BI012515
MARCH 2013

Operation and Maintenance Manual

MD6750 Blast Hole Drill

Serial Number DR711136 / 2Z71A16

Section 1
Introduction

GENERAL INFORMATION

This manual is designed to assist the owner in the operation 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.

Safe operation of the machine minimizes production delays and costly damage to equipment. Carefully study and follow all recommended procedures in this manual. Safety guidelines are intended to prevent accidents from occurring and are provided in the interest of all mine personnel. Overall safety depends upon the use of good judgment and the alertness of the entire mining crew.

Throughout this manual, the use of the terms "*LEFT*, *RIGHT*, *FRONT*, and *REAR*" refer to machine locations as viewed by the operator sitting in the operator's seat in the cab.

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 for this purpose.

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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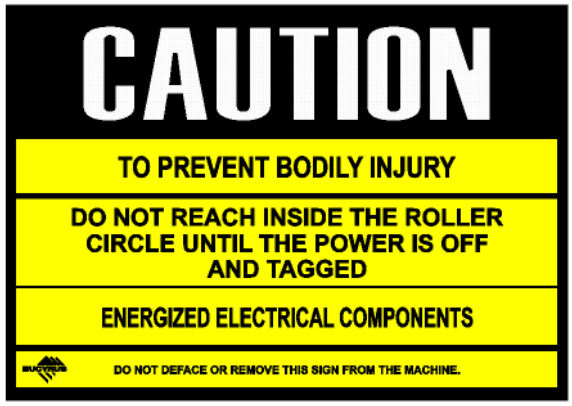

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Stored Energy Signs

	Qty.	*Weight Ea. (Lbs.)*
Box, Pipe Handling	1	145
Box, Bit Handling	1	60
Extender, Drill Pipe	1	1,700
Cylinder, Tool Wrench	2	470
Dust Curtain	18	10
Dust Seal	1	20
Cone, Chip Deflector	1	110
Stairway, Boarding	1	270
Cable Reel Assembly	1	6,600
Reducer, Right Angle	1	50
Arm, Upper Support	2	50
Collector Rings, Cable Reel	1	185
Machinery House		
Wall, Machinery House R.H.	1	3,000
Wall, Machinery House Front	1	1,000
Extension, Left	1	10,000
Cove, Hydraulic	1	1,800
Panel, Center Roof	1	710
Panel, Rear Roof	1	670
Wall, Machinery House Left	1	1,700
Door, Service, Machy House, 30”	2	170
Door, Service, Machy House, 34”	2	300
Door & Frame Assy, L.H.	1	250
Door, LH Extension (large)	2	285
Door, LH Extension (small)	1	145
Hatch, Pressurization Unit Roof	1	375
Enclosure, Dynavane Bleed Fan	1	275
Duct, Pressurization Unit Transition	1	280
Duct, Upper Bleed Fan Discharge	1	90
Duct, Lower Bleed Fan Discharge	1	100
Shroud, Pressurization Unit Rain	1	120
Filter, Air/Bleed Air Duct	1	1,000
Fan, Vane Axial	1	825
Blower & Motor	1	230
Operator Cab Structure	1	5,000
Hatch, Bit View	1	180

HOIST/PULLDOWN RHEOSTAT

The hoist/pulldown rheostat (1) controls the speed and direction of the hoist-pulldown motor for hoisting or lowering the rotary drive unit.

Turning the rheostat in the hoist direction from the “0” position will raise the rotary drive unit. Maximum speed is available at full clockwise position.

Turning the rheostat in the pulldown direction from the “0” position will lower the rotary drive unit. Maximum speed is available at full counterclockwise position.

NOTE: The rheostat utilizes a reference scale and pointer. When the rheostat is turned, the pointer indicates, on the reference scale, the relative percentage of full speed being set.

ROTARY RHEOSTAT

The rotary rheostat (2) controls the speed and direction of the rotary motor which in turn drives the machinery to rotate the tool string.

Turning the rheostat clockwise from the “0” position will turn the tool string in a clockwise direction. Maximum rotary speed is achieved at full clockwise position.

Turning the rheostat counterclockwise from the “0” position will turn the tool string in the reverse direction. Maximum rotary speed is achieved at full counterclockwise position.

NOTE: The rheostat utilizes a reference scale and pointer. When the rheostat is turned, the pointer indicates, on the reference scale, the relative percentage of full speed being set.

DRILL/PROPEL CONTROLS ON AND OFF PUSHBUTTON

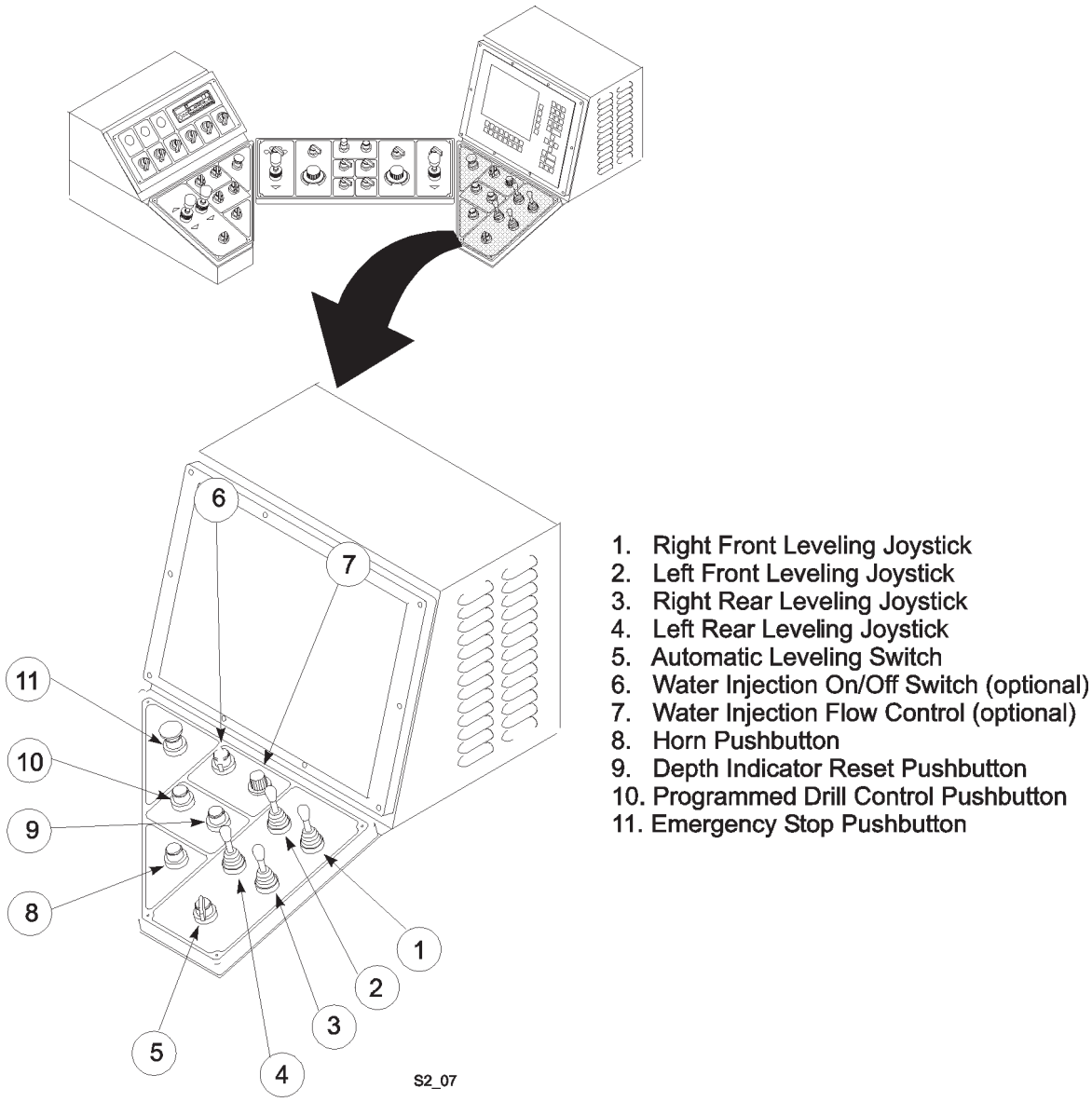
The drill/propel controls on (3) and off (4) push-buttons are used to energize or de-energize the control levers and switches of the machine.

When the operating mode selector switch is in the DRILL position, depressing the ON pushbutton will energize the hoist/pulldown and rotary drives if all appropriate circuit breakers are closed; no drive or power system faults exist, and master switches are in NEUTRAL.

When the operating mode selector switch is in the PROPEL position, depressing the ON pushbutton will enable the propel controls if all appropriate circuit breakers are closed, compressor motor is operating normally, and no power system faults exist.

When the operating mode selector switch is in the REMOTE position the ON and OFF push-buttons are not functional.

LEVELING CONTROL PANEL



1. Right Front Leveling Joystick
2. Left Front Leveling Joystick
3. Right Rear Leveling Joystick
4. Left Rear Leveling Joystick
5. Automatic Leveling Switch
6. Water Injection On/Off Switch (optional)
7. Water Injection Flow Control (optional)
8. Horn Pushbutton
9. Depth Indicator Reset Pushbutton
10. Programmed Drill Control Pushbutton
11. Emergency Stop Pushbutton

Leveling Control Panel

The leveling portion of the panel consists of four two-directional joysticks, one for each leveling jack cylinder and an automatic leveling switch.

MACHINE START-UP

Start-up of this machine is a very important operation. Improper start-up could cause various safety and operating difficulties as well as damage to the machine. Following the step-by-step procedure listed below to start the machine will help reduce the possibility of accidental injury or machine damage.

NOTE: The machine is to be started only after the prestart inspection and lubrication as detailed earlier in this section, have been completed.

1. Go into the operator's cab and verify that all controls on the operator's console are in the off or neutral position. Be sure that the EMERGENCY STOP pushbutton is in the pulled-up position.

NOTE: On some machines there are two or more Emergency Stop push-buttons. Be sure ALL Emergency Stop push-buttons are in the RELEASED (UP) position.

2. Go to the machinery house to the low voltage start cabinet. Turn ON the main compressor breaker.

3. On the low voltage cabinet turn all the breakers to the ON position.

4. On the programmable controller cabinet verify that the lockout control pushbutton is in the RELEASED position. Turn the house pressurization fan switch to the desired operating position. Verify that the operator's display terminal power supply, PLC input and PLC output breakers are in the ON position,

5. Press the air compressor start pushbutton on the programmable controller cabinet to start the main compressor.

NOTE: If the ambient temperature is below 32°F (0°C), the machine will normally use special fluids in the hydraulic system and/or heaters for the system.

When the machine is shutdown, temporarily or for an extended time, power should be left on the machine to maintain heater operation. If power is removed at shutdown, the machine fluids should be warmed to at least 32°F (0°C) before attempting to start the machine.

MACHINE OPERATION

Operation of the machine is, in principle, the same as the operation of any other machine. But just because the machines operate using the same in principles does not mean they operate the same in all respects. For this reason it is important that the operator become 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.

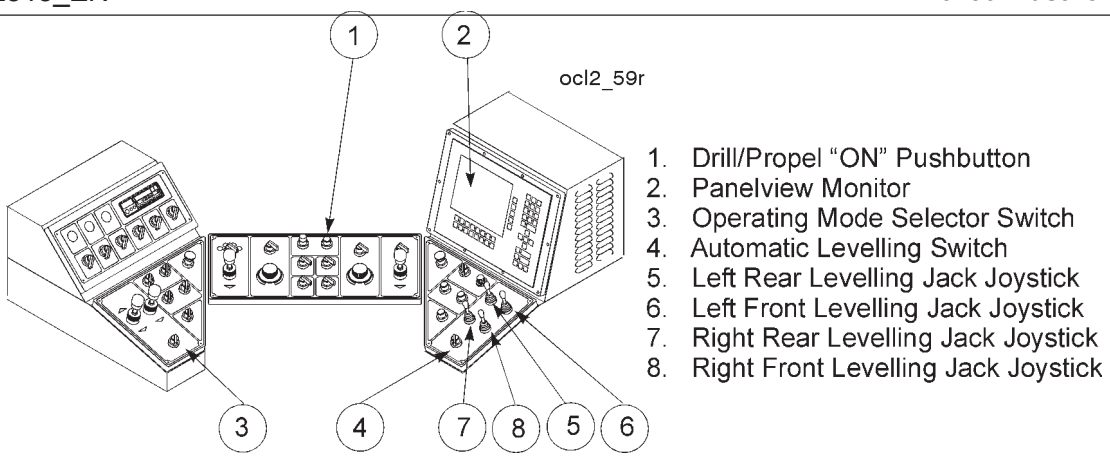
For the purpose of this manual, we will assume that the drill has been left in the proper condition for operating. If this is not the case, complete the prestart checks and start the machine using the procedures as outlined.

PROPELLING

"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.



Controls for Leveling the Machine

MAST RAISING AND LOWERING

The mast 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.

MAST RAISING

CAUTION: Raising or lowering the mast is a two-person job. Do not attempt to raise or lower the mast without the assistance of a helper familiar with the procedures involved.

CAUTION: During the mast raising procedure personnel should be kept clear of the machine and the area immediately surrounding the machine, especially the front of the machine. No one is to be allowed on the mast, operator’s cab roof, or machinery house roof while the mast is in the air. Failure to heed this caution may result in the death or serious injury of personnel struck by the mast should it fall for some reason.

TOOL HANDLING

This section describes the procedures necessary to load, unload, handle, assemble and disassemble the drill tools.

The procedures detailed in this section are intended to be as universally applicable as possible. It is, however, impossible to prepare a procedure that will take into account every possible machine option or tool vendors' products. For this reason it is important that the operator not only become familiar with these procedures, but with the machine and the particular tools being handled.

PIPE LOADING AND UNLOADING

Loading pipe onto the drill is necessary when the drill is new and has not yet had the pipe installed or when the pipe has been removed for change out or for maintenance to the mast. The procedure in this manual, unlike some more commonly used procedures, requires that the mast be in the horizontal or lowered position to load the drill pipe. This is necessary for safety.

This procedure, while not the most expedient for machines requiring pipe change out while the mast is in the drilling position, is quite efficient while the mast is in the stored position. Proper scheduling of maintenance and production requirements against pipe life will allow using this procedure while reducing the downtime of the machine.

CAUTION: Limitations exist as to the length, diameter, wall thickness and number of drill pipes that may be stored in the tool racks when raising or lowering the mast. Refer to the pipe size limitation chart in the appendix of this manual before loading pipe onto the machine with the mast down and before raising or lowering the mast. Failure to comply with these limitations will overload the mast, mast support and hydraulic system possibly causing loss of control of the mast. Refer to the appendix of this manual for an alternate method of loading and unloading pipe from the machine in order to comply with the mast raising and lowering limitations.

To load drill pipe onto the drill, proceed as follows:

1. If the mast is in the vertical or drilling position, lower the mast and store it in the mast rests. Refer to the appropriate topic in this manual for the exact operating procedures.

2. Obtain a crane with suitable capacity and reach to place the drill pipe into the pipe racks with the mast in the stored position. Normal placement of the crane is on the left side of the drill since this allows the shortest reach and greatest boom angle.

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.

4. After selecting the pipe rack to be used by turning the pipe rack selector switch to #l or #4, swing the pipe rack over the hole. Then return the joystick to the NEUTRAL position.

5. Slowly lower the rotary/pulldown unit and place the lower end of the pipe into the pipe rack pocket. Make sure that the pipe is seated firmly on the bottom of the pocket.

6. Quickly turn the rotary rheostat to the left (counterclockwise) to approximately one-half of full speed. The joint should break at the rotary coupling.

NOTE: If the joint does not break immediately, return the rotary rheostat to the zero position to reduce the chance of damaging the motor by stalling it.

7. If the joint does not break, it will be necessary to index the slots on the drill pipe so as to allow the rotary drive unit to build up speed before stopping the drill pipe. This is done by rotating the drill pipe in the forward direction until the slots in the pipe are almost aligned with the pawls in the sockets. This allows the drill pipe to rotate almost one-half turn before being stopped by the pawls.

After indexing the pipe to allow the one-half turn rotation, repeat step 6 above to break the joint. Repeat this procedure as many times as is necessary to break the joint.

8. When the joint breaks, gently raise the rotary/pulldown unit as the joint is unscrewing.

9. When the joint completely unscrews, the pipe will drop to the bottom of the pipe rack pocket. The upper gate will automatically close around the drill pipe. When the joint is completely unscrewed, raise the rotary/pulldown unit until it is in a position so as not to be struck by the pipe rack when it is moved. Set the hoist brake.

10. Swing the pipe rack into the stored position.

To remove the stabilizer, proceed as follows;

1. With the stabilizer still clamped in the tool wrenches, attach a lifting bell to the upper end of the stabilizer. Attach the auxiliary winch line to the lifting bell and lift the stabilizer and guide bushing from the hole in the drill deck. Block the assembly in a horizontal position.

2. Remove the auxiliary winch line from the stabilizer. Remove the guide bushing from the stabilizer and replace the auxiliary winch line.

3. Using the auxiliary winch line, remove the stabilizer from the drill. Replace the guide bushing in the hole in the deck.

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.

ENDING THE HOLE (MULTIPLE PIPE SECTIONS)

Reaming the hole with multi-section tool strings is the same as reaming with single pipe section strings. The reaming procedure must be done in stages as the pipe sections are removed.

While removing the drill pipe the cuttings dislodged from the sides of the hole and the cuttings generated by reaming will fall to the bottom of the hole. To effectively clean the hole, it would be necessary to reassemble the tool string and lower it to the bottom of the hole. This is not desirable as it is time consuming. One method to eliminate the need to clean the hole is to overdrill the depth and allow cuttings to fill the hole to the desired finishing depth. Experience in this area will show how much to overdrill the hole. A good practice is to overdrill the hole by 1 to 2 feet (0.3 to 0.6 m) over the estimated finished hole depth. This way, if the estimate is wrong, the hole will be 1 to 2 feet (0.3 to 0.6 m) too deep. This can easily be corrected by a few shovels full of cutting thrown into the hole. Underestimating, on the other hand will require that the tool string be reassembled and the hole cleaned.

DRILLING DIFFICULT FORMATIONS

For the purpose of explanation, the drilling procedure given in the Drilling section of the manual assumes that drilling takes place in consistent, consolidated rock formation. Unfortunately, not all drilling is in this type of formation. This section of the Operator's Manual will detail, in general, some typical drilling difficulties encountered.

The main cause of difficult drilling are unconsolidated material or wet sticky material. Unconsolidated material causes vibration far greater than experienced in consolidated formation, and if severe enough, may also decrease the bailing velocity of the main air stream. Wet, sticky material causes problems with cleaning the hole since the material may coat the hole and the drill pipe, increasing the air pressure above the working range. Wet material may also plug the bit orifices, freeze the bit cones, or compact into balls that refuse to be bailed out of the hole. The general procedure for drilling in difficult formations is the same as the procedure for drilling in good formations. The hole is collared, drilled, reamed, and cleaned using the standard operating procedures. Monitoring of the machine is, however, critical while drilling in difficult formations.

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.

Section 3

Lubrication

LUBRICATION PRINCIPLES

The proper lubrication of this machine is vital to its successful, continued operation. Application of the CORRECT lubricant in the CORRECT amount at the CORRECT place as part of a PROVEN maintenance program is required to keep the machine operating at a level of productivity. Proper lubrication will provide better component service life with a reduction of repairs and downtime. When not properly lubricated, moving parts wear quicker and fail sooner.

The primary wear items of this machine are lubricated by an automatic system that dispenses lube to selected points at pre-selected, timed intervals during machine operation. This system is covered in more detail further on in this section. It is important to the operation of this automatic lube system that you become familiar with it and understand its operation in order to properly maintain and service it, thus keeping it operable. It is also necessary that you inspect on a regular basis the points for automatic lubricant application to insure the system is performing its job adequately.

Some components, due to their location and function, can not be readily covered by the automatic lube system. You should become familiar with these points so you can service them properly at the intervals listed. A listing of the parts covered by the automatic lubrication system is included later in this section. The standard lubrication fittings used for manual service are the hydraulic type, push-on fittings having 1/8 inch or 1/4 inch NPT threads.

Bushings and bearings operating in a highly contaminated atmosphere (dust, grit, etc.) should be lubricated until clean grease seeps out around the journal or seal, or comes out the purge fitting, if one is provided.

Overfilling an anti-friction bearing can cause it to run excessively warm. After lubricating anti-friction bearings (those that are sealed such as in electric motors must use electric motor grease) remove the pressure fitting, or the relief plug when provided, allowing the bearing to purge itself of any excess lube during the first 10-15 minutes of operation. Replace the fitting or plug after that time. Grease in a bearing generally deteriorates gradually, not suddenly. Only a small amount needs to be added to it at regular intervals to maintain the proper lubricant level. Adding a small quantity of grease to the bearing every 600 operating hours, unless otherwise specified, is adequate.

Open gears and pinions require a constant coating of high grade lubricant which is specified for operation. Inspect all open gear sets at least once daily (every 24 hours) to ensure they are coated with OGL.

CAUTION: Contact with or ingestion of petroleum products can be harmful. Automatic lubrication systems operate under pressure. Before opening any lube supply line, relieve the system and that line in particular, of any residual pressure.

PUMP DISASSEMBLY PROCEDURE

1. Remove and separate manifold (37) from the hydraulic motor (42).

2. Remove the pipe plug (45) and drain the crank case oil from the pump housing (46).

3. Remove the housing cover (30) and cover gasket (31).

4. Remove the retaining ring (57) and pull the shovel plug (56) from the housing tube (55).

5. Remove and separate the hydraulic motor (42) from the pump housing (46).

6. Remove the 2 outlet pin nuts (50) from the pump housing (46).

7. Remove the pump sub-assembly (1-28) from the pump housing (46). Pushing the sub-assembly up with a wooden or plastic rod .75 inch O.D. against the check seat housing (28) is helpful.

8. Remove the housing tube (55) from the pump housing (46) by inserting a .75 inch O.D. rod through the inlet holes at the bottom of the housing tube (55) and unscrewing it.

9. Remove the bronze bearing (51), o-ring (52) and back-up washer (53) from the housing tube (55).

10. Remove the crankrod assembly (1-8) from the pump by unscrewing the screws (12) and then pulling out the wrist pin bushings (13).

11. Remove the check seat housing (28) from the reciprocating tube (21).

12. Unscrew the wrist pin anchor (14) from the reciprocating tube (21) and pull the plunger assembly (9-20) from the tube.

13. Using a .50 inch O.D. rod, push the cup seal (22) and pump cylinder (24) from the reciprocating tube (21).

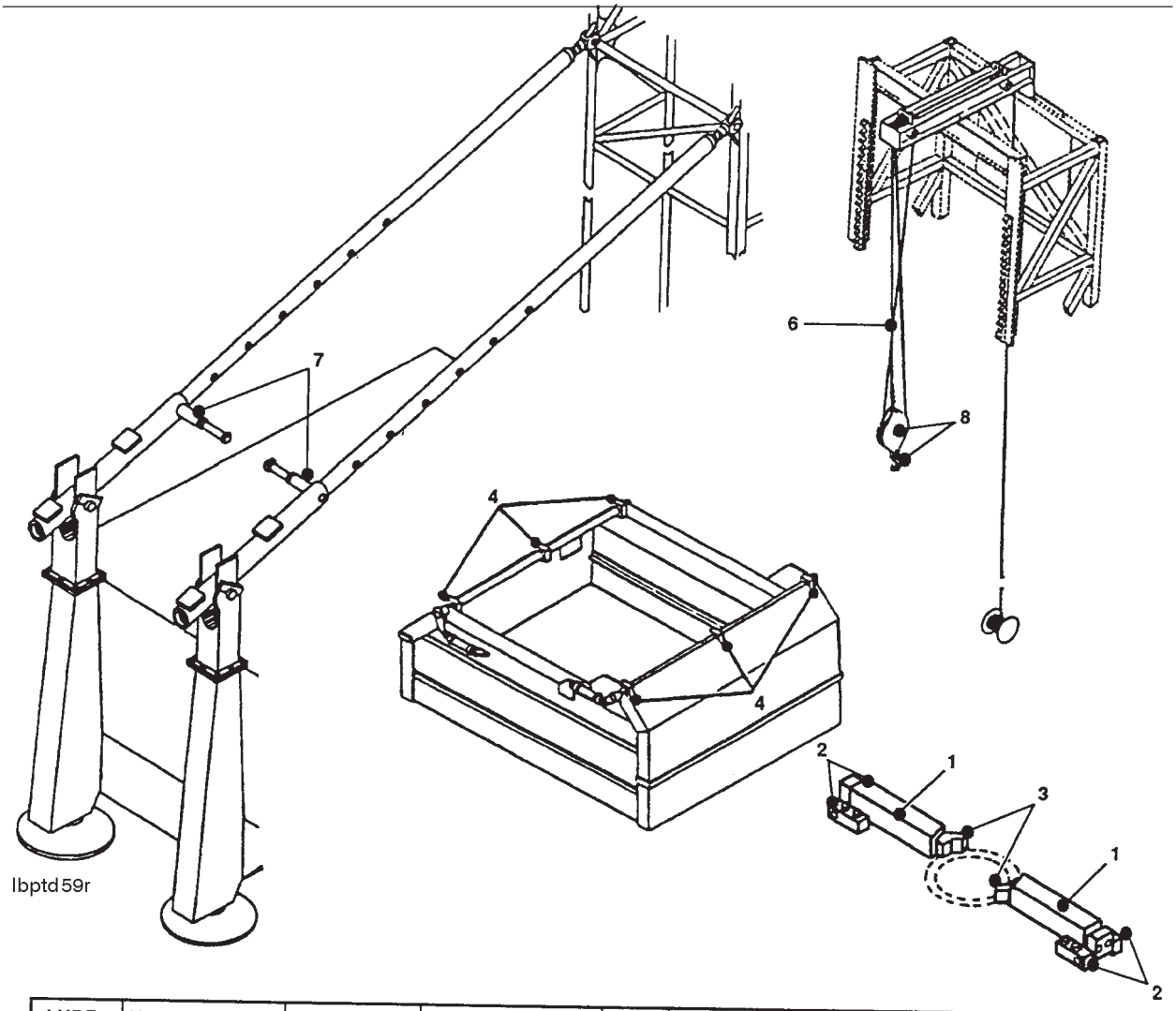
14 Remove the pump plunger (20) from the plunger link rod (17). A spanner wrench is required.

15. Unscrew the plunger link rod (17) from the plunger tube (11) and slide off the cup seal (16), back-up washer (15) and the wrist pin anchor (14).

16 Unscrew the plunger tube (11) from the outlet pin (9).

17. To dismantle the crankrod assembly (1-8), remove the screws (1) and counter weights (2).

18. Remove the retaining rings (6) and press the crank eccentric (7) out of the ball bearing (8). Be sure to support the ball bearing (8) on the inner race.



LUBE POINT	NO. OF POINTS LUBRICATED	TYPE LUBRICANT	HOURS 8	40	160	1000	AS REQ.	AUTOMATED	COMPONENTS
1	2	MPG	X					X	TOOL WRENCH CYLINDER GUIDES
2	4	MPG	X					X	TOOL WRENCH BEARING BLOCKS
3	2	MPG	X						TOOL WRENCH CYLINDER PINS
4	6	MPG			X				DUST CURTAIN LEVER BUSHINGS
6	1	RWRL					X		AUXILIARY WINCH ROPE
7	2	MPG				X			MAST BRACE LOCK PINS
8	2	MPG					X		HOOK BLOCK (OPTIONAL)

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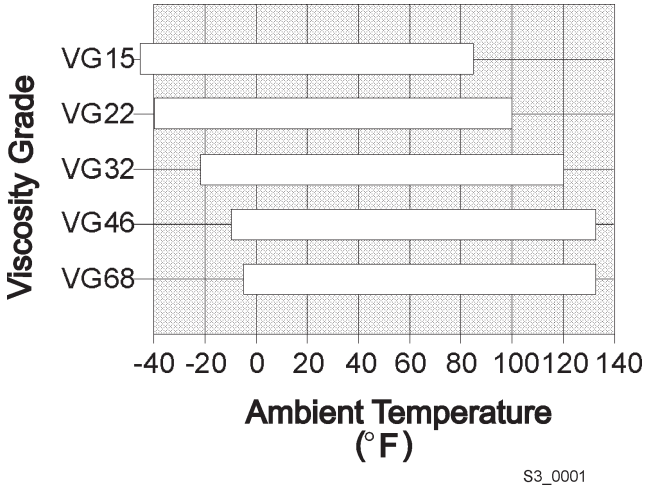
NOTE: The above frequencies are for manual lubrication. When the machine is equipped with automatic lube systems, the frequencies are set at the lube control station. At initial start-up of a new machine with an automatic lube system, the injectors should be set at full opening then readjusted as required.

Lubrication - Mast, View 1

PAO SYNTHETIC HYDRAULIC FLUID

The following bar graph shows recommended viscosity grades for SHC hydraulic oil for various ambient temperatures. For temperatures outside of these ranges, contact the Caterpillar Global Mining Department for recommended oil.



Recommended Viscosity vs. OAT Chart

PARAFFINIC BASE PETROLEUM HYDRAULIC FLUID

Approved oils will typically have Denison HF-O specification certification. In general, the oils will meet the following minimum requirements:

1. Maximum Viscosity = 14,000 SUS (3,000 CST) at the minimum expected ambient temperature (for start-up).

CAUTION: Starting with viscosities greater than 3,000 CST could void warranty.

2. Minimum Viscosity = 65 SUS at the maximum operating temperature of the hydraulic system.

3. Ideal Viscosity = 100 SUS at normal operating temperature of the hydraulic system.

4. Minimum Viscosity Index = 90

5. Neutralization Number = 10 or less for new oil.

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.

SPECIFICATION FOR

OGL – OPEN GEAR LUBRICANT

SD4713 *(August 18, 2005)*

SCOPE:

1. This specification covers “Open Gear Lubricant”.

2. Materials furnished under this specification are primarily intended to lubricate open gears, but may also be used to lubricate racks, bushings, rails, rollers, dipper handles and propel mechanism components.

3. The material furnished under this specification must be dispensable through the distribution lines of a centralized lubrication system to the most remote application point, at the lowest anticipated operating temperature. It must not plate or plug components of the centralized lubrication system such as injectors, metering blocks, or spray nozzles.

4. This specification covers open gear lubricants that may be applied in service at temperatures ranging from -50°C (-58°F) to the highest ambient temperature conditions. The particular grade or consistency selected must perform within the specific temperature range in which it is utilized.

PHYSICAL CHARACTERISTICS:

1. Materials furnished under this specification may be asphaltic (bitumen) compounds, or blends of a thickener and mineral oils and/or synthetic fluids. They may be in the form of viscous fluids, semi-fluid greases or pastes.

2. Materials furnished under this specification are produced with highly fortified blends of viscous fluids combined with additives to form stable, long lasting, high load carrying, wear resistant films that lubricate under mixed film and boundary conditions.

3. Open gear lubricants supplied under this specification must have excellent adhesive and cohesive qualities, must not chip or throw off, and must provide sufficient film thickness and scuffing resistance to prevent metal to metal contact between applications under all operating conditions.

4. Various grades or consistencies of open gear lubricants may be required to provide proper lubrication and application properties over a wide range of ambient temperatures. The consistency of the lubricant as applied must be appropriate for the method of application, and the in-service consistency shall be appropriate for the lubricant to meet or exceed the minimum performance requirements listed in the "MINIMUM PERFORMANCE REQUIREMENTS" section.

MAINTENANCE PRECAUTIONS

The operator must be sure that the 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. Lower the Pulldown/Rotary gearcase to its lower stops.
2. Set all brakes.
3. De-energize control functions.
4. Do whatever else is necessary to prevent accidental movement of the machine.

DANGER: HIGH VOLTAGE! If power is essential to the repair, it should only be energized when all personnel are clear of electrical and mechanical hazards. The power should only be energized during the required period and not when repair work is 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 this 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 SHOULD 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.

MAINTENANCE INSPECTION CHECK POINTS

EVERY 100 HOURS, OR WEEKLY

(Whichever Occurs First)

1. Check for missing or worn crawler link pins and retaining pins.
2. Check for cracked or worn crawler links.
3. Check the tumblers and rollers for cracking, wear and lubrication.
4. Check for cracking of the crawler frames.
5. Check for excessive dirt accumulation.
6. Check for proper belt adjustment (1-3 inch sag between end of upper slide and drive or take-up tumbler).
7. Check drive tumbler for cracking and wear.
8. Check the oil level in the propel planetary gearcase.

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 SOME FORCE.

9. Check the propel gearcase, hydraulic motor and hydraulic lines for leaks.
10. Check that rear axle bearing block bolts are tight.
11. Check front equalizer axle for wear and cracking.

MD6750
Blast Hole Drill

pmc_6750

ITEM #	NOTED DISCREPANCY

Date: _____

Shift: _____

Inspected By: _____

Supervisor: _____

Section **5**

Service Procedures

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

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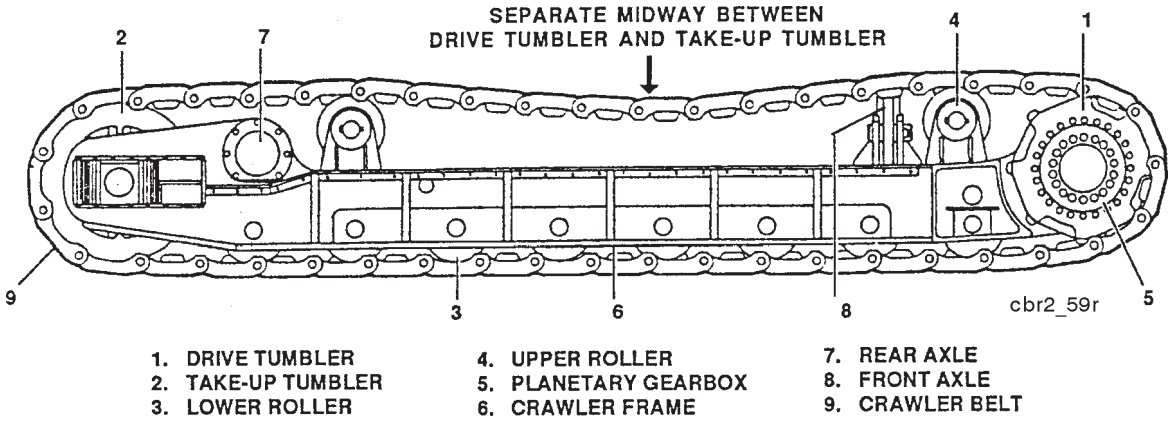
BELT REPLACEMENT

Although belt replacement is required infrequently, there are times when it is necessary. *To replace a belt:*

1. Propel the machine to firm, flat, level ground. 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 between the upper rollers by removing the link pins.



Crawler Belt Replacement

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.

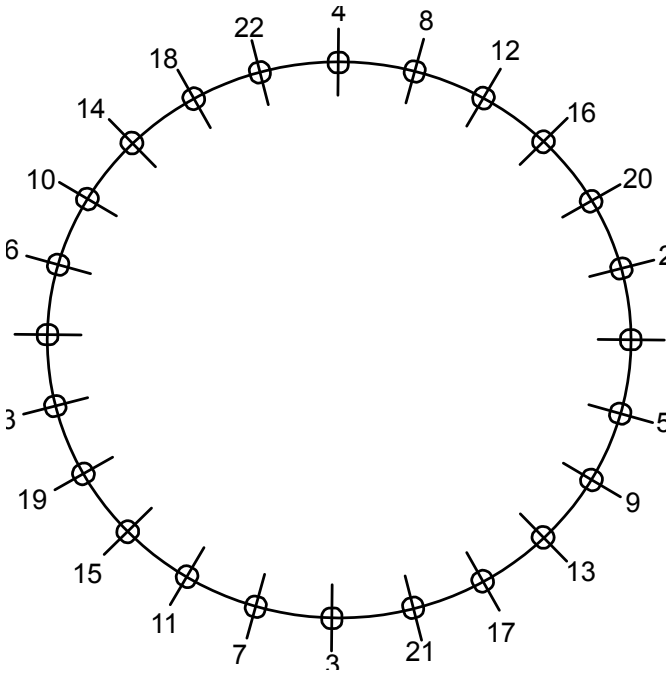
7. Using a suitable vehicle and rigging, drag the new belt underneath of the crawler frame so that the roller path in the center of the belt is aligned with the lower rollers, drive tumbler and take-up tumbler.

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.

6. Clean and inspect the gearcase. Repair or replace the gearcase as required. Reinstall the gearcase in the reverse procedure as removal. Tighten the mounting bolts using the sequence in the following view. For torque values, refer to the view in the previous “Drive Tumbler” topic.

NOTE: The gearbox mounting bolts are metric bolts.

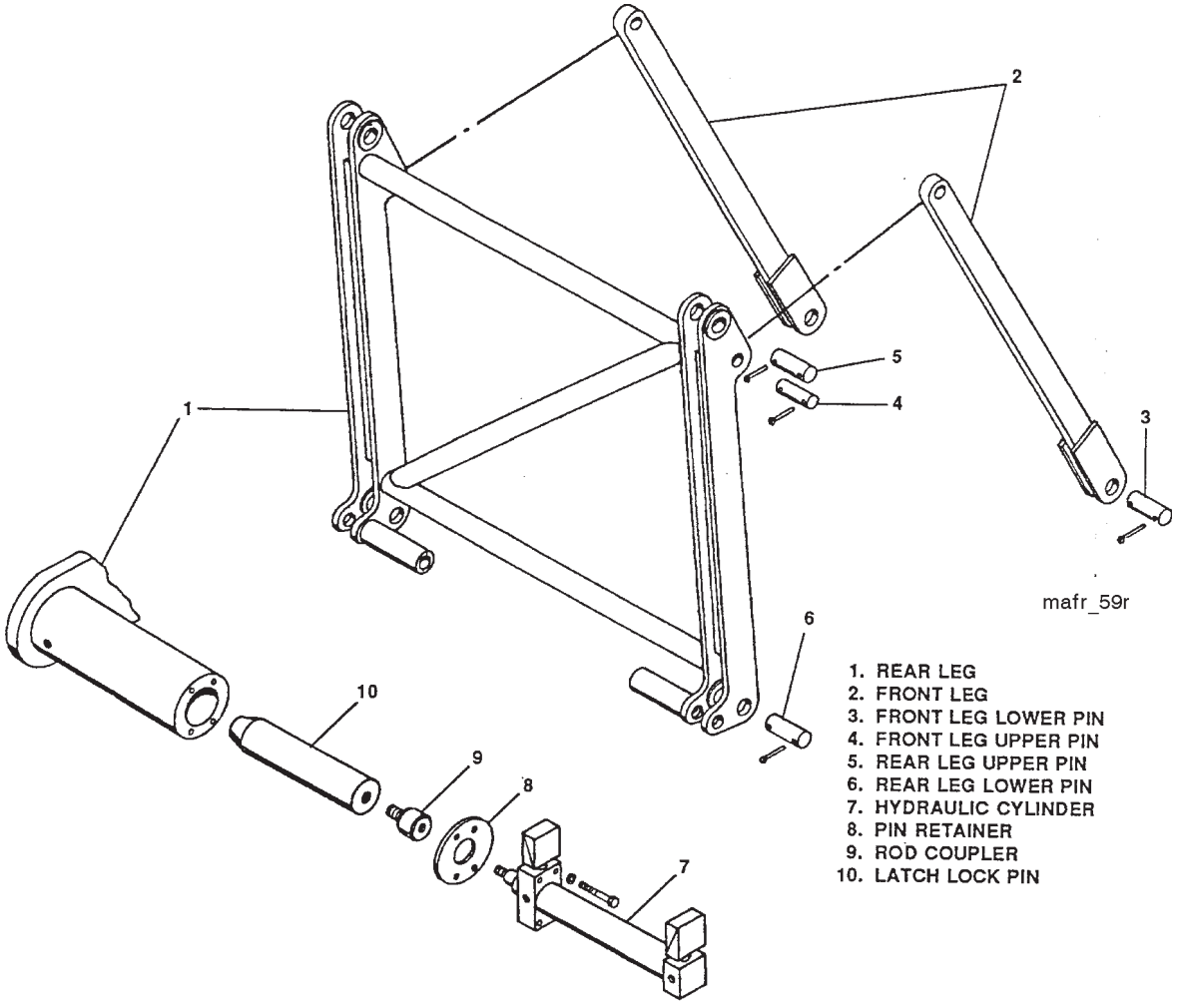


Planetary Gearbox Mount Bolt Torque Sequence

MAST A-FRAME

The mast A-Frame is a welded structure that is pinned to the mast and the mainframe and helps support the mast at it's lower end. The rear leg lock pins are hydraulically operated.

The structure should be checked monthly for weld cracks, structural bending and wear. The cylinders and hydraulic lines should be checked daily.

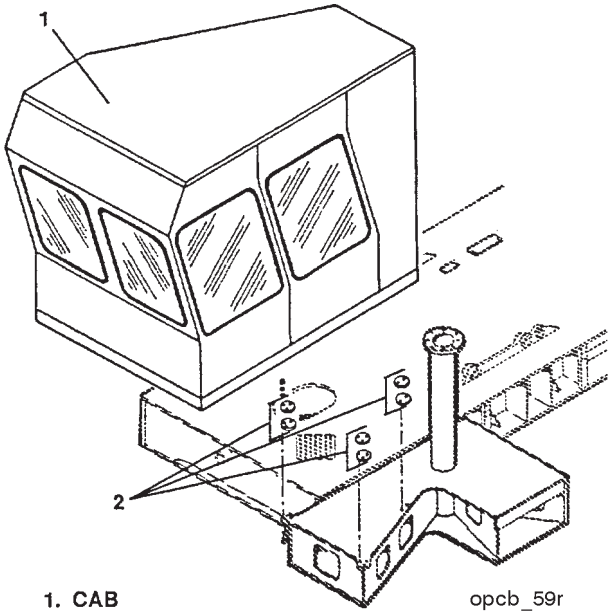


REPAIR

Any cracking, wear, or damage to the A-Frame must be repaired immediately. Repair to the A-Frame and rear leg is limited to repair welding. Contact your local Caterpillar Global Mining representative for a specific weld repair solution.

OPERATOR'S CAB

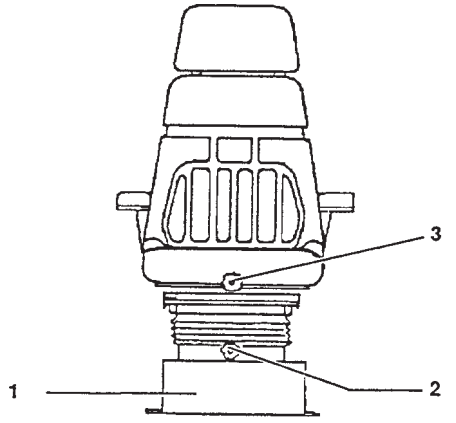
Inspect the operator's cab daily for cracks or structural damage to all side, roof and floor panels. Check the doors and windows for proper operation and correct sealing. Keep the cab clear of all oil, grease or water spills to help prevent slipping.



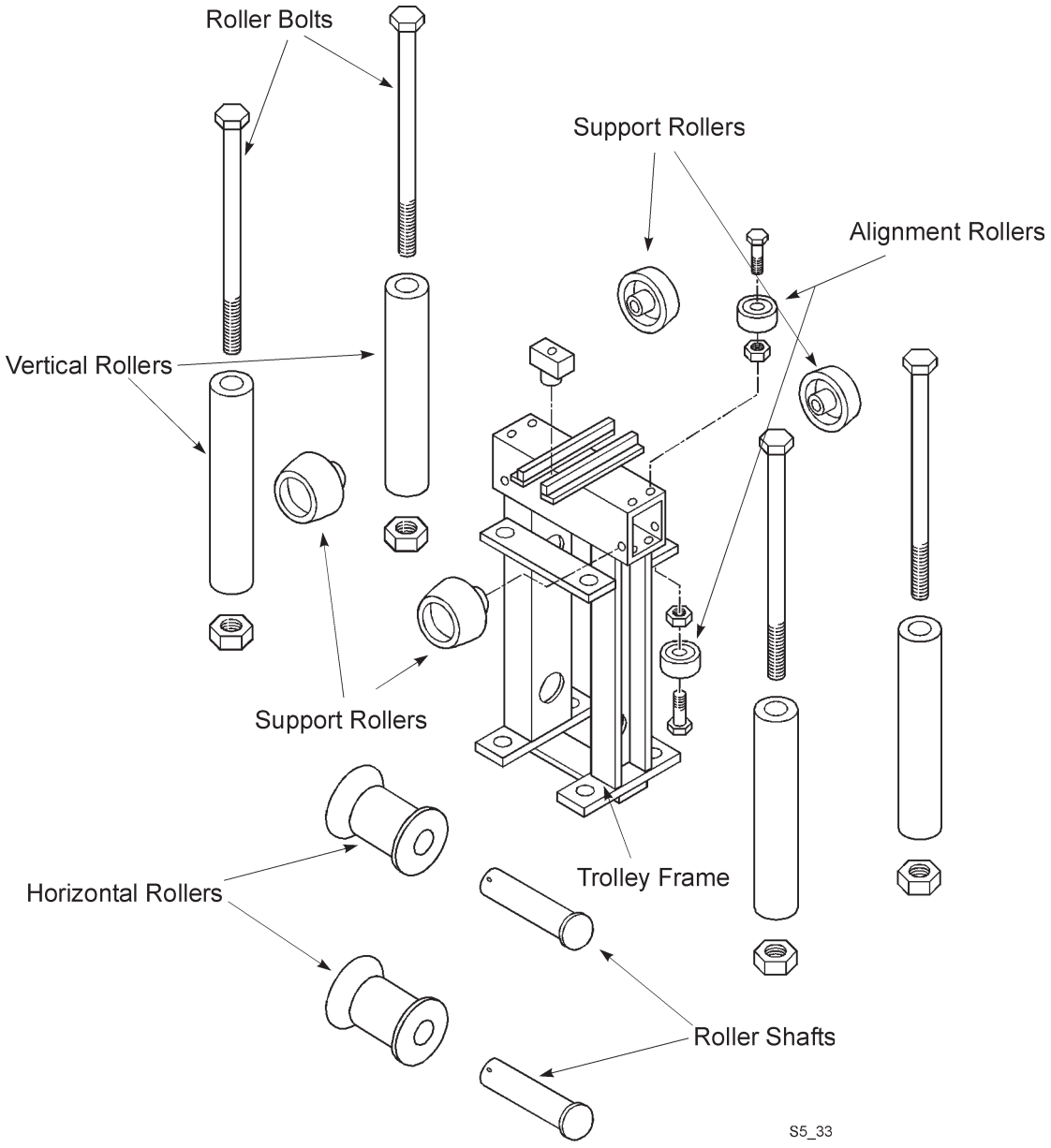
Operator's Cab Location Mounting

OPERATOR'S SEAT

The individual operator may adjust the operator's seat as desired with respect to height, tilt and travel. Periodically lubricate all bearings and pivot points to maintain smooth movement.



Operator's Seat - Adjustments



Cable Reel Level Wind - Details

25. Inspect all components. Repair of replace all components as necessary.

CAUTION: There are a number of steps in the following procedure which require heating of certain items prior to assembly. Use suitable protective equipment when handling the heated items.

26. To reassemble the gearcase first clean all components thoroughly. Inspect all bores and shaft surfaces, and remove any nicks or burrs. Lightly oil all parts. Apply Loctite #271 to all clean threads at assembly. Be sure to follow manufacturer's instructions when using Loctite.

27. Install the thrust bearing and lower bearing cage on the drive shaft upper section. The cage and thrust bearing are interference fit and will require heating in an oil bath to 250°F prior to assembly. Be sure the cage and bearing are tight against the shoulders of the shaft. Install the gear spacer on the shaft.

28. Assemble the lower bearing retainer assembly as follows:

    a. Install the lower bearing cup in the retainer. This cup is interference fit and will have to be pressed in. Be sure the cup is tight against the shoulder of the retainer.

    b. Install the oil seals and spacer in the retainer. Be sure the lips of the seals face toward the bearing cup.

    c. Install the seal retainer and bolts. Tighten and lockwire the bolts.

    d. Install the o-ring on the retainer.

29. Install the retainer assembly on the drive shaft upper section. Do not install the shims on the retainer.

30. Install the o-ring in the bottom of the shaft upper section.

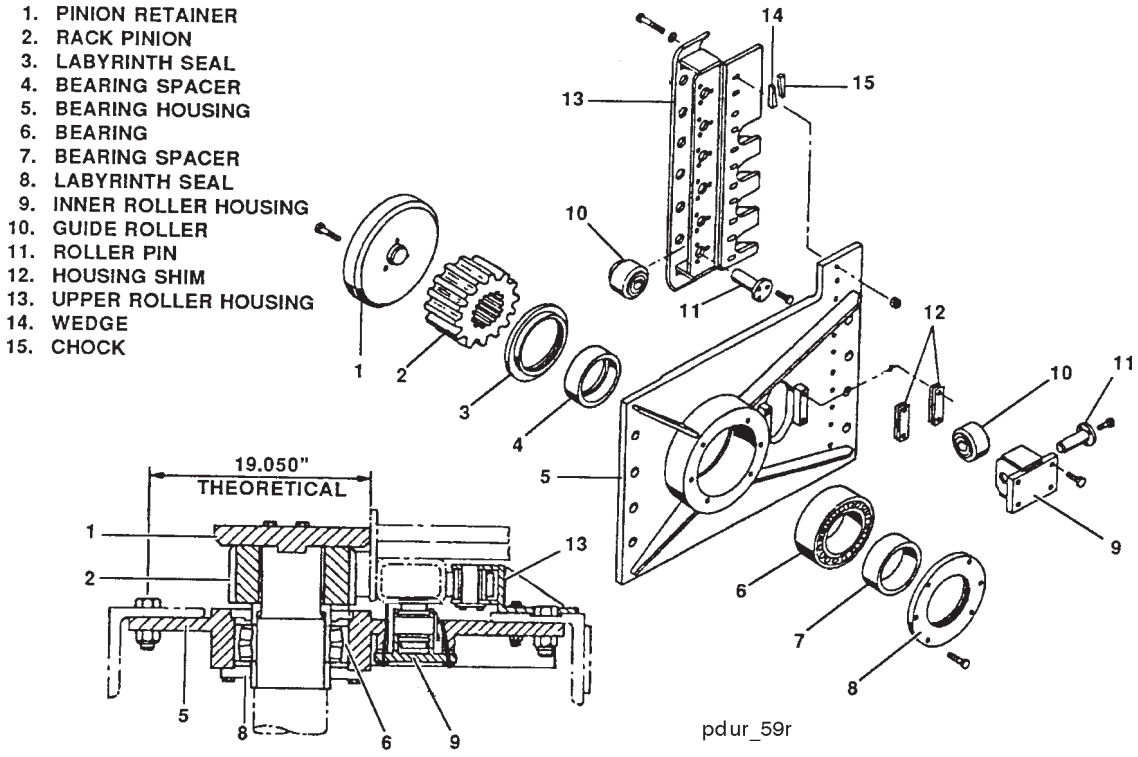
31. Heat drive shaft lower section in an oven or oil bath to 250° - 300°F maximum. Install the rotary drive collar on the shaft lower section. Insert lower section on upper section and install clamp collars and bolts. Allow shaft to cool to ambient temperature.

32. Remove the clamp collars and install the rotary coupling upper cushion seal strip. Reinstall the shaft clamp collars, tighten bolts and lockwire. The splits in the collars should be offset 90° from each other.

33. Re-install remaining parts of rotary coupling per topic, ROTARY COUPLING.

GUIDE ROLLER ADJUSTMENT

The guide rollers on the rotary/pulldown guide frame keep the assembly aligned to the mast and the rack pinions in contact with the mast rack. As the guide rollers wear, it is necessary to periodically adjust the clearance between the rollers and the mast rack mounting tee. When the thickness of the roller tread has decreased to 1/4”, the roller should be replaced. To adjust the guide rollers proceed as follows:



Rack Pinion and Upper Guide Roller

1. Position the rotary/pulldown unit so that the upper guide rollers and rack pinions are accessible. Shutdown and tag the controls.

2. Using a suitable jack or pulling device, pull or push the rack pinion keeper plate snug against the mast column plate on both sides of the mast. This assures that the backlash of the pinions is correct.

6. Remove the encoder coupling spring pins, then unbolt and remove the encoder and coupling. Remove the retainer/encoder support from the gearcase. Remove the o-ring and oil seal from the retainer.

7. Remove the bearing retainer from each end of the shipper shaft. Separate the o-ring, oil seal and labyrinth seal from the retainer.

8. Remove the rod bolts, tapered pins and bolts securing the gearcase cover to the gearcase. With a crane lift the cover from the gearcase.

9. Lift the shipper shaft from the gearcase. Remove the bearing spacer from the short end of the shipper shaft.

10. Remove the bearing retaining nut and lockwasher, along with the bearing and spacers from each end of the shaft,

11. Slide the shipper shaft gear from the shaft.

12. Lift the intermediate shaft from the gearcase. Remove the gear end bearing retainer and bearing. The bearing has an interference fit of 0.0012 - 0.0032” to the shaft and will require a puller for removal.

13. Remove the encoder end bearing retainer and bearing. The bearing has an interference of 0.0012 - 0.0032” to the shaft and will require a puller for removal.

14. Remove the gear spacer. The gear is interference fit to the shaft and will require puller for removal. Remove the gear key.

15. Remove the cover from the hoist brake. Remove the bolts securing the brake cage to the gearcase. Slide the brake off the brake hub. Remove the brake hub, hub retainer, retainer bolt and oil slinger.

16. At the coupling end of the shaft remove the bearing carrier bolts. Slide the shaft assembly from the gearcase. The brake end bearing inner race will be removed with the shaft assembly. Remove the carrier gasket.

17. Remove slinger spacer, bearing retainer, retainer o-ring, oil seals, bearing cage, bearing spacer and oil deflector from the brake side of the gearcase.

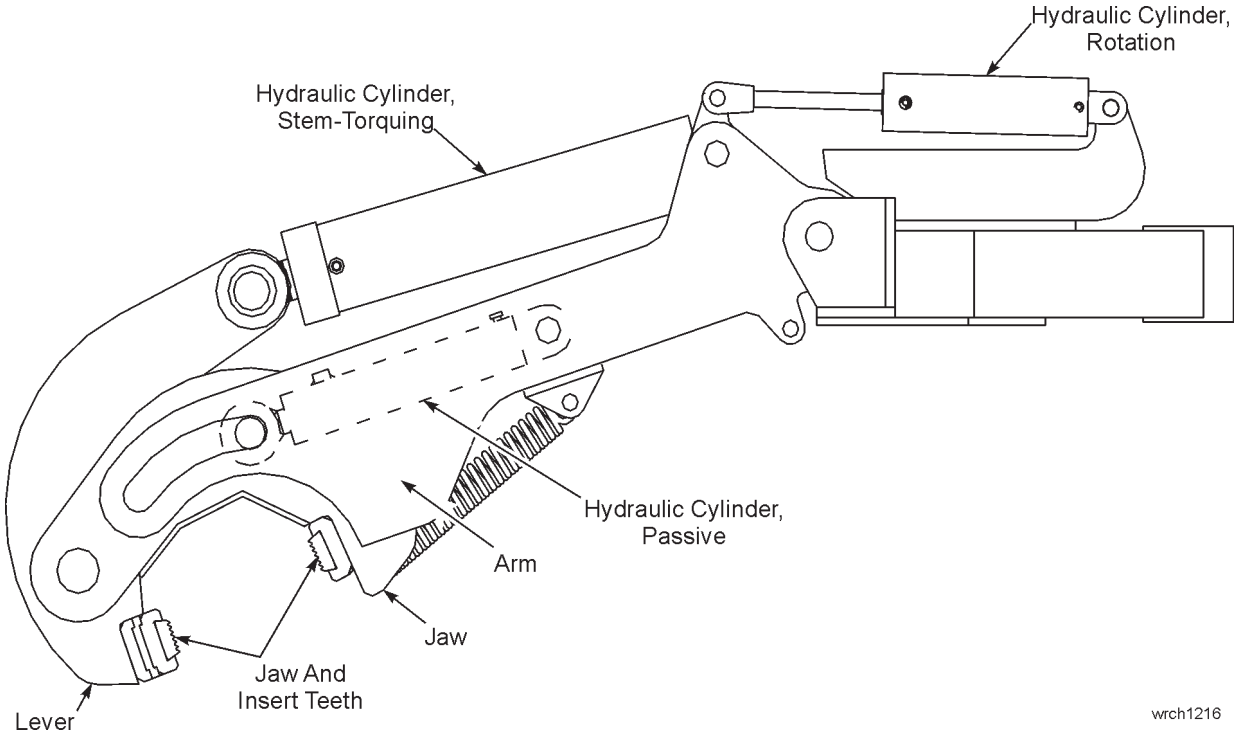
18. Use a puller to remove the half coupling from the end of the shaft. Remove the coupling key.

19. Remove the seal retainer from the bearing carrier. Remove the o-ring, oil seals and seal spacer from the retainer.

BREAKOUT WRENCH

The breakout wrench is used to break pipe joints that will not break using the rotary drive.

With the pipe secured by the tool wrenches, the breakout wrench switch is turned to and held in the EXTEND position. The breakout wrench extends, grips the pipe, then turns, breaking the pipe joint.



REPAIR

The breakout wrench should be inspected daily for wear or damage, loose or missing hardware, and proper operation. Repair of the breakout wrench is limited to the replacement of worn or damaged components.

GENERAL GUIDELINES FOR DISASSEMBLY

1. Remove attachment pins to remove hydraulic cylinders.
2. Remove pin to dismount lever.
3. Remove pins to dismount jaws.
4. Remove pins to sidemount arm. Check for excessive wear on brass washers.
5. If jaw replacement is necessary, teeth or jaw inserts must be removed. Softly strike the tooth to take it out.
6. Reinstall in reverse order, except for cotter pin.
7. Check the operation of the wrench. If the inserts contact the pipe, wrench is ready for use. If inserts do not contact the pipe, repeat steps.

5. To remove the oil from the other front jack, a helper will be required. Have the helper continue to hold the disconnected hose into a empty 5 gallon container while you re-couple the quick disconnect on the other front jack. The oil from this jack will now flow from the hose being held by the helper.

6. When the oil flow has stopped and the jack pad is on the ground, the loose end of the hose can be reconnected to the electrical junction box.

7. With the pressure relieved, the counterbalance valve or jack cylinder can now be safely worked on.

PRESTART INSPECTION

If the machine hydraulic systems have had a major overhaul, the following prestart inspection should be completed before start-up of the machine.

CAUTION: Before starting pumps, establish a safe walking perimeter around machine to reduce possible injury to ground personnel due to automatic operation of boarding stair, dust curtain, or cable reel.

NOTE: Read all instructions before starting any individual test. Initial each step after its completion or record the requested information.

1. Check all lines and fittings for tightness and plumbing accuracy.

2. Visually check that no open port exists on any valve.

3. If the crawlers or mast have been removed from the machine, be sure that all ports have been plugged or capped and all loose lines terminated in a quick disconnect or plugged with a steel fitting.

NOTE: Make note of the oil manufacturer and type of oil being used in this hydraulic system (e.g. Conoco Syncom AW22).

4. Verify that the hydraulic reservoir is filled to the correct level with the required hydraulic oil.

5. Check the suction plumbing and the reservoir for external leaks.

6. From the test kit install 0-1500 PSI gauges to test ports 14 and 15 at the left and right propel pump charge filter outlet, respectively, as shown on the gauge port location table at the end of this section of this manual.

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.

BIT VIEWING HATCH CHECK

Check function of bit viewing hatch with switch in operator's cab. Hatch should open and close smoothly with no chattering action.

BOARDING STAIR CHECK

Check function of boarding stair with switch in operator's cab. Stairway should raise and lower smoothly with no chattering action.

WATER INJECTION WASHDOWN CHECK

1. With a 0-1500 PSI gauge at test port 76, and with pumps running, use hydraulic test function on operator's display terminal screen to energize Main Flow Increase Valve (MFV) solenoid.

2. Adjust pressure reducing valve located immediately beneath test port 76, to see 175 PSI on gauge.

3. De-energize Main Flow Increase Valve (MFV).

4. With an empty 5-gallon container available, locate washdown switch and hose.

NOTE: Switch is in operator's cab on water injection console. A coiled hose with a quarter-turn shutoff valve is secured on hooks outside of the railing to the rear of the left rear jack tower. When the switch is energized, the Washdown Valve (WV) will energize causing a quarter-turn water valve to block flow to the main air line and also causing the water pump to run at maximum speed.

5. Remove sufficient hose length from the hooks so the manually operated quarter-turn valve can be positioned close to the 5-gallon container. With quarter-turn valve CLOSED, energize washdown switch. Open quarter-turn valve to check function.

6. Close quarter-turn valve and de-energize switch. Open quarter-turn valve with switch de-energized to relieve water pressure from the hose.

7. Recoil hose on hooks.

MOTOR COUPLING INSTALLATION

Motor couplings must be shrunk onto tapered motor shafts in order to transmit the torque values involved without slippage. The procedure described below is intended to develop sufficient frictional force to transmit the imposed torque without dependence on the keyway.

Clean and dress the bore and shaft to remove any deformity and foreign matter.

Mount the cold coupling onto the shaft and measure the position of the coupling on the shaft carefully. Measure the distance from the end of the coupling to the end of the shaft. The dimension derived during this step will be used later.

Remove the coupling and pre-heat the item until the “estimated temperature difference” has been reached. Refer to table below.

Example:

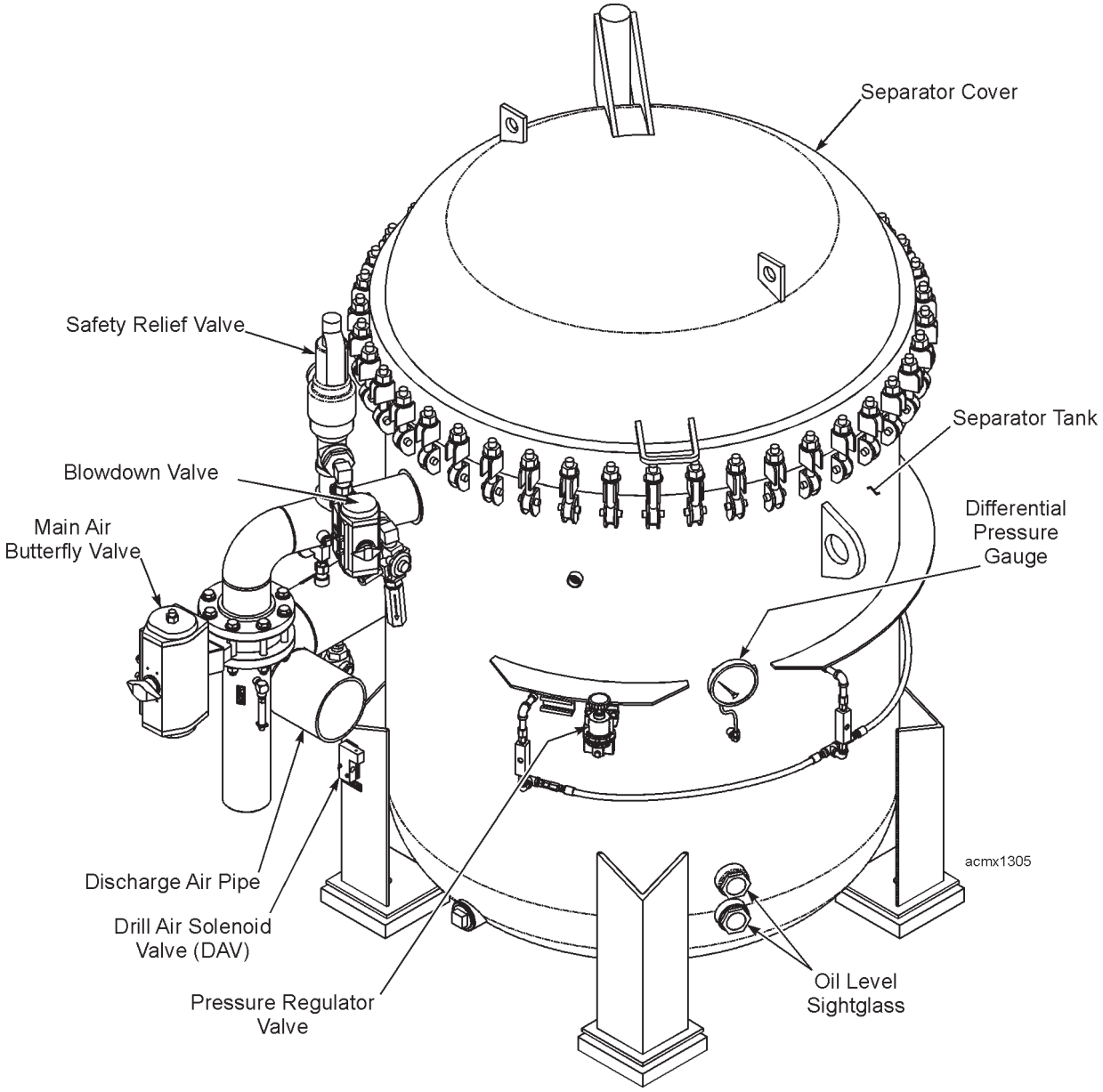
> If the shaft temperature = 25° C (77°F) and the estimated temperature difference derived from the table is 100°C (180°F), the coupling must be heated to 125°C (257°F) for mounting.

CAUTION: PINION OR BRAKE COUPLING TEMPERATURE SHOULD NEVER EXCEED 190°C (374°F) FOR INSTALLATION.

CAUTION: Pre-heated components temperatures will often be brought to temperatures that can be extremely hazardous to the human body. USE EXTREME CARE AND ALWAYS WEAR APPROPRIATE SAFETY EQUIPMENT WHEN WORKING WITH PRE-HEATED COMPONENTS AND AROUND THE PROCESSES.

Wipe all oil from both the shaft and the bore of the coupling prior to installation.

Replace the heated coupling hubs on the shaft once again and take care to note the amount of advance (further movement) onto the shaft that has been obtained. If the advance amount does not fall within the limits called out in the table it will be necessary to remove the coupling and re-heat it to the specified temperature. *IN ALL APPLICATIONS THE PROPER AMOUNT OF ADVANCE MUST BE ACHIEVED!*



Separator Control Components

COMPRESSOR START-UP

NOTE: For accurate readings, the machine must be level when checking the oil level.

1. COMPRESSOR OIL - The compressor air end, separator and cooler must be filled with the recommended compressor oil.

NOTE: After initial start-up, the oil level in the separator will drop due to the oil filling the piping system. Shut down the compressor after approximately 15 minutes of operation. Allow the machine to sit for 10 to 15 minutes to allow air bubbles to settle out of the oil. Check the oil level gauge. If the oil level is below the sight glass, refill to the top of the sight glass.

CAUTION: The system contains hot oil under pressure. Always check the pressure gauge to make certain the pressure is at zero before opening the fill plug.

2. DRAIN THE CONDENSATE - Open the drain valve slightly to drain off any condensate into a container. Close the valve securely when oil appears. Dispose of the oil and condensate properly.

3. START THE UNIT - Start-up the compressor.

4. OBSERVE THE DISCHARGE AIR PRESSURE - During drilling operations, the main air valve will maintain a minimum pressure of approximately 30 PSIG in the receiver. Pressure higher than this minimum will be regulated by the drill bit orifice size or air pressure control valve setting. The discharge air pressure must not operate above the maximum rating plate pressure during the loaded cycle. However, momentary high pressures up to the 85 PSIG are permitted (e.g. to blow out clogged drill bit orifices).

NOTE: The tank safety relief valve is set at 150 PSI and should be replaced or serviced anytime it is opened.

5. OBSERVE THE DISCHARGE AIR TEMPERATURE - The maximum discharge air temperature must not exceed 225°F (107ºC).

NOTE: The air temperature limit is factory set to shut down the unit at 225°F (107ºC).

6. OBSERVE THE OIL INJECTION TEMPERATURE - The oil injection temperature must not exceed 185°F (85ºC).

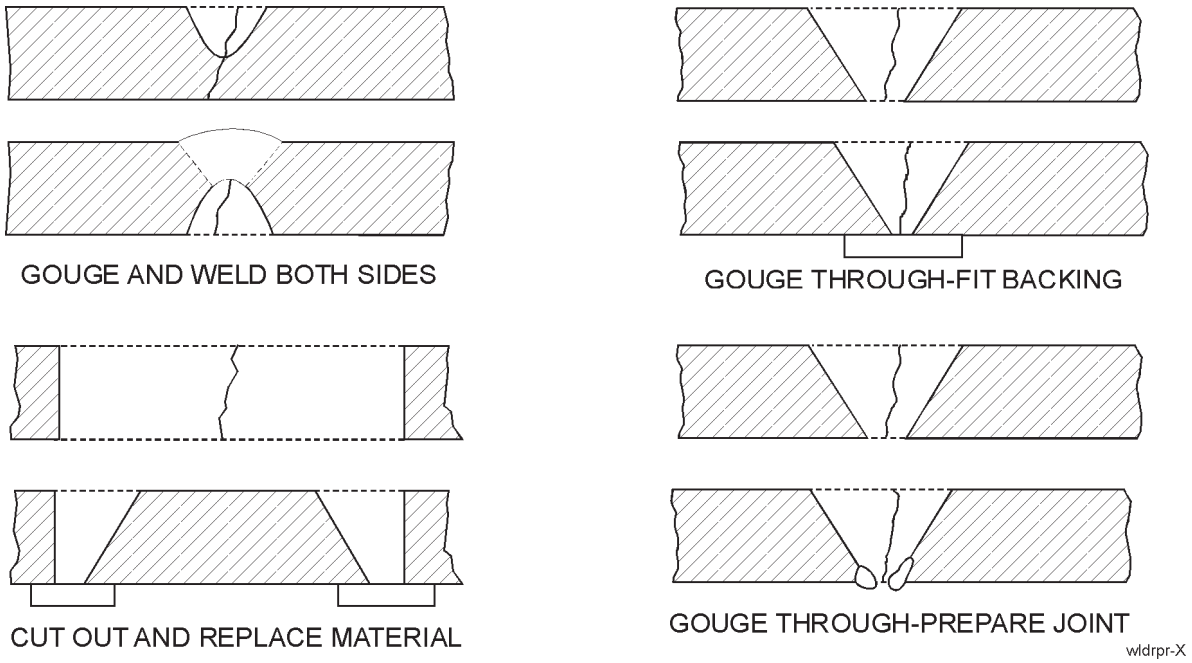
7. PERFORM MAINTENANCE CHECKS - Refer to the proper area of this manual for recommended maintenance checks.

SPECIFICATIONS

Nominal Cooling Capacity:	31,000 Btu/hr @ 460V/60Hz 27,000 Btu/hr @ 380V/50Hz		
Heating Capacity:	12 kw @ 460V 60HZ 10 kw @ 380V 50HZ		
Power requirements:	380V / 3ph / 50Hz 17.5 Amps (Norm)	415V / 3ph / 50Hz 19.0 Amps (Norm)	460V / 3ph / 60Hz 21.0 Amps (Norm)
Refrigerant:	HFC 134a – 24 lbs.		
Oil:	POE Variety Mobil Arctic EAL22CC or ICI Emcarate RL32CF		
Compressor:	Fully sealed, scroll compressor		
Condenser Coil:	5 row, 3/8 inch copper tube with 8 aluminum fins per inch		
Evaporator Coil:	4 row, 3/8 inch copper tube with 10 aluminum fins per inch		
Condenser Fan:	Multi-blade axial, 17¼" inch diameter, two speed, 35° pitch to provide in excess of 3000 cfm @ 60 Hz.		
Supply Air:	One forward curve double inlet fan supplies a nominal - 1300 cfm (610 l/s) @ 60 Hz 1100 cfm (190 l/s) @ 50 Hz		

NOTE: Further information on the MPV9 can be found in the vendor's documentation that accompanies your machine and the General Arrangement drawings provided by Bucyrus International, Inc.

REPAIR WELDING OF CRACKS



Joint Preparation for Repair of Cracks

Remove the entire crack by arc air-gouging or grinding. Prepare a V-groove of approximately 45-60° included angle for rewelding. If cracked through the full thickness and if it is possible to make the repair from both sides, a double V preparation is preferred. When welding from both sides, back-gouging for complete penetration is always recommended.

When it is not physically possible to back-gouge and weld the second side, an alternate approach must be taken. Sometimes it is possible to gouge through to completely remove the crack, and then fit a backup bar on the underside to facilitate making a complete penetration weld.

NOTE: The backup bar must fit tightly to the underside otherwise poor welding conditions conducive to cracking may occur.

When it is not possible to fit a backup due to limited accessibility to the underside, it is advisable to remove a portion of the defective plate and weld in a new piece, using back up bars on all sides to ensure complete penetration welds.

A further alternative is to gouge through, removing the crack, and then weld small stringer beads to close the gap and prepare a groove for a repair weld. In this case, the repair weld will be essentially full penetration, but will be less than perfect on the under side. The other methods are preferred in the order described, that is, welding both sides, welding against a backup bar, or completely replacing a section of plate.

VOLUME MEASUREMENTS - APOTHECARIES

The Apothecaries Measure was established in England in 1824. Originally set up to be similar to the Apothecaries Weight System, parts of it were abandoned in 1963 and banned from use in 1971. The only remnants still in limited use are the UK (Imperial) Gallon, Pint and Fluid Ounce measurements.

Volume Conversions - English to Metric

English	Metric
1 US Gallon = 3.785 Liters	1 Liter = 0.2642 Gallon
1 Quart = 0.9464 Liter	1 Liter = 1.057 Quart
1 Pint = 0.4732 Liter	1 Liter = 2.113 Pints

Volume Conversions - Apothecaries' Measure to English

English	Apothecaries' Measure
1 US Gallon = 0.8327 UK Gallon	1 UK Gallon = 1.201 US Gallon
1 US Pint = 0.8327 UK Pint	1 UK Pint = 1.201 Pint US
1 US Fld Oz = 1.041 UK Fld Oz	1 UK Fld Oz = 0.9608 US Fld Oz

Volume Conversions - Apothecaries' Measure to Metric

Apothecaries' Measure	Metric
1 UK Gallon = 4.546 Liters	1 Liter = 0.2200 UK Gallon
1 UK Quart = 1.137 Liter	1 Liter = 0.8799 UK Quart
1 UK Pint = 0.5683 Liter	1 Liter = 1.760 UK Pint

CNV-VOL3

TORQUE MEASUREMENTS

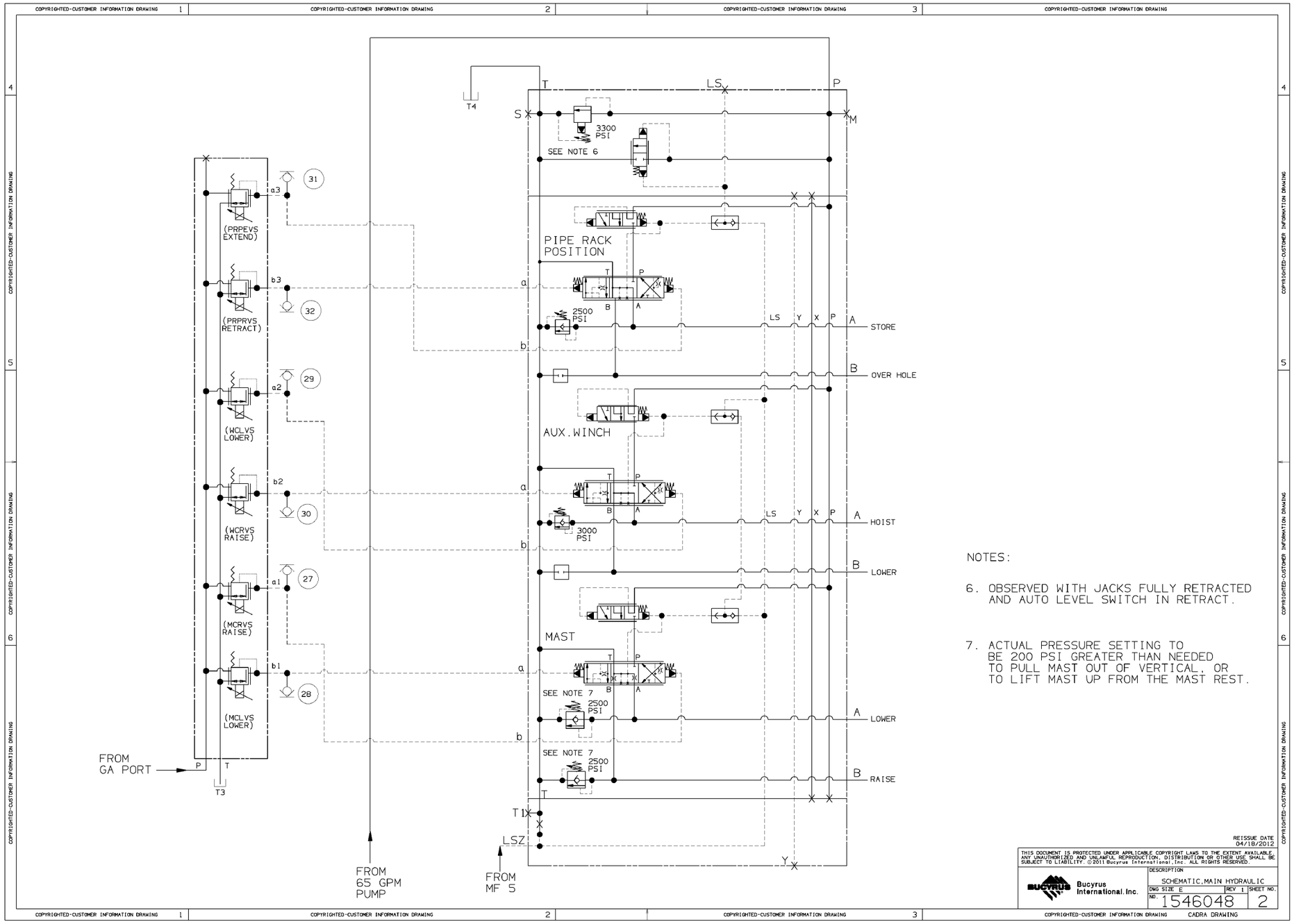
Torque Standards

Metric	English
1 N•m = 1000 mN•m	1 ft-lb = 12 in-lb
	1 ft-lb = 192 oz-in

Torque Conversions

Metric to English	English to Metric
1 N•m = 0.7376 ft-lb	1 ft-lb = 1.356 N•m
1 N•m = 8.851 in-lb	1 in-lb = 0.1130 N•m
1 mN•m = 0.1416 oz-in	1 oz-in = 7.062 mN•m

CNV-TORQ



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
04/18/2012

Bucyrus International, Inc.

DESCRIPTION: SCHEMATIC,MAIN HYDRAULIC
DWG SIZE E | REV 1 | SHEET NO. 2
NO. 1546048

COPYRIGHTED-CUSTOMER INFORMATION DRAWING
CADRA DRAWING

SEE SHEET 1 MAIN FRAME HYDRAULICS

MF-9 FROM 5 GPM
MF-10 TO OR FROM 0 TO 11 GPM
MF-11 TO OR FROM 0 TO 11 GPM
MF-12 TO OR FROM 0 TO 35 GPM
MF-13 TO OR FROM 0 TO 35 GPM
MF-14 FROM 17 GPM

PIPE #1 POSITION CYLINDER
4.00 BASE DIA
1.75 ROD DIA
21.50 STROKE

PIPE #4 (OPTIONAL) POSITION CYLINDER
4.00 BASE DIA
1.75 ROD DIA
21.50 STROKE

#1
PRSV4
(WACV)

AUXILIARY WINCH
13.62
9.75 DIA. DRUM
36:1
ONE WAY CLUTCH HOLDS LOAD
390 PSI MIN TO RELEASE
8.40 CIR
LOWER FLOW
HOIST MOTOR

TORQUE LIMITER VALVE (OPTIONAL)
HOLD BACK WRENCH VALVE (OPTIONAL)
WINDOW GUARD VALVE
(WGV)
CLOSE A B OPEN
1000 PSID
(TLV)
(HBWV)
OVER HOLE A B STORE
500 PSI
6.1 GPM
2000 PSI
2.5 GPM
4 PSI CRACK
P
T
T3
A1 B4 A3 B3 A2 B2 A1 B1
BASE DIA. 2.00
ROD DIA. 625
STROKE 2.50
WINDOW GUARD CYLINDER

3:1 1500 PSI
3:1 1500 PSI
HOLD BACK CYLINDER
BASE DIA. 2.50
ROD DIA. 1.00
STROKE 12.00

(TWV 1)
RETRACT A B
P T
(TWV 2)
LEFT EXT/RT A B
5.6 GPM
500 PSI
4000 PSID

PIPE RACK GATE & LOCK CYLINDERS
(PIRV4) (PIRV3) (PIRV2) (PIRV1) (PRUV3) (PRUV4) (PRUV1) (PRUV2)
600 PSI
P T
74 A10 B10 52 A9 B9 A8 B8 A7 B7 A6 B6 A5 B5 A4 B4 A3 B3 A2 B2 A1 B1
24
T3

FROM MF-22
TO MF-21
SEE SHEET 8 AUTO BREAK OUT WRENCH

PIPE #4 (OPTIONAL)
BASE DIA. 2.00
ROD DIA. .62
STROKE 3.00

PIPE #1
BASE DIA. 2.00
ROD DIA. .62
STROKE 3.00

PIPE #4 (OPTIONAL)
BASE DIA. 2.00
ROD DIA. 1.00
STROKE 3.00

PIPE #1
BASE DIA. 2.00
ROD DIA. 1.00
STROKE 3.00

A1 B1 P T
A B 2.8 GPM
2.8 GPM
(SPV)
PD PP 73
C2 C1
FROM MF-20
SEE SHEET 1 MAIN FRAME HYDRAULICS

B A LEFT TOOL WRENCH
B A RIGHT TOOL WRENCH

MAST HYDRAULICS

REISSUE DATE 04/18/2012

Bucyrus International, Inc.

DESCRIPTION		
SCHEMATIC, HYDRAULIC		
DWG SIZE E	REV 1	SHEET NO.
NO. 1546048		7