BI012084
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Operation and Maintenance Manual

MD6640 Blast Hole Drill

Serial Number DR612176 / 2U70A10

Section 1

Introduction

GENERAL INFORMATION

This manual is designed to assist the owner in the operation and maintenance of this machine. By following easy to understand step-by-step procedures the operators and maintenance personnel can perform all tasks in a safe manner. When a systematic and thorough maintenance/service procedure is used for this machine, a minimum of unplanned downtime and more reliable operation will result.

THIS MANUAL IS NOT THE PARTS BOOK, and cannot be used as reference material to order parts. A separate, detailed parts book has been supplied. Please carefully read the instructions in it. All parts are listed by group and/or product code numbers with the associated item/part numbers for THIS SPECIFIC MACHINE. Order parts in the exact quantity needed. RIGHT and LEFT refer to machine locations as viewed by the operator sitting in the operator's seat in the cab. Please state the correct machine SERIAL NUMBER when corresponding or contacting the factory service or parts departments. Records on each machine are filed by serial number and when given this number, your machine's specific design and original equipment is accessed by the parts representative. Periodic additions or revisions may be made to this manual. Should you require additional information or factory service assistance contact your regional service representative or:

Caterpillar Global Mining, LLC
Mining Products Division
3501 S FM 1417
Denison, TX 75020
903-786-9621

The company reserves the right to make changes or add improvements to its machines at any time. This will be without incurred obligations to install such changes on machines sold previously. Due to this ongoing program of product research and development some procedures, specifications and parts may be altered in a constant effort to improve our machines.

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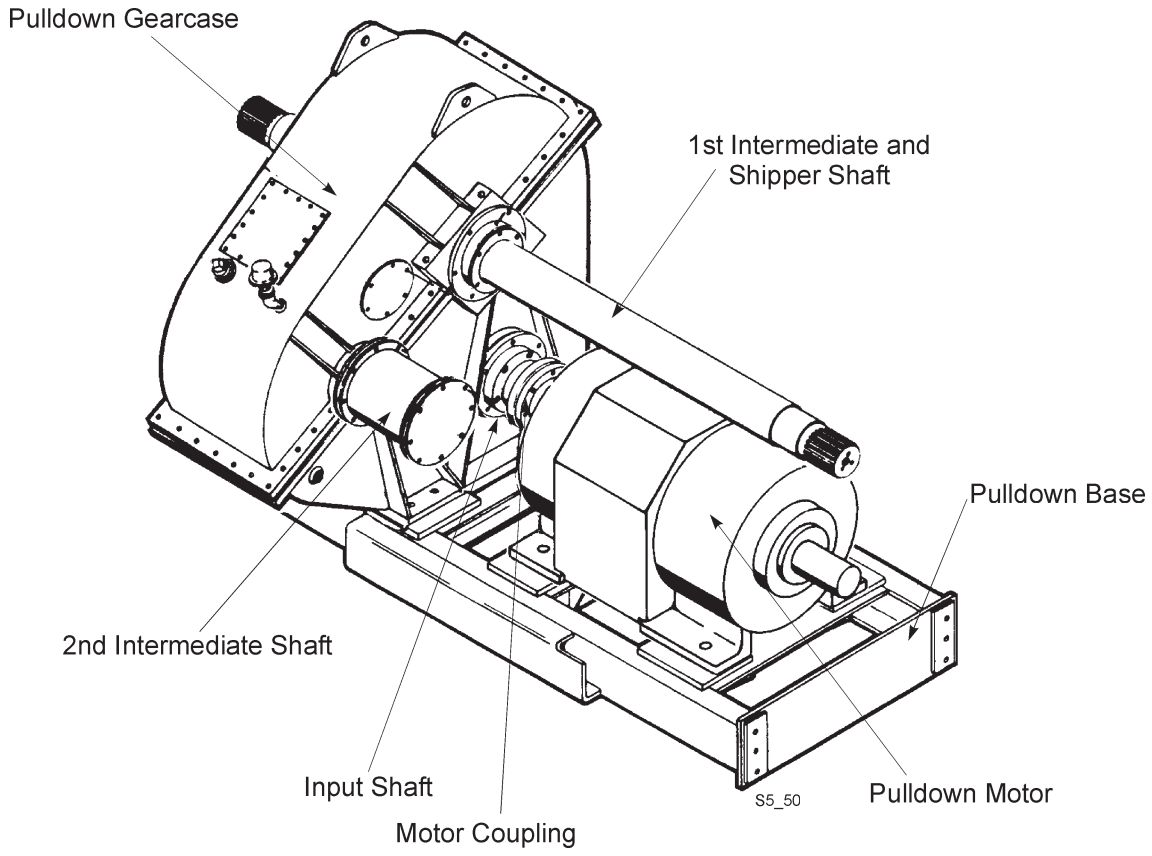
Stored Energy Signs

PULLDOWN GEARCASE



Section **2**

Operation

Always refer to the safety information in Section 1 of this manual before starting any maintenance procedure on this machine.

Table of Contents

EMERGENCY STOP PUSH-BUTTON

The emergency stop push-button on the left control console is a large red mushroom head push-button switch. Pressing the emergency stop push-button will shut-down the air compressor, hydraulic systems and shut-off all controls. It will also simultaneously provide immediate mechanical braking. This button should only be used in emergency situations.

CAUTION: PRESSING THIS BUTTON WHEN ANY DRIVE IS IN MOTION MAY RESULT IN COMPONENT DAMAGE.

BIT VIEW HATCH SWITCH

This two-position switch is used to move the hatch for viewing the drill bit on the ground. Moving the switch to the CLOSE position will close the hatch. Turning the switch to the OPEN position will open the hatch.

LEFT JOYSTICK (DUAL FUNCTION) - PROPEL TRACK / WINCH

NOTE: A neutral lock is provided to prevent accidental movement of the joystick. The joystick automatically returns to neutral and the lock is engaged anytime that the joystick is released. To enable movement of the joystick, lift up on the lock (located below the joystick knob). Speed of operation increases as the joystick's position is deflected farther away from neutral.

LEFT TRACK PROPEL - Use to control the propel speed and direction for the left track when the OPERATING MODE switch is at the PROPEL position.

NOTE: The propel brake must be released, the jacks fully retracted, the boarding stairs up.

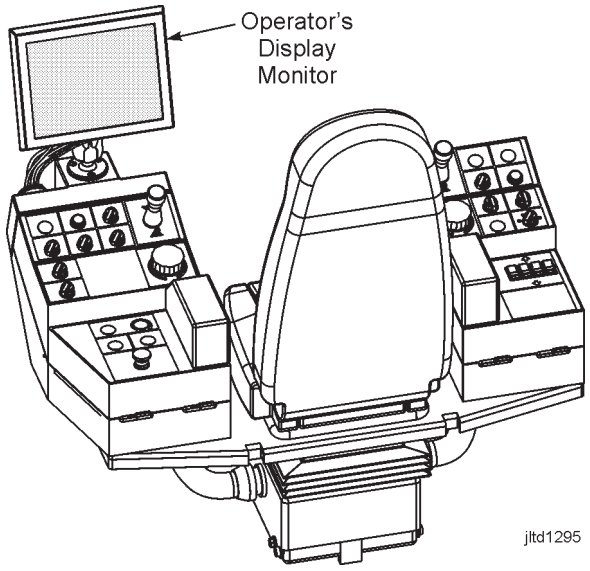
1. PUSH the joystick away from you to propel the left track forward.
2. PULL the joystick toward you to propel the left track in reverse.

WINCH - Use to control the winch hoist/lowering speed, along with the direction of travel when the OPERATING MODE switch is in the MAST/WINCH position.

1. PUSH the joystick away from you to hoist or raise the winch hook.
2. PULL the joystick toward you to lower the winch hook.

OPERATOR'S DISPLAY

The operator's display provides the operator with an interface to the machine and it's functional areas. From this informational display, the operator can make inputs that effect machine operation, monitor systems and make system adjustments. Through this display terminal the operator will receive pertinent fault data to identify potential problems and prevent machine damage.



OPERATOR'S DISPLAY MONITOR

Refer to a separate manual for further operational procedures for the Operator's Display Monitor.

The display monitor is mounted on a tilt-swivel bracket on the left control console. Individual operators can position the screen in any desired position.

DISPLAY AREA & INDICATORS

The display area of the monitor screen is the large area in the center of the screen. This area is "touch sensitive." All information will be displayed on this area either in a text format or in the form of visual icons. The buttons and icons that appear on the screen will respond to touching the screen in the appropriate area of the icon.

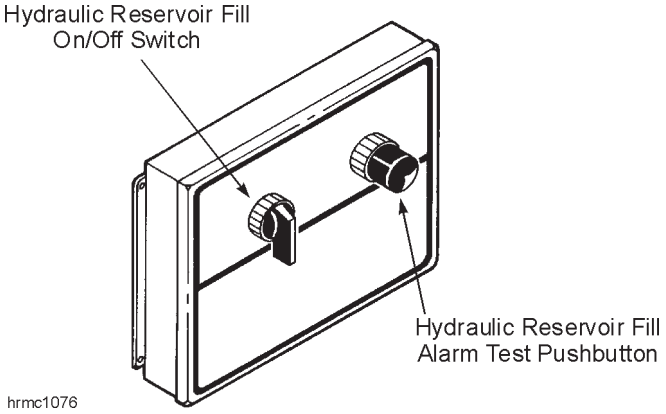
These icons and buttons will react by activating the screen, switch activation or display information relevant to the icon. The switches and buttons will be covered in the following pages under the screen topic in which they appear.

MISCELLANEOUS CONTROLS

Located about the machine are various miscellaneous controls and monitors which would be used with optional equipment or do not fit in the previously described groups.

HYDRAULIC RESERVOIR REMOTE FILL CONTROL PANEL

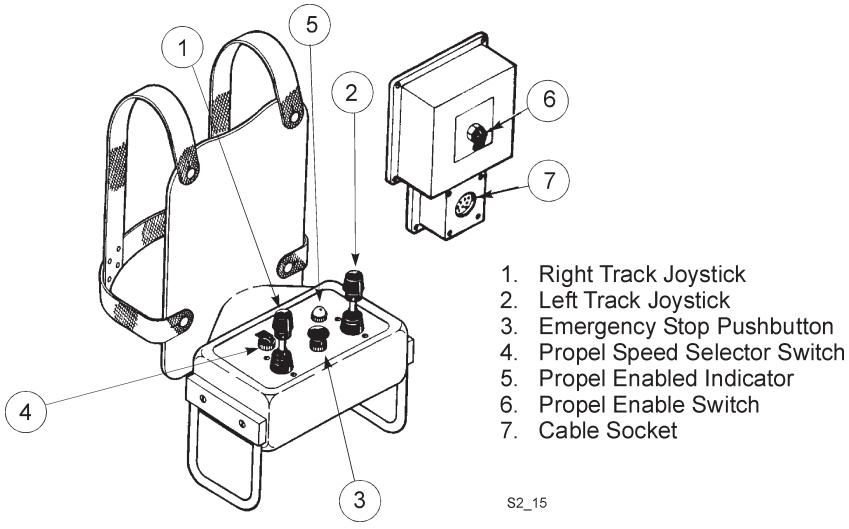
The hydraulic reservoir remote fill control panel is used to monitor the reservoir as it is being filled. The instructions for use of these controls are printed directly below the controls.



Hydraulic Reservoir Remote Fill Control Panel

PORTABLE REMOTE PROPEL STATION (Optional)

The portable remote propel station is located in an enclosure under the operator's cab on the right side of the machine. In addition to storing the portable station the enclosure includes 40 feet of cable and an enabling switch to energize or de-energize the station. Another enabling switch and plug in socket are located at the front right corner of the drill main frame. The station includes two joysticks, one for each crawler frame; an emergency stop push-button; a propel speed selector; and a red indicator which will light up when the station is energized.



PORTABLE REMOTE PROPEL STATION

they lead to serious damage to the motors or the machine. Inspection should include monitoring the motor temperature and listening for unusual noises which might indicate a problem. Inspection should also include verifying that all blower vents and intake openings are open.

OPERATION

Operation of this machine is the same as the operation of any other drill. But just because the machines operate the same in principle does not mean they operate the same in all respects. For this reason it is important that the operator becomes familiar with the particular machine that is being operated.

The purpose of this section of the operator's manual is to detail the procedures involved in operating many of the major components and preparing to drill a hole. The actual drilling procedure is detailed later within this section.

Become familiar with the controls and learn to operate at reduced speeds. As the machine and drilling cycle become more familiar, increase speeds gradually to the full operating capability of the machine.

The most important reason to operate slowly at first is safety. Operating at full speed means that things happen quickly, perhaps more quickly than expected. This unexpected operation of equipment can very easily lead to an accident.

For the purpose of this manual, we will assume that the drill has been left in the proper condition for operating. If this is not the case, complete the prestart checks and start the machine using the procedures as outlined.

PROPELLING

DEFINITIONS

"Listing" is a machine geometry condition which can occur on vehicles which have a pivotal axle and a fixed axle. It is that condition when the upper works is tilting over onto the pivotal axle, lifting one side of the fixed axle.

"Tipping" is defined as the point of impending overturning. A machine can tip to the rear without listing first. Under all other conditions, the machine will "list" before tipping.

"Maneuvering slope" is the grade on which the machine can be propelled in any direction without listing or tipping.

4. To level the machine manually, use the three jack switches and the automatic leveling screen on the operator's display terminal. The operator uses control switches on the right-hand console and observes the operator's display screen.

5. Lower all four leveling jacks until they are resting on the ground. Then, starting with the low side (left or right) of the drill, slowly lower the jacks until the weight of the machine is resting on them. The leveling jack controls should be operated in pairs while doing this operation. This reduces the twisting of the drill frame. Once the weight of the machine is resting on the downhill side leveling jacks, slowly lower the uphill side leveling jacks until the machine weight is resting on them. The machine need not be raised a great deal during this operation, since the purpose is only to get the weight of the machine resting on the leveling jacks.

CAUTION: During this and subsequent leveling procedures, it is important that the drill stays as close to level as possible. Care should be taken especially when working on steep grades.

6. Once the machine weight is resting on the leveling jacks, the machine may be leveled. Starting with the downhill side of the machine, lower the two side leveling jacks to bring the machine into side-to-side level as observed on the operator's display terminal screen. Then, once the machine is level from side-to-side, operate the leveling jack controls for the downhill end of the machine to bring the machine into level end-to-end as observed on the operator's display terminal screen.

7. Once the machine is level, make sure that the weight of the machine is off of the crawlers. The preferred method of doing this is to raise the machine until the closest point of the lower rollers to the crawler belts is 2" to 7" (5.1 to 17.8 cm). This assures that the machine is resting on the leveling jacks while maintaining a low center of gravity.

MAST RAISING AND LOWERING

The mast on this machine is normally left in the raised position for most situations including propelling from hole to hole on a blast pattern. Lowering the mast is necessary under three conditions:

1. Maintenance work is not possible or too dangerous to perform with the mast up.

2. Long moves over 1,000 feet (304 m) where the drill will be towed into position, propelled at high speed, or be loaded onto a trailer.

3. Any situation when steep slopes are encountered. Contact Caterpillar Global Mining Service Department if unsure of slope limitation for propelling.

CAUTION: Follow all applicable safety measures when working with cranes and rigging. Failure to follow safe working procedures can cause an accident, leading to the possible death or injury of personnel.

3. Position the pipe to be installed in such a position so as to be accessible to the crane. Normal placement of the drill pipe is on the left side of the machine, laying at right angles to the machine. This allows the crane to lift the pipe and swing without excessive boom hoisting and lowering. The pipe may be stored on suitable blocking on the ground, or on a truck or trailer.

CAUTION: Make sure the drill pipe is secured against unwanted or unexpected movement. Failure to secure the pipe properly may result in the pipe shifting and causing death or serious injury to personnel in the area.

4. The upper gate is open when the pipe rack is empty. This function is controlled by a limit switch in the lower pocket of the pipe rack.

5. Using suitable rigging, attach the crane to the drill pipe. The pipe should be rigged so that it will remain horizontal while being lifted. Attach suitable tag lines to the pipe. Remove the thread protectors and clean and lubricate the threads and shoulders on each end of the pipe. Install an approved lifting bell to the pin (upper) end of the pipe. Lift the pipe into position over the mast.

6. Using a tag line guide the pipe into the desired pipe rack. Place suitable blocking beneath the pipe to allow the sling to be removed from the pipe.

CAUTION: Block the pipe securely to prevent it from moving unexpectedly.

7. Remove the slings from the pipe. Attach a sling to the lifting bell on the pin end of the pipe and lift the pipe sufficiently to remove the blocking.

8. Slide the pipe down the pipe rack until it rests on the bottom of the pocket. Lay the pipe in the pipe rack and remove the sling and lifting bell.

9. When the pipe rest in the bottom of the pocket it will trigger the limit switch and close the upper gate.

10. Repeat the procedure for additional lengths of pipe.

11. Unloading the pipe is the reverse of the procedure used for loading the pipe.

8. After cleaning and lubricating the threads, turn the rotary rheostat until the drill pipe is rotating at approximately 5 RPM as shown on the operator's display terminal operator's display screen. Lower the rotary/pulldown unit slowly by gravity until the threads begin to contact. Once the threads begin to join the two pipes, attempt to minimize the pressure on the threads by allowing the joint to close slightly while holding the upper pipe in position with the hoist brake, then allowing the upper pipe to descend slightly to keep the tool wrench from losing its grip on the lower pipe. Once the joint is tight, stop the rotary motion.

NOTE: Be sure that the joint is made properly before attempting to unclamp the lower pipe. Should the joint not be made properly and fail, the lower pipe will fall into the hole and be difficult to recover.

9. Disengage the tool wrench and retract it fully. The second section of pipe is now installed.

To install the third section of pipe, follow the procedure for installation of the second section of pipe, except that the third section of pipe is now installed between the rotary unit and the second section of pipe.

REMOVAL OF MULTIPLE SECTION DRILL PIPE

Disassembly of multisection pipe strings is essentially the same as disassembly of a single section of pipe. The difference is that instead of the stabilizer being held by the tool wrench, it is the first or second section of pipe.

The tool string is disassembled to reverse order of assembly. First, the last section of pipe to be installed is removed, followed by the second section of pipe installed, and then the first. In each case the lower section of pipe is held by the tool wrench while the joint is broken by the breakout wrench. The joint is then disassembled by the rotary motion and the pipe stored in the pipe rack. The procedure is then repeated as necessary to remove all, or part of the tool string.

NOTE: For normal operation it is not necessary to completely disassemble the tool string to move from hole-to-hole within the drill pattern as long as the stability limitations are not exceeded. Do not disassemble the tool string more than necessary.

ENDING THE HOLE

Once the finished hole depth is reached normal drilling ceases. It is now necessary to ream the hole before preparing the drill to move to the next hole. Reaming the hole removes cuttings that have fallen to the bottom of the hole and also straightens and increases the diameter of the hole.

As the bit and tool string are cutting through the formation, the bit may tend to wander slightly. This wandering is due to the fact that the stabilizer cannot be exactly the same diameter of the bit or it would wear out quickly and create operation problems. The stabilizer tends to keep the bit on course, but it cannot keep the hole exactly straight. Reaming the hole straightens the hole and therefore increases the diameter of the hole slightly. Reaming the hole also removes any cuttings that are lodged in the hole. These cuttings must be removed or they will eventually fall to the bottom of the hole, reducing the drilling depth.

To complete the drilling procedure the hole is reamed as follows:

1. When the hole is drilled to the finished depth, leave the main air stream on and the rotary rheostat to the MINIMUM position and the motion activated. Return the hoist/pulldown rheostat to the “0” position and set the hoist brake. Allow the tool string to rotate and the air to bail the hole for a moment. This removes all of the cuttings in suspension from the hole.

2. Turn the hoist/pulldown speed selector switch to the LOW HOIST position and the hoist/pulldown rheostat in the HOIST direction while simultaneously releasing the hoist brake. Slowly hoist the tool string out of the hole. If resistance is met, or if vibration increases, return the hoist/pulldown rheostat to OFF position and set the hoist brake. Allow the obstruction to be removed by the bit before continuing. If the hole is very crooked (indicating a worn stabilizer) it may be necessary to repeat this procedure of hoisting, then stopping and allowing the bit to clear, many times before reaching the top of the hole. This procedure straightens the hole and allows the tool string to be removed.

3. Once the tool string has been removed and the hole reamed, it must now be cleaned out. Reaming the hole loosens cuttings that have become lodged in the side of the hole. These cuttings, and most of the cuttings generated during reaming will fall to the bottom of the hole. This filling of the hole may reduce the actual depth of the hole significantly, so it is necessary to remove these cuttings from the hole. To do this, release the hoist brake and turn the hoist/pulldown rheostat slowly in the pulldown mode.

Leave the air on and the tool string turning at 25-30 RPM. When the bit reaches the point where the cuttings have accumulated on the bottom of the hole, these cuttings will be forced out of the hole. When the cuttings have been cleaned out of the bottom of the hole, the bit will contact the undrilled formation at the bottom of the hole and stop penetrating. Once the flow of cuttings out of the hole stops and the tool string stops penetrating, the hole is clean.

4. After cleaning the hole the tool string may be raised to the top. Turning the hoist/pulldown rheostat control in the HOIST direction and the hoist/pulldown speed selector switch in the HOIST HIGH position will hoist the tool string.

4. Manually cycle the lube system and verify that all points on the mast are receiving lubricant. If the auto lube system is not functioning properly, repair or replace components as necessary.

5. Lower the leveling jacks until the jack pads are resting on the ground, but no machine weight is on them.

6. Inspect the air compressor for signs of wear or damage. Make note of any damage discovered.

7. If the air compressor motor is equipped with anti-condensation heaters, turn them on at this time. If the motor is not equipped with heaters, have a qualified electrician install heaters or a suitable substitute. Cover the motor with a waterproof tarp or cover.

8. Close and lock all electrical cabinet doors.

9. Fill the radiator to the top with the proper oil on machines equipped with screw compressors.

10. Manually cycle the auto lube system to verify that all points on the machine are receiving lubricant. Repair the system as necessary to lube all points.

11. Lube all manual lube points.

12. Clean the dust hoppers on the dust control system if required.

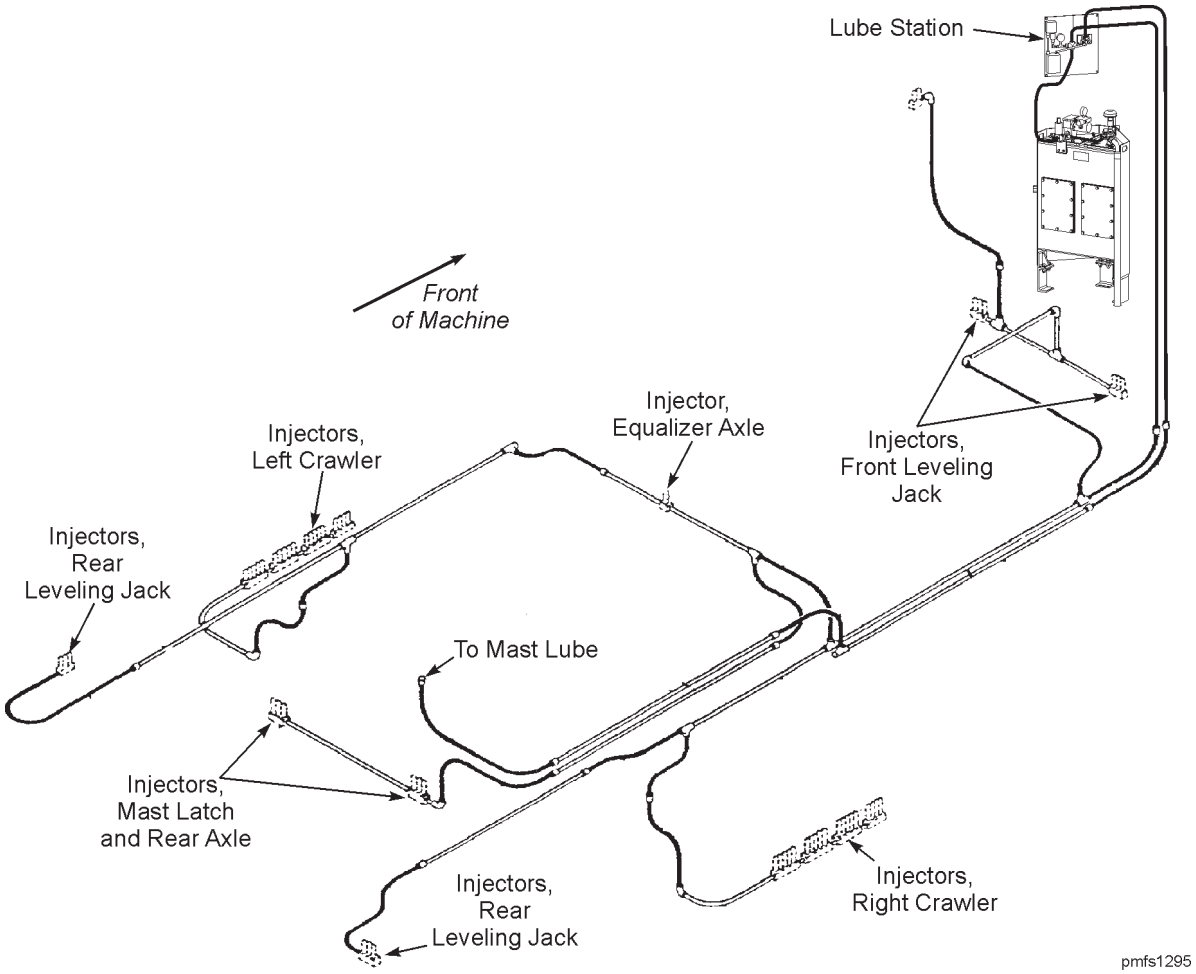
13. Close and lock all windows and doors.

LONG TERM STORAGE

Long term storage procedures are necessary any time the machine is to be left for a period exceeding 3 weeks. Long term storage includes all procedures necessary for short term storage, and depending on the situation, some additional precautions.

There are two procedures involved in long term storage of the drill, the choice of which depends upon whether the machine can be attended to while in storage. If the machine can be started and the majority of the machinery operated once a month during the storage period, much less protective work is necessary. If the machine must remain unattended, special precautions are necessary to prevent damage to the machine.

NOTE: If the machine is to be unattended during the storage procedure the procedures necessary to store the machine properly will take considerable time and restoring the machine to production will take even longer. Do not utilize the unattended long term storage procedure unless absolutely necessary.



Auto Lube Piping ~Mainframe (View #1)

FLOWMASTER PUMP SERVICING

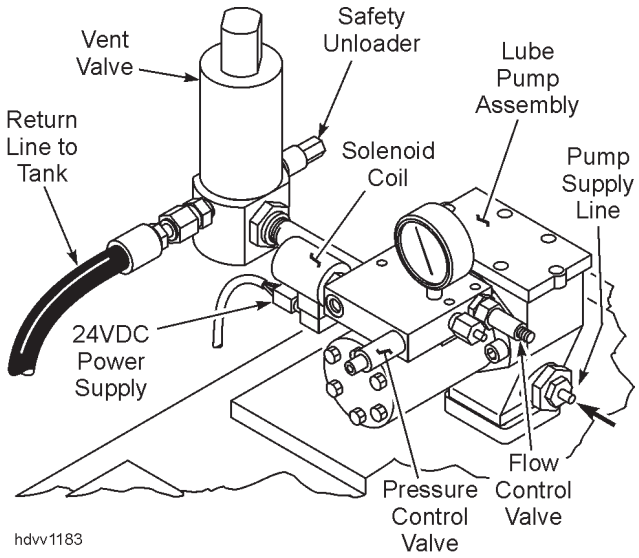
CAUTION: To reduce the risk of serious bodily injury, including fluid injection, injury from moving parts, and splashing in the eyes or on the skin: always follow the following Pressure Relief Procedure whenever you shut off the pump; when checking or servicing any part of the spray system; when installing, cleaning or changing dispense valve nozzles; or whenever you stop dispensing.

PRESSURE RELIEF PROCEDURE

1. Close the shut-off valve to the material supply line.

2. Turn power OFF to lube pump at the control panel. Disconnect 24DCV power supply at the solenoid valve.

3. Relieve pressure at safety unloader.



The lube pump is factory set at 350 PSI working inlet hydraulic pressure with a flow rate of 2.5 GPM. Maintain hydraulic pressure between 300-450 PSI. Maximum flow rate is 7 GPM. However, adjusting the lowest pump outlet pressure and hydraulic fluid flow to obtain the desired to results will minimize pump wear.

Pump pressure and flow rate will vary depending on operating temperatures. DO NOT ADJUST THE PUMPS PRESSURE BEFORE THE INITIAL START-UP PROCEDURE. For more information on installation and start-up, refer to the manufacturer's literature included with this machine.

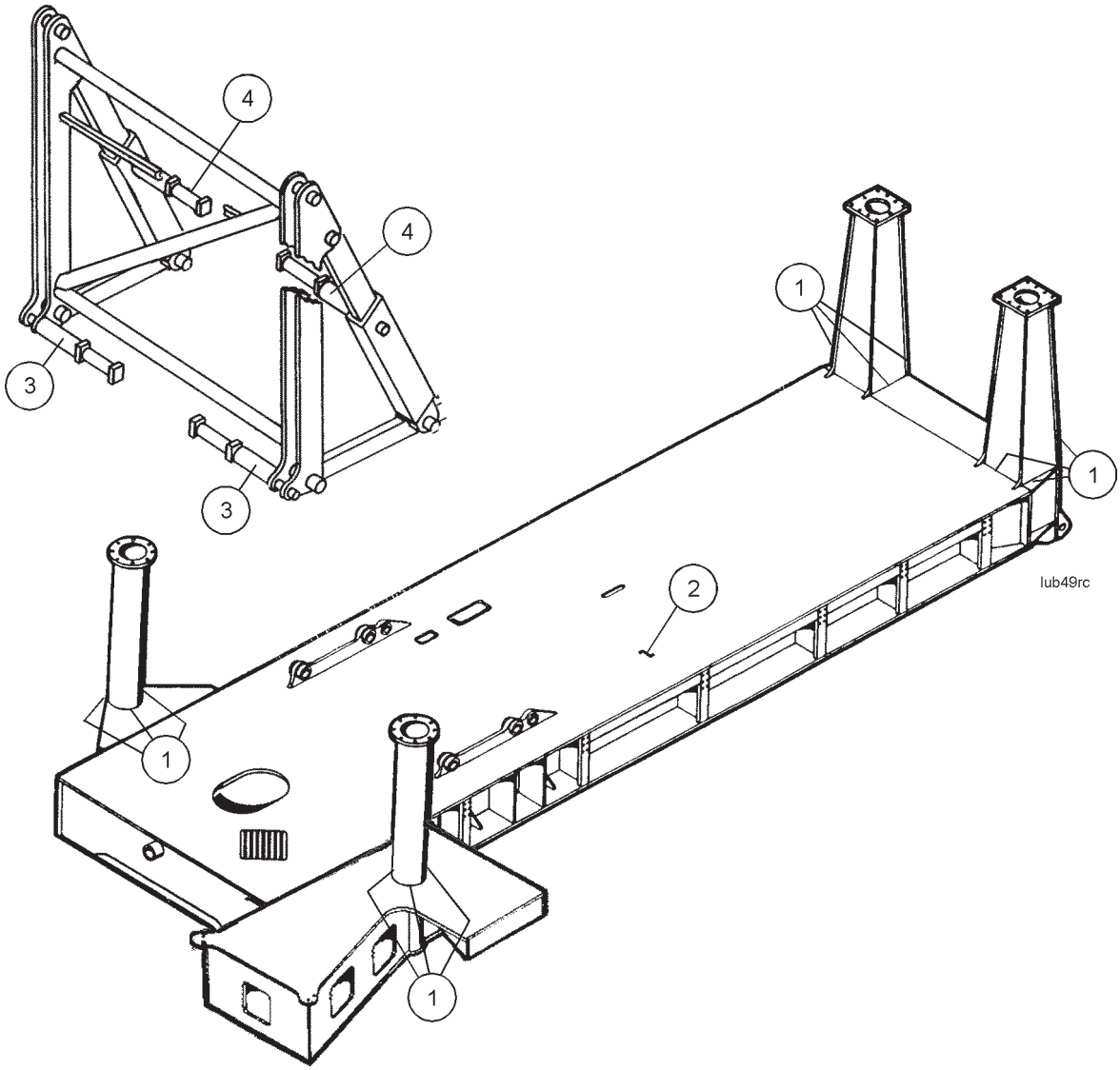
PRESSURE CONTROL VALVE ADJUSTMENT

1. Loosen the locknut on the pressure reducing valve by turning the nut COUNTER-CLOCKWISE.

2. Turn the valve stem COUNTER-CLOCKWISE until it reaches the stop. This adjustment allows the minimum pressure setting which is approximately 170 psi.

3. With the pump stalled against pressure, turn the pressure control valve stem CLOCKWISE until the desired pressure is attained on the manifold pressure gauge. DO NOT EXCEED 450 PSI.

4. Tighten (CLOCKWISE) the locknut to 20-25 Ft.Lbs.



MAIN FRAME LUBRICATION

LUBE POINT	NO. OF POINTS LUBRICATED	TYPE LUBRICANT	HOURS 8	40	160	1000	AS REQ.	AUTO	COMPONENTS
1	12	MPG	X					X	LEVELING JACK CASING - LOWER
2	1	MPG	X					X	EQUALIZER AXLE CENTER PIN
3	2	MPG	X					X	MAST LOCK PINS
4	2	MPG	X					X	A-FRAME LOCK PINS (OPTIONAL)

NOTE: The above frequencies are for manual lubrication. When equipped with an automatic lube system the frequencies are set at the lube control station.

On automatic lube systems the injectors should be set at full opening at start-up of a new machine and then readjusted as required. Refer to LUBRICANT INJECTORS in this section of the manual.

HYDO – HYDRAULIC OIL

Hhydraulic oil suitable for year-round use is recommended, rather than summer or winter only, which can create a mixing of viscosities if a complete draining of oil is not accomplished. This can compromise the intended oil viscosity.

The oil viscosity benchmark for this machine is 3,000 centistokes (CST) maximum on the coldest day for start-up, and 10 centistokes absolute minimum on the hottest day during machine operation. Optimum oil viscosity at normal operating temperatures is 30 to 60 centistokes.

For climates that rarely see ambient temperatures drop much below freezing (25°F to 32°F), a paraffinic-based petroleum hydraulic oil with little or no viscosity improver (VI) can be acceptable.

For climates where ambient temperatures drop as low as -40°F on their coldest day and are as high as 104°F on their hottest day, a higher VI fluid is required. Paraffinic-based fluids should NOT be used where ambient temperatures reach freezing or slightly below freezing. At freezing or slightly below freezing temperatures, the paraffin wax starts to solidify causing the fluid to have a thicker viscosity than the temperature-viscosity curve actually implies. In addition, the VI additive in petroleum-based oils has the ability to be mechanically sheared, causing the viscosity to drop. This can result in a fluid that can be totally incorrect for use after it has been in service for some time.

For all the above reasons, plus concerns of the oxidation-rate and water-ingestion that leads to sludging, recommended draining intervals of 2,000 hours when using petroleum-based paraffinic or naphthenic-type hydraulic oils should be followed.

The preferred hydraulic oil for this machine is a PAO (poly-alpha-olefin) synthetic fluid with a naturally high VI. Examples being: 198 for Shell® Oil Tellus T 722, a range of 135 to 145 for Mobil® Oil SHC 500 series, 134 for Esso/Exxon® Terrestic SHP 22 Hydraulic Fluid, or 135 for Conoco® SYNCON AW Oil.

The 3 to 4 times multiplier in the cost of synthetic fluids, as compared with paraffinic-based petroleum oils, is offset by the fact that the synthetic oil can be left in the system 4 times longer (i.e. 8,000 hours) before a drain interval requirement. The savings with synthetic fluid use results because the frequency of draining intervals is decreased by a factor of 4. This reduces the maintenance time dedicated to changing the system oil and the cost of system oil disposal to 1/4 of what they would otherwise be.

With all of the above in mind, using a SHC-type oil from Shell®, Mobil®, Esso/Exxon® or Conoco® can result in considerable cost savings, whether the mine is located in a cold or warm climate.

SPECIFICATION FOR
ENCLOSED GEARCASE LUBRICANT
SD4722 *(June 26, 2006)*

Applicable to Models 33HR, 35HR, 37HR, 39HR, 49HR and 59HR Rotary Blasthole Drills.

SCOPE:

This specification covers the requirements for “Enclosed Gearcase Lubricant” used on models 33HR, 35HR, 37HR, 39HR, 49HR and 59HR Rotary Blasthole Drills.

The materials furnished under this specification are intended to lubricate spur and helical gears as well as anti-friction bearings at the interior of enclosed planetary and non-planetary type gearcases (Propel, Rotary, Pull Down and Pump Drive).

This specification covers “Enclosed Gearcase Lubricants” that may be applied in service at temperatures ranging from –50ºC (-58ºF) to the highest ambient temperature conditions.

GUIDELINES FOR SELECTING AN APPROVED LUBRICANT:

Step #1

Using Table 1, determine the recommended oil type (Mineral or Synthetic) based upon the anticipated ambient temperature range.

AMBIENT TEMPERATURE RANGE:

Ambient Temperature: The ambient temperature is defined as the air temperature in the immediate vicinity of the gearcase.

a. Use atmospheric temperature for gearcases located outside of the machinery house (Rotary, Pull Down and Propel Gearcases).

b. Use machinery house temperature for gearcases located inside of the machinery house (Pump Drive Gearcase) for some machines are equipped with machinery house heaters.

c. For cold weather applications, the pour point of the lubricant must be at least 5°C (9°F) below the minimum ambient starting temperature. If the ambient starting temperature approaches the lubricant pour point, oil sump heaters may be required to facilitate starting and ensure proper lubrication. Use oil temperature for gearcases having oil sump heaters.

5. Viscosity, a fluid's resistance to flow, is the principal physical characteristic of a fluid in terms of its ability to produce a lubricating film between two interfacing surfaces. All lubricating fluids possess a natural viscosity that may be altered (enhanced) by additives such as resins or polymers. Some "viscosity enhancers" are shear sensitive, which could result in insufficient protection of the lubricated components under high load, elevated temperatures and/or high shear conditions. The viscosity of the fluids utilized in the open gear lubricants shall be sufficient under operating conditions for the product to meet or exceed the performance requirements listed in the "MINIMUM PERFORMANCE REQUIREMENTS" section.

6. Open gear lubricants supplied under this specification must be specifically formulated to protect surfaces, reduce wear, and provide satisfactory service life under all anticipated operating conditions.

7. Open gear lubricants supplied under this specification must have excellent water tolerance and rust preventive qualities, as well as minimal dripping qualities for operation over wide temperature ranges.

8. Should the material furnished under this specification contain a diluent to improve dispensability, special care must be exercised to ensure its compatibility with all centralized lubrication system components, i.e., gaskets, o-rings, vent valves, etc., and oil seal lip materials (Nitriles, Viton). Reference ASTM D 4289-03.

9. For extended use in low temperature areas, open gear lubricants supplied under this specification should be capable of slumping in containers and should be pumpable through lube lines without the aid of heat tracing. In order to minimize compatibility problems, it is desirable that the thickener and additive system be compatible with the additional grades that are suitable for the other ambient temperatures.

MAINTENANCE PRECAUTIONS

The operator must be sure that the machine equipment is in a safe position before repairs or adjustments are made. The machine should not be endangered by falling rock or a possibly yielding support surface. Before beginning repair or adjustment, the operator shall:

1. Set all brakes.
2. De-energize control functions.
3. Do whatever else is necessary to prevent accidental movement of the machine.

DANGER: HIGH VOLTAGE! IF POWER IS ESSENTIAL TO THE REPAIR, SUCH AS FOR TESTING, IT SHOULD ONLY BE ENERGIZED WHEN ALL PERSONNEL ARE CLEAR OF ELECTRICAL AND MECHANICAL HAZARDS. The power should only be energized during the testing period and not when repair work is actually being done.

Prior to undertaking any work, maintenance personnel should notify the operator about the nature and location of the job. If work is to be done on or near moving parts, the starting controls should be locked in the OFF position and tagged. The lock and tag should be removed only by the maintenance people who installed them, or other authorized personnel. During all phases of maintenance, use extreme caution when working near electrical equipment. Never work near exposed, energized high voltage connections.

Approved protective equipment such as gloves and insulated hooks or tongs should always be used when high voltage electrical cables are handled.

DANGER: Only qualified electricians are permitted to directly maintain electrical equipment such as motors, transformers and switches.

While performing maintenance, the awkward positions assumed and the handling of heavy parts often increases the possibility of injuries. As a precautionary measure, use mechanical handling equipment whenever possible. The mining foreman can facilitate safer and easier maintenance work by providing blocking materials. Service crews should have a fundamental knowledge of lifting practices so their knees and legs are used rather than their backs.

DANGER: Many of the components comprising the machine are heavy, bulky items. EXTREME CAUTION SHOULD BE USED WHEN LIFTING THESE ITEMS. PERSONNEL SHOULD BE CERTAIN OF THE WEIGHTS OF COMPONENTS BEFORE ATTEMPTING TO LIFT THEM, EITHER MANUALLY OR WITH A LIFTING DEVICE. ALL APPLICABLE SAFETY RULES MUST BE FOLLOWED WHEN USING A CRANE OR OTHER LIFTING DEVICE. Be aware of the load rating, lifting height and swing radius of the lifting device before lifting a load. Failure to follow all applicable safety rules when performing maintenance could result in serious injury, or death.

DAILY Check Points *(cont.)*

18. Inspect the guide bushing for excessive wear or dirt accumulation. Also inspect the retainer lugs to be sure they are intact. Do not operate the machine without both retainer lugs intact and securely welded to the deck.

19. Inspect the tool string for excessive wear, dirt accumulation, bent pipe and secure joints. The bit cones and bearing should be in good condition. Manually turn the cones to make sure they turn freely.

20. Inspect the rotary gear case for lubricant leaks, damaged lines, dirt accumulation and other damaged or missing parts. Check the lubricant level in the gearbox. Fill to the recommended level with an approved gear lubricant. Check the rotary motor ventilation inlets for leaves, paper, rags, etc. blocking the flow of air.

21. Inspect the rotary drive unit for excessive wear or dirt accumulation. Inspect the guide rollers for proper adjustment and excessive wear. Check for loose or missing bolts and bent or cracked structural members.

22. Inspect the pulldown unit for excessive wear or dirt accumulation. Inspect the rack pinions for excessive wear, proper lubrication, and tight retainer bolts. Inspect the guide rollers for proper adjustment and excessive wear.

MD6640
Blast Hole Drill

pmc_6640

ITEM #	NOTED DISCREPANCY

Date: _____

Shift: _____

Inspected By: _____

Supervisor: _____

MAINTENANCE INSPECTION CHECK POINTS

EVERY 2500 HOURS, OR SEMI-ANNUALLY

(WHICHEVER OCCURS FIRST)

1. Position the machine so that one take-up tumbler and lower roller can be removed for inspection of the bushings.

2. Drain the propel gearcase and fill with new oil.

CAUTION: Be careful when removing the plugs, especially if the unit is hot. Pressure builds in the gearcase and as the last thread of the plug is removed, the plug may fly-off with great force.

3. While the gearcase is drained, inspect the gears, pinions, bearings and seals.

4. Drain the pump drive gearbox and fill with new oil.

5. Drain the rotary gearcase and fill with new oil.

6. While the gearcase is drained, remove the motor and inspect the gears, pinions, bearings and seals.

7. Drain the pulldown gearcase and fill with new oil.

8. While the gearcase is drained, inspect the gears, pinions, bearings and seals.

9. Re-pack the bearings in the masthead winch sheaves.

MD6640
Blast Hole Drill

pmc_6640

ITEM #	NOTED DISCREPANCY

Date: _____

Shift: _____

Inspected By: _____

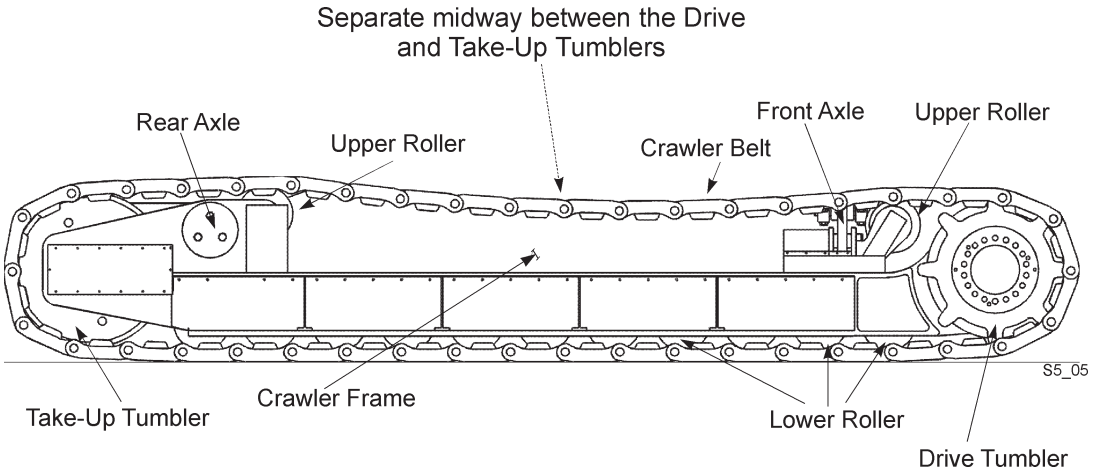
Supervisor: _____

BELT REPLACEMENT

Although belt replacement is required infrequently, there are times when it is necessary. To replace a belt, first propel the machine to firm, flat, level ground.

1. Remove tension from the belt by removing the shims from behind the take-up tumbler supports as described in the topic Crawler Belt Adjustment.

2. Part the belt at the midway point of the upper slide by removing the link pins.



Crawler Belt Replacement - Details

3. Attach a suitable lifting device to the ends of the belt and drag and lift each end of the belt off the crawler frame and lay it on the ground.

4. Using the machine leveling jacks, raise the machine sufficiently to allow the old belt to be dragged from underneath of the crawler frame. Securely block the machine in this position.

5. Using a suitable vehicle and rigging, drag the old belt from underneath of the crawler frame.

6. Assemble the new belt and lay it flat on the ground near the crawler frame.

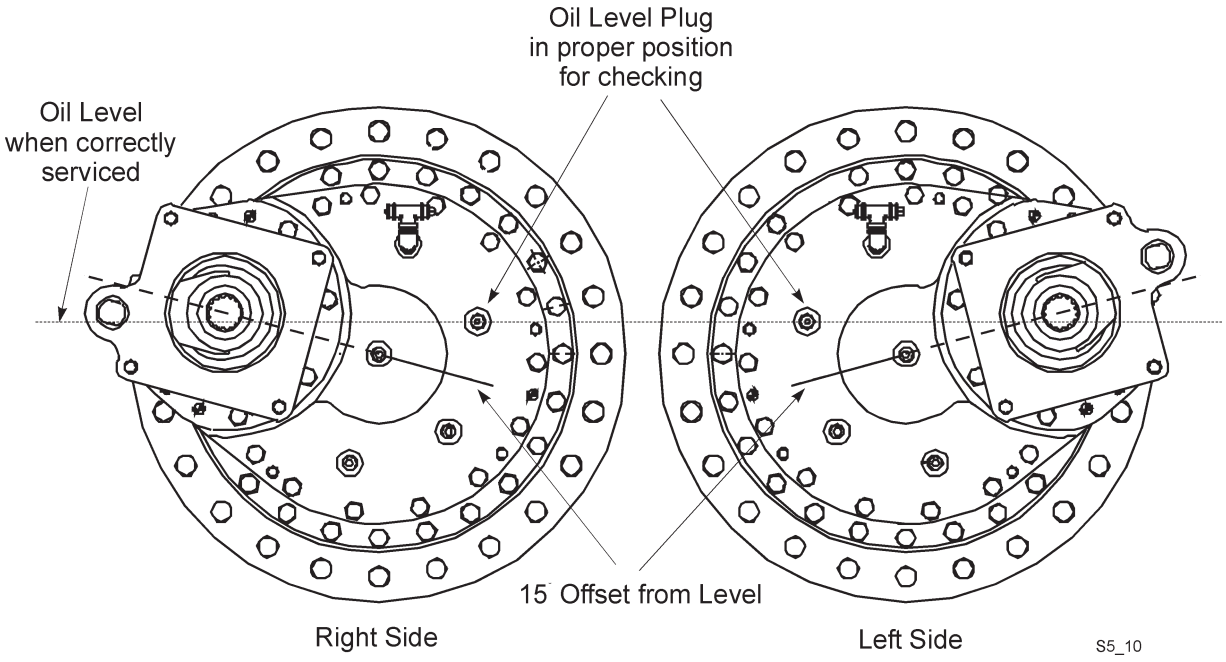
7. Using a suitable vehicle and rigging, drag the new belt underneath of the crawler frame so that the roller path in the center of the belt is aligned with the lower rollers, drive tumbler and take-up tumbler.

8. Remove the blocking and slowly lower the machine until the crawler rollers and tumblers are resting on the belt.

9. Using a suitable lifting device, lift the ends of the belt into a position to insert the link pins.

CHECKING/CHANGING OIL

1. Check the level of the oil in the gearbox every day by removing the level plug. The oil should be up to the bottom of the hole. Fill as necessary.



Planetary Gearbox Oil Check - Details

2. Examine the (magnetic) level plug. The oil should be its normal color possibly with some fine metal particles. Clean the plug and install it in the gearbox cover.

   If the oil is not its normal color, it should be replaced. If the oil is black the gearbox has been running above 300° F for extended amounts of time. If the oil is a milky yellow color, it has been contaminated with water.

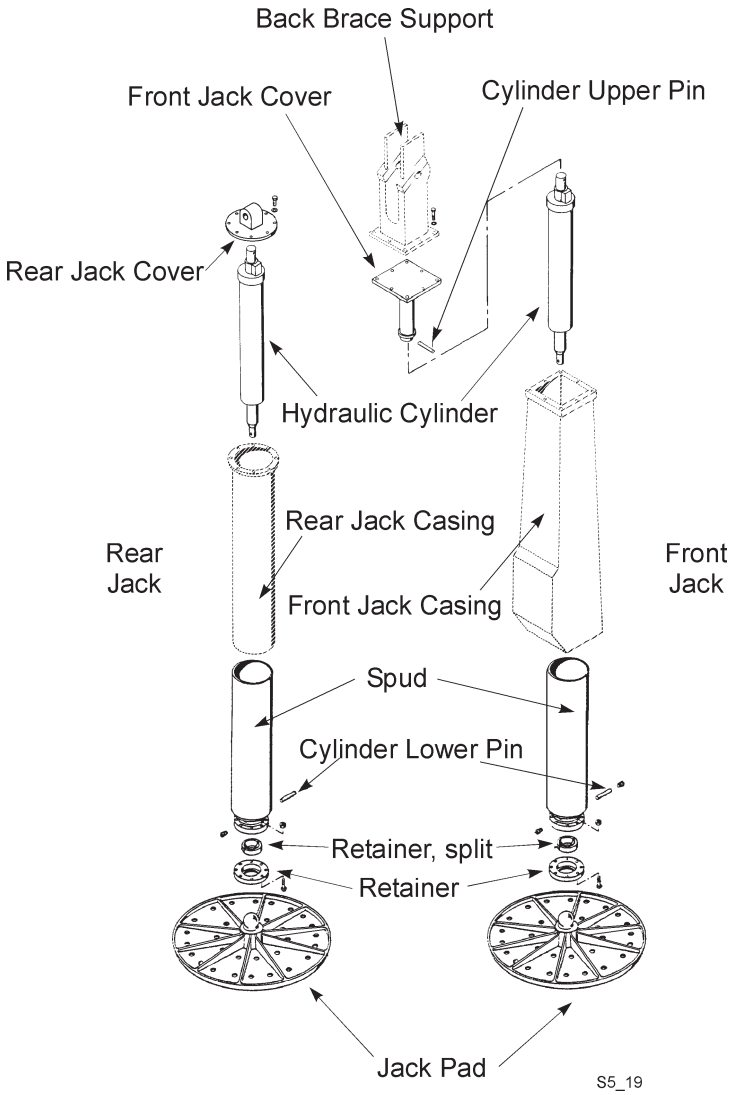
   When in doubt, submit an oil sample to any laboratory that performs contamination analysis services. The oil should be changed when the contaminants exceed 10,000 particles per million.

   Change the oil every 2000 hours, (1) year or if found to be contaminated:

LEVELING JACKS

Inspect the leveling jacks for structural damage, proper lubricant coating and proper operation. Verify that all bolts are tight and all pins are in place.

Check the jack pads for cracks or damage. Clean excess material from the jack pads. Check the jack spuds for wear or damage. Verify that the spuds are coated with lubricant.



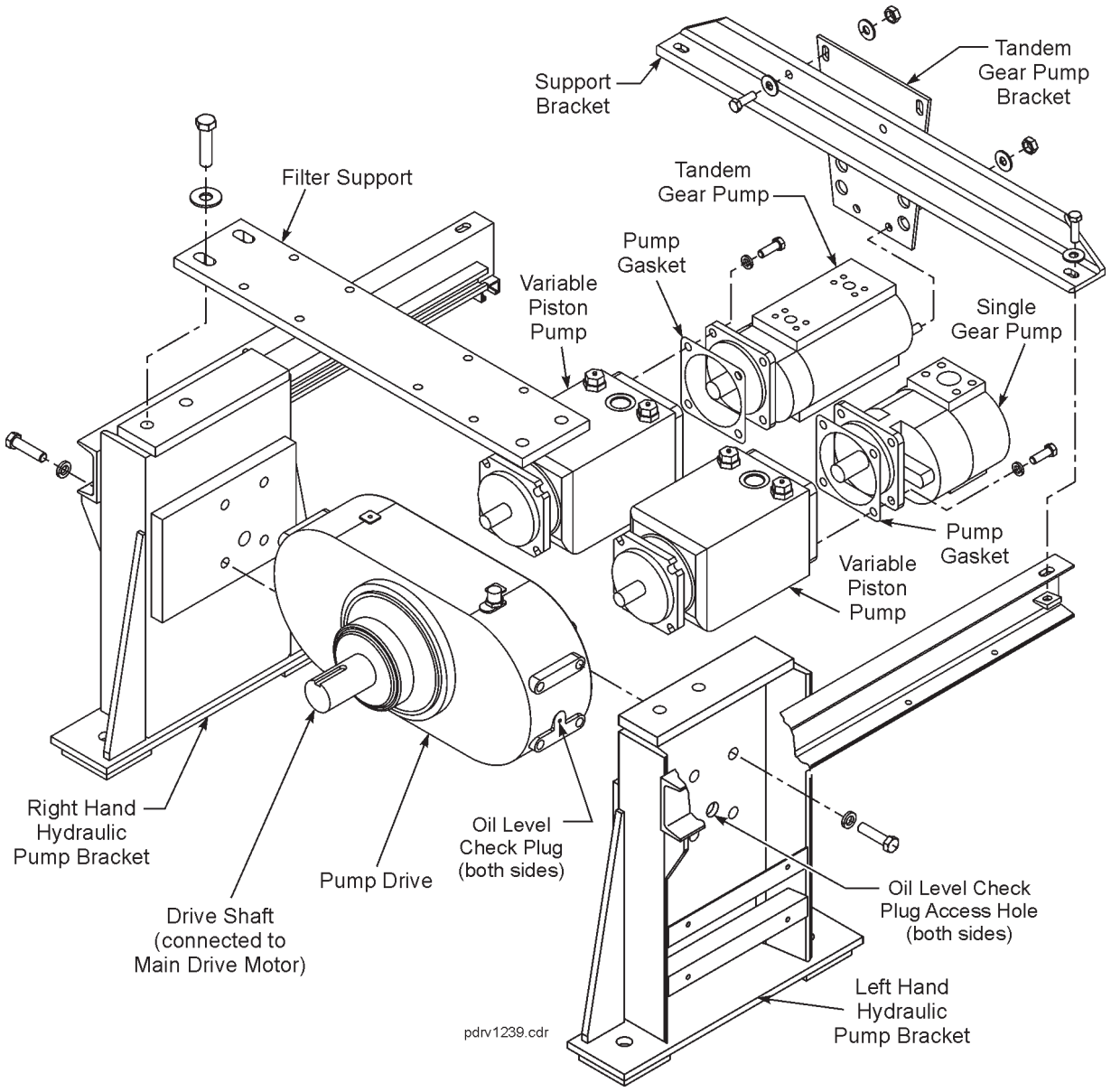
Leveling Jack - Details

Proper operation of the jack dictates that the jacks do not settle either while the machine weight is resting on the jacks or when the jacks are in the stored position. To check the jacks, raise the machine on the leveling jacks until the machine is completely off of the ground. Scribe a line on the jack spuds 1 foot below the jack housing. Allow the machine to remain idle for 1 hour. Measure the distance between the scribe lines and the jack housings. If the jacks have drifted more than 1/4", the jack(s) and/or other hydraulic components are leaking and should be repaired.

HYDRAULIC PUMP DRIVE

The hydraulic system pumps are driven by the main air compressor motor through a gearbox. The gearbox is mounted to the compressor base.

The oil level in the gearbox should be checked weekly and oil added if required. Daily check the gearbox for oil leaks and repair as required.



Hydraulic Pump Drive

To remove and disassemble the pump drive gearbox, proceed as follows:

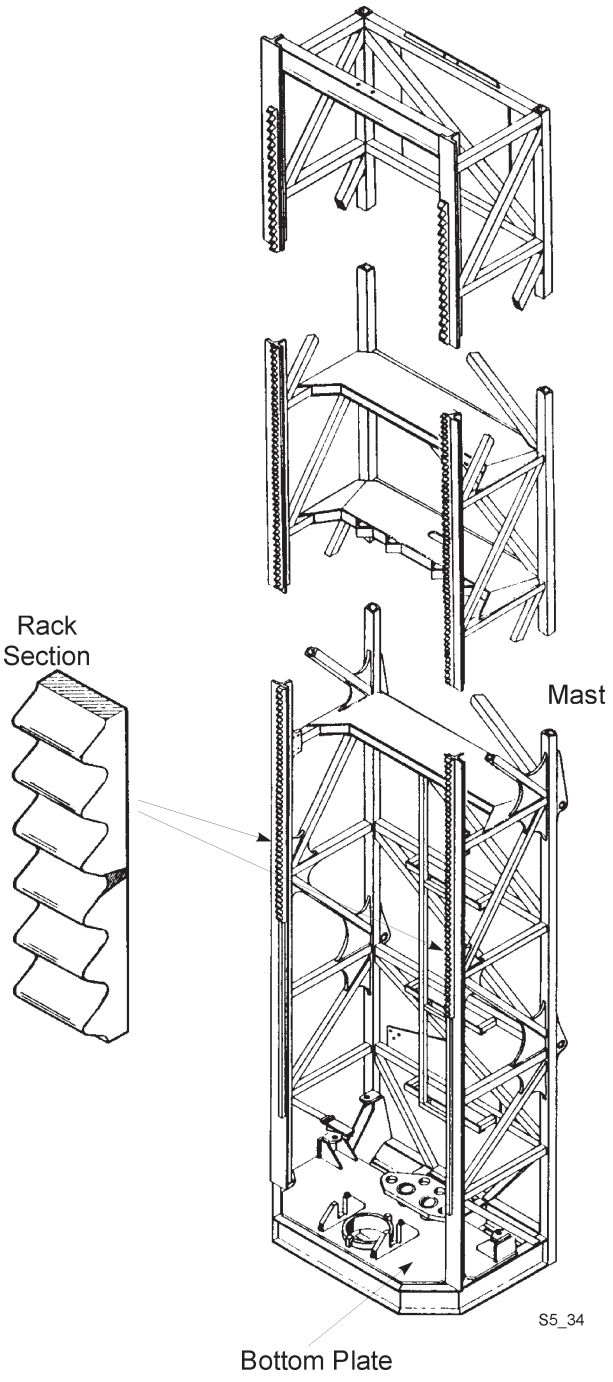
1. Place the machine in a secure area to perform the repair. Shut off and tag the controls.

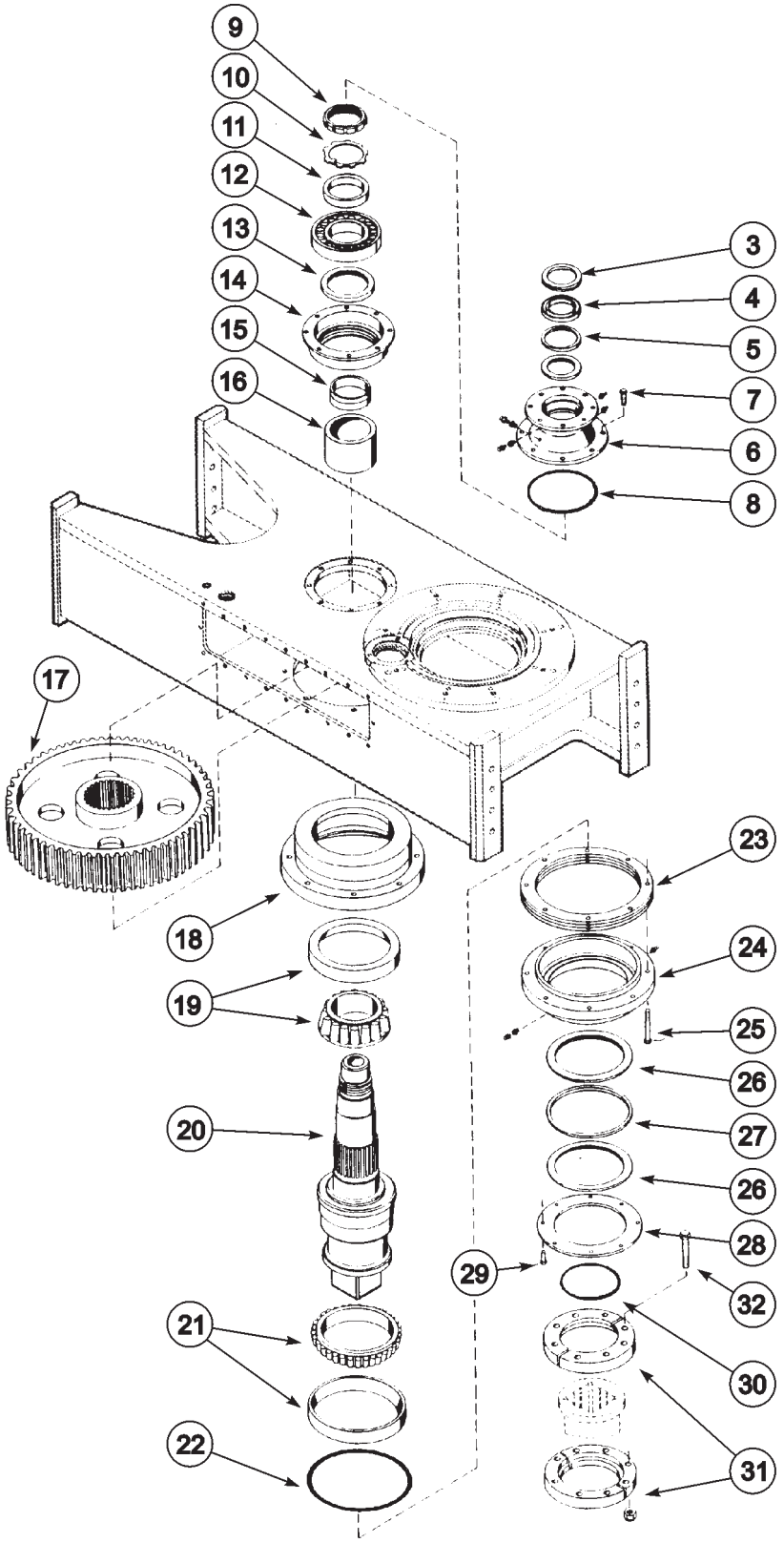
MAST STRUCTURE

The mast is a fabricated structure made of steel tubes and formed plates. The structure is formed by four vertical tubes tied together on three sides with tubular lacing. The fourth side is open to allow the rotary drive unit to be raised and lowered the length of the mast.

Inspect the structure daily for wear or damage. Inspect all mast ladders and platforms for loose hardware and structural integrity. Inspect the racking on the outside of the rear mast tubes for proper lubrication and any wear or damage. Inspect the mast hinge pins and the structure surrounding the pins for wear or damage. Verify that the hinge pin keepers are in place and tight. Inspect the mast hoist cylinder attachments for wear or damage. Lubricate the pins weekly with the appropriate lubricant. Inspect the mast lock pins for wear and damage. Verify that the lock pin hydraulic cylinders and hydraulic line are not leaking.

Every 80 operating shifts lower the mast and inspect all welds thoroughly for cracks or damage. Clean the racking on the outside of the two rear mast tubes and check the welds securing the racking to the tubes.





3. Swivel Seal
4. Seal Spacer
5. Oil Seal
6. Swivel Housing
7. Housing Bolt
8. O Ring
9. Lock Nut
10. Lock Washer
11. Bearing Spacer
12. Upper Bearing
13. Oil Seal
14. Bearing Carrier
15. Seal Sleeve
16. Gear Spacer
17. Drive Gear
18. Bearing Carrier
19. Top Lower Bearing
20. Shaft - Upper Section
21. Bottom Lower Bearing
22. O Ring
23. Shims
24. Bearing Retainer
25. Retainer Bolt
26. Oil Seal
27. Seal Spacer
28. Seal Retainer
29. Retainer Bolt
30. O Ring
31. Shaft Clamp Collar
32. Collar Bolt

Rotary Machine Driveshaft - Details

REPAIR

Repair of the rotary/pulldown guide frame is limited to replacement of worn or damaged components. Repair welding of any of the components is not recommended. Since only limited repairs to the guide frame are possible with the unit installed on the machine, it is assumed for the purposes of this manual that the entire rotary/pulldown unit will be removed from the machine prior to repairs. Replacement of the rack pinions and guide rollers is possible without removal of the entire guide frame from the machine. The repair procedures for these components are included in the following procedures.

To remove the guide frame assembly complete with the rotary gearcase and pulldown machinery form the machine, proceed as follows:

1. Lower the rotary drive unit to its lowest position and rest it on the lower mast stops. Open the auxiliary power and control breakers and tag all controls to prevent unauthorized operation.

2. Remove the upper air pipe from the swivel housing and from the guide angle. Discard the gasket. Use new gaskets at reassembly.

3. Disconnect the electrical leads to the rotary and pulldown motor and remove the cable from the drive unit.

4. Disconnect and remove the lubrication hoses leading to rotary drive unit, if so equipped.

5. Using a suitable crane and rigging, support the entire rotary/pulldown unit.

6. Remove the upper and lower front guide roller eccentric pin handle anchor bolts and turn handles to back off on the tension on the rollers to the mast.

7. Remove the capscrews that secure wear plate.

8. Remove the capscrews that secure bearing to the eccentric pins.

NOTE: To remove the retainer capscrews it may be necessary to rotate the eccentric pin to gain access to the capscrews.

9. Support the upper bogie rollers and lower front roller, then using the pin handles, pull the upper and lower front eccentric pins from the rollers, bearing housings and guide frames.

10. With the crane and rigging installed in Step 5, lift the rotary/pulldown unit from the mast and place it on secure blocking.

21. At the coupling end of the shaft remove the bearing carrier capscrews. Slide the shaft assembly from the gearcase. Remove the carrier gasket.

22. Remove spacer and bearing from the brake end of the shaft. The spacer and bearing are interference fit to the shaft and will require a slight force for removal.

23. Use a puller to remove half coupling from the end of the shaft.

24. Remove seal retainer from bearing carrier. Remove O-ring, oil seals and seal spacer from the retainer.

25. Remove bearing spacer and coupling spacer. The coupling and bearing have an interference fit to the shaft and will require a slight force for removal. Remove the carrier and bearing as an assembly, then separate them.

26. Remove seal retainer from the brake side of the gearcase. Remove gasket and oil seal from the retainer.

27. Clean and inspect all parts and repair or replace all damaged or worn parts. Reassemble in reverse of disassembly noting the following:

CAUTION: During reassembly of the pulldown gearcase certain items must be heated or cooled for assembly purpose. When heating or cooling the items take all necessary precautions and use suitable protective equipment when handling the heating or cooled items.

a. The input shaft bearings, bearing spacer and coupling half are interference fit to the shaft and will require heating to install.

b. Use thread locking compound on the brake hub retainer capscrews, the coupling end bearing oil seal retainer capscrews and the brake drive ring mounting capscrews. Torque drive ring mounting capscrews to 140-150 ft-lbs.

c. Fill the cavity between seals with lubricant at assembly.

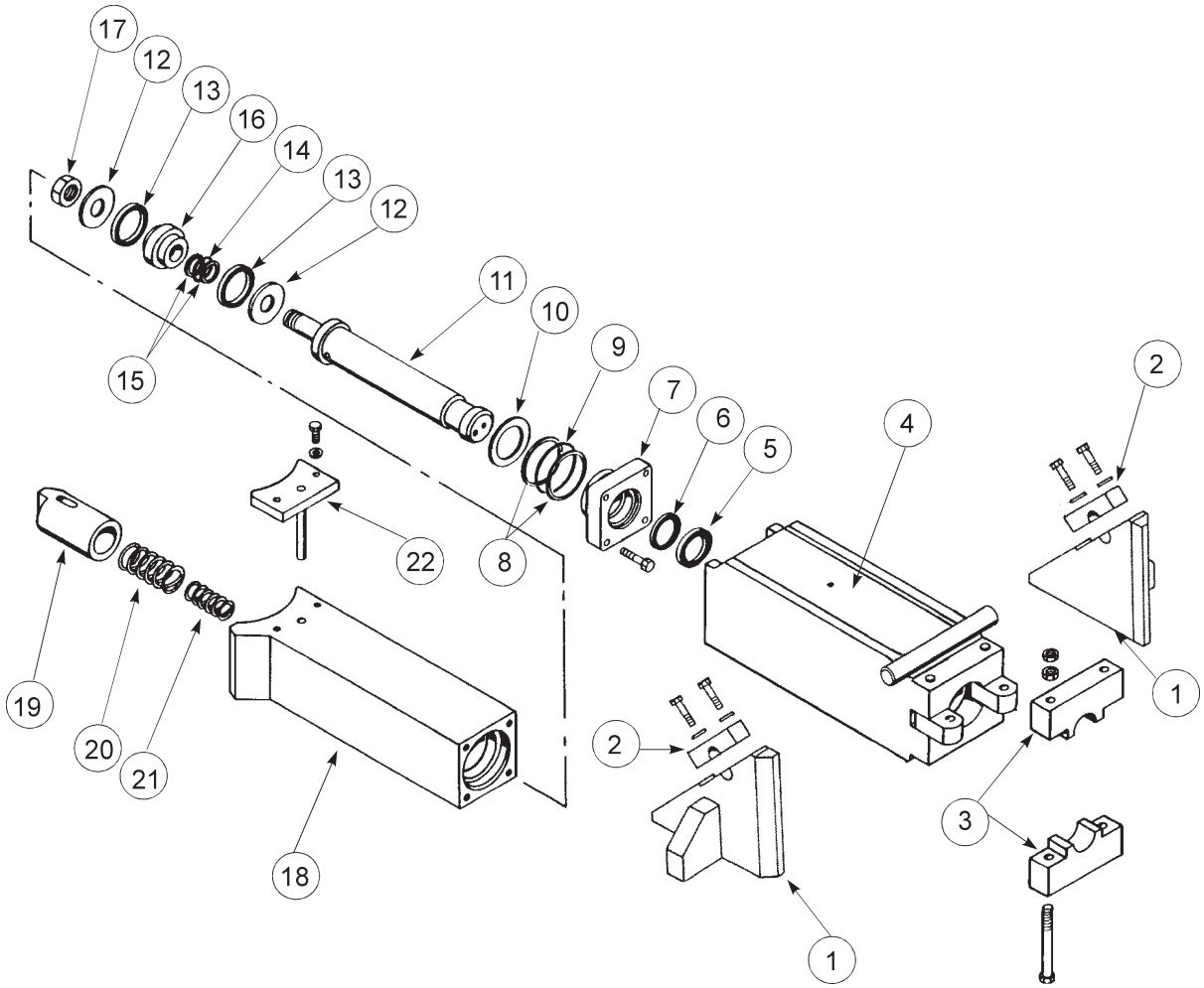
d. The second intermediate shaft bearing and gear are interference fit to the shaft and will require heating to install.

e. Use thread locking compound on the encoder end bearing retainer socket head capscrews.

f. The first intermediate shaft should be assembled as follows:

TOOL WRENCH

The tool wrenches consist of the Tool Wrench and the Breakout Wrench. They are used to clamp the drill pipe in order to break a pipe joint. The tool wrenches are two specially built hydraulic cylinders operating inside a square casing. A spring loaded pawl engages a pocket in the drill pipe to prevent rotation of the pipe.



1. Mounting Block
2. Bearing Block
3. Retaining Collar
4. Cylinder Guide
5. Oil Seal
6. U-Cup Seal
7. Cylinder Cap
8. Back-Up Ring
9. O Ring
10. Spacer
11. Piston Rod
12. Spacer
13. U-Cup Seal
14. O Ring
15. Back-Up Ring
16. Seal Housing
17. Jam Nut
18. Cylinder Body
19. Cylinder Pin
20. Uoter Spring
21 Inner Spring
22. Pad Assembly

S5_60

Tool Wrench - Details

WEEKLY MAINTENANCE CHECKS

Check for correct operation of all components of the system. Valves, cylinders, and motors and pumps should operate smoothly, with no jerking or binding. Check the oil level in the reservoir. The reservoir should be almost full (108 gal.) when the mast is horizontal and all other cylinders are retracted. With the mast vertical and all other cylinders retracted, the reservoir should be slightly below 7/8 full.

CAUTION: Before topping off the fluid in the hydraulic tank, verify that the mast cylinders are extended and all other cylinders are retracted. Failure to comply with the above (i.e. jack cylinders extended) will overfill the tank when the jack cylinders are retracted and will cause the tank to rupture.

CAUTION: Do not operate with low oil level. Operating with low oil level can cause cavitation and air pockets. This will cause faulty operation and can also cause damage to the system components.

Inspect all components and lines to be sure they are in good operating condition. Check for obstructed or distorted cylinders. Inspect the system for leaks. If a leak is found, tighten the screws or fittings around the leaking area before beginning major repairs. If that does not stop the leak, it may then be necessary to repair or replace the leaking part.

OIL RESERVOIR REPAIRS

The hydraulic oil reservoir is epoxy coated on the inside to prevent scale and oxidation.

CAUTION: DO NOT weld on the reservoir; it will damage the coating.

LEVELING JACK COUNTERBALANCE VALVE PRESSURE RELIEVING PROCEDURE

If it becomes necessary to work on the leveling jack counterbalance valve for any reason, relieve pressure in the cylinder using the following procedure:

1. Position the machine with crawlers on the ground and jacks retracted so that the jack pads are approximately one inch off the ground.

2. Turn off the hydraulic pump and relieve any pressure in the system by loosening the reservoir breather. When trapped air in the reservoir is relieved, immediately replace the breather.

5. With the pumps running, operate the right crawler control in the FORWARD direction by manually pressing coil PRV-FWD. Adjust main relief valve as required to see 4,500 PSI on gauge at test port 4.

6. Repeat step 5 but place the right crawler control in the REVERSE direction by manually pressing coil PRV-REV. Adjust pressure as required to see 4,500 PSI at test port 3.

7. Reconnect the propel brake release hoses disconnected in step 1.

8. De-energize propel active valve (PAV).

CRAWLER FUNCTION CHECK

NOTE: Check that the crawler boxes have each been filled with 7.5 gallons of 80W-90W oil.

1. With propel selector in SLOW SPEED, check the left crawler function in FORWARD and REVERSE. Record time for 3 revolutions of crawler sprocket:

   60 Hz should be 3 revolutions in 56 seconds.

   50 Hz should be 3 revolutions in 75 seconds.

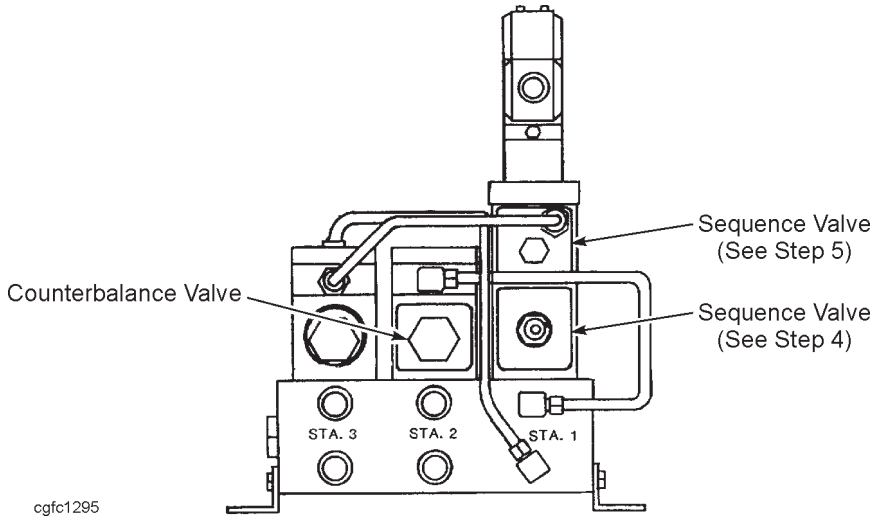
2. Repeat step 1 with propel selector in NORMAL SPEED. Record time for 10 revolutions of crawler sprocket:

   60 Hz should be 10 revolutions in 67 seconds.

   50 Hz should be 10 revolutions in 80 seconds.

3. Repeat step 1 for right crawler.

4. Repeat step 2 for right crawler.



6. Repeat operation of the center guide to ensure sequencing operation is correct and repeatable. Readjust sequence valves in step 4 or 5 as required.

AUTOMATIC BREAKOUT WRENCH CHECK

1. Attach a 0- 3000 PSI gauge to test port 55 on two station valve located on the side of the mast.

2. Retract the breakout wrench fully.

3. Verify 3000 PSI is at test port 55.

Activate the automatic breakout wrench switch to EXTEND and then RETRACT to check proper function.

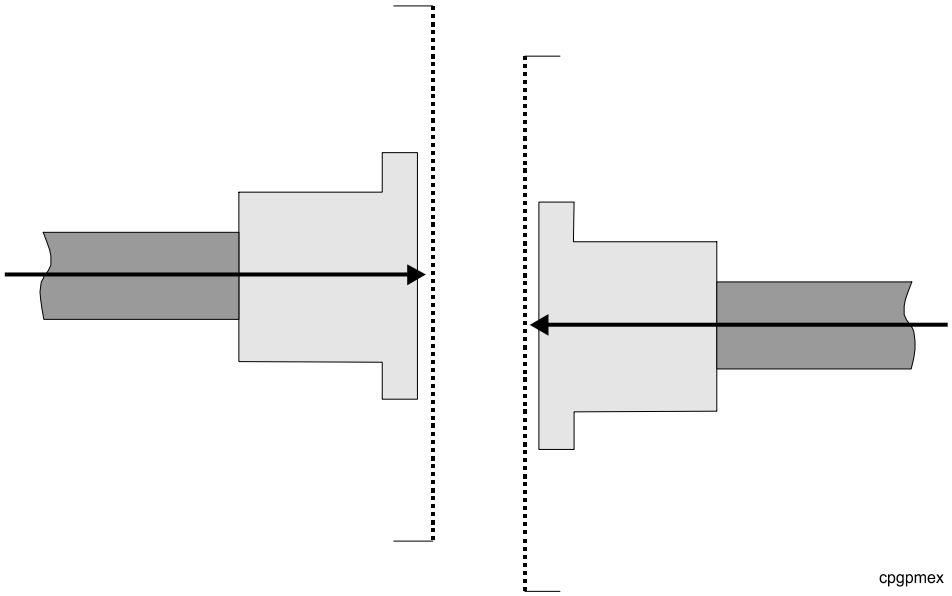
Refer to OEM documentation for sequence valve setup.

DUST CONTROL

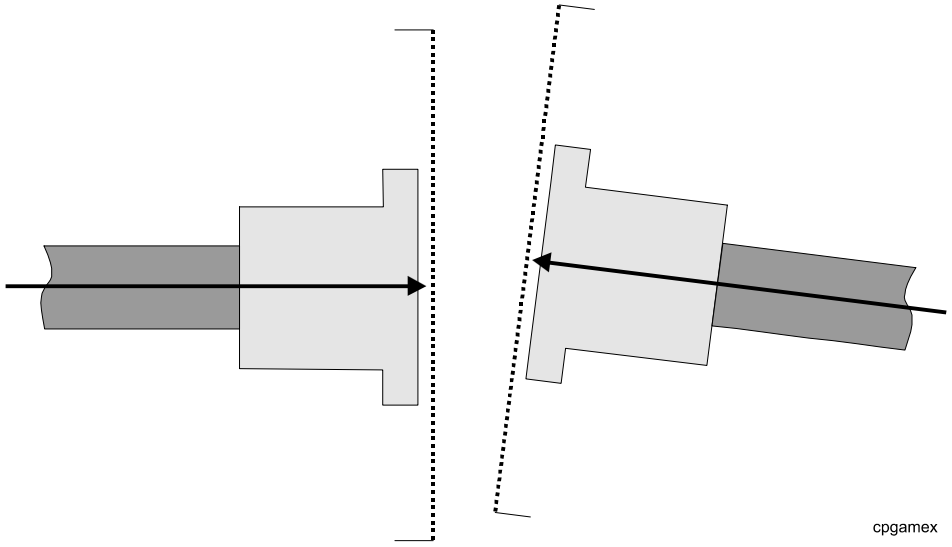
GENERAL MAINTENANCE

The dust control system on this drill consists of 1) the drilling platform and 2) dust curtains which trap the cuttings and dust in an area under the machine. Two methods of controlling the trapped dust are available: water injection which dampens the dust before it leaves the drilling hole, and a dry-type system which draws the dust laden air through filter elements which separates the dust from the air.

MISALIGNMENT EXAMPLES



Parallel Misalignment Example



Angular Misalignment Example

3. With all bolts pulled away, use the installed hydraulic jack at the lower, left hand side of the separator tank to raise the separator cover enough to clear the filter cartridges.

NOTE: Be sure that the cover seal is not damaged during cover seal removal.

4. Once lifted, rotate the cover out of the way.

5. Remove the hex nuts and the filter retainer which covers one of the filter cartridges.

6. Pull the filter cartridge out of the separator tank. Repeat for the remaining 3 cartridges.

Inspect all parts. Repair or replace as required. *Reassembly is the opposite of disassembly. Note the following:*

SEPARATOR COVER HARDWARE TIGHTENING PROCEDURE

Refer to the label on the left side of the separator tank. If the label is not readable, use the following tightening sequence.

Tighten all bolts hand-tight to begin. Then tighten all bolts in order. Start at any bolt and continue in a diametrically opposed (star) pattern. Tighten the bolts incrementally 3 times as follows:

1. Tighten ALL bolts to 30 Ft. Lbs.
2. Tighten ALL bolts to 60 Ft.Lbs.
3. Tighten ALL bolts to 100 Ft.Lbs.

Section **8**

Heating, Ventilation and Air Conditioning

Always refer to the safety information in Section 1 of this manual before starting any maintenance procedure on this machine.

Table of Contents

TURN-OF-NUT METHOD

CAUTION: THIS TIGHTENING PROCEDURE IS ONLY APPLICABLE FOR BOLT GRADES 5 AND 8 WITH UNC THREADS. For bolts with other than UNC threads, contact the Caterpillar Global Mining Service Department.

NOTE: When using this procedure the bolt threads and the surfaces under the bolt head and nut must be lubricated. This procedure is applicable only if the joint and under head surfaces for bolt and nut are machined for parallelism.

1. The bolts should be brought to a “snug tight” condition to insure that the parts of the joint have good contact with each other. “Snug Tight” is defined as the tightness attained by torquing a bolt to the value specified in the table on the following page. Snug tightening should progress systematically from the most rigid part of the joint to its free edges while alternating from bolt to bolt to assure gradual even pull up of the mating parts. After all bolts have been snugged, the first bolts tightened at the most rigid part of the joint should be rechecked for proper torque retention. If these bolts are loose due to pull up of the joint, the snug tightening sequence should be repeated for all bolts in the connection. This rechecking and re-torquing procedure should be repeated as many times as is required until the joint is completely pulled up and all bolts are at the specified “snug tight” torque. Tightness of the mating surfaces of the joint should then be verified by using feeler gauges.

“Snug Tight” Torque Values			
Bolt Diameter		Torque Values (1)	
Inches	Cm.	Ft. Lbs.	Nm.
.500	1.27	15	20
.625	1.58	30	40
.750	1.90	53	71
.875	2.22	86	116
1.000	2.54	128	173
1.250	3.17	224	303
1.500	3.81	390	523
1.750	4.44	457	619
2.000	5.08	688	932
2.250	5.71	1005	1362
2.500	6.35	1375	1864
2.750	6.98	1864	2527
3.000	7.62	2462	3337

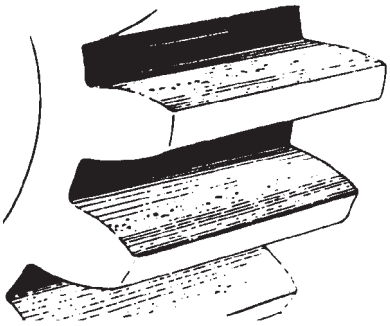
Part No.	Nut Rotation	Bolt Length(2)
747773-01	1/3 Turn of ±10%	Up to and including 4 diameters
747773-02	1/2 Turn of ±10%	Over 4 diameters but not exceeding 8 diameters
747773-03	2/3 Turn ±10%	Over 8 diameters but not exceeding 12 diameters.

(1) Tighten to values listed ± 10%. The torque values listed are calculated for 20% x proof load with lubricated threads and under the head surfaces of the bolt and nut.

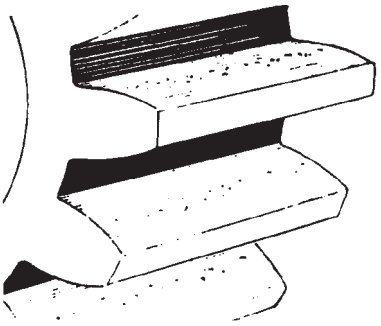
(2) In case part number or nut rotation designation is not given, the nut rotation can be determined by the bolt length (Grip length +1/2 bolt diameter.). For bolt lengths exceeding 12 diameters contact the Bucyrus International, Inc. Engineering Department tbl-bt34

Table of Snug Tight Torque Values

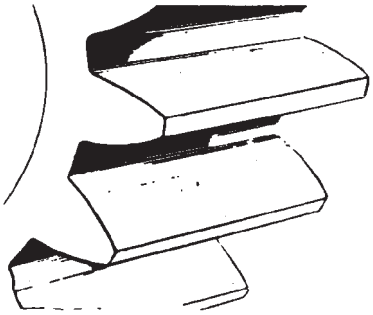
2. The nuts and bolts should then be matched marked by center punching the bolt end and nut. On rod bolts match mark both rod ends and nuts. The bolts and nuts should then be tightened additionally by the applicable amount of nut rotation as specified in Table 4. It is not necessary to follow any particular bolt to bolt sequence during this portion of the “turn of the nut” tightening.



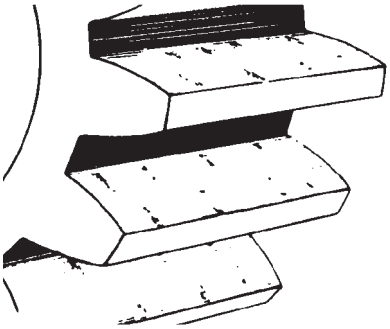
Incipient Pitting. Repeated stresses on the high or hard spots of gear teeth cause local fatigue failure of the metal. Small pieces or particales of metal break out at slightly below the pitch line, leaving small craters or pits. After the high spots have broken out, further pitting may cease and normal wear may eventually polish out the pits.



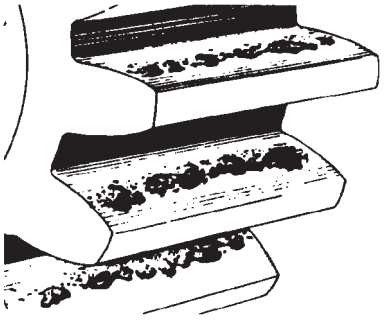
Destructive Pitting. Rough surfaces may have many high spots and may pit so badly that too much of the load-carrying surface is rendered ineffective. When this occurs, the increased loading of the remaining surface causes further pitting until the working areas are destroyed.



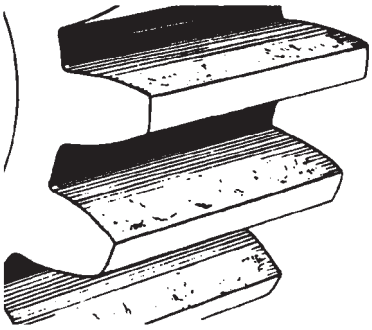
Abrasion. When foreign material of an abrasive nature enters between the meshing teeth, the resulting lapping or grinding action may either polish the surfaces or scratch them. In either case, this is abnormal wear.



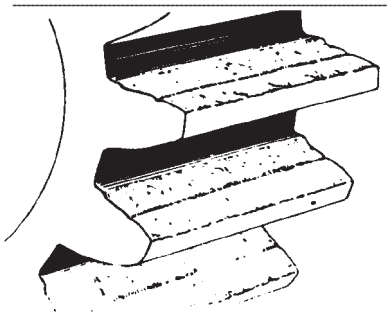
Scratching. When sharp projections on the surfaces of gear teeth pierce the oil film, they gouge or score the surface of the teeth. Rough finish, pitting surfaces, or misalignment may be the cause.



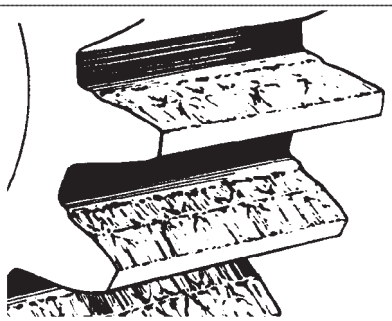
Spalling. Abnormal loading of tooth surface may overstress the subsurface metal until large chips or flakes break away from the teeth.



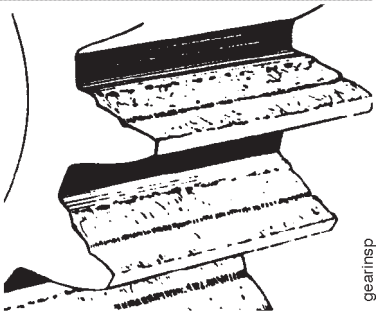
DRIVING PINION. Mild Galling. When full fluid films fail, the first signs of wear occur above the pitch lines of the teeth. The teeth then usually show evidence of a yielding and sliding of the surface and subsurface metal. This yielding then progresses toward the tips of the driving teeth and below the pitch line of the driven teeth.



DRIVING PINION. Advanced Galling. Consistent failure of the lubricating film may cause not only localized yielding and displacement of the metal, but also a pressure-welding or seizure between the engaged surfaces when such welding occurs, chips and scales of metal tear from the teeth, and the working surfaces become roughened. Scoring, abrasion and excessive wear follow.



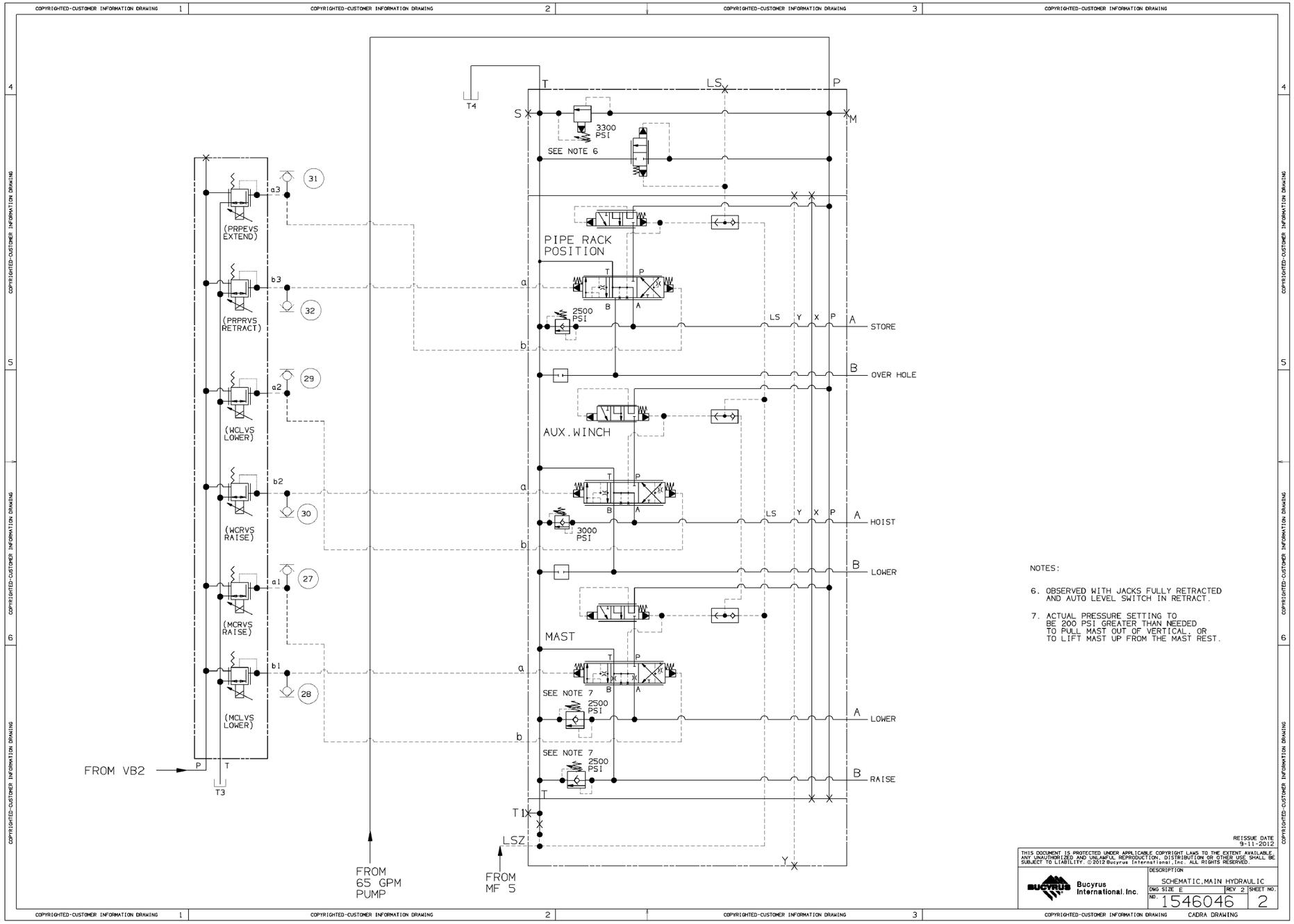
DRIVING PINION. Severe Galling. On a driving gear (pinion) the direction of the slide is always away from the pitch line. Thus where simple galling occurs, the plastic flow of metal tends eventually to create a hollow or groove across the face of each driving tooth and a ridge along the top tooth edge and near the tooth root.



DRIVEN GEAR. Severe Galling. The direction of slide on the teeth of a driven gear is always toward the pitch line. Thus, where simple galling occurs, the movement of metal is always toward the pitch line. Eventually this plastic flow of metal creates a hump or ridge across each tooth.

gearinsp

Gear Tooth Surface Failures



NOTES:

6. OBSERVED WITH JACKS FULLY RETRACTED AND AUTO LEVEL SWITCH IN RETRACT.

7. ACTUAL PRESSURE SETTING TO BE 200 PSI GREATER THAN NEEDED TO PULL MAST OUT OF VERTICAL, OR TO LIFT MAST UP FROM THE MAST REST.

REISSUE DATE
9-11-2012

Bucyrus International, Inc.

DESCRIPTION: SCHEMATIC,MAIN HYDRAULIC
DWG SIZE E | REV 2 | SHEET NO. 2
NO. 1546046

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