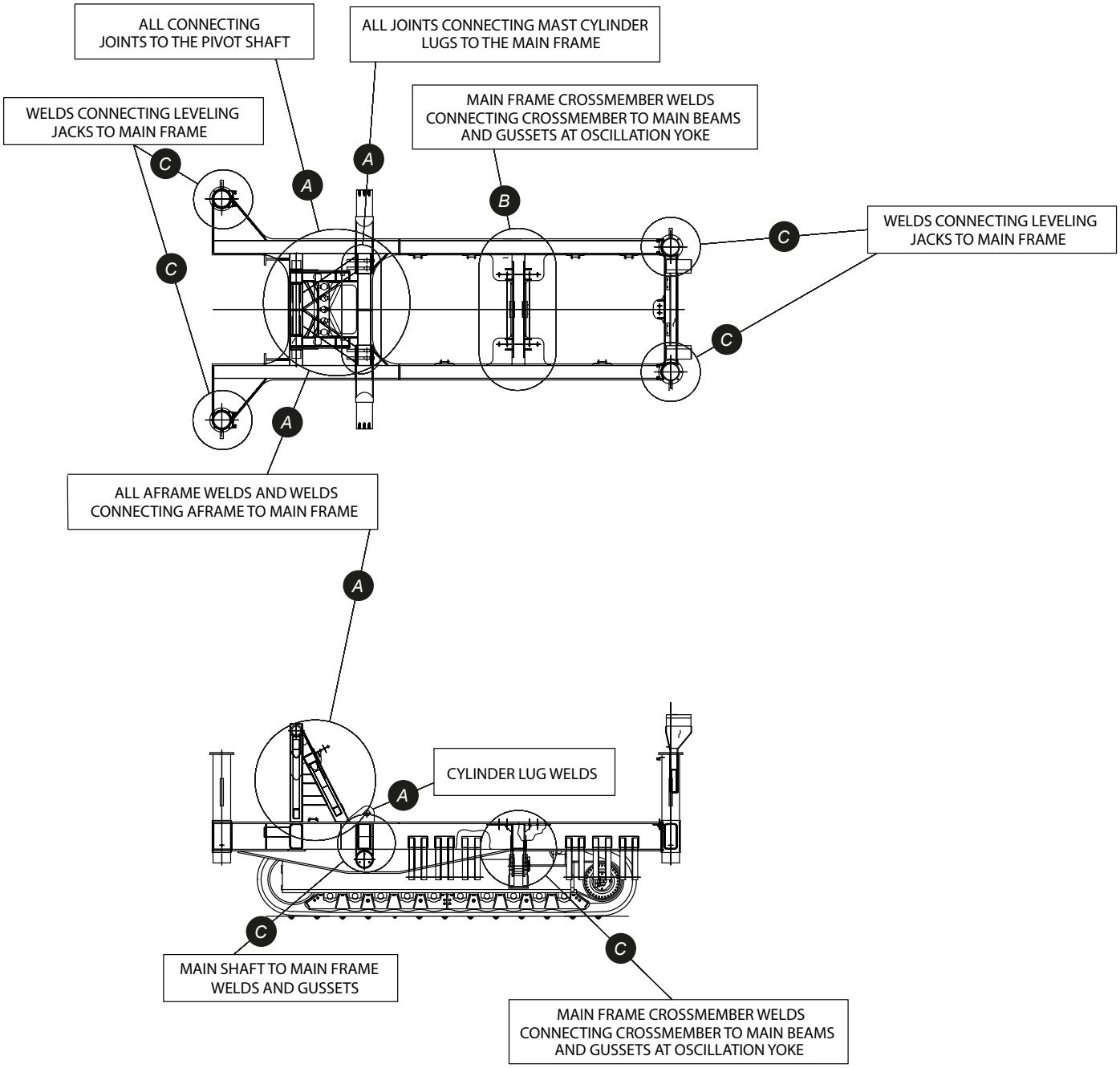
SY-KLONE IS NOT RESPONSIBLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. REMEDIES UNDER THIS WARRANTY ARE THE EXCLUSIVE REMEDIES AVAILABLE AND ARE LIMITED TO THE PROVISIONS FOR REFUND, REPLACEMENT OR REPAIR OF THE WARRANTED PRODUCT AS SPECIFIED HEREIN.

This limited warranty gives you specific legal rights and you may also have other rights that vary from state to state.

Ltd_Warranty_Rev_2009

Weld Inspection Schedule

Main Frame



A CURSORY VISUAL INSPECTION SHOULD BE PERFORMED BY THE OPERATORS AT THE START OF EACH OPERTORS SHIFT.	
INTERVALS FOR MAGNETIC PARTICLE INPECTION IN ACCORDANCE WITH AS1171 MACHINE SERVICE HOURS:	
LESS THAN 30,000 HOURS	GREATER THAN 30,000 HOURS
(A) INSPECT EVERY 3000 HRS	(A) INSPECT EVERY 1500 HRS
(B) INSPECT EVERY 6000 HRS	(B) INSPECT EVERY 3000 HRS
(C) INSPECT EVERY 9000 HRS	(C) INSPECT EVERY 4500 HRS

Note: This weld inspection schedule does not replace any inspection intervals already identified in the 'Operation and Maintenance' manual(s) for the machine. All inspection and maintenance items identified in the 'Operation and Maintenance' manual(s) must continue to be performed.

Maintenance checks For Tramming For Caterpillar Drills

Requirements For Propelling The Machine

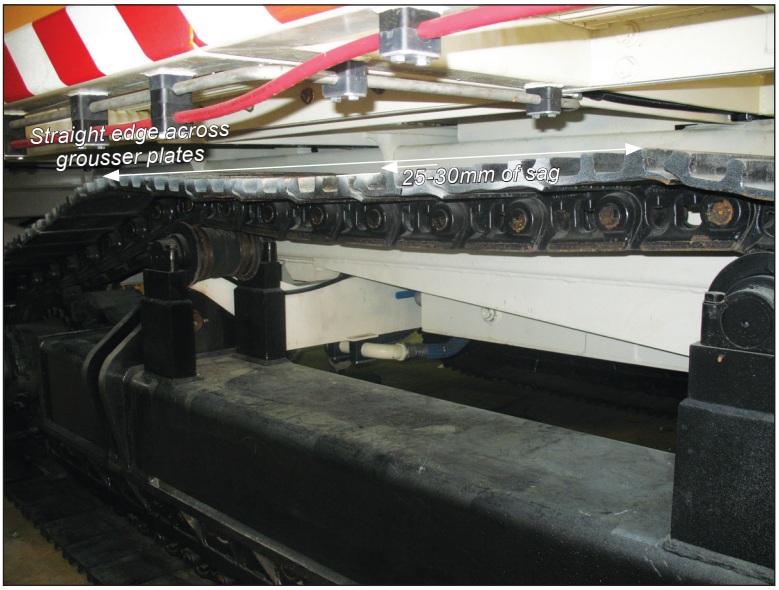
NOTE: If the machine is to be trammed for a distance of over 500 meters the following information must be adhered to.

Checks prior to tramming the machine:

- A general operational understanding of the machine is required as a minimum.
- Pages2 -66 to 2-73 in Section 2 must be read.
- Ensure all site requirements regarding machine movement are adhered to.
- The tracks, final drives and carrier rollers need to be cleaned so they are free of any material build up. To maximise undercarriage life it is recommended that the track frames be washed prior to tramming.
- The final drives need to have there levels checked and topped up as required.
- All undercarriage components must be checked for oil leaks and as a minimum any faulty condition recorded on the 'Temperature and Condition Record' chart (page 3-21 in Section 2).
- The general condition of all undercarriage items must be checked and any faulty components should be replaced or repaired.
- The track tension should be checked and adjusted so that it is correct.
- The path to be travelled should be inspected to ensure it is clear and accessible.
- Communication between the operator and the maintainer is required so that the tasks to be completed during the tramming are clearly understood by both parties.
- The tram hourmeter (where fitted) reading must be recorded.
- The roller and idler temperatures must be recorded.

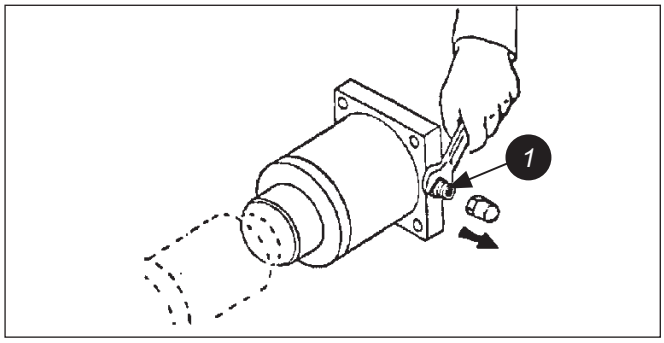
Track Adjustments

The track assembly as a grease dilled jack which tensions the track chains, plus a spring to provide the 'recoil or dampening' effect for the chains and front idler assembly. The correct adjustment will have 25–30mm sag between a straight edge and the top of the grouser plate, on the section of track between the final drive and the top carrier roller or the Idler roller and the top carrier roller.

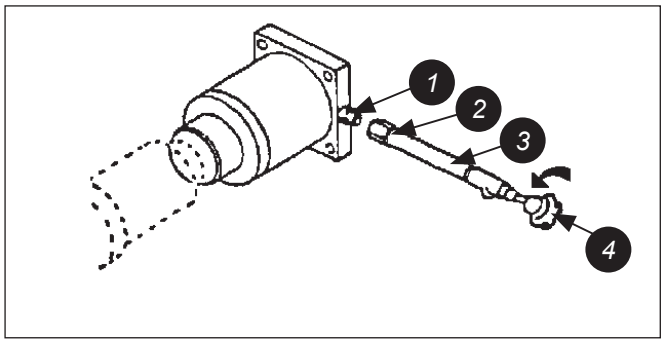


Track Adjustment

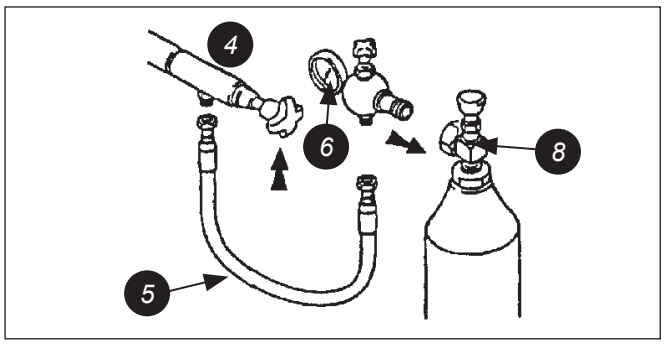
Track Tension Adjustment



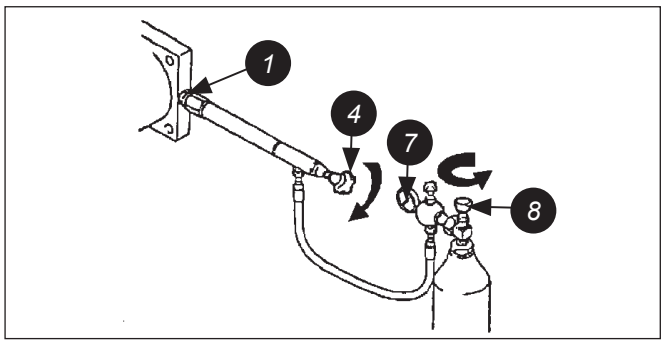
Nitrogen Tensioner



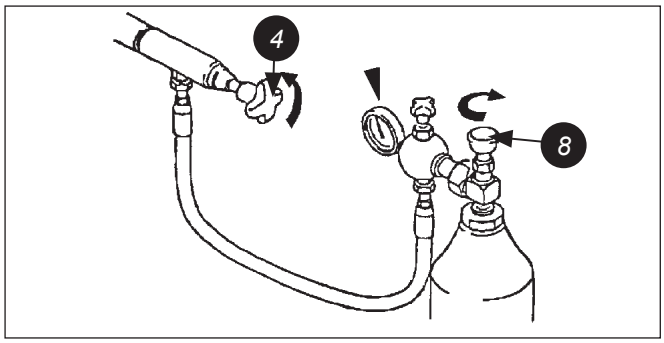
Nitrogen Tensioner – Filling Valve Hook-up



Nitrogen Charging Set-up



Nitrogen Filling



Nitrogen Filling

Nitrogen Tensioner (cont.)

Filling Instructions

1. Remove protective cap on the nitrogen tensioner, then remove the brass cap at the gas valve (1).
2. Be sure the hand wheel (4) on the filling valve is CLOSED.

NOTE: Left hand thread.

Screw filling valve and extension (3) by means of union nut (2) to gas valve (1).

3. Screw gauge/valve (6) onto the nitrogen cylinder (8) and connect hose (5) to filling valve (4) and gauge/valve (6).
4. Turn hand wheel of the filling valve (4) to the right (clockwise) so that the gas valve (1) opens. Open the nitrogen cylinder valve (8). Turn counterclockwise.

NOTE: Purge air from hosing, adaptor and tensioner to ensure that tensioner is filled with Nitrogen gas only using valve 7).

5. Check pressure on gauge on nitrogen bottle with nitrogen flowing. When the desired pressure is reached, close the valve (clockwise) on the nitrogen bottle. **Normal charging pressure is 2320psi (160bar)**. Wait about five minutes and equalise the pressure again. Turn filling valve (4) counterclockwise to close gas valve.
6. Remove charging set-up from nitrogen tensioner. Always keep gas valve clean and free from any dirt or debris. Apply Loctite 270 to brass cap and replace the brass cap on the gas valve. Replace the protection cap.

Note: Tensioner cannot be transported pressurised and therefore must be charged on installation. Charge kit available from Bucyrus.

Track Chain and Shoe Installation

Track Chain with Shoe (cont.)

Assembly and Installation (cont.)

4. Lay track chain with grousers attached, flat on ground. Place crawler assembly over track chain (fig. 3-15) so that the idler is near the end of the track chain.
5. Pull the track chain over the crawler assembly from the sprocket end (fig. 3-16).
6. The end position should be the top of the idler (fig. 3-17).

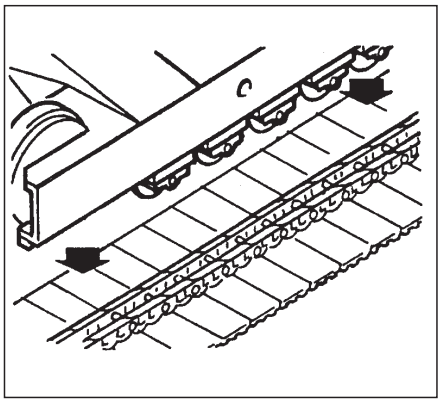


Fig. 3-15 Crawler To Track Chain

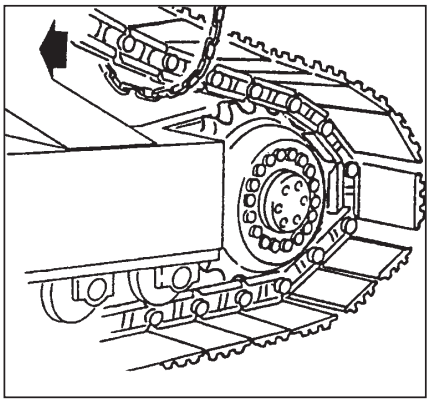


Fig. 3-16 Pull Track Chain Over Sprocket

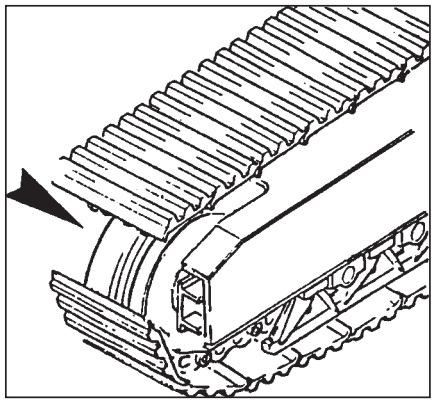


Fig. 3-17 End Position of Track Chain

7. Grease two master collars and place in link pin boss (fig. 3-18).
8. Align the pin bores of the track links and insert master pin (fig. 3-20).
9. Press pin in all the way using the hydraulic press. (fig. 3-19).

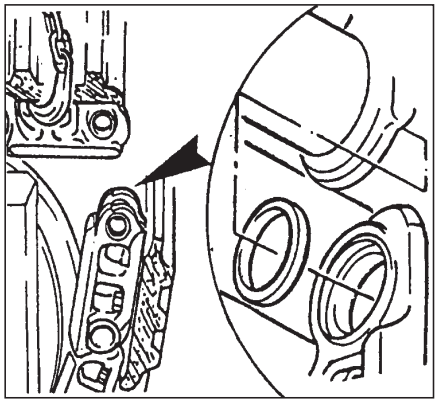


Fig. 3-18 Master collars – grease and install

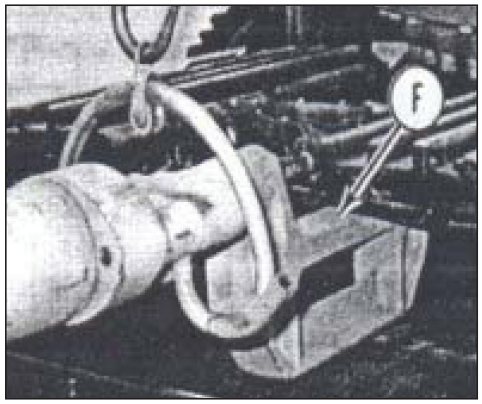


Fig. 3-19 Align pin bores and insert pin using hydraulic press

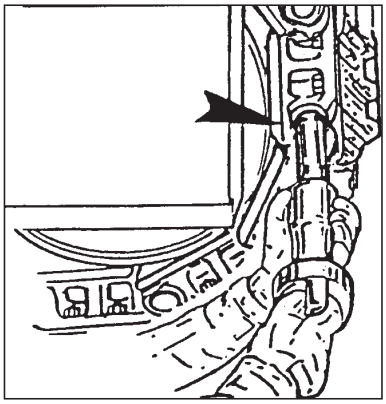
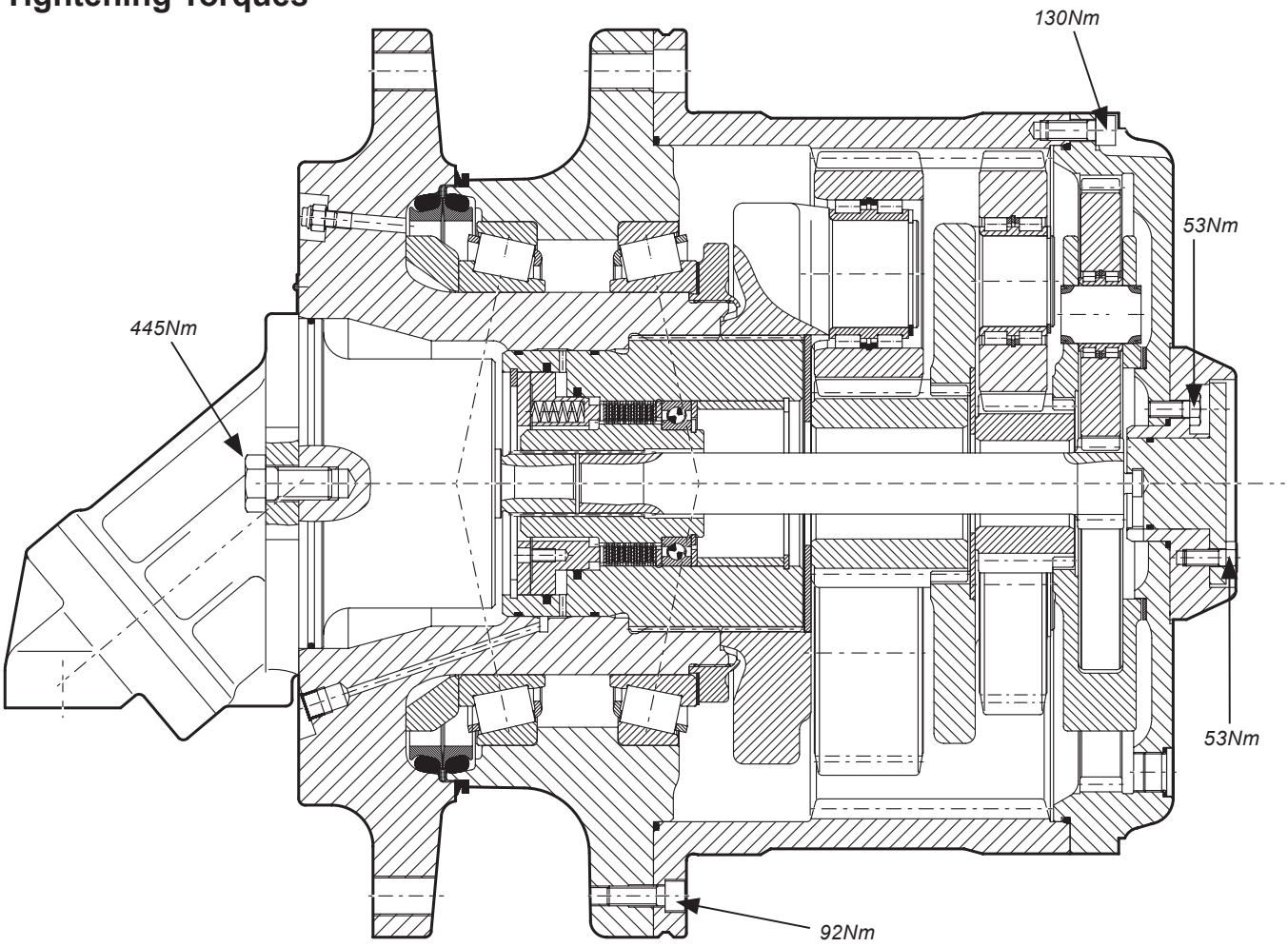


Fig. 3-20

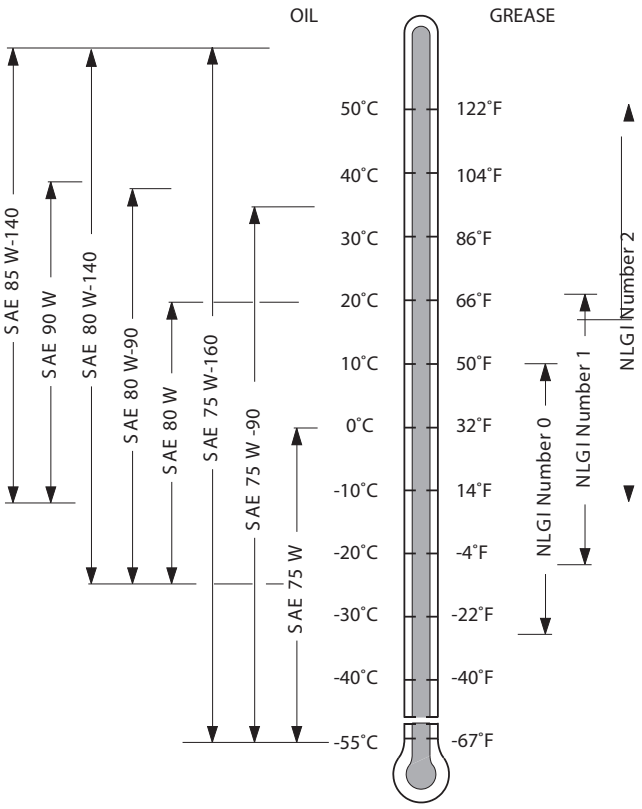
10. This completes the track chain installation.

Final Drive Unit

Tightening Torques



Lubrication / Greasing – Grades And Application Range



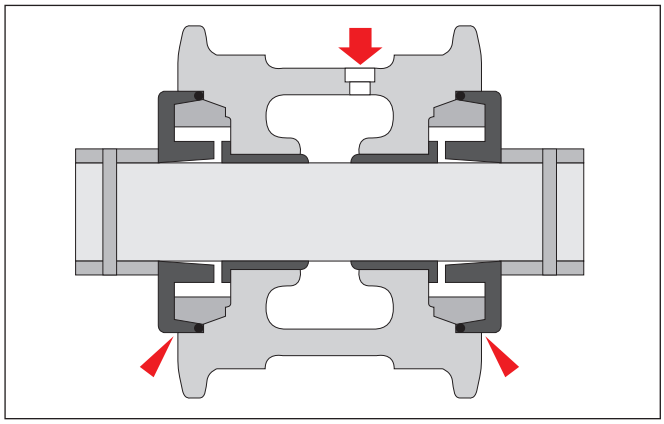
To fill and drain oil remove plug (3). At the end of the operation tighten the plug at 70Nm torque wrench.

Track And Support Roller – Test And Install

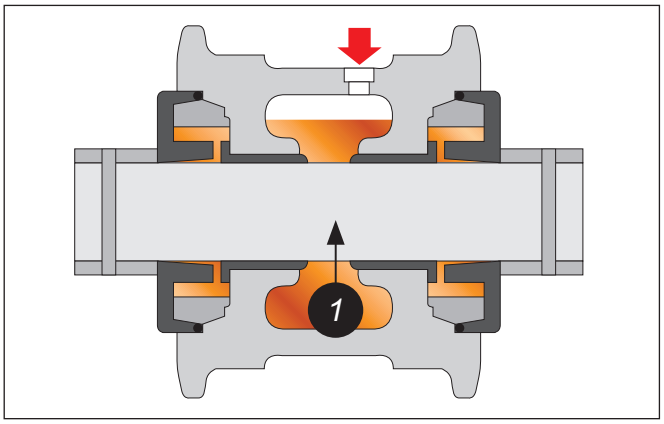
1. Check the end play. Check for air tightness by applying air pressure through the oil fill hole. Test pressure should be not more than 87psi (6bar).
2. If the air test is satisfactory, with no air leakage around the seals, fill roller with SAE 90 oil through the oil fill hole.
3. Hold the roller in such a way so the oil groove is at the bottom and the oil fill hole is at the top. Now apply air pressure into the roller as in step 7 so the oil is pressed into the seal retaining spaces (9).
4. After filling with oil, check for correct level.

- **MAX Oil Level** – Turn the roller so the oil fill hole is 40° from a horizontal line through the centre. Oil should not spill out of the oil fill hole in this position.
- **MIN Oil Level** – Turn the roller so the oil fill hole is 10° from a horizontal line through the centre. Oil MUST spill out of the oil fill hole in this position.

5. Put some loctite on the threads of the oil fill plug and install with a 6mm allen wrench (fig. 3-36).

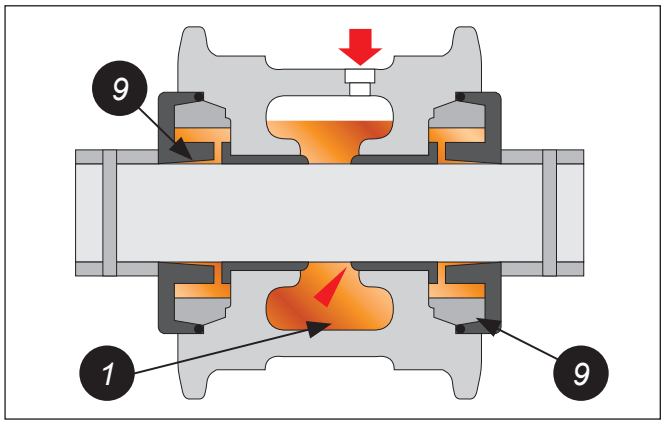


Track roller – air leakage test



Track roller – oil fill

1. Oil



Track roller – air/oil

1. Oil *9. Seal retaining spaces*

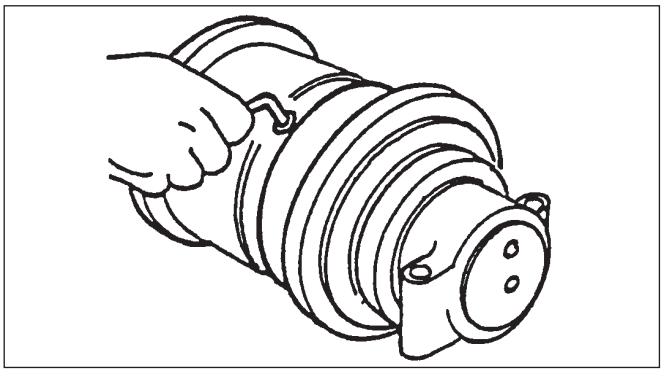


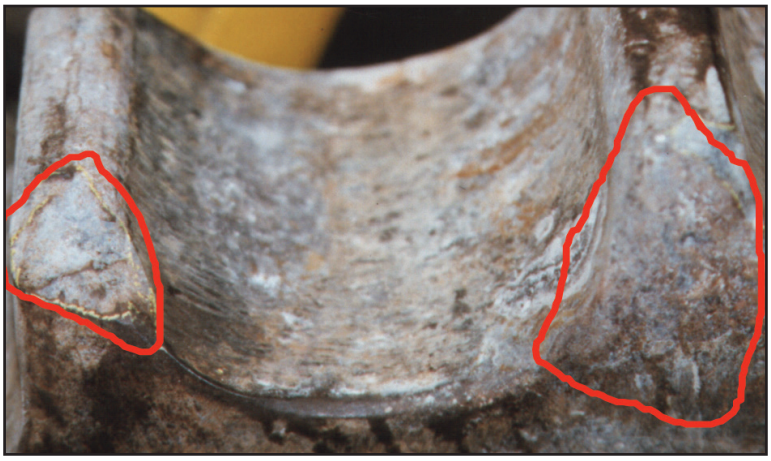
Fig. 3-38 Track roller – oil level

Track and Sprocket Inspection

Sprocket Wear Patterns (cont.)

Tooth Tip Broken Off

Tooth tips broken off.



Causes:

- Sprocket not in alignment with rollers.
- Snaky track.
- Frequent steering manoeuvres.
- Tooth tip not adequately rounded making engagement with bushing difficult.
- Sprocket is too wide for chain.
- Sprocket wobbles.

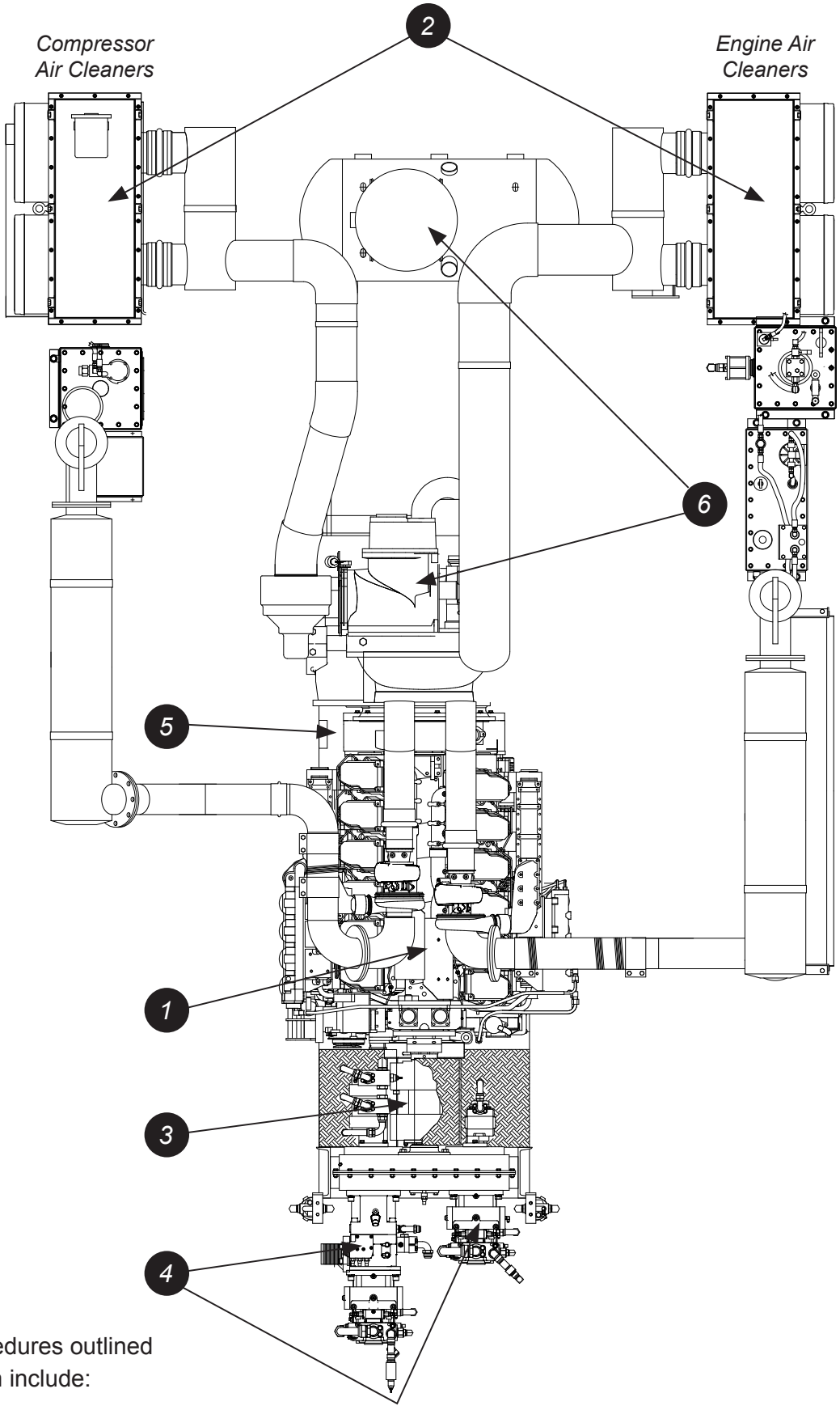
Effects:

- Small cracks may continue until complete tooth failure occurs.
- Sprocket becomes less usable in high impact loads.

Remedies:

- Align sprocket and rollers.
- Use track guides between last roller and sprocket.
- Only use sprockets with adequately rounded tooth tips.

Power Group Locator



Service procedures outlined in this section include:

1. *Diesel engine*
2. *Air cleaners*
3. *Flexible drive coupling*
4. *Pump drive and pumps*
5. *Compressor drive coupling*
6. *Air compressor system*

For hydraulic pump adjustment see Section 7.

Oil Reserve Systems

Operation

Oil Reserve systems are designed to maintain a constant running oil level throughout all types of conditions, as well as extending oil changed to 500 hours intervals.

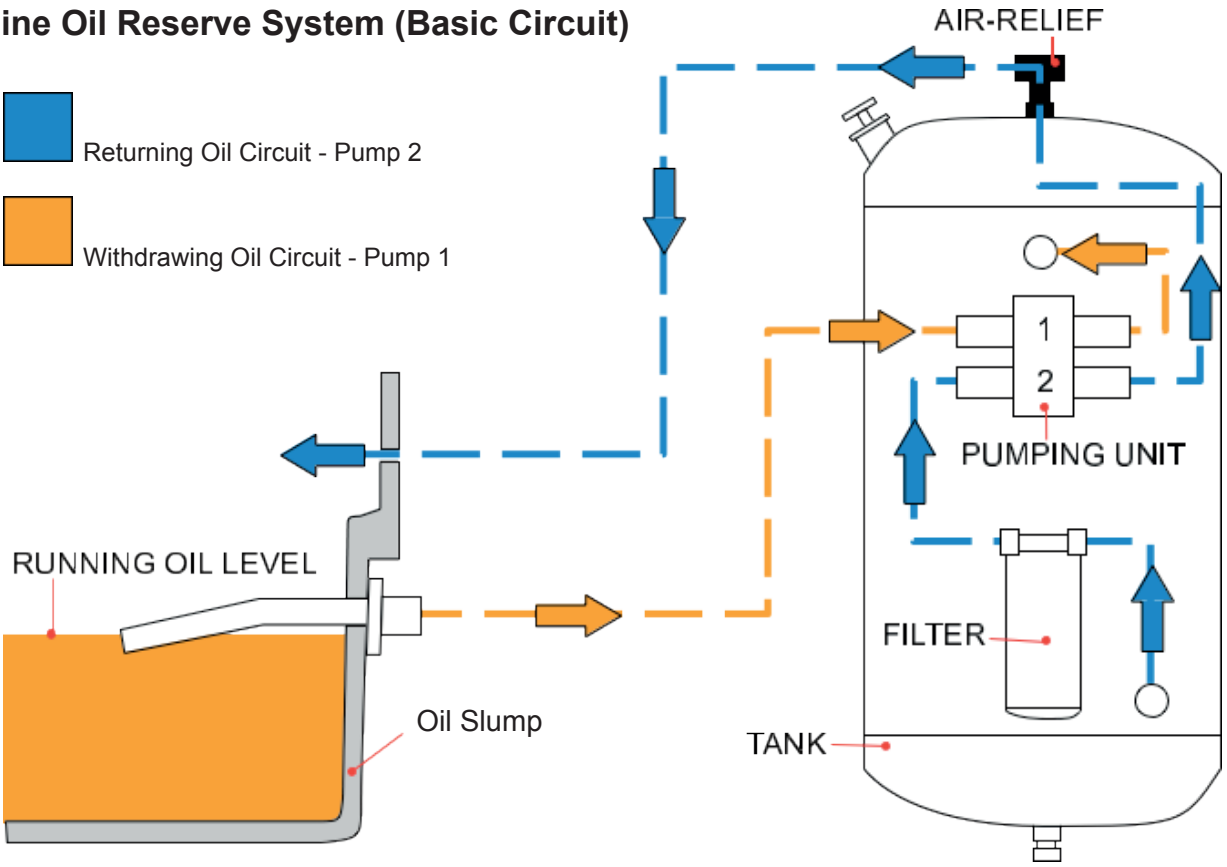
Micro-glass filters have been introduced to extend filter life to 500 hours. Standard engine filters must be changed at 250-hour intervals.

The reserve system works by circulating oil between a remote mounted tank and the engine sump by using two electrically driven pumps mounted on the reserve tank (refer Fig 4-7). The first pump (Pump 1) (refer Fig 4-8) runs continuously, withdrawing oil from the sump via a tube set at the correct operating oil level. When oil is above the bottom of this tube, Pump 1 removes oil from the sump and delivers it to the reserve tank. Once the oil level drops enough for Pump 1 to start withdrawing air, the second pump (Pump 2) cuts in and returns oil from the reserve tank to the sump. The oil level now rises until Pump 1 is no longer with drawing air, and once again starts to withdraw oil. Pump 2 now cuts out until Pump 1 starts to draw air again. This process is repeated constantly, circulating oil between the sump and the tank, as well as maintaining a close running oil level.
The operation of the pumps and oil level is monitored by a LED light mounted in the cab.

Fig 4-7: Engine Oil Reserve Assembly

1. *Level sight gauge*
2. *Oil reserve tank*
3. *Engine oil reserve filters*
4. *Pumping unit*

Engine Oil Reserve System (Basic Circuit)



Flexible Drive Coupling

Flexible Drive Coupling Service (cont.)

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

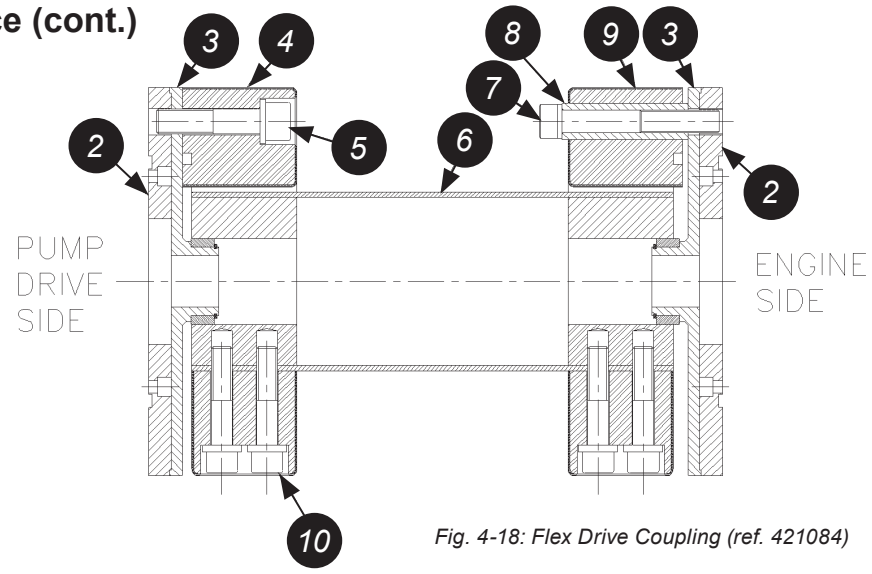


Fig. 4-18: Flex Drive Coupling (ref. 421084)

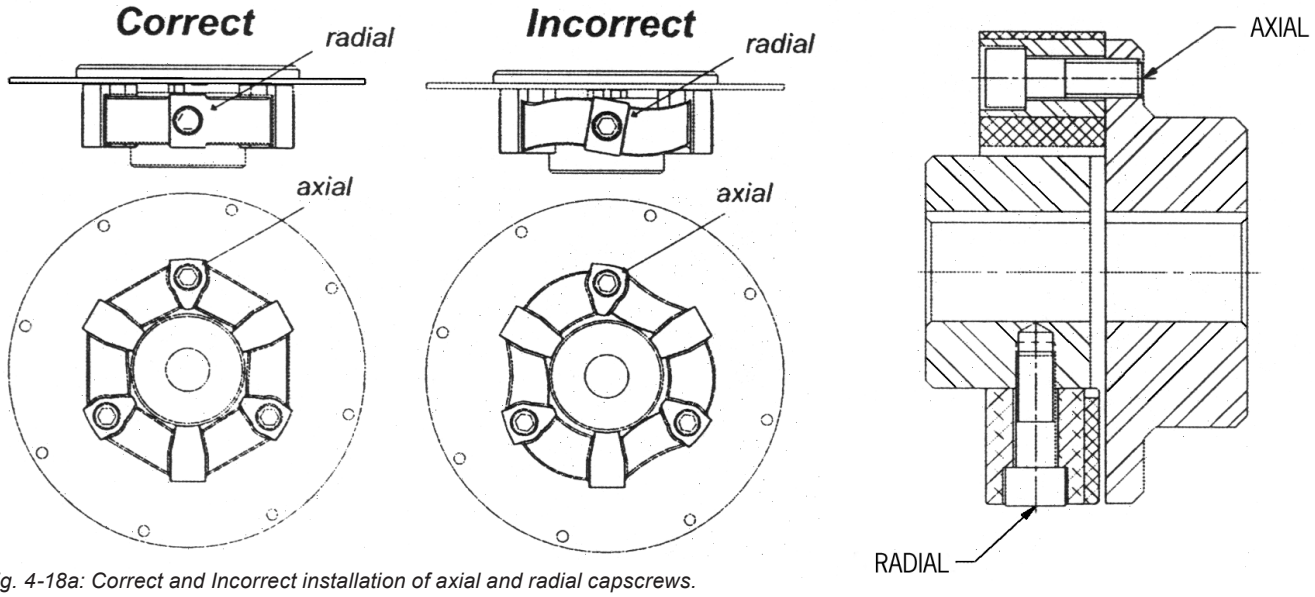


Fig. 4-18a: Correct and Incorrect installation of axial and radial capscrews.

1. Be sure the flange hubs on the engine and pump drive are not damaged. Be sure they are free of nicks and burrs and that all mounting bolts are tight.
2. Place a small amount of grease under the head of each capscrew. This reduces the possibility of twisting the rubber element (see fig. 4-18a). Install 8 pre-coated axial capscrews (longer) finger tight. Be sure the flexible flange with the steel sleeves is on the engine side (fig. 4-18).

3. Rotate the tube (item 6, fig. 4-18) so all 8 axial capscrews (shorter) can be installed finger tight.

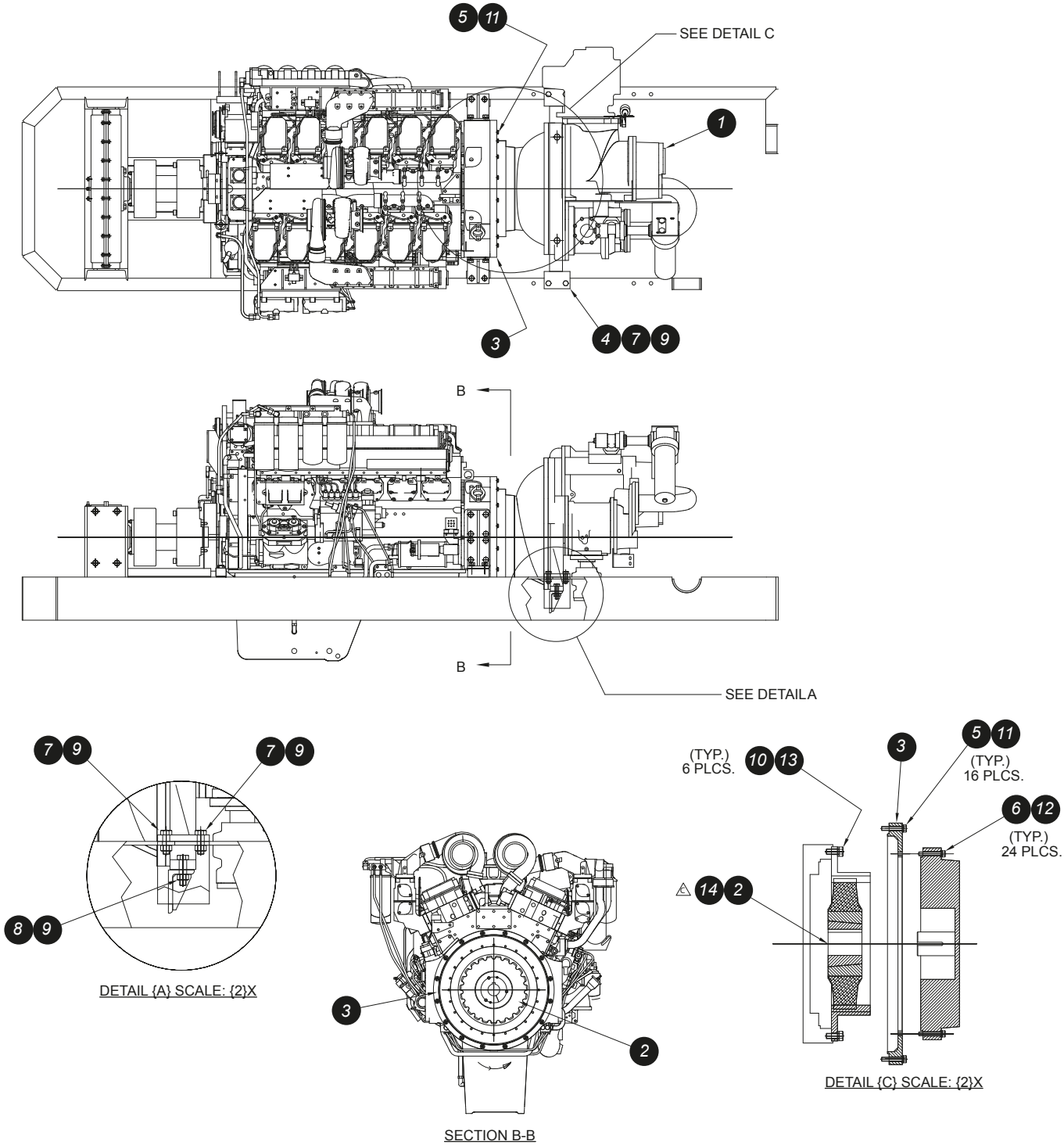
NOTE: Use caution when tightening capscrews to prevent twisting of the flexible flange, see fig. 4-18a. This is particularly important for the radial capscrews. If the part is twisted, the cylindrical surface between the insert and the hub does not carry the load with the whole surface, but with the two corners only. If this happens the other radial bolts can loosen and the coupling will be destroyed.

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

5. Install flex drive cover.

Compressor Installation

Compressor Drive Coupling



1. *Compressor unit*
2. *Drive coupling*
3. *Adapter, engine/compressor*
4. *Mounting bracket, compressor*
5. *Capscrew, hex hd.Metric (M12x1.75x65)*
6. *Capscrew, hex hd grd 5 (7/16-14 UNC x2.70L)*
7. *Capscrew, hex hd grd 5 (3/4-10 UNC x2.50L)*
8. *Capscrew, hex hd grd 5 (3/4-10 UNC x3.00L)*
9. *Nut, lock, 3/4-10*
10. *Capscrew, hex hd grd 5 (5/8-11 UNC x1.50L)*
11. *Washer, flat 1/2*
12. *Washer, lock 7/16*
13. *Washer, lock 5/8*
14. *Bushing, taper lock*
15. *Shim set*

High Pressure Compressor

Description

Introduction

Your new Sullair Drill air compressor will offer superior performance and reliability along with a minimal amount of maintenance requirements.

The compressor is a two stage Sullair rotary screw compressor unit.

As you continue reading this manual and come to learn how the compressor operates and is cared for, you will see how surprisingly easy it is to keep a Sullair compressor in top operating condition.

The package includes a compressor unit, cooling and lubrication system, air inlet system, compressor discharge system, pressure control system and instruments.

Compressed Air Functions

Fig. 4-2: Sullair High Pressure Compressor

Compressor Functional Description

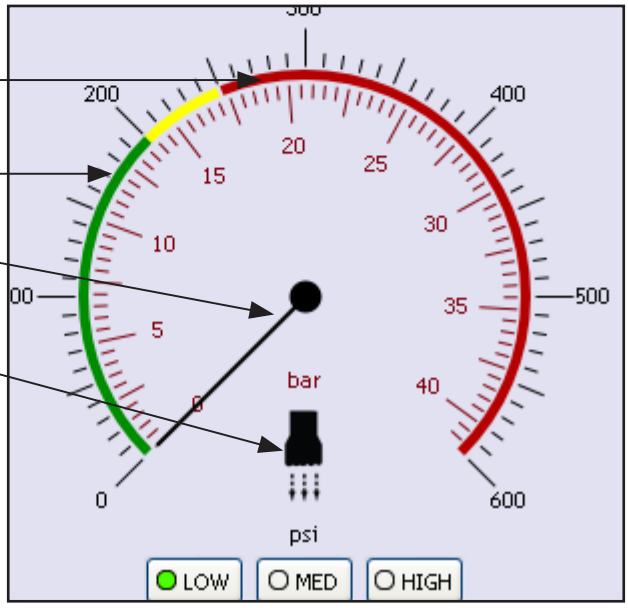
Compressor Gauge

Red arc on compressor gauge shows max setting + 50psi

Green arc indicates receiver pressure

Gauge needle indicates Bit air pressure

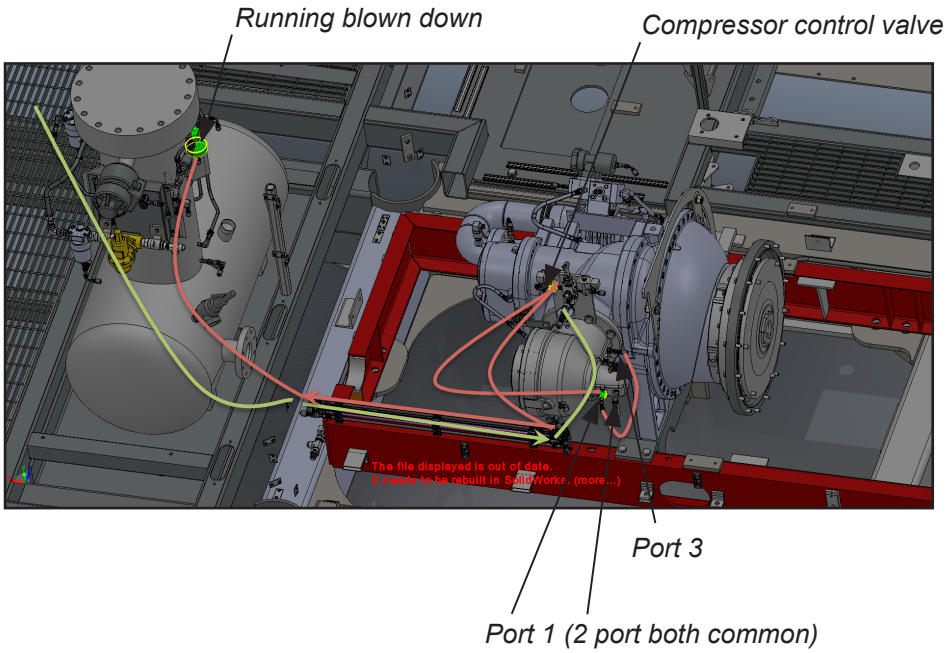
Bit air symbol on drill gauge needs to be green to enable compressor to load or main air valve to open.

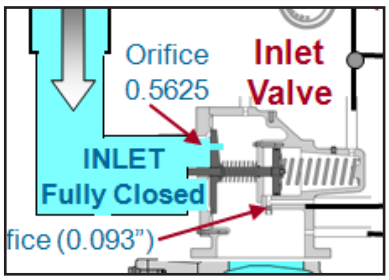


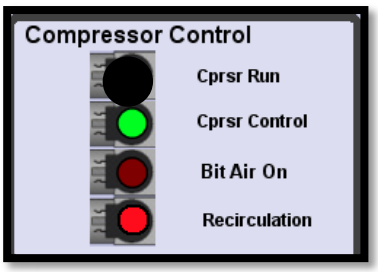
Compressor Control Valve

Compressor Control Valve (NO compressor valve) -controls the maximum receiver pressure- this valve is normally open so in case of failure will fail to safe. Therefore solenoid is energised to allow the compressor to load or make air, if the Compressor Control solenoid is energised this valve will then then close, stopping pilot signal that closes poppet inlet thru port 1 on Poppet inlet and opens running blow down, this signal will bleed off over orifice at port 3 on poppet inlet. This set point for pressure control is a processed value on Drill ECMs pressure is monitored on both the Wet and dry pressure transducers, Wet as primary pressure control, with dry-side as a secondary input (highest value is control value, as there should be a pressure drop over separator wet side should always be slightly higher). Maximum pressure setting changes as each pressure setting is selected. Low / Medium / High, each of these values can be adjusted by Cat Technician to suit the highest required setting- high should be just above the max pressure achieved with hammer in competent rock and water on full, this will generally be a maximum of 400 - 420psi with 8 hammer or 500psi with a 6 hammer.

Compressor control valve shown below in non energised (normal state) open, therefore piloting inlet valve closed and running blow down open.

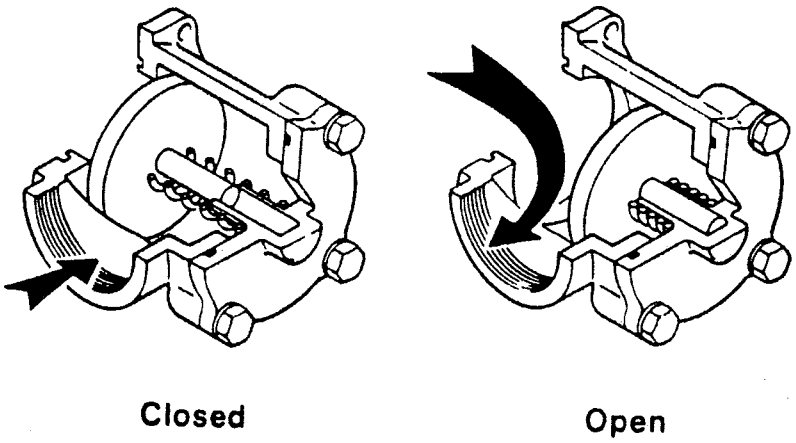






Compressor Maintenance

Discharge Check Valve

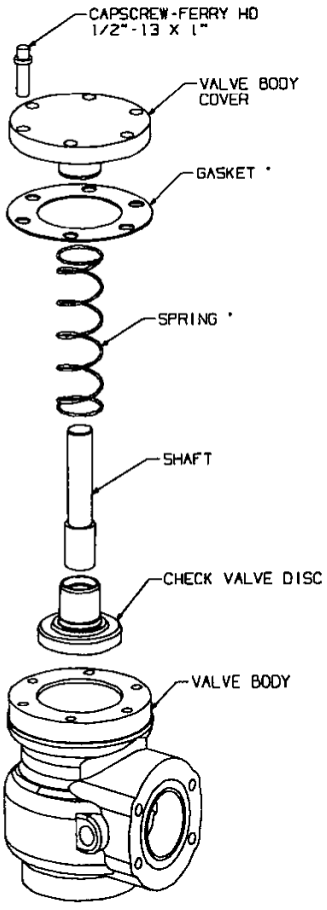


The air/fluid mixture leaving the compressor unit overcomes a spring loaded piston in the discharge check valve, and flows into the separator/receiver tank. On shutdown, back pressure will force the piston closed, restricting flow back into the compressor unit.

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

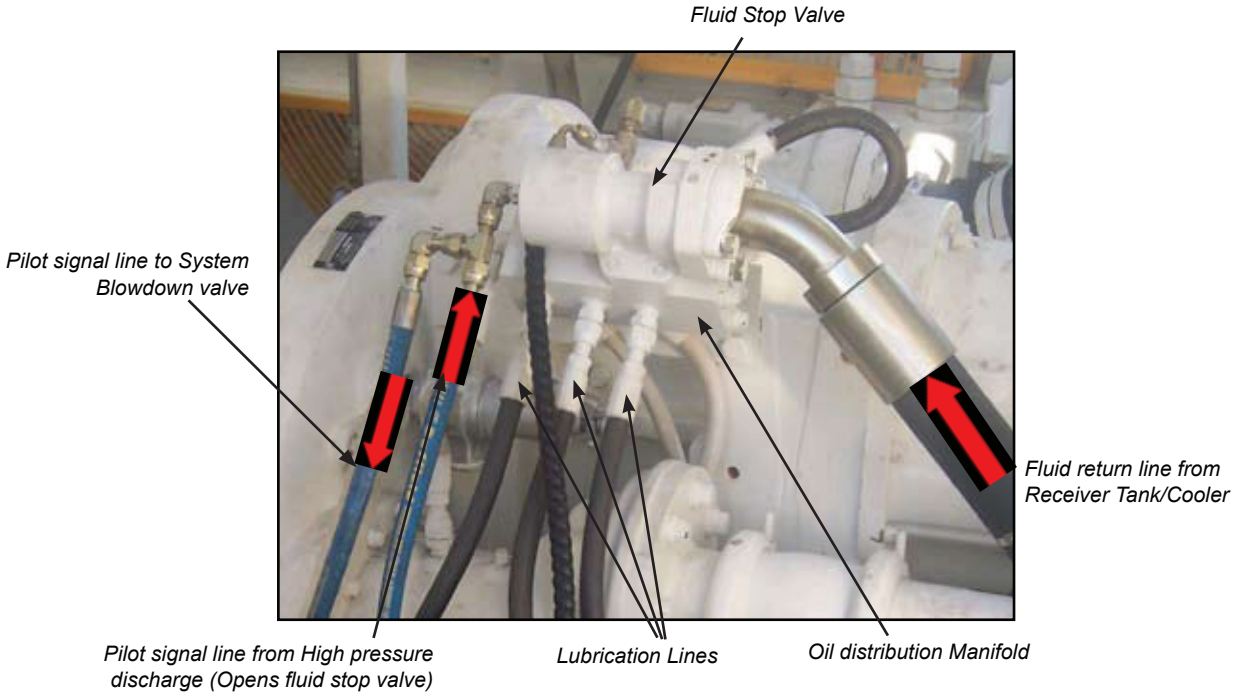
The Discharge check valve.

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

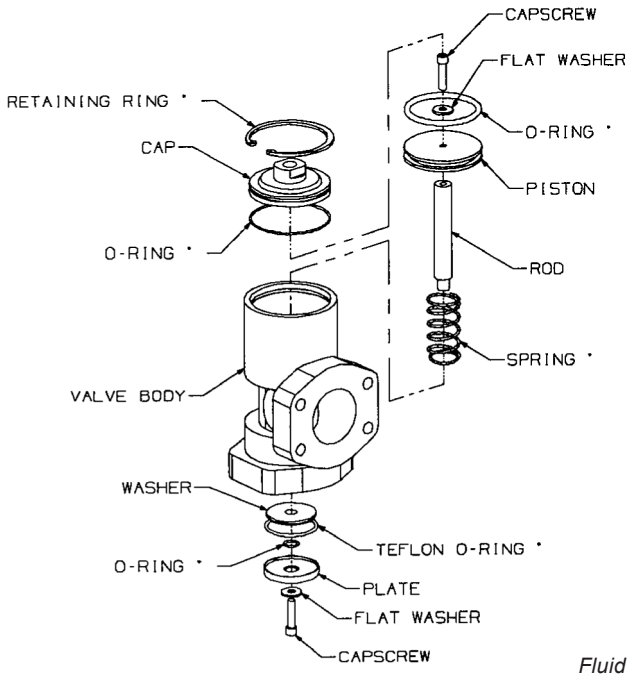


Discharge Check Valve

Fluid Stop Valve



The valve is normally closed and is piloted open at Start-up by pressure generated at the discharge of the Compressor, this in turn means that at Shut-down when pressure ceases to be generated at the compressor discharge, the Fluid Stop valve will close, stopping oil flow back through the unit. When running, compressor oil flows from the discharge, into the receiver tank, through the cooler and oil filter then back through the Fluid Stop valve. Once through the valve, oil is distributed through a manifold and onto the compressor to lubricate its various parts, such as the rotors and bearings. Therefore in order to provide the oil needed for lubrication, air pressure is needed.



Fluid Stop Valve

Compressor Maintenance

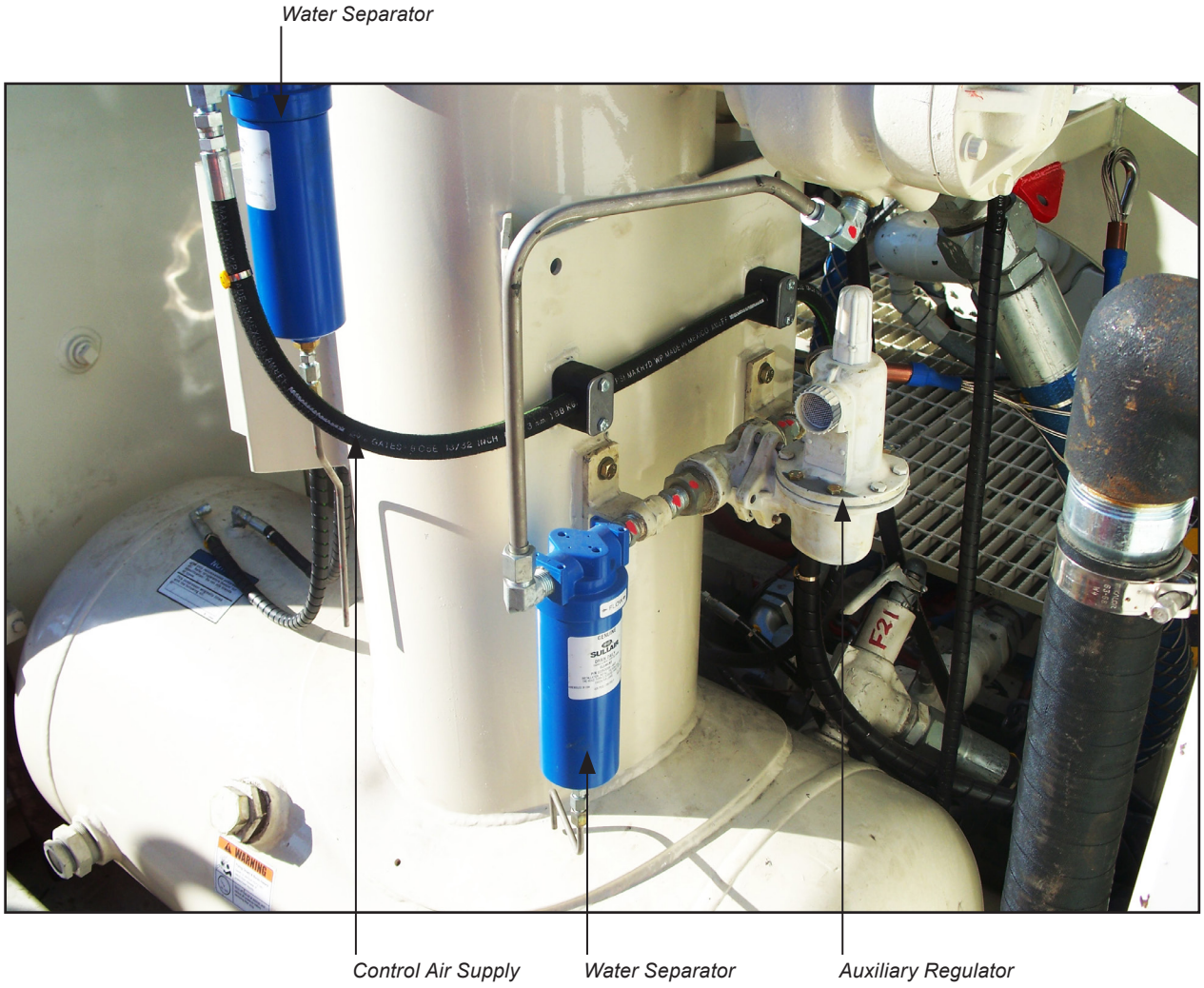
Moisture Separator Maintenance

Daily

Check for slight air flow from constant drain

Every 500 Hours - Replace Element

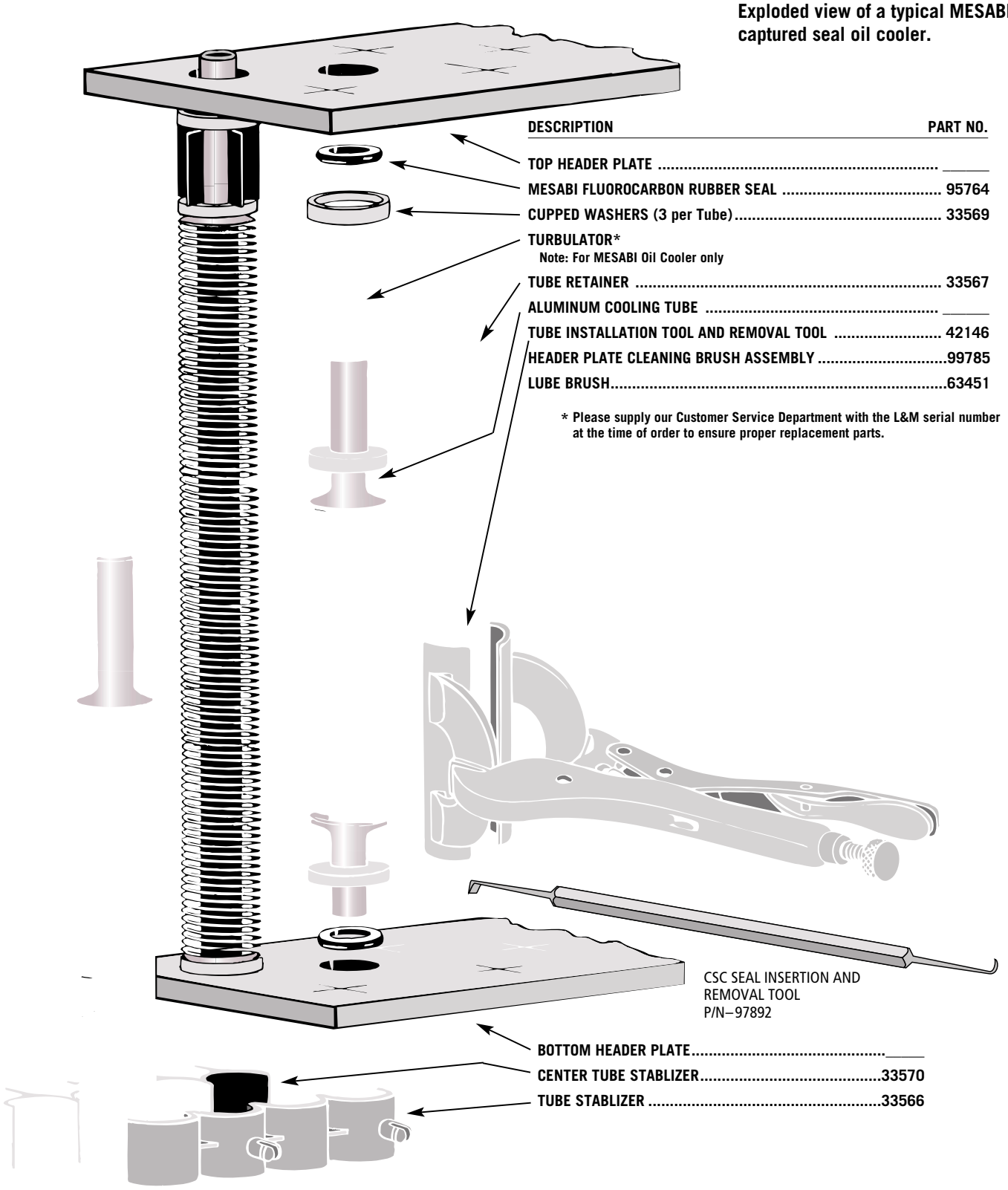
Remove the separator from the system. Through the 1/2” NPT OUTLET port, flush with warm water and detergent, allowing the cleaner to drain out the bottom port. Repeat the process several times, flush with clean water. (DO NOT USE SOLVENTS.)



Standard Parts:

MESABI® CSC™ High Pressure Oil Coolers

Exploded view of a typical MESABI captured seal oil cooler.



DESCRIPTION	PART NO.
TOP HEADER PLATE	_____
MESABI FLUOROCARBON RUBBER SEAL	95764
CUPPED WASHERS (3 per Tube)	33569
TURBULATOR* Note: For MESABI Oil Cooler only	
TUBE RETAINER	33567
ALUMINUM COOLING TUBE	_____
TUBE INSTALLATION TOOL AND REMOVAL TOOL	42146
HEADER PLATE CLEANING BRUSH ASSEMBLY	99785
LUBE BRUSH	63451
BOTTOM HEADER PLATE	_____
CENTER TUBE STABLIZER	33570
TUBE STABLIZER	33566

* Please supply our Customer Service Department with the L&M serial number at the time of order to ensure proper replacement parts.

CSC SEAL INSERTION AND REMOVAL TOOL P/N–97892

NOTICE: DO NOT WELD DO NOT WELD ON ANY PART OF THIS MACHINE WITHOUT FOLLOWING THE INSTRUCTIONS IN THE SERVICE MANUAL.

1. **Stop the engine. Turn the switched power to the OFF position.**
2. **Disconnect the negative battery cable from the battery. If a battery disconnect switch is provided, open the switch.**
3. **Disconnect all electrical connectors from the engine ECM. Move the harness to a position that will not allow the harness to accidentally move back and make contact with any of the ECM pins.**
4. **Connect the welding ground cable directly to the part that will be welded. Place the ground cable as close as possible to the weld in order to reduce the possibility of welding current damage to bearings, hydraulic components, electrical components, and ground straps.**

NOTE: If electrical / electronic components are used as a ground for the welder, or electrical / electronic components are located between the welder ground and the weld, current flow from the welder could severely damage the component.

5. **Protect the wiring harness from welding debris and spatter.**
6. **Use standard welding practices to weld the materials.**

Water Pump

Replacing Piston Cup Seals

1. Remove fluid chamber from pump by removing the three cap screws holding it to the power frame, then lift off the top of the ceramic cylinders.
2. Remove the cap screw and piston retainer from each of the two cylinders.

3. Lift the ceramic cylinder off from the top of the power frame. Friction will usually keep the piston inside the cylinder as it is removed. Once the cylinder and pistons are off the pump, take them to a bench and press them out from the top.
4. Inspect all O-rings, gaskets, seals, and other components for signs of damage or wear. Any damaged components should be replaced at this time. Inspect cylinder liners for cracks or grooves by running thumbnail around the bore of the cylinder. Replace if grooves are detected. New cups will wear quickly if operated in cylinders with rough or grooved bores. Note: to provide maximum operational time between services, FMC recommends that both piston cups, not just the one that shows signs of leakage, be replaced whenever piston service is required.

5. Insure that the umbrella fluid shield is not damaged. A damaged umbrella could allow fluid to contaminate the power end oil. If the umbrella requires replacement, the best way to remove it from the pump is to cut it free with a sharp knife.

NOTE: It is recommended that all gaskets or O-rings be replaced at each piston cup service interval.

6. If new umbrellas are required, fold the plastic as shown and insert through the opening and over the ends of the plunger rod. For easier installation of the umbrella, immerse in hot water for 2-3 minutes to soften. Press tops of umbrellas to place pilot washers over ends of plunger rods with groove in up position.

7. Place O-rings and packing holders in position on ends of plunger rod.
8. Place ceramic cylinders and gaskets in counter bore in power frame.
9. Apply light oil or glycerin around the OD of the piston cups, then place them in the open end of the cylinders. Use the thumb to press the cups down firmly into the holder of each cylinder.

10. Insert the cup retainers into the cylinders with the ribbed side facing the piston cup.
11. Secure packing assembly using cap screws. Torque as per specification.
12. Insert top gasket (or O-ring and ring seal) in fluid chamber counter bore using heavy oil or grease to hold in place.

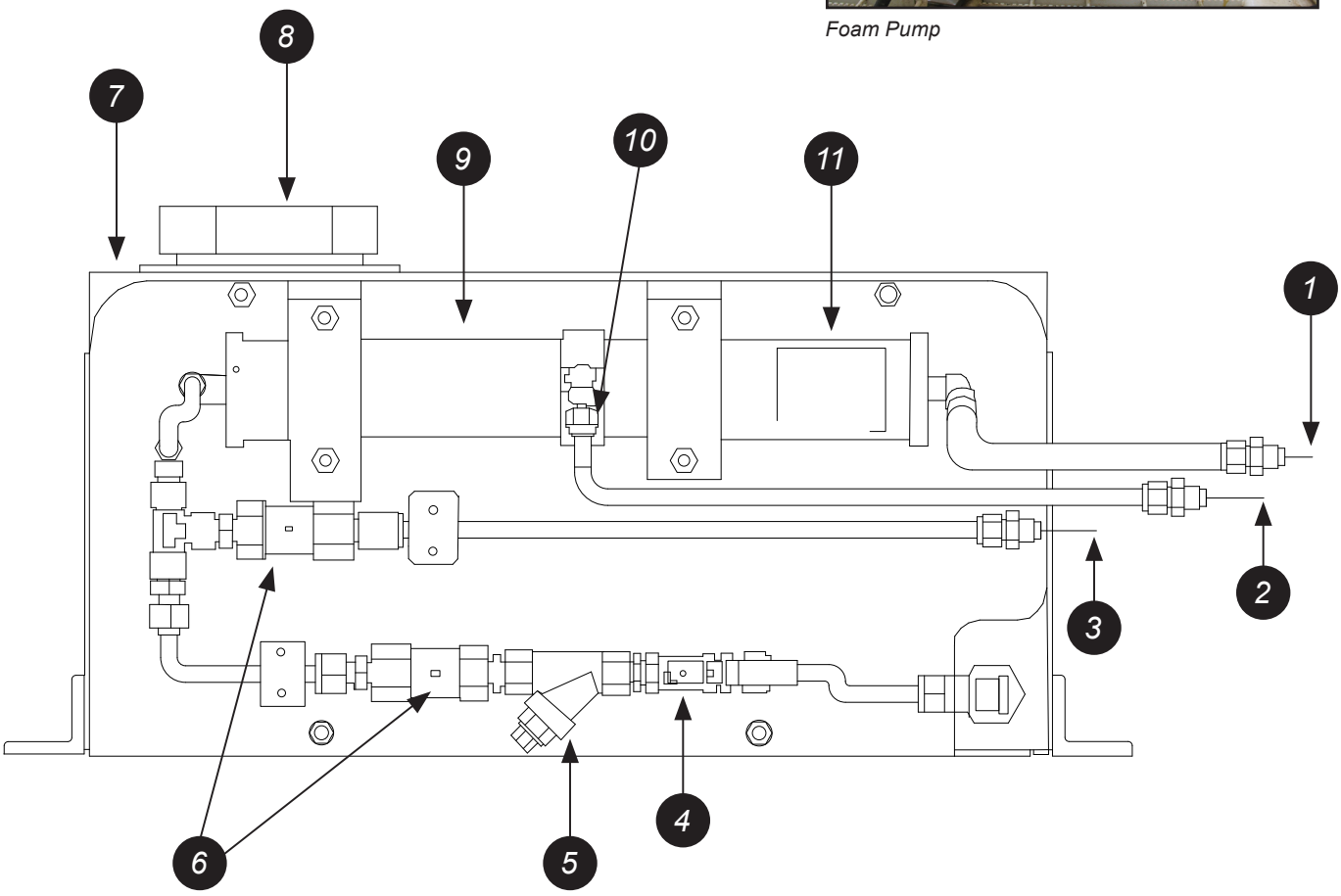
13. Return fluid chamber to position over cylinders and insure that all seals are in place.
14. Replace fluid end cap screws. Torque cap screws in 3 stages to values shown in the Fastener Torque Requirements section.

Foam System

Foam Pump

A foam pump is a hydraulic powered positive displacement single piston pump, controlled by an integrated control through drill control system. Each stroke of this pump delivers 100ml of foam to drill water injection system. Each cycles consists of a suction and injection stage. The volume is determined by the 'OFF' time between cycles. There is a directional control valve on drill 6 spool valve, that supplies oil for the suction or injection stages. This valve is paired with a pressure reducing valve set at 600psi.

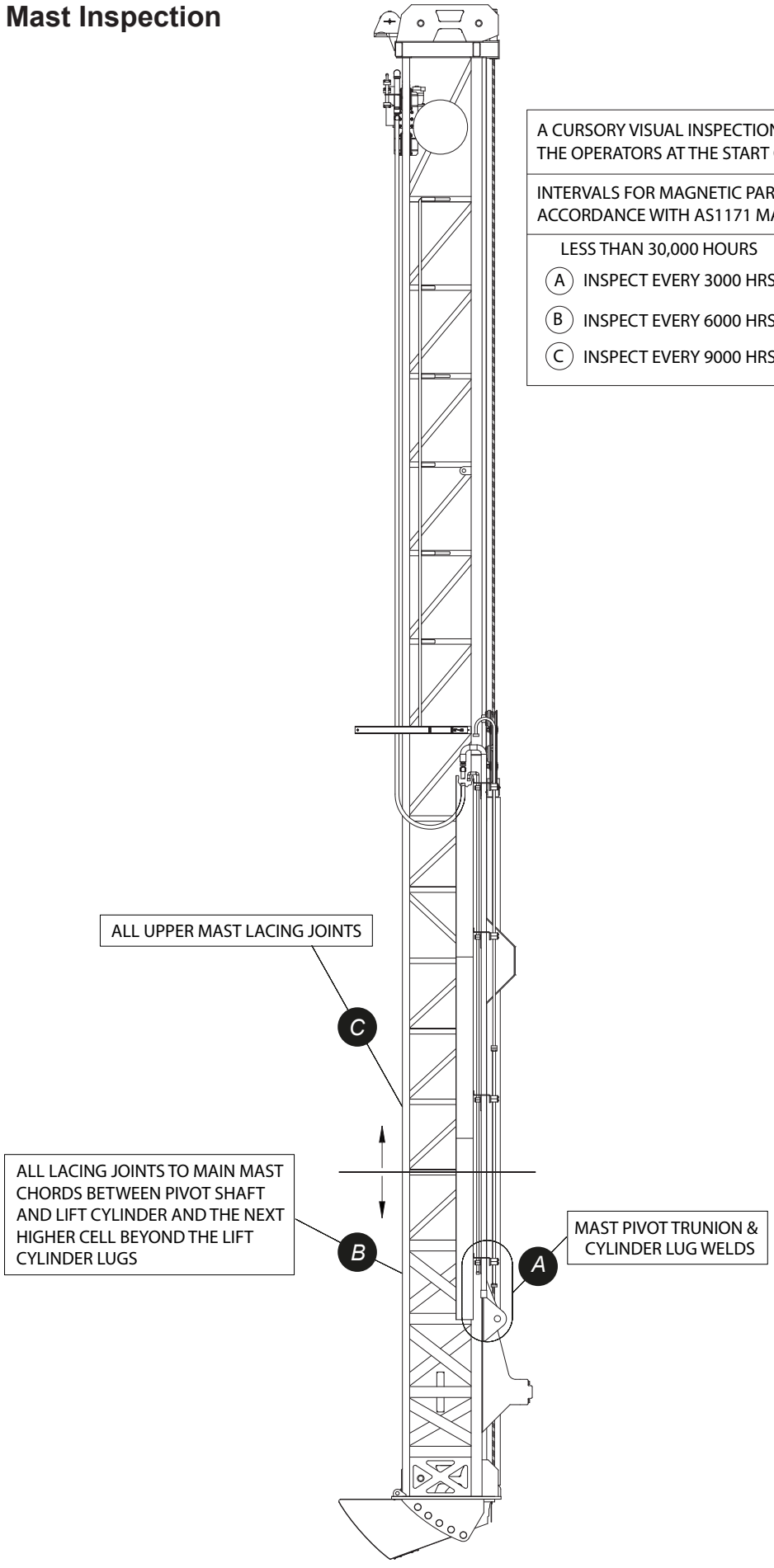
Foam Pump



1. *Foam C-Top B port*
2. *Foam C-Top A port*
3. *To Hammer System*
4. *Valve part*
5. *Y Stainer part*
6. *Check Valve part*
7. *Tank 30Lt part*
8. *Cap part*
9. *Pump part*
10. *Breather part*
11. *Stop Stroke part*

Weld Inspection Schedule

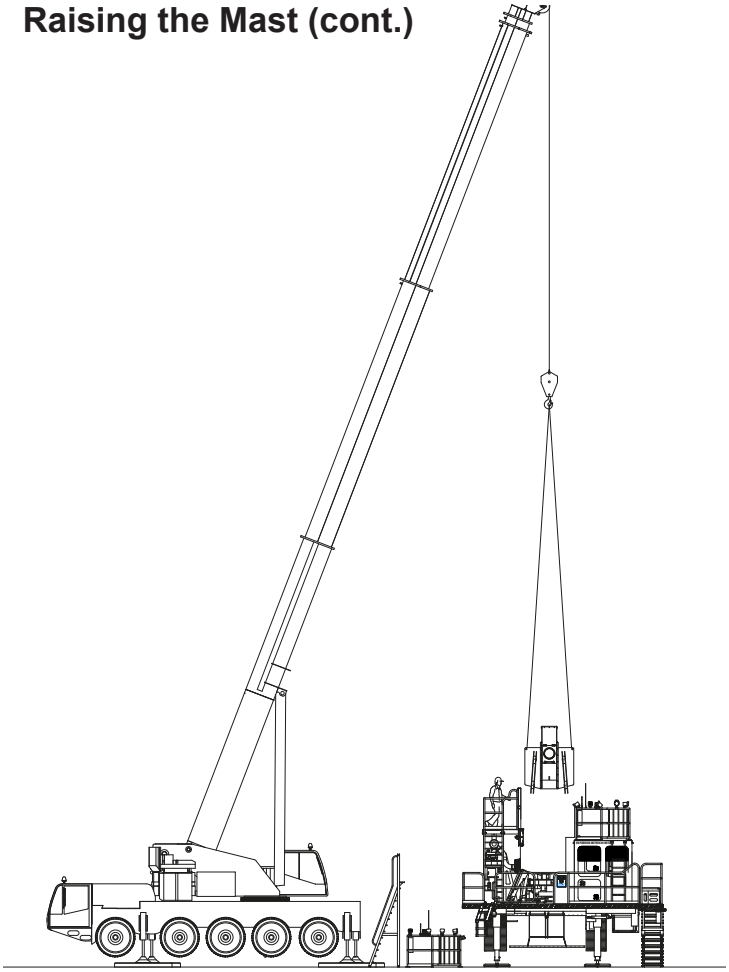
Mast Inspection

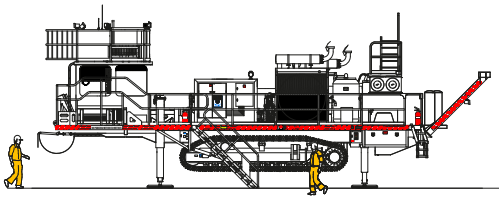


A CURSORY VISUAL INSPECTION SHOULD BE PERFORMED BY THE OPERATORS AT THE START OF EACH OPERTORS SHIFT.	
INTERVALS FOR MAGNETIC PARTICLE INPECTION IN ACCORDANCE WITH AS1171 MACHINE SERVICE HOURS:	
LESS THAN 30,000 HOURS	GREATER THAN 30,000 HOURS
(A) INSPECT EVERY 3000 HRS	(A) INSPECT EVERY 1500 HRS
(B) INSPECT EVERY 6000 HRS	(B) INSPECT EVERY 3000 HRS
(C) INSPECT EVERY 9000 HRS	(C) INSPECT EVERY 4500 HRS

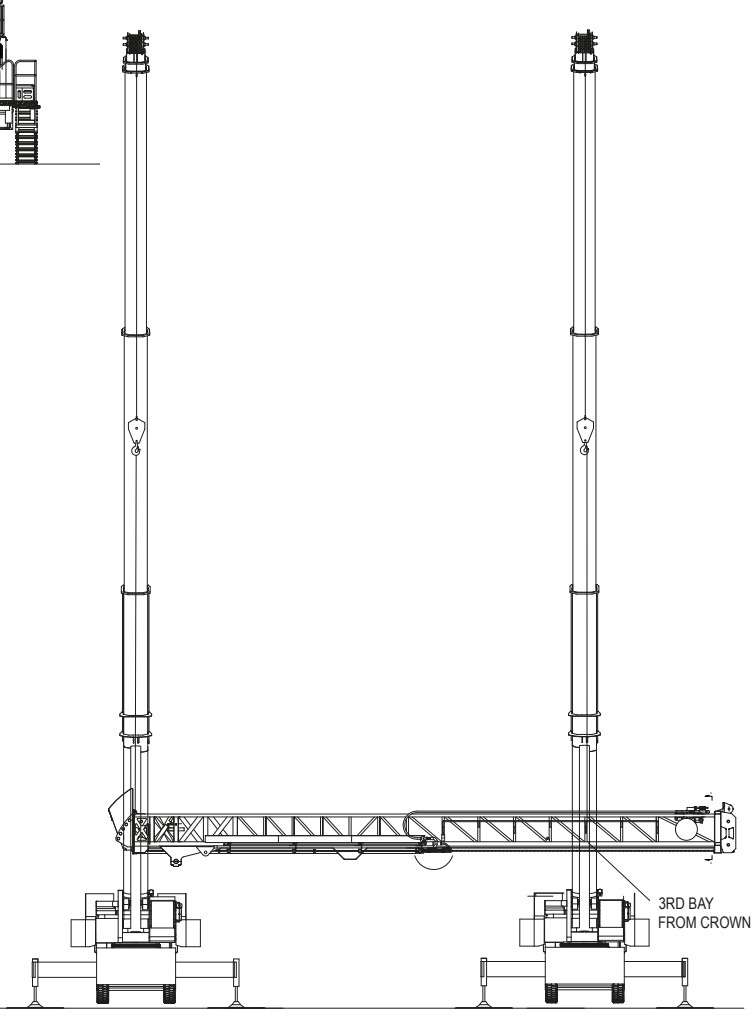
Mast Assembly and Installation

Raising the Mast (cont.)





DIRECTION OF TRAM



Note: Drill cab must never be under suspended load or crane boom.

Note: Riggers with tag lines must never stand under suspended load.

Manual Hoist / Pulldown Cable Adjustment

Adjustment (cont.)

Step 4: Once the bottom cables are hanging exactly the same apply minimal feed pressure (approx. 500-600psi (34.5-41.4bar) to bring the cable slack onto the hoist cables, then activate the Auto feed to maintain the determined pressure. Check the hang of the top cables and adjust both cables to exactly the same hang, using the hoist cable adjusting nuts (fig. 6-7).

WARNING: DO NOT climb on mast, serious injury or death can occur.

Step 5: Disengage auto pulldown and hoist very slightly to bring the cable slack back to the lower cables.

CAUTION: Do not hoist far enough to damage the deck wrench assembly

Check the hang / lay of the lower cables and adjust to even if not the same.

Step 6: Apply 1000psi (68.94bar) pulldown pressure and engage the auto feed switch. Check the hang of the top cables and adjust both cables to hang exactly the same. Then adjust each top cable so as they both hang approximately 50mm (2”) below the bottom of the top mast rail, (fig. 6-10). Release the hydraulic pressure on the system. Ensure all lock nuts are tightened. The cables are now adjusted.

NOTE: Over time, as the cables are adjusted, it will be noticed that the rotary head does not travel all the way to the bottom of the mast, potentially causing non-engagement of the breakout wrench on the flats of the drill stem.

At this point it will be necessary to loosen the top cable adjustment nuts and then tighten the lower cable adjustment nuts and lock nuts up, 75-100mm (3-4"). 'The lower cable adjusters may require removing, cleaning and lubricating to enable adjustment.

Once this is done, the normal cable adjustment procedure is to be followed.

Before removing locknut and adjusting nut, measure the amount of thread protruding from the locknut and record, this length can then be added to the 75-100mm (3-4") adjustment made. Repeat Step 3 before attempting this.

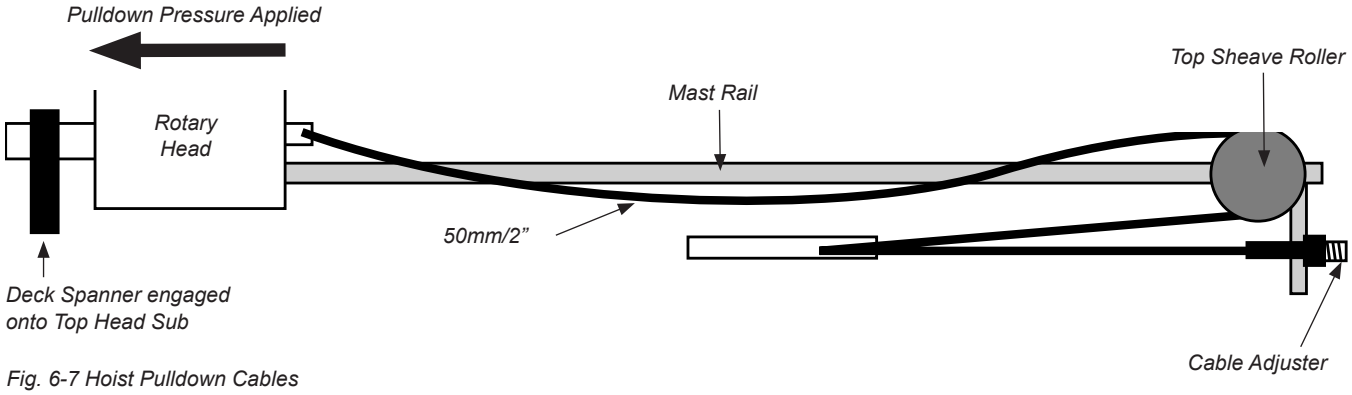


Fig. 6-7 Hoist Pulldown Cables

N.B: Both hoist cables adjusted equal and tensioned to lay 50mm (2”) below top mast rail.

Manufacturers Recommendations – Blast Hole Drilling Consumables

Top Sub Serviceable

Recent analysis of some used top subs returned to Caterpillar for refurbishment have revealed that cracking can occur in the thread that connects the top sub to the spindle shaft in the rotary head if the top sub is left in service indefinitely. This cracking could lead to a failure of the pin thread.

NOTE: Caterpillar recommends that top subs should be replaced after a maximum of 450,000 metres of drilling. Should you have any queries regarding this issue contact Caterpillar.

Lifting Bails

Caterpillar supplies a variety of lifting bails to site to lift drill bits and blast hole drill drilling consumables (bit subs, saver subs and top subs). These items are lifting equipment and should be inspected regularly in line with site lifting equipment policy and procedures.

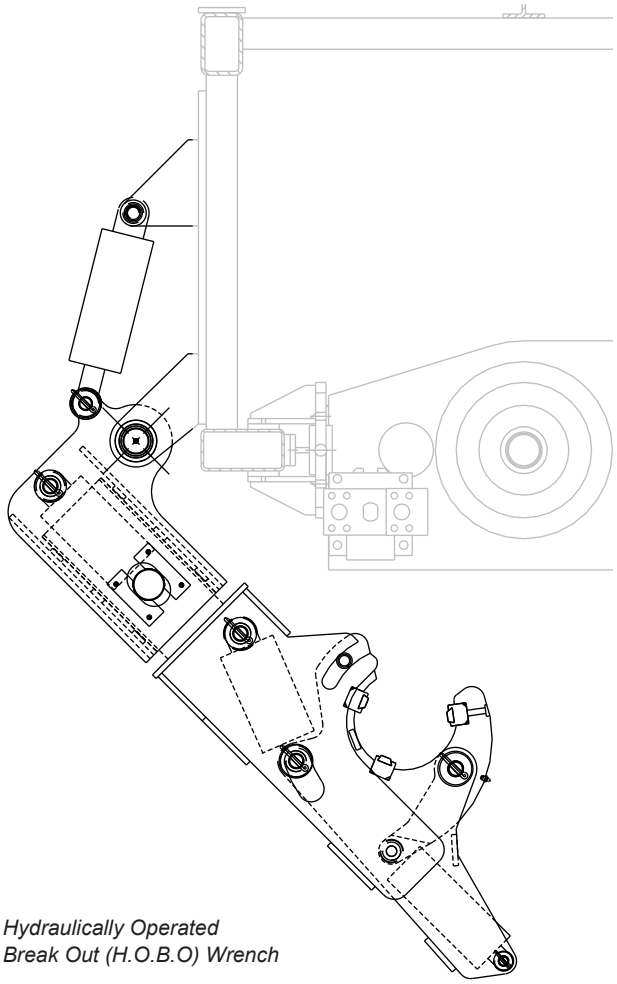
Each lifting bail should be marked with; manufactures name; safe working load; mass and a serial number. Any lifting bails that don’t meet this criteria should be removed from service.

Most lifting bails incorporate a bow shackle or 'D' shackle, these shackles should also be inspected and tagged in line with site lifting equipment policy and procedures.

Attention should be given to the SWL of the individual lifting bail when planning a lift. Some light weight lifting bails are rated as low as 120kg and are primarily intended for lifting drill bits and are only designed to lift vertically (not from horizontal to vertical).

NOTE: Lifting bails are intended for lifting items with treads in good condition. Lifting bails are not designed to lift worn or damaged threads. Operators and fitters should be made aware of the manufacturer’s recommendations for the use of lifting bails. Should you have any queries regarding this issue contact Caterpillar.

H.O.B.O Wrench



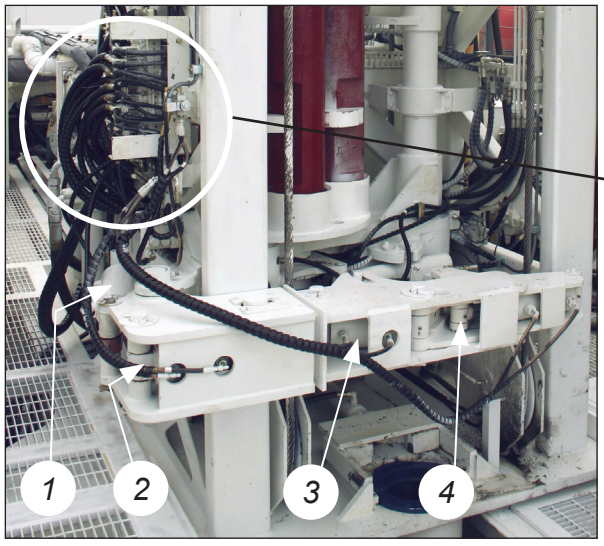
Hydraulically Operated Break Out (H.O.B.O) Wrench

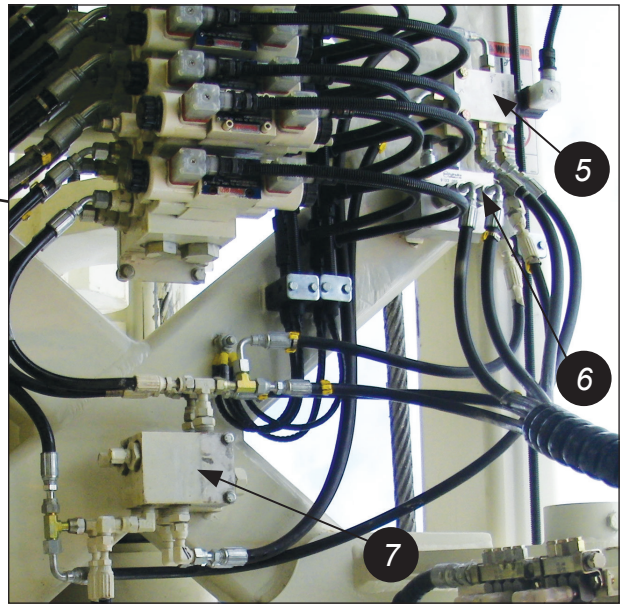
WARNING: BE SURE to relieve pressure on hydraulic or pneumatic systems before loosening connections or parts.

Service procedures for the 'Hydraulically Operated Break Out' (H.O.B.O) wrench are limited to replacing or repairing cylinders, and replacing the tong dies and holders. Refer to parts manual for specific repair part numbers, detailed drawings and cylinder repair kits.

- Refer to Section 7 of this manual for repair procedures on hydraulics cylinders. When repairing hydraulic cylinders follow the 'General Information' instructions, then follow the specific instructions for the type of head and piston the cylinder you are working on has.
- Refer to Section 7 of this manual for pressure relief valve settings, sequence valve adjustment and hydraulic schematic and piping diagrams.

NOTE: To prevent premature failure of the H.O.B.O fabricated components (weldments) CHECK the torque on the die holder mounting bolts regularly.





1. *Swing cylinder*
2. *Telescoping cylinder*
3. *Rotate cylinder*
4. *Clamp cylinder*
5. *H.O.B.O reverse valve*
6. *Telescoping cylinder lock valve*
7. *Sequence valves for H.O.B.O clamp / rotate*

Carousel Pipe Rack

Pipe Rack Roller – Remove And Replace

1. Lower mast to horizontal position, resting on mast rest.
2. Remove pipe rack roller from lower pipe rack support, by removing the two capscrews that hold the pipe rack roller shaft retainer plate (fig. 6-20). Then remove the retainer plate.
3. Remove grease fitting from end of roller shaft, and use a port-a-power to drive shaft out of lower pipe rack support. Repair or replace roller assembly.
4. Install roller shaft into bore far enough so retainer plate will fit into the slot.
5. Install the two capscrews and lock washers and tighten.
6. Grease bearings through grease fitting at end of shaft. Grease once each shift.

NOTE: To prevent premature failure of the pipe rack roller CHECK the torque on the retaining bolts regularly.

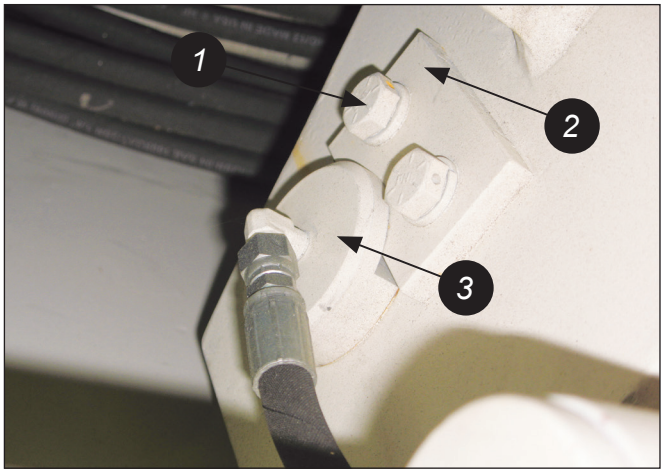
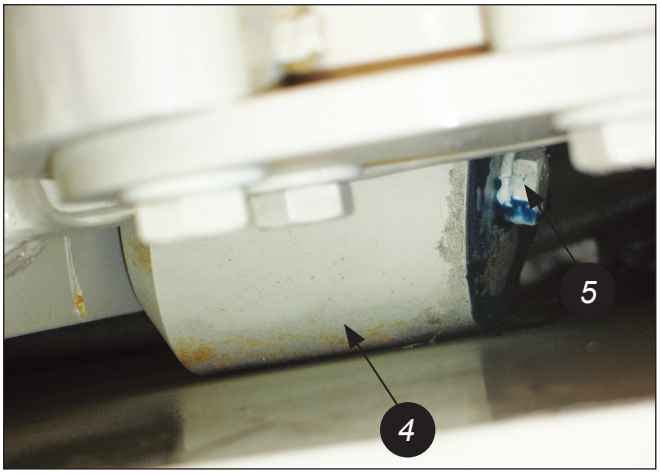


Fig. 6-20 Pipe Rack Roller

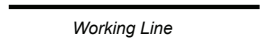
1. *Capscrew*
2. *Retainer plate, pipe rack roller shaft*
3. *Shaft, pipe rack roller*



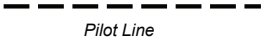
Pipe Rack Roller (viewed from mast pivot end)

4. *Roller, pipe rack*
5. *Stop, roller*

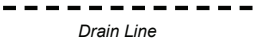
BASIC BUILDING BLOCKS HYDRAULIC SYMBOLS



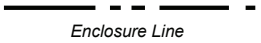
Working Line



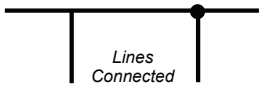
Pilot Line



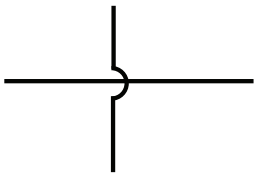
Drain Line



Enclosure Line



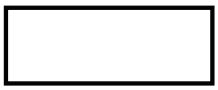
Lines Connected



Lines Crossing

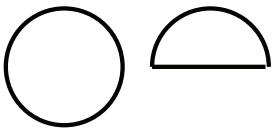
Flexible Line

Vented reservoir

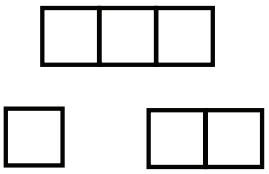


Sealed Reservoir

Arrows show Adjustability, Variabilty or Direction of Flow

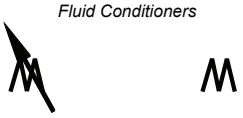


Circles or Partial Circles Indicate Pumps or Rotary Actuators



Squares or combinations of Squares indicate Valves

Fluid Conditioners

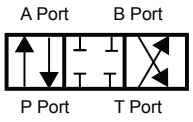


Springs

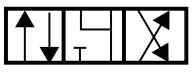
An arrow thru the spring indicates an adjustment

DIRECTIONAL VALVE SYMBOLS

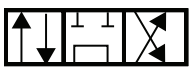
3 POSITION – 4 WAY VALVES



Closed Centre Closed Port (Cylinder Spool)

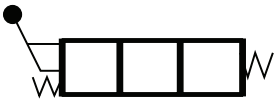


Closed Centre Open Port (Motor Spool)

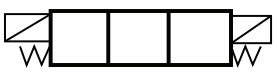


Open Centre Closed Port

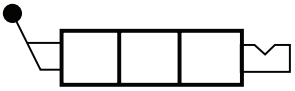
Open Centre Open Port



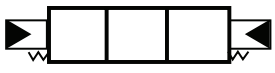
Lever Actuated Spring Centred



Direct Solenoid Actuated Spring Centred

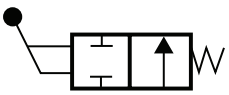


Lever Actuated Neutral Detent



Pilot Actuated Spring Centred

2 POSITION – 1 WAY VALVE



Spring Offset Normally Open

2 POSITION – 4 WAY VALVE

Spring Offset Pilot Actuated

Spring Offset Solenoid Actuated

Dentented Lever Actauted

Right Track, Left Track / Rotation Pumps

Main Pumps (cont.)

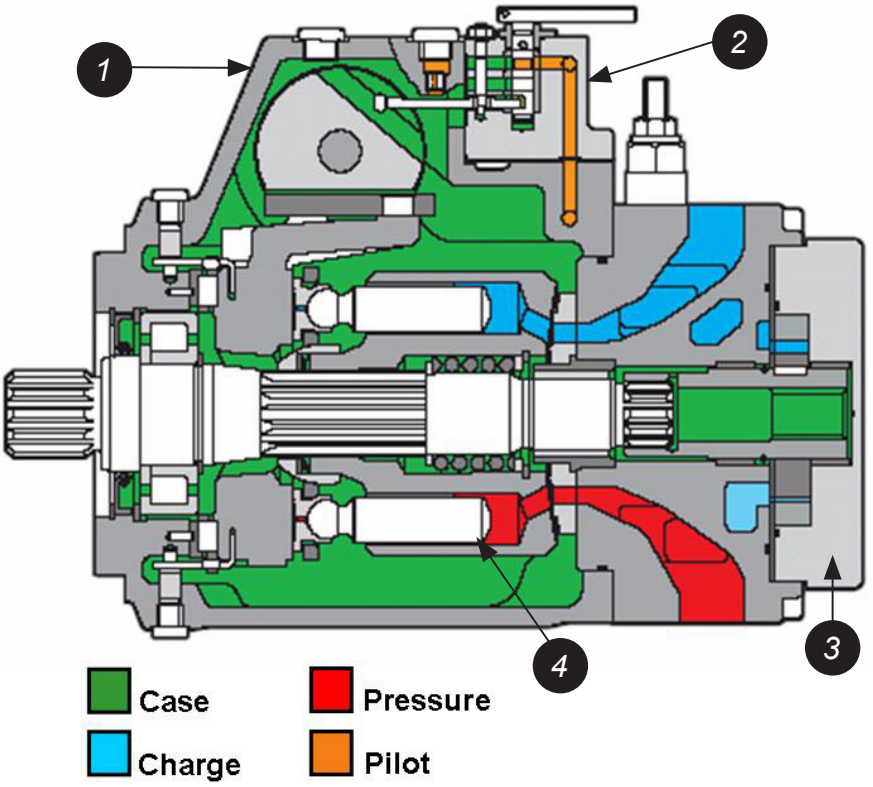
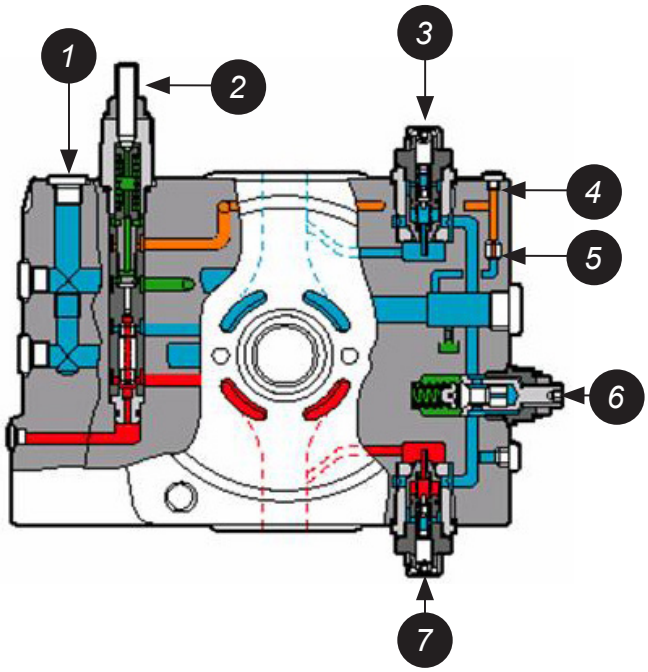
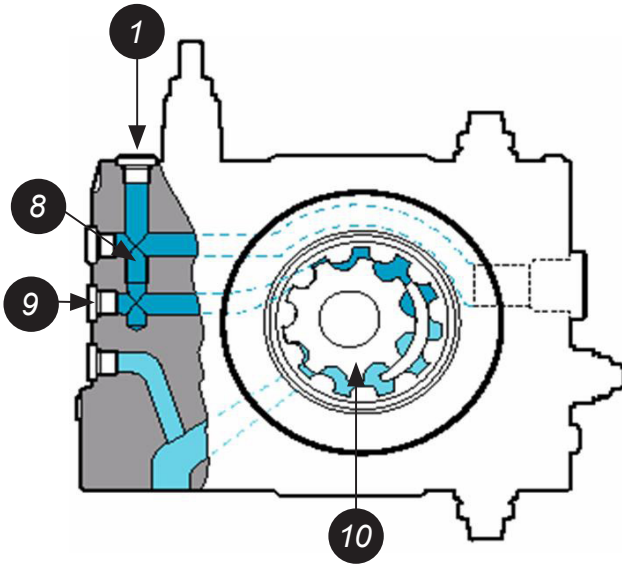


Fig. 7-4a AA4VG Pump

1. *Servo piston*
2. *Controller*
3. *Charge pump*
4. *Rotary group*





1. *'Fa' Charge pressure, in from charge filter*
2. *Pressure cut off or override*
3. *High pressure cross over relief (B port)*
4. *Pilot oil to controller and P.O.R*
5. *Orifice*
6. *Standard charge relief, removed and replaced with an orifice plug to still allow flushing of the case.*
7. *High pressure cross over relief (A port)*
8. *Plug*
9. *'Fe' Charge pump discharge, to charge filter*
10. *Charge Pump*

Right Track, Left Track / Rotation Pumps

Charge Pressure, High Pressure, P.O.R. and Zero Position Settings (cont.)

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.

Set Charge Pressure – 450psi (31bar)

1. Shut down machine and relieve standing pressure.
2. Install a 600psi (41 bar) gauge in the relief valve test port (item 2, fig. 7 - 8) or if machine is equipped with a hydraulic pressure test station, turn knob to LH or RH CHARGE position, depending on which pump is being set.
3. Start machine and allow time to warm up. Correct charge pressure is 450psi (31bar). If adjustment is required, loosen locknut and turn relief valve adjustment screw to obtain correct pressure. Tighten locknut.
4. Repeat steps 3 and 4 for the other charge pump.

Set Crossover Relief (High Pressure) – 5500psi (380bar)

1. Shut down machine and relieve standing pressure.
2. Install a 6000psi (414bar) gauge in ports MA and MB or if machine is equipped with a hydraulic pressure test station, turn knob to RH LOOP or LH LOOP position. Remove solenoid coil from brake solenoid valve (fig. 7-7a).
3. Back out both high pressure relief valves all the way (counterclockwise) until spring tension is completely relieved. Turn both high pressure relief valves in one full turn (clockwise).
4. Start machine and allow time to warm up.
5. Turn P.O.R. adjusting screw in (clockwise) until firm resistance is encountered. Do not force the adjustment beyond this point.

NOTE: Perform steps 6 and 7 as quickly as possible to prevent overheating of pump. Flow should not be allowed to spill over the high pressure relief valves for longer than 10 seconds.

6. Stroke the pump to approximately 20 percent of full flow in one direction. Do this by having a helper move the tram lever for the track pump you are adjusting forward slightly. Adjust the high pressure relief valve 500psi (35bar) higher than the P.O.R. setting.
7. Repeat step 6 moving the tram lever in reverse direction and adjusting opposite high pressure relief valve.
8. Tighten locknuts. Reset P.O.R. to proper pressure as mentioned previously. Repeat all steps for other pump.

Charge Filter

Changing Filter Elements

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

1. Turn off and depressurise system. Open bleed plug (if fitted) one and one-half turns. (refer Fig 7-9)
2. Unscrew and remove filter bowl (2) from head assembly (1), counterclockwise when viewed from below. It may be necessary to use a lever on the 'Rotolock Ring' of the filter bowl (2) to loosen the bowl initially.
3. Remove filter element (4) 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.

4. DO NOT run the system without a filter element (4) installed. Check that the O-ring (3) on the head assembly (1) is not damaged. Use replacement filter element part number called for on the element change label, or refer to the parts manual.
5. Lubricate element O-ring (5) with clean system fluid and push open end of filter element (4) straight onto the nipple in the head assembly (1). Clean out filter bowl (2) interior and lightly lubricate threads of filter bowl with clean system fluid. Screw filter bowl 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. Pressurise system fully and check for leaks; if leaks occur, check O-rings and sealing surfaces.

Rotary Drive Gear Box Motor

Shaft Seal Replacement

Removal - Refer to fig. 7-18

1. Remove four screws (33), gaskets (32), seal retainer (31), and O-ring (29).
2. Remove shaft seal (30) from shaft (27).
3. Remove screw (26) that secures cam (23) to housing.
4. Remove shaft and bearing assembly and cam (23) by grasping shaft and pulling out of housing from end of unit opposite mounting flange.

CAUTION: When removing shaft from cam, use extreme care not to damage seal surface of shaft. Any scratches or marks on this surface will cause leaks around shaft seal.

5. Carefully remove shaft and bearing assembly from cam.

NOTE: Do not remove bearing (18) from housing, unless damaged or worn.

Installation – Refer to fig. 7-18

1. Insert barrel stop (14) into the spring assembly (15) through the shaft seal end of motor.
2. Insert the small end of drive shaft (27) and bearing through the bore of housing, bore of cam, and into the barrel spline until shaft rests against the springs (15) in the barrel.
3. Install O-rings (29) into counterbore of housing.
4. Press shaft seal (30) into seal retainer (31). Grease seal lips.
5. Install screws (33) through retainer (31). Install O-ring (32) over screw end protruding through retainer. O-ring to be trapped in retainer recess.
6. Install shaft seal (30) onto shaft using shaft seal assembly tool (see fig. 7-18a).

NOTE: Use care not to scratch seal surface of shaft. Scratches will cause leakage around the seal.

7. Slide seal retainer over shaft and into housing, letting bolts go through housing to cam. Engage each screw 1-2 turns into cam.
8. Tighten each screw by no more than 1/4” in sequence so that each screw is advanced equally. Failure to do this may damage O-ring (32).
9. Pull screws down tight and torque evenly to 50ft lbs (68Nm).

Feed and Auxillary Pump Circuit

Hydraulic Piston Pumps – Removal and Replacement (cont.)

NOTE: Refer to envelope at rear of manual for complete Hoist/Pulldown and Auxiliary circuit drawings.

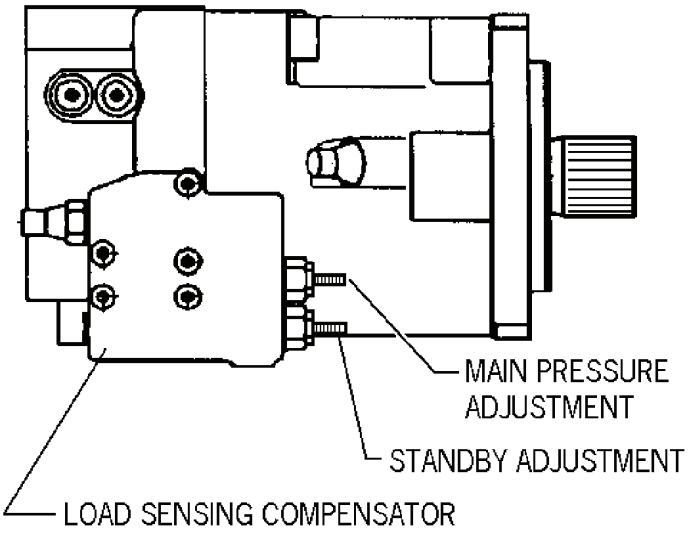
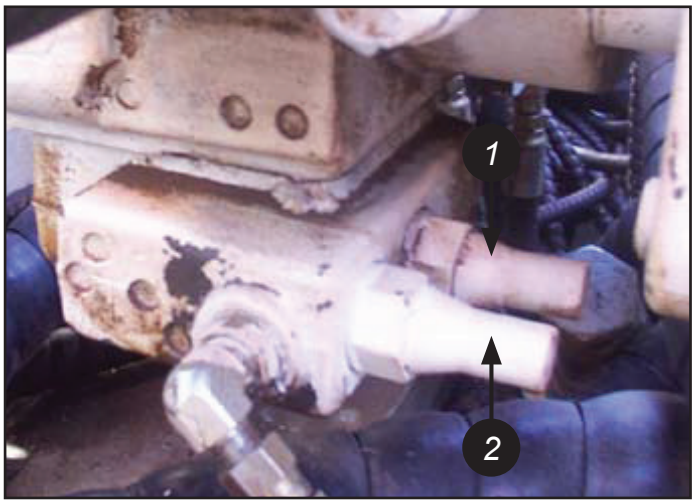


Fig. 7-23a Feed and auxiliary functions pump AA11VLO190



1. *Main pressure adjuster*
2. *Standby adjuster*

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

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.

PWM Proportional Pilot Valves (cont.)

Valve 'F' should be turned IN all the way and not adjusted.

• **(Valve 'G')** Excess flow by-pass

Hoisting causes excessive return flows with dual and larger bore pulldown cylinders in many cases. This valve will shift as back-pressure builds in the hoist side and will open another passage for return oil.

Procedure for adjusting valve 'G':

Excess flow bypass valve (item 7, fig. 7-35).

Normally this valve does not require adjustment. It is factory set at 400psi (28bar). If, however the valve has been tampered with and you need to get back to the original setting. Use the following procedure:

1. Shutdown machine and relieve standing pressure.
2. The screw adjustment range is fiveturns, 200-800psi (14-55bar). All the way in is 800psi (55bar). Loosen lock nut and turn screw in (clockwise) all the way, then back out five turns.
3. Turn screw in a little less than 1 3/4 turns. Each full turn equals 12psi (8bar). This should be about 400psi (28bar). Tighten lock nut.

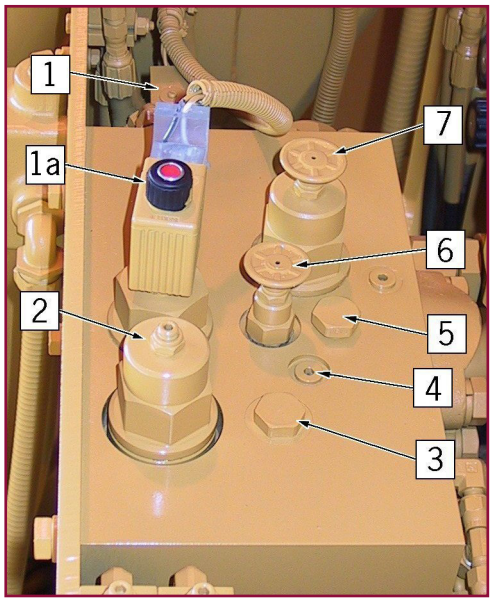
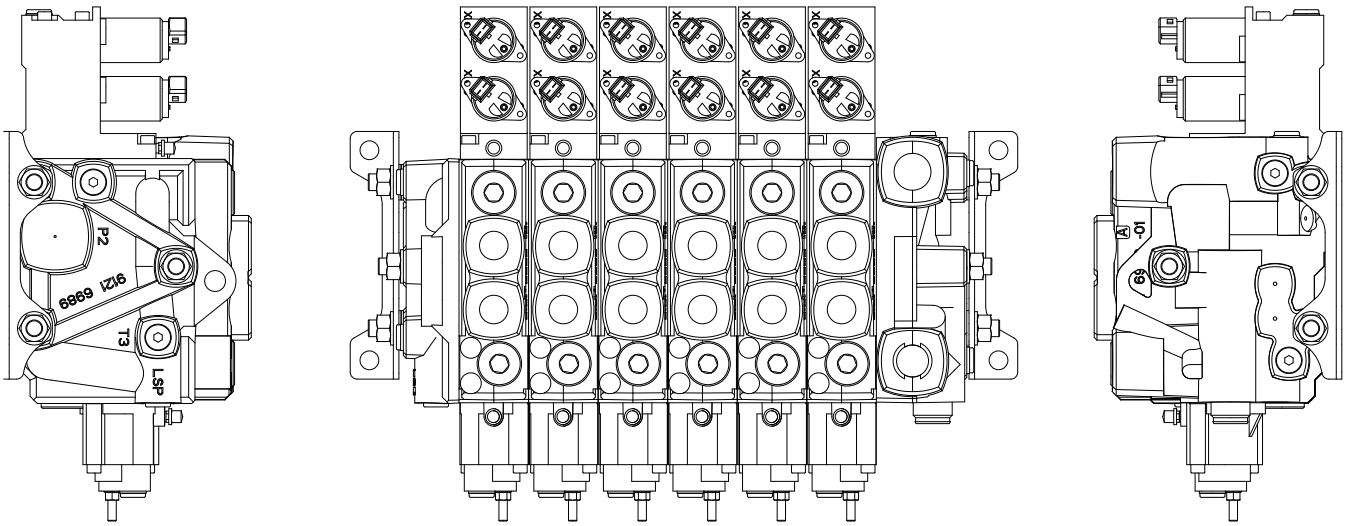


Fig. 7-35 Feed control valve

1. *Regeneration valve 'E' (normally closed) cartridge 'E1' (normally closed)*
1a. *Regeneration valve 'D' (normally closed) cartridge 'D1' (normally closed)*
2. *Counterbalance valve 'A'*
3. *Plug*
4. *Orifice .016”*
5. *Plug*
6. *Hoist control valve 'F'*
7. *Excess flow bypass valve 'G'*

Mast Jacks Winch And Water Injection Circuit.

K170 (cont.)

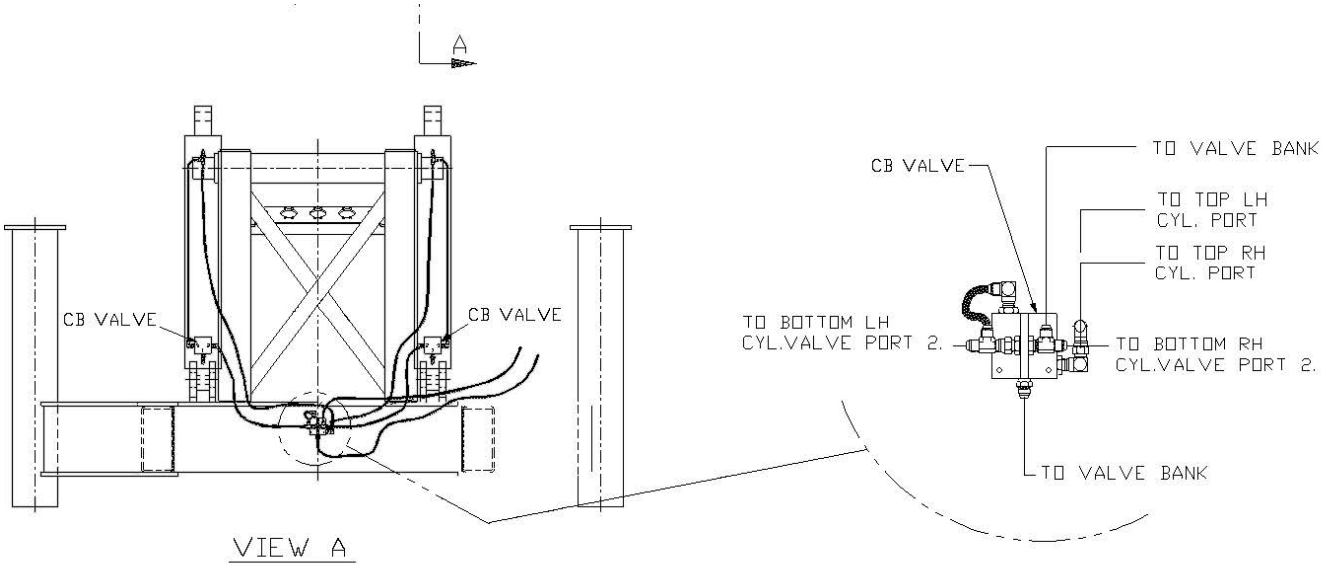


K170 Mast jacks winch and water injection circuit.

Electro Proportional Levers.

Mast Elevating Cylinders

Counterbalance Valve Adjustments (cont.)



The elevating cylinders have a built in cushioning design for full extension protection. As the cylinder approaches full extension the rod end of the piston which has an extended back end, enters the cylinder gland and blocks off the normal oil porting. Oil then passes through a restricting orifice which slows down the flow leaving the cylinder, thus slowing the travel speed of the cylinder.

Hydraulic Cushion Porting Detail

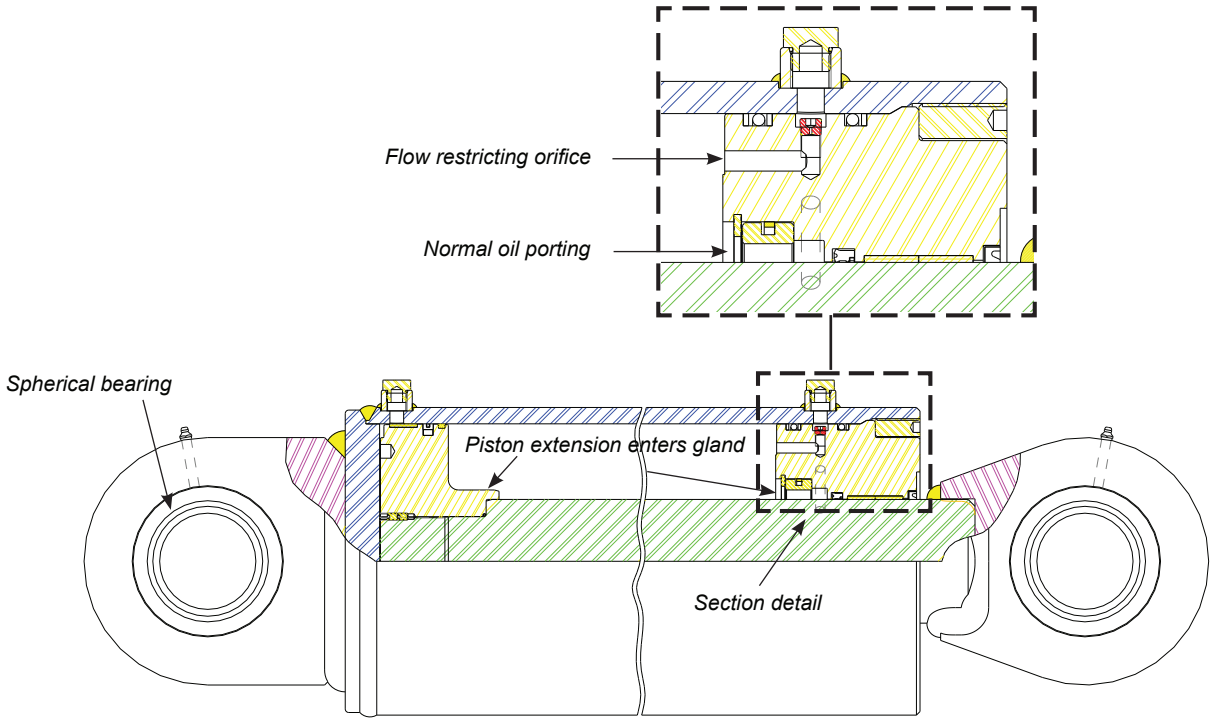


Fig 40a Mast elevating cylinder

Hydraulic Operated Breakout Wrench

Pipe Positioner

The function of the Pipe positioner is to stabilise and guide the drill pipe to and from the Carousel. The positioner consists of the main swing arm and the sliding guide assembly, both of which are connected to hydraulic cylinders. The cylinders are sequenced to allow the main arm to swing in to the mast, and once it has reached its extended position, then divert oil to the guide assembly cylinder to slide into the drill pipe and essentially hold it in position.

Fig 7-39 Pipe Positioner

Setting of Pipe Positioner Sequence Valves

1. Swing Pipe Positioner fully out.
2. Loosen both sequence valve adjustment locknuts.
3. Adjust both valve adjusters fully in.
4. Swing Pipe Positioner in and have a helper hold the switch on.
5. Adjust the Clamp Sequence valve out until the Sliding jaw closes.
6. Have a helper hold the switch in the swing out position (Clamping jaw will slide open but the Pipe Positioner will not swing out).
7. Adjust the Open Sequence valve out until the Pipe Positoner swings out.
8. Tighten up both of the adjusting locknuts.

Cooler Fan Motor

Hydraulic Motor (cont.)

Specifications and Tools

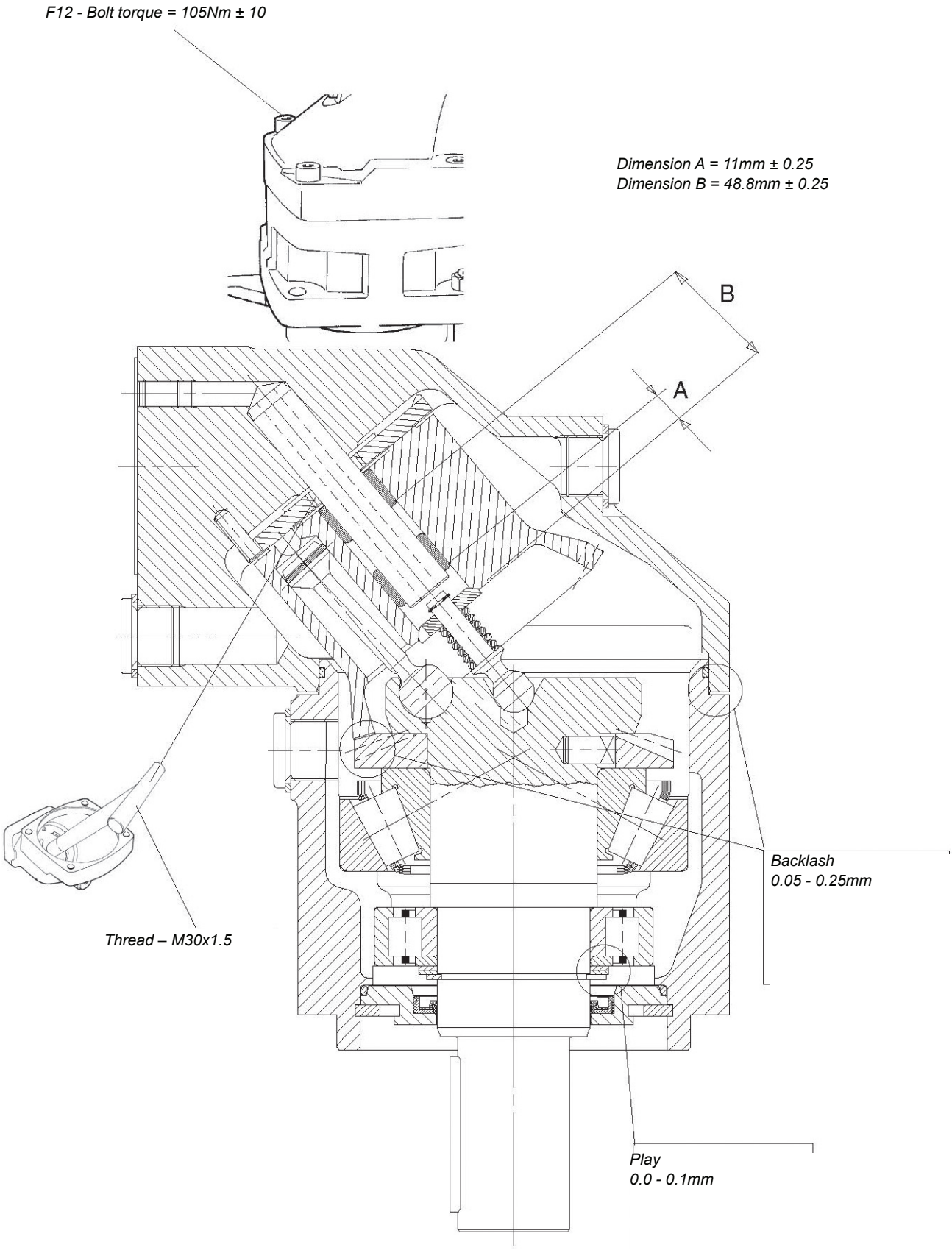


Fig 7-47e Cooler fan motor cross section

Water Pump Motor

Shaft Seal Repair

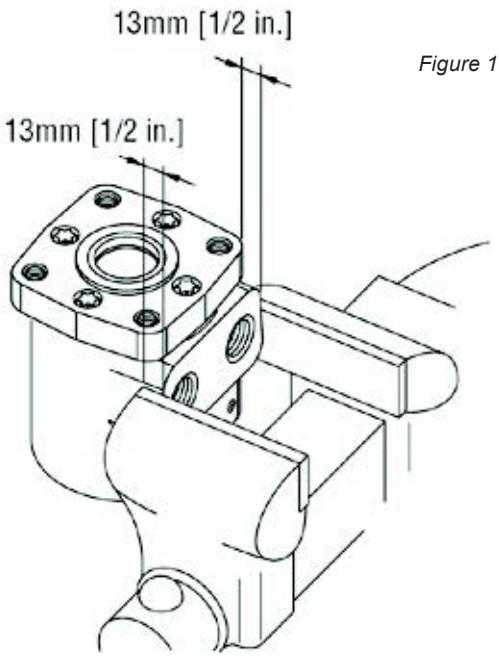


Figure 1

Cleanliness is extremely important when repairing these motors. Work in a clean area. Before disconnecting lines, clean port area of motor. Remove key when used. Check shaft and key slot. Remove burrs, nicks and sharp edges. Before disassembly, drain oil from motor. Then plug ports and thoroughly clean exterior of motor.

1. Place motor in vice and clamp across edge of flange with output shaft down. When clamping, use protective device on vise such as special soft jaws, pieces of hard rubber or board (see Figure 1). Do not clamp on side of housing. Excessive clamping pressure on side of housing causes distortion.
2. Remove cap screws from mounting flange. These screws are assembled with Loctite to hold them in place. The screws will require 35-45 Nm (300-400lb in) of torque to break loose and 11Nm (100lb in) torque to remove. Do not use impact wrench on screws that have been secured with Loctite . This could result in rounded heads or broken sockets.

Note: If torque higher than given above is required to break screws loose, apply heat according to following instructions:

When heated, Loctite partially melts. This reduces torque to remove screw. Use small flame propane torch to heat small area of housing where screw enters (see Figure 2). Be careful not to overheat housing and damage motor. Gradually apply torque to screw with socket wrench as heat is applied for 8 to 10 seconds. As soon as screw breaks loose, remove heat from housing. Continue turning screw until it is completely removed.

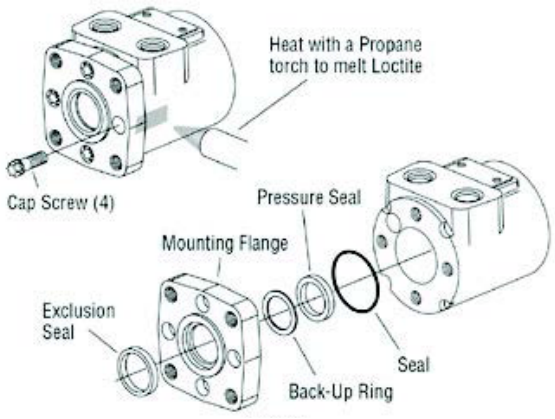


Figure 2

3. Carefully remove flange from housing.

Important: Some motors may have a quad seal and back-up ring in place of the pressure seal. The quad seal and back-up ring are no longer available and are replaced by the pressure seal. They are interchangeable, but some precautions must be taken to insure proper installation. Follow the reassembly instructions.

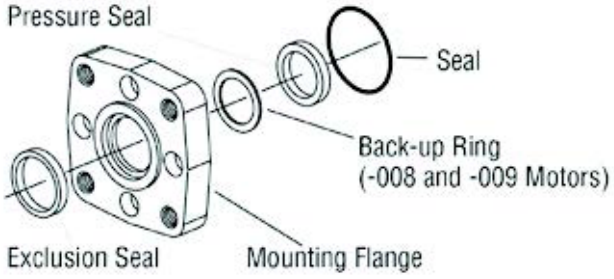
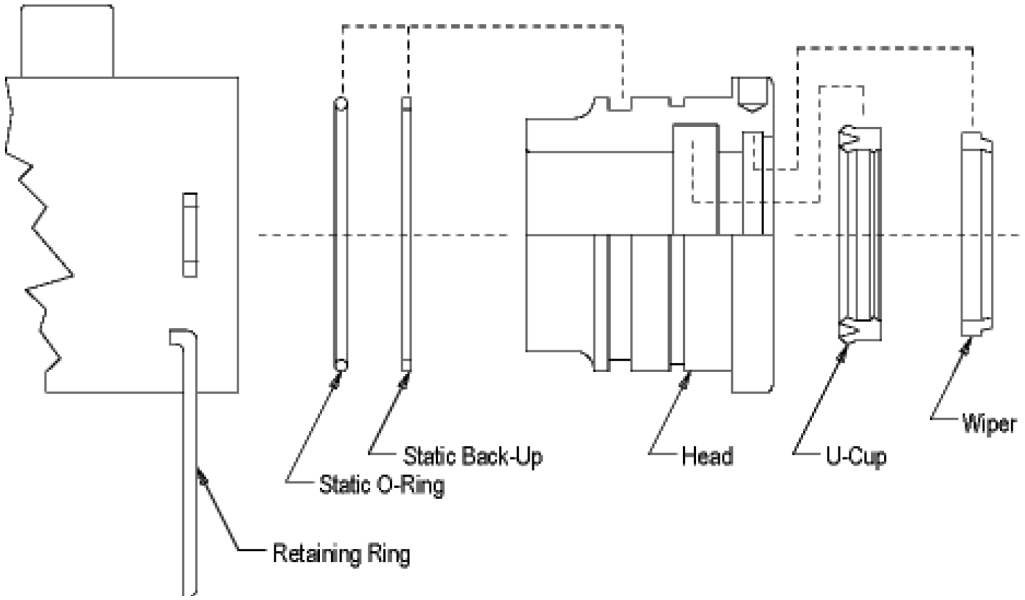


Figure 3

K Head

General

The K series head uses aluminium material and has a polyurethane U-cup as the primary sealing element. The wiper is a standard type D polyurethane. The head is retained within the tube by means of 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 you 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 bevelled 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

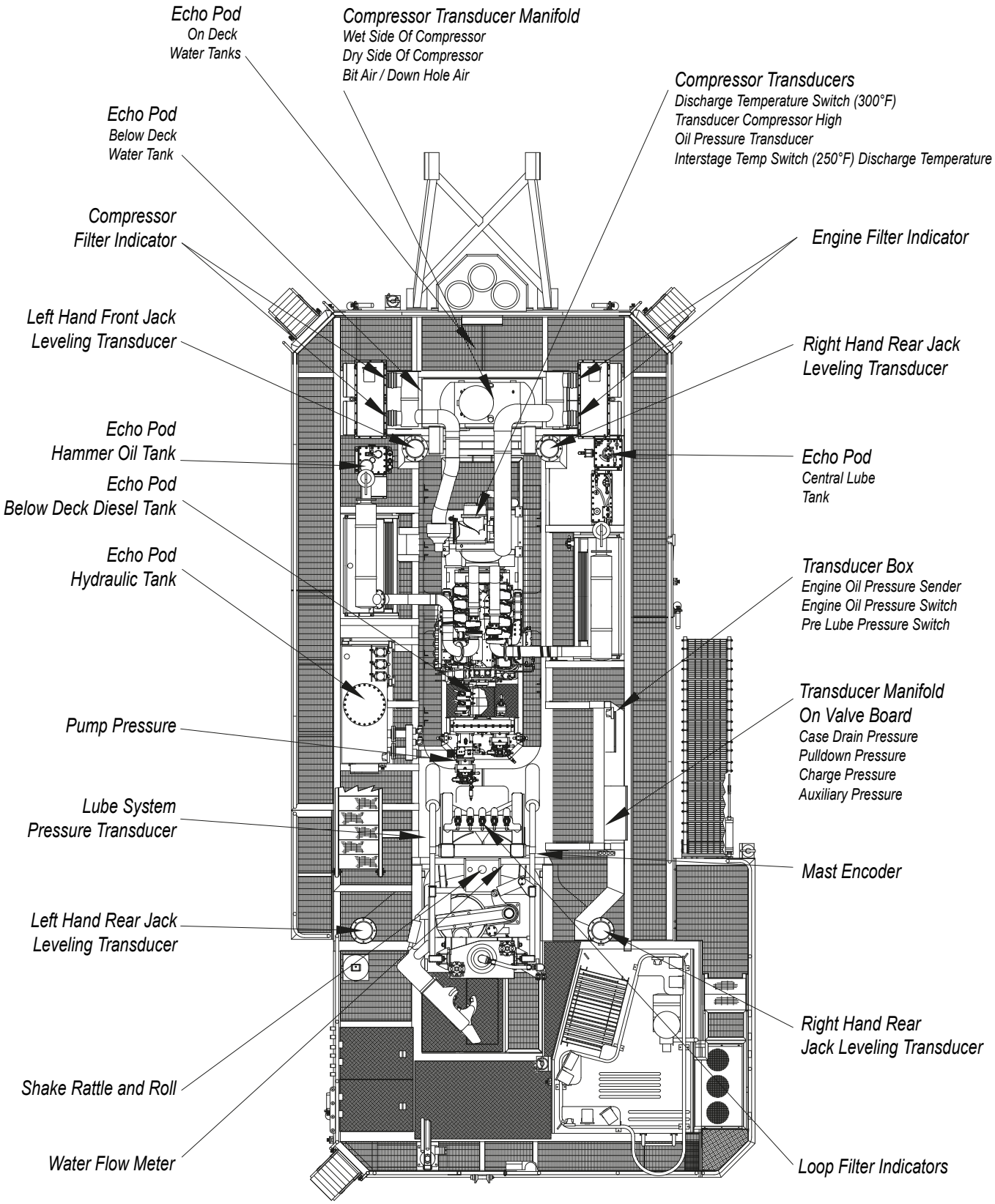
Lubricate the head and all seals with hydraulic fluid prior to installation. Using round nose pliers or special installation tools, twist the dual lip U-cup seal into a “C” shape and allow it to snap into groove. Use a similar technique for installing the wiper. Install the static O-ring and backup into 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.

Electrical Components

General Arrangement Layout



Introducing Level Sensor (cont.)

Specifications	
Accuracy	0.125" (3 mm)
Resolution	0.019" (0.5 mm)
Beam width	2" (5 cm)
Dead band	2" (5 cm)
Supply voltage	24 VDC
Consumption	0.5 W
Signal output	10 V
Frequency	Sink current = 15 mA nominal
Fail-safety	Empty
Process temp.	F: 20° to 140° C: -7° to 60°
Ambient temp.	F: -31° to 140° C: -35° to 60°
Pressure	MWP = 30 PSI
Enclosure	Type 6P encapsulated, corrosion resistant and submersible
Encl. material	Polycarbonate
Strain relief mat.	Santoprene
Trans. material	PVDF
Cable length	48” (1.2 m)
Cable jacket mat.	Polyurethane
Process mount	1" NPT (1" G)
Mount. gasket	Viton®
Classification	General purpose
Approvals	CE, cFMus

Rock Oil

Fuel Level

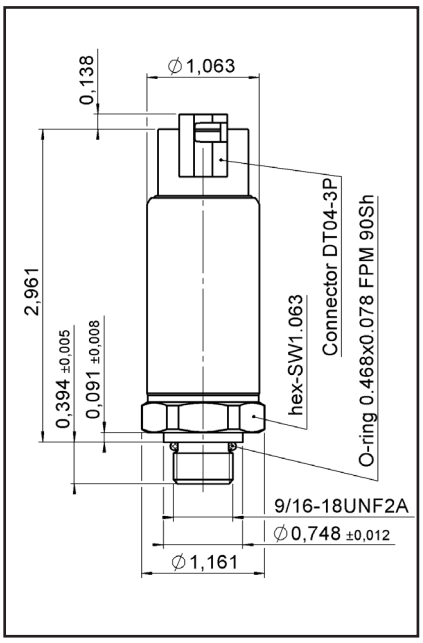
Lower Water Level

Lower Water Level

Description

The pressure transmitter series is specifically made for caterpillar drill product and has a very accurate and robust sensor cell with a thin-film strain gauge on a stainless steel membrane.

The output signals 4 ..20 Ma or 0 -10V.



250 Bar Electronic Pressure Transducer

Special Features

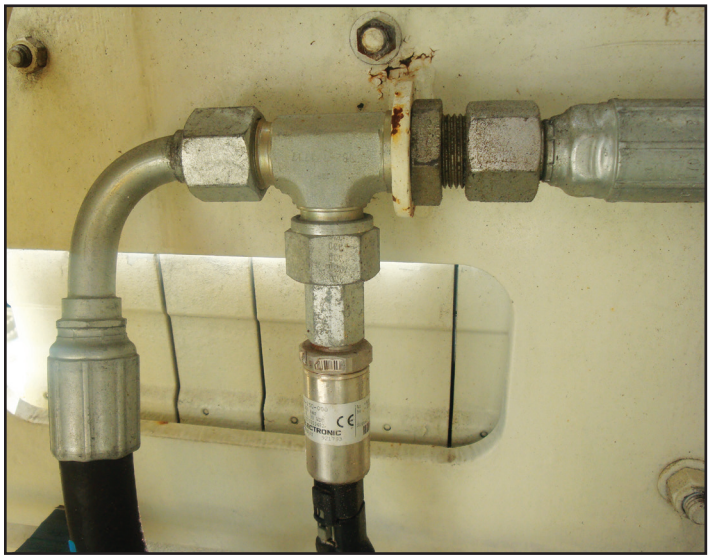
I Accuracy ≤ ± 0.25 % FS typ
I Highly robust sensor cell
I Very small temperature error

Technical Specifications
Input Data

Measuring range 250 bar
Overload pressures 400 bar
Burst pressures 1000 bar
Mechanical connection -6 SAE. 9/16-18 UNF
Torque value 20 Nm
Parts in contact with medium Mech. connection: Stainless steel
Seal: FPM

Environmental Conditions

Compensated temperature range -25 .. +85 °C
Operating temperature range -40 .. +85 °C
Storage temperature range -40 .. +100 °C
Fluid temperature range -40 .. +100 °C


Grease Transducer

Solenoid Control

Tram

If any one or more jack proximity switches is not active (Jack up = active) then the jacks down interlock will be active.

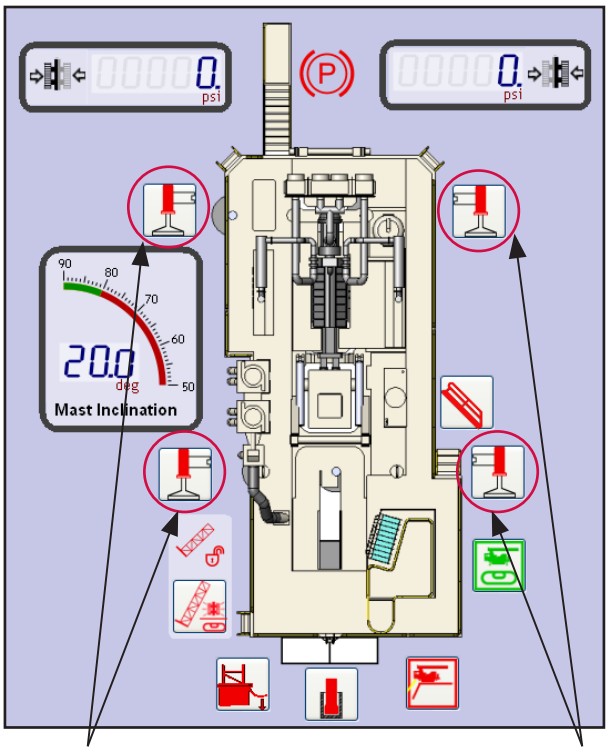
Drill / Tram Solenoid (Off to Tram / On to Drill)

Drill mode is selected = Drill Solenoid ON.

- Drill functions, pulldown / Hoist and rotation will only operate with mast locks indicating “locked”.

Tram mode is selected = Drill Solenoid OFF.

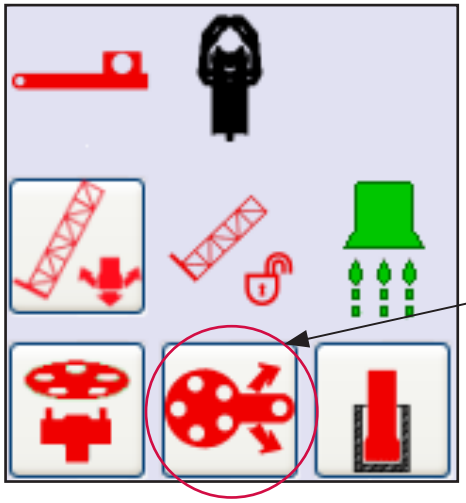
- Head is at top of mast (Not pipe in hole) and jacks are raised to TRAM.



Jacks Down interlock, all jacks must be completely up before the machine will tram. All jacks symbols on screen must be Green to Tram.

Carousel

If neither the pipe rack parked nor the pipe rack under the head “load” proximity switches are active, then the Pipe Rack interlock will be Active =
NO PULLDOWN, HOIST OR ROTATION.



The Pipe Rack (Carousel) must be PARKED or in the LOAD position otherwise the pulldown/hoist and rotation are interlocked, in the Load position the max pulldown pressure is limited to 1000psi and hoist speed is reduced.

Drill

Drill mode is selected + mast locks indicating “locked” + Pipe Rack is parked. OR Drill mode is selected + mast locks indicating “locked”+ Pipe Rack is Under the Head.

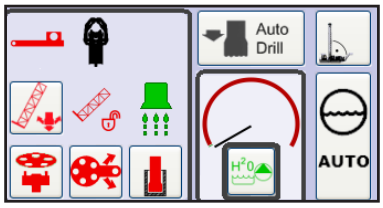
Load Position, Mast locks symbol on screen must be Green and Locked to Drill Pipe rack symbol on screen must indicate parked or load position.

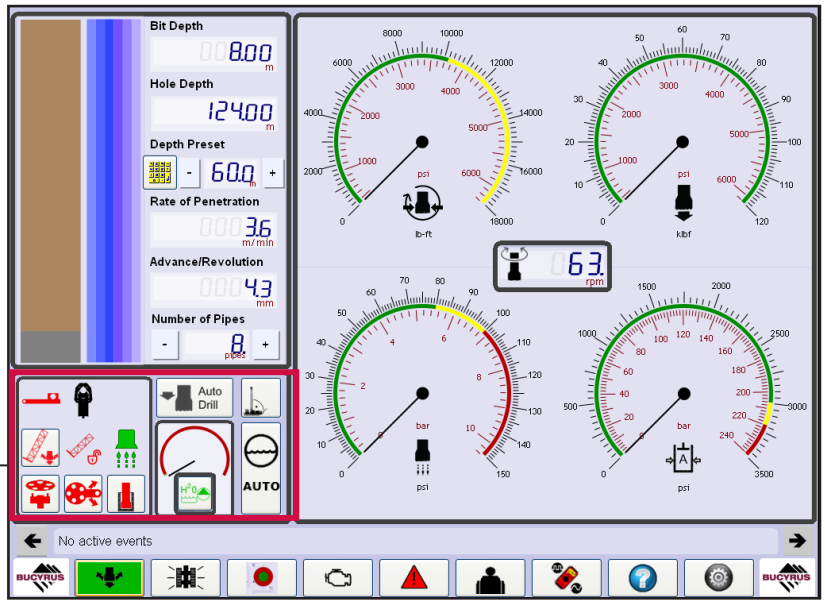
Drill Status

Drill Status and Override

The drill status and override panel displays the status of the functions indicated by the icon for each.

- Green is normal status.
- Red indicates an alert.
- Blinking indicates the system is unsure of the position of the function and needs to be checked or re-set.





WARNING

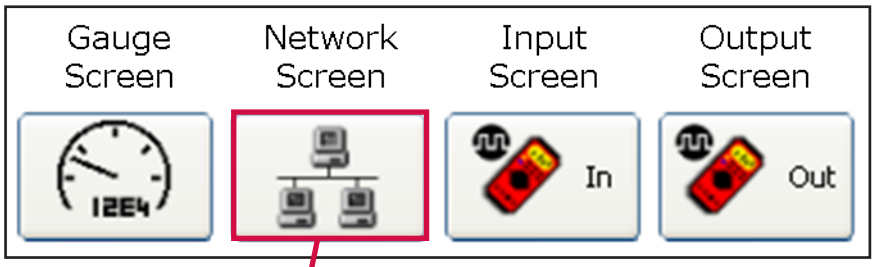
Overriding any system has the potential for component or machine damage as well as operator hazards!

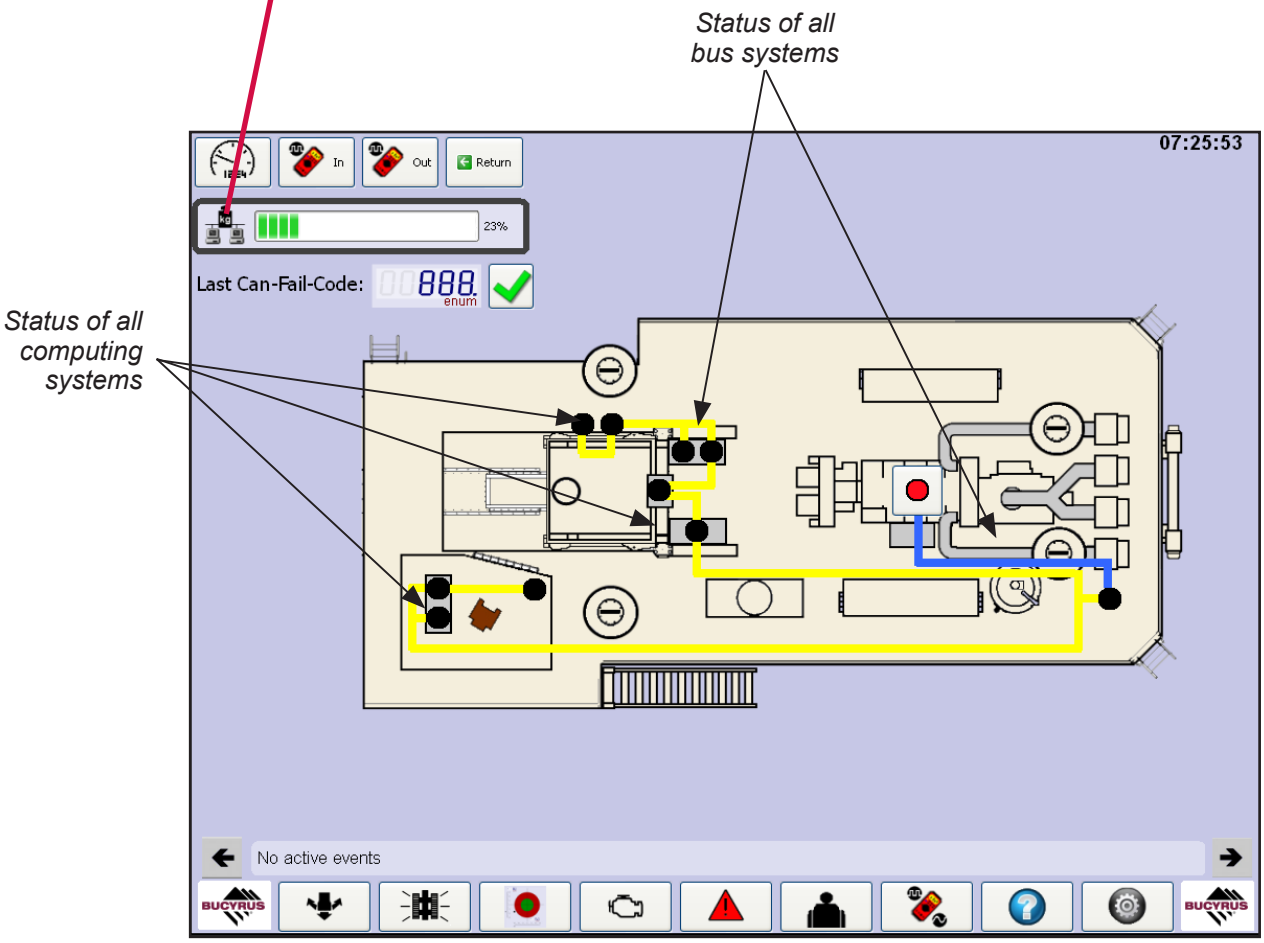
Proceed only after thorough fault evaluation and with due care.

Proceed?

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

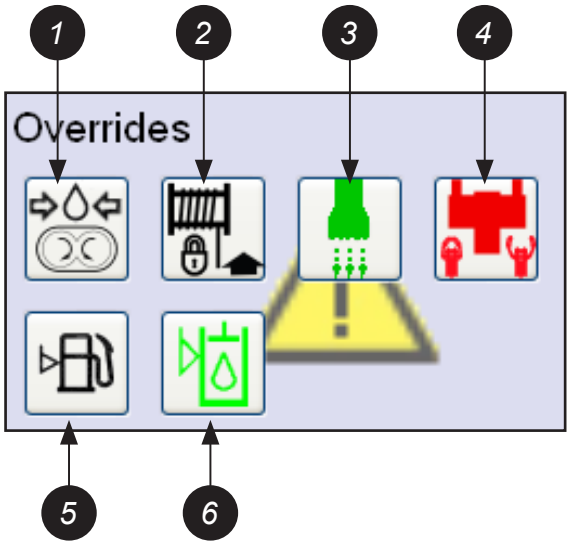
Sub Screen - Network





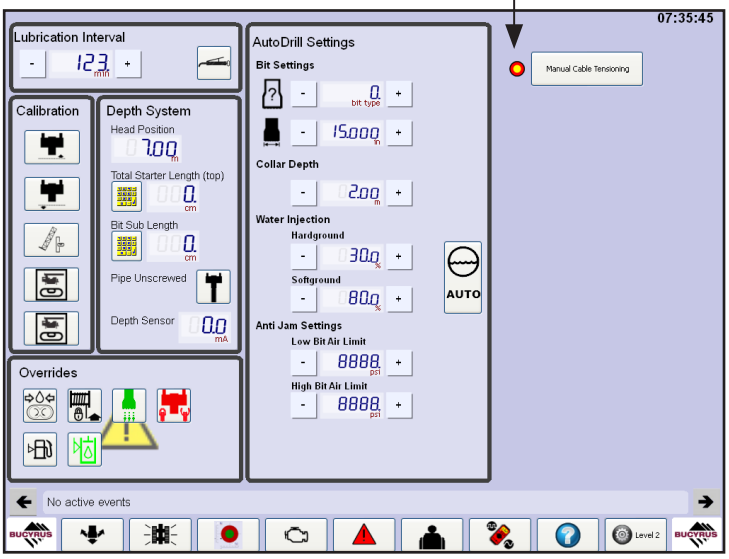
Overrides

The override buttons allow the function to be operated when they are in normal lockout conditions.



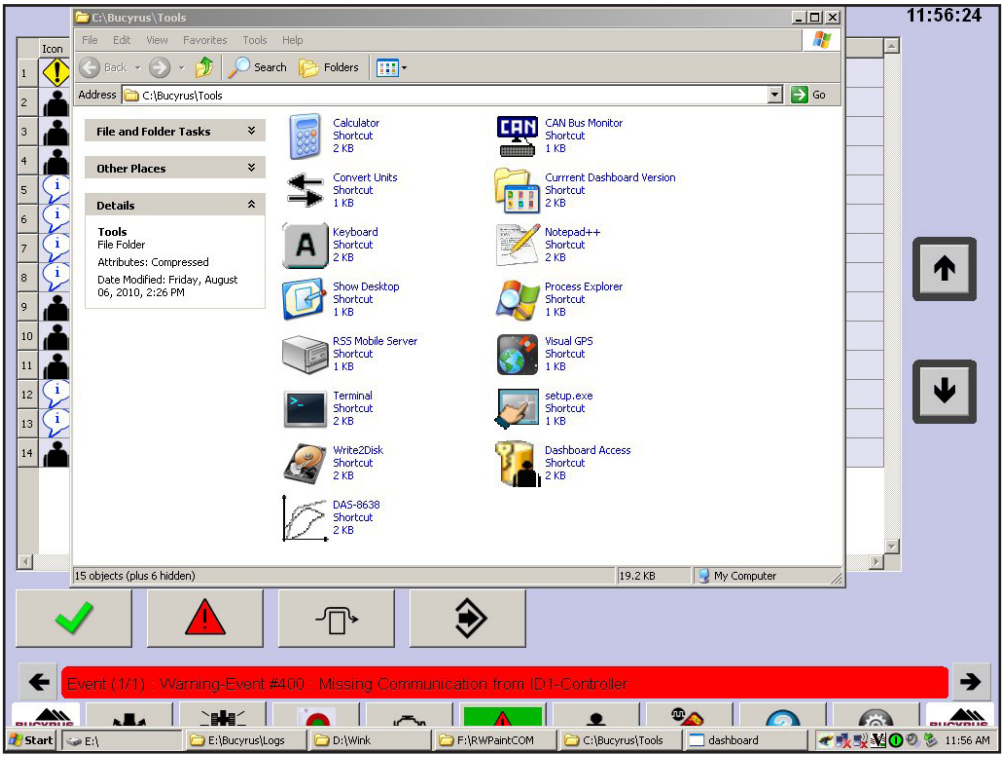
1. *Compressor oil pressure shutdown*
2. *Winch up cut off*
3. *Low bit air*
4. *Pipe support in/out*
5. *Low fuel level*
6. *Low hydraulic oil level*

Pull down cable auto tension

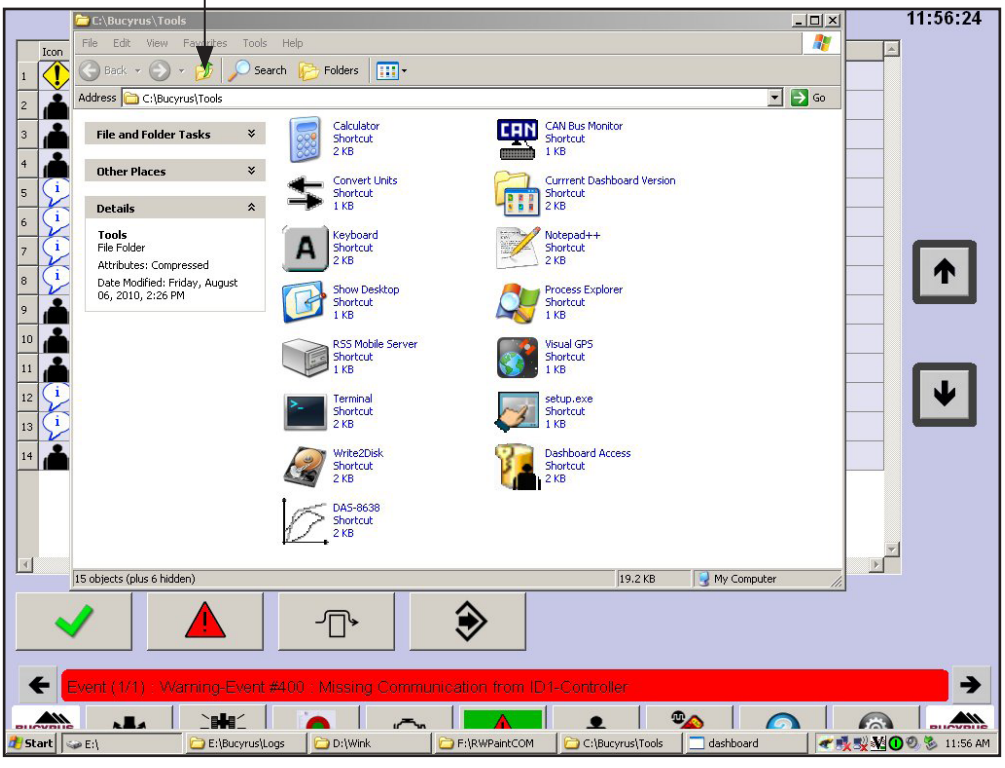


Procedure To Backup Log Files Of The Monitor

1. Press Shift +F1 key on the monitor.
2. Navigate to E: folder under My Computer as shown below.

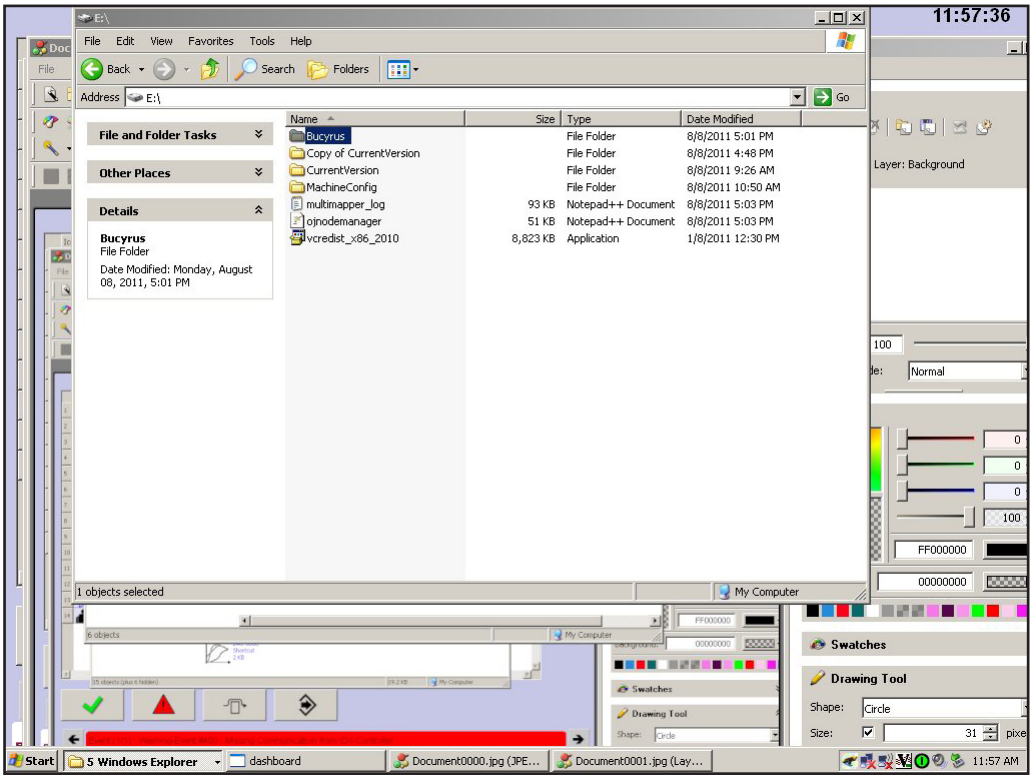


3. Press folder up 3 times to navigate back to My Computer.



Procedure To Backup User Database From Old Monitor For Installation Of New Monitor (cont.)

4. Double click on D drive to access userdb folder.



5. Navigate to D:/Bucyrus -> userDB/.

6. Copy the file user2E67F20.db3 into a USB drive and backup
(*The database name is based on machine serial number. Above example is for F20 machine*).

7. Copy the above .db3 file into the new CF cards D: drive location
D:/Bucyrus/userDB/.

Mast Angle Encoder (cont.)

The encoder is fitted with an LED light for diagnostics (as shown):

Green LED = BUS state.

Red LED = ERR display.

Yellow LED = Diagnostics.

Solid Green indicates encoder is operational (has CAN connection and power supply.

Flashing Green indicates encoder is powered and attempting to connect to the CAN.

Flashing Red indicates encoder in powered with no CAN connection.

Flashing Red and Green indicates the encoder is not programed.

No LED indicates problem with the power supply to the sensor.

NOTICE: DO NOT WELD DO NOT WELD ON ANY PART OF THIS MACHINE WITHOUT FOLLOWING THE INSTRUCTIONS IN THE SERVICE MANUAL.

1. **Stop the engine. Turn the switched power to the OFF position.**
2. **Disconnect the negative battery cable from the battery. If a battery disconnect switch is provided, open the switch.**
3. **Disconnect all electrical connectors from the engine ECM. Move the harness to a position that will not allow the harness to accidentally move back and make contact with any of the ECM pins.**
4. **Connect the welding ground cable directly to the part that will be welded. Place the ground cable as close as possible to the weld in order to reduce the possibility of welding current damage to bearings, hydraulic components, electrical components, and ground straps.**

NOTE: If electrical / electronic components are used as a ground for the welder, or electrical / electronic components are located between the welder ground and the weld, current flow from the welder could severely damage the component.

5. **Protect the wiring harness from welding debris and spatter.**
6. **Use standard welding practices to weld the materials.**

Central Lube System

Symbols

Warning Symbol

⚠ WARNING

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

Caution Symbol

⚠ CAUTION

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

⚠ WARNING

EQUIPMENT MISUSE HAZARD

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

- This equipment is for professional use only.
- Read all instruction manuals, tags, and labels before you operate this equipment.
- Use the equipment only for its intended purpose. If you are not sure, call your Graco distributor.
- Do not alter or modify this equipment. Use only Graco approved repair parts.
- Check equipment daily. Repair or replace worn or damaged parts immediately.
- Do not exceed the maximum working pressure of the lowest rated component in your system.
- Use fluids and solvents that are compatible with the equipment wetted parts. Refer to the **Technical Data** section of all equipment manuals. Read the fluid and solvent manufacturer's warnings.
- Handle hoses carefully. Do not pull on hoses to move equipment.
- Route hoses away from traffic areas, sharp edges, moving parts, and hot surfaces. Do not expose Graco hoses to temperatures above 82°C (180°F) or below –40°C (–40°F).
- Do not lift pressurized equipment.
- Comply with all applicable local, state, and national fire, electrical, and safety regulations.
- Be sure breather is not plugged before filling reservoir.
- Be sure unit is securely mounted before operation.

Central Lube System

Symbols

Warning Symbol

⚠ WARNING

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

Caution Symbol

⚠ CAUTION

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

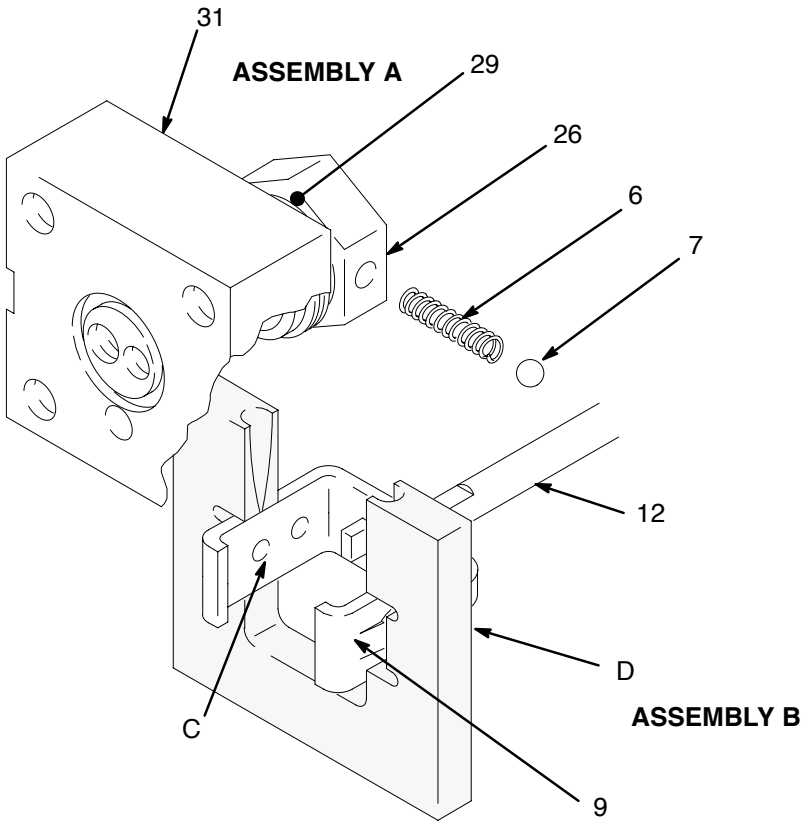
⚠ WARNING

EQUIPMENT MISUSE HAZARD

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

- This equipment is for professional use only.
- Read all instruction manuals, tags, and labels before operating the equipment.
- Use the equipment only for its intended purpose. If you are not sure, call your Graco distributor.
- Do not alter or modify this equipment. Use only genuine Graco parts and accessories.
- Check equipment daily. Repair or replace worn or damaged parts immediately.
- Do not exceed the maximum working pressure of the lowest rated component in your system. This equipment has a **1500 psi (10 MPa, 102 bar) maximum hydraulic input pressure and 7500 psi (51 MPa, 517 bar) maximum fluid outlet pressure.**
- Use fluids and solvents that are compatible with the equipment wetted parts. Refer to the **Technical Data** section of all equipment manuals. Read the fluid and solvent manufacturer's warnings.
- Handle hoses carefully. Do not pull on hoses to move equipment.
- Route hoses away from traffic areas, sharp edges, moving parts, and hot surfaces. Do not expose Graco hoses to temperatures above 82°C (180°F) or below –40°C (–40°F).
- Do not lift pressurized equipment.
- Comply with all applicable local, state, and national fire, electrical, and safety regulations.

Reciprocator Repair (cont.)



06148

Fig. 10

15. Insert the spring (6) and one ball (7) into the valve stop (26) of Assembly A. Tilt the valve stop and start guiding it into the tool (D), making sure the ball is sliding into the rounded slot in the tool (D). Place the other ball at the other end of the spring and push it in with your thumb while rotating the valve stop (26) until the spring is horizontal and the balls are in place. Continue holding this assembly together. See Fig. 10.

16. Slide the valve stop assembly down into the tool. Make sure the balls (7) snap into the upper set of holes (C) in the yoke (9), and the curved ends of the guide clamp have engaged the valve sleeve (29) groove. See Fig. 10. Slide the tool (D) back over the rod (12) to remove it.

Refer to Fig. 11 for Steps 17 to 24.

17. Place the adapter (43) in a vise, and install the seals. Install the cylinder cap (32).

18. If the tie rods (38) were removed, reinstall them with the short threaded end up. The other end should be screwed about 9/16” into the bottom cylinder cap (32).

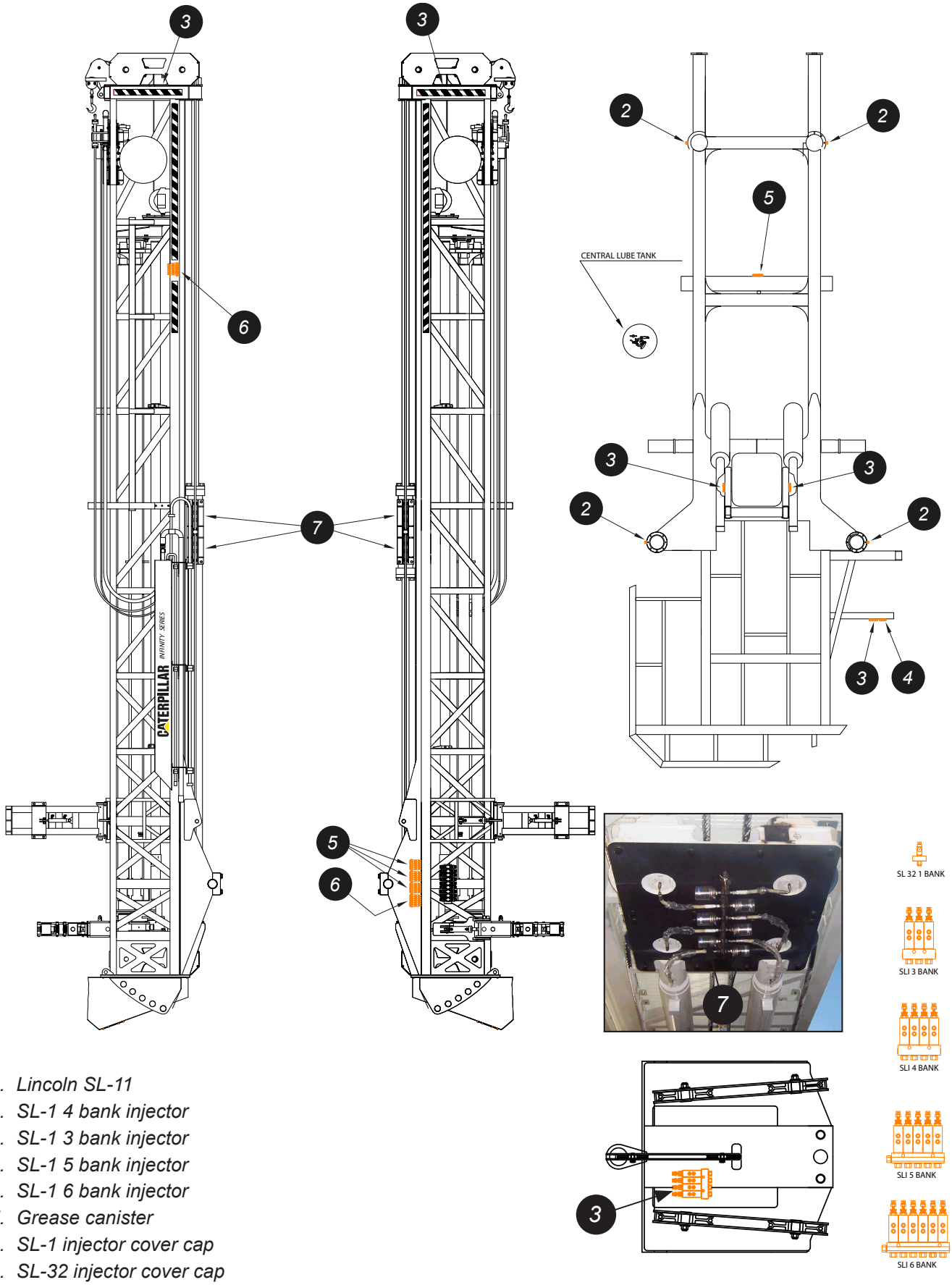
NOTE: When reinstalling the cylinder (25) (Step 19), be sure the “P” port in the valve spool (31) and the port in the bottom cylinder cap (32) are in line with each other. Be sure the o-rings (13*) are in place in the valve spool and cylinder cap.

19. Place the cylinder (25) on the cylinder cap (32). Install the piston (22) and valve assembly (31).

20. Install the o-ring (49*) in the deep lower groove of the piston (22) and install the seal (23*) over the o-ring. Install the piston bearing (24*) around the upper groove of the piston. Holding the piston bearing in place to avoid damage, slide the cylinder over the piston and press it down.

Central Lube System

Typical Grease System Circuit



2. *Lincoln SL-11*
3. *SL-1 4 bank injector*
4. *SL-1 3 bank injector*
5. *SL-1 5 bank injector*
6. *SL-1 6 bank injector*
7. *Grease canister*
8. *SL-1 injector cover cap*
9. *SL-32 injector cover cap*

NOTE: Actual layout varies from drill to drill including size, type and location of injectors.

Hammer Oil Tank

Installation (cont.)

Grounding

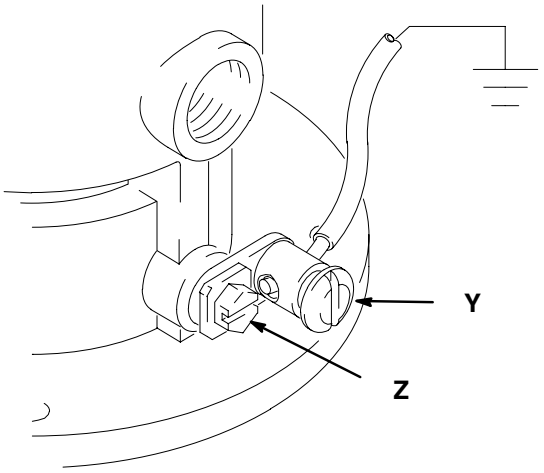
Proper grounding is an essential part of maintaining a safe system.

To reduce the risk of static sparking, ground the pump. Check your local electrical code for detailed grounding instructions for your area and type of equipment. Be sure to ground this equipment:

- *Pump:* Use a ground wire and clamp as shown in Fig. 2.
- *Air and Fluid hoses:* Use only electrically conductive hoses.
- *Air compressor:* Follow the manufacturer's recommendations.
- *Fluid supply container:* Follow the local code.
- *Object being lubricated:* Follow the local code.
- *To maintain grounding continuity when flushing or relieving pressure,* always hold a metal part of the valve firmly to the side of a grounded metal pail, then trigger the valve.

To ground the pump, remove the ground screw (Z) and insert through the eye of the ring terminal at end of the ground wire (Y). Fasten the ground screw back onto the pump and tighten securely. Connect the other end of the ground wire to a true earth ground. See Fig. 2.

.



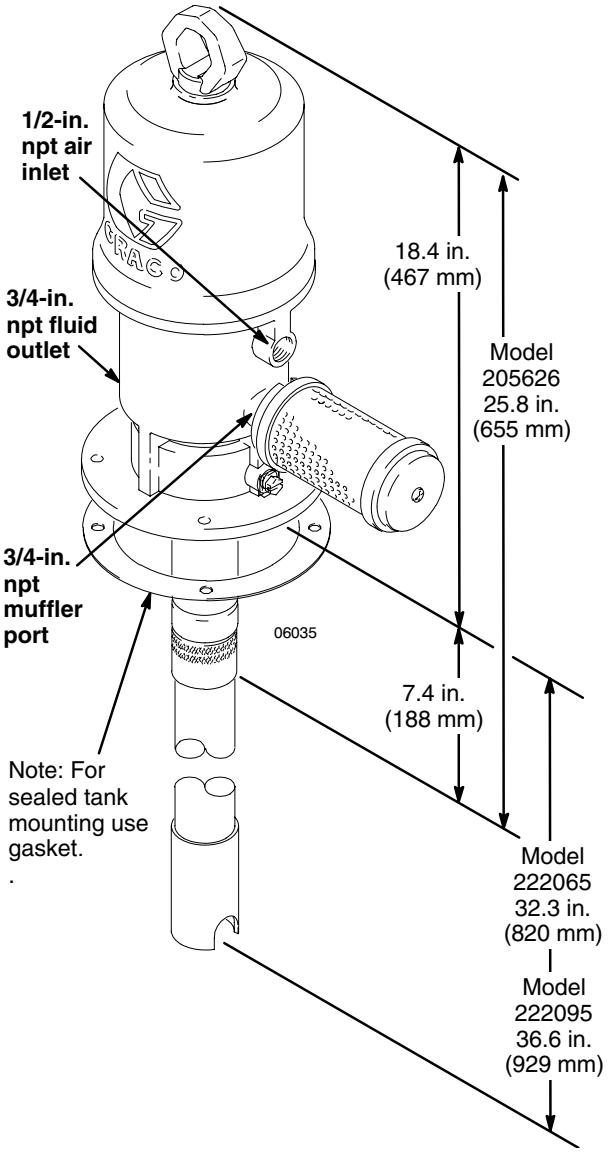
TI1052

Fig. 2

Hammer Oil Tank

Dimensions

MODEL 205626, Series J



Technical Data

Maximum working pressure	1800 psi (124 bar)
Fluid pressure ratio	10:1
Air operating range	40 to 180 psi (2.8 to 12.4 bar)
Air consumption	Approximately 13 ft^3/min per gallon pumped, (6 m^3/hour per liter pumped) at 100 psi (6.9 bar)
Pump cycles per gallon (liter)	20 (5.3)
Maximum recommended continuous pump speed	60 cycles/min; 3 gpm (11.4 liter/min)
Recommended speed for optimum pump life	15 to 25 cycles per min
Sound data	78.0 dBA sound power at 100 psi air, 40 cycles per minute
Piston seals	polyurethane with nitrile spreader
Rod seals	polyurethane with nitrile spreader
Wetted parts	aluminum, steel, polyurethane, nitrile
Weight (Model 205626, Universal Pump)	28.7 lb (13.0 kg)

Loctite® is a registered trademark of the Loctite Corporation.

Pipe Thread Lubricator

Air Operated Pipe Thread Pump (cont.)

If the pump accelerates quickly or is running too fast, stop it immediately. Check the grease supply and refill it if necessary. Prime the pump to remove all air from the system, or flush the pump and relieve pressure.

In a circulating system, the pump runs continuously and slows down or speeds up as supply demands, until the air supply is hot off.

In a direct supply system, with adequate air pressure supplied tot he motor, the pump starts when the gun or dispensing valve is opened and stalls against pressure when it is closed.

Use the air regulator to control pump speed and grease pressure Always use the lowest pressure required to achieve the desired results. Higher pressures will cause pump packings to wear prematurely.

Maintenance

WARNING: To prevent personal injury, perform pressure relief procedure before and after operating the pump.

Lubrication

An air line filter / regulator / lubricator is recommended for use with your Lincoln pump to remove harmful dirt and moisture from your compressor air supply and to provide automatic air motor lubrication.

If an air line lubricator is not used, the following procedure should be performed daily:

a. Disconnect air coupler from air fitting.

b. Fill air coupler with no. 20 SAE motor oil and reconnect to air fitting.

c. Operate pump to distribute lubricant

Material Restriction Prevention

Flush the system as required with a compatible solvent to prevent material buildup when pumping material that dries or hardens.

Corrosion Prevention

WARNING: To reduce the risk of injury from splashing or static sparking when flushing the pump with solvents, always hold a metal part of the dispensing valve firmly to the side of a grounded metal pail and operate pump a lowest possible fluid pressure.

To prevent water or air corrosion, never leave the pump filled with water or air. Flush the pump first with compatible solvent and then again with mineral spirits or oil based solvent.

Disassembly

WARNING: To prevent personal injury, perform Pressure relief procedure before and after operating the pump and before performing any disassembling or assembly.

NOTE: If completes disassembly is required, order the repair kit and replace ALL gaskets, O-rings and packings.

Engine Maintenance

NOTE: Caterpillar advises to contact your local service agent for your particular engine for correct and up to date service information.

10hrs/daily
– Check / refill engine and engine reserve tank (15W/40, sump 85 litres, reserve tank 125 litres).
– Check / refill engine fuel tanks main and reserve (main tank 1700 litres, auxiliary tank 1300 litres).
– Drain water from fuel/water separator.
– Clean / check air filter dust bowls.
– Check air filter indicator when engine is running.
– Check air induction clamps and hoses for security.

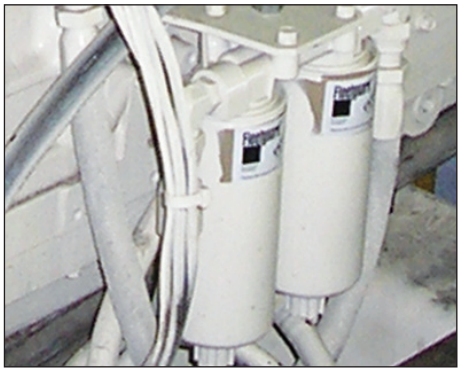
250 hrs
– Replace primary engine air filter.
– Check replace if required engine safety air filter.

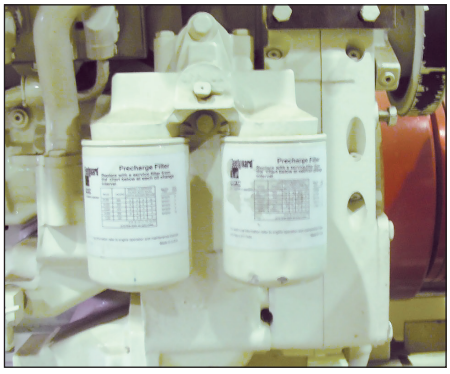
500 hrs
– Drain / refill engine oil from sump and oil reserve tank.
– Clean engine crankcase breather.
– Replace engine oil filters.
– Replace fuel filters.
– Drain water from fuel tank.
– Replace engine air filters primary / safety.
– Clean engine air filter housing.

1000/2000 hrs
– All check's and servicing carried out in previous service intervals to be done at these intervals.

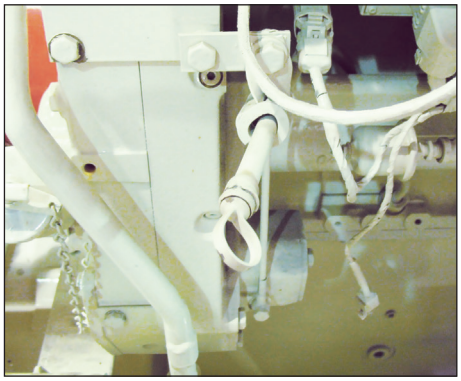
3000 hrs
– Engine valve rotors, inspect.

Engine Oil Reserve Tank and Filters


Cummins QST30 Fuel Filter (2)


Cummins QST30 Coolant Filter

Cummins QST30 Oil Filters (2)


Engine Oil Dipstick (RH side of Engine)


Engine Oil Fill Point (L.H side of Engine)

Lubrication And Preventive Maintenance

Air Conditioner Maintenance

250 hrs – Check tension and condition of air conditioner belts

500 hrs
– Replace return air filter element
– Replace pressuriser air filter element
– Check fans for tightness on shafts

1000 hrs
– Clean air conditioner condenser
– Clean air conditioner evaporator
– Check all mounting bolts, fasteners, terminals, etc.
– Flush drains
– Check / replace condensor and blower fan motor brushes

Battery Maintenance

WARNING: Batteries can emit explosive gases.
DO NOT smoke or use open flame near batteries, serious personal injury can result.
Batteries contain acid.
ALWAYS wear eye protection when working around batteries.
ALWAYS remove negative (-) battery cable first and attach negative (-) battery last.

200 hrs – Check all wiring and connections for damage, corrosion and tightness

500 hrs
– Check electrolyte level in batteries
– Check / clean terminals
– Check batteries for security

NOTE: NEVER weld on any part of the machine without first switching the battery disconnect switch to the OPEN position and removing the ECM connections from the engine (refer to electrical section for complete information).

Lubrication System Maintenance

10 hrs / daily
– Check / refill hammer oiler system pilot air lubricator (100ml)
– Check / refill pipe thread grease pump lubricator (100ml)
– Check / refill main air valve actuator pilot air lubricator

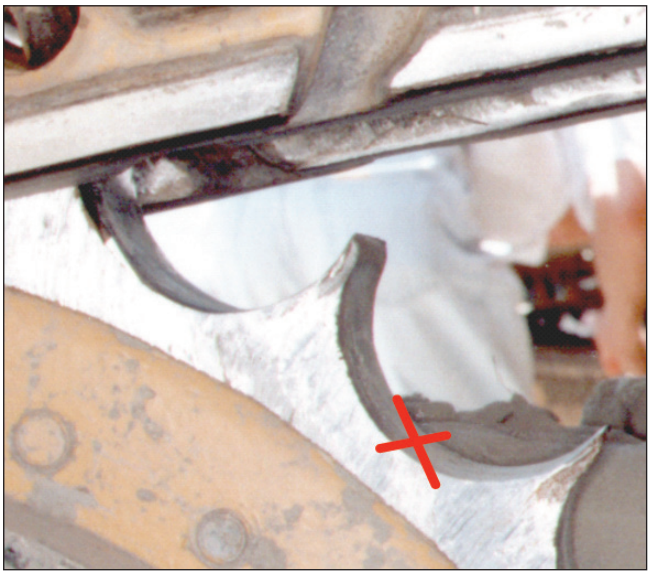
Fire Suppression Maintenance

10 hrs / daily
– Check system charge on fire suppression
– Check condition and security of fire extinguishers
– Report any damage or undercharged system

Track And Sprocket Inspection

Sprocket Wear Patterns (cont.)

Root Wear



Wear in the tooth bottom.

Causes:

- Transmission of vertical forces.
- Sliding bushing movement from tooth profile to tooth profile when changing machine directions.
- Lubricated track bushings ride in the tooth bottom because of the elimination of pitch extension.
- Bushings slide side to side in the tooth bottom when steering machine.
- Large tooth spacing leads to long sliding distances the bushing must cover when changing machine directions.
- Sprockets with mud reliefs increase surface load leading to higher root wear.

Effects:

- Risk of tooth breakage. Reduction of pitch increases bushing wear rate.

Remedies:

- Root wear in inevitable.
- Do not use sprockets with mud reliefs if the machine is to be used on non-cohesive soils for an extended time.
- Use track guides in order to reduce the side to side movement between bushing and tooth.

Lubricant Specifications

Lubricating Grease

Use SAE designation MPGM which contains 3-5% Molybdenum disulfide conforming to MIL-M-7866 and a suitable corrosion inhibitor.

NLGI grade No. 2 is suitable for most temperatures. Use NLGI No. 1 or 0 for extremely low temperatures.

Gear Lubricant

Use any oil which meets EP gear lubricant specification MIL-L-2105C or API-GL-5 of SAE J3083C.

Lubricant Grades:

- Below -23ºC (-10ºF) ambient use 40W.
- Above -23ºC (-10ºF) and up to 100ºF (37.8ºC) ambient use 80W-90 or EP90.
- Above 37.8ºC (100ºF) ambient use 85W/140.
- Optional: Mobil SHC 635 synthetic or equivalent (all temperature ranges).

Scheduled Oil Sampling Analysis

Caterpillar recommends that scheduled oil sampling be taken at regular intervals. This will maintain all warranty requirements and monitor condition of component wear in the system. Oil sampling must be carried out at regular intervals to serve as an effective indicator for component wear. Intermittent oil sampling does not allow a wear pattern to be established.

Samples should be taken from the following components:

- Hydraulic oil
- Compressor oil
- Engine oil
- Engine coolant
- Rotary gearbox
- Pump drive gearbox oil
- Final drive gear boxes

When to Take Samples:

Caterpillar recommends taking oil samples every 250 hours.

How to Take Samples:

Take samples when oil is warm and well mixed to assure an accurate reading.

NOTE: Use lube sampling station where fitted.

What the Analysis Consists of:

A proper oil analysis should include the following three elements:

1. Wear analysis
2. Chemical and physical tests
3. Oil condition analysis