



TRENCHLESS EQUIPMENT SPECIALISTS

OPERATOR'S MANUAL

5000 Jacking System

Pump Unit S/N: PU5050-27 & After

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SERVICE • RELIABILITY • INNOVATION

Introduction

This operator's manual contains important safety, operation, and maintenance information for your Akkerman 5000 Jacking System. This system includes the 5000 Pump Unit, Auxiliary Pump Unit, Yoke Assembly, and Skid Assembly. You must read and understand this manual before you operate and maintain this equipment. Keep this manual with your Pump Unit at all times. Additional copies of this manual may be purchased from the Akkerman Product Support Department, or downloaded from the Akkerman web site at www.akkerman.com.

The contractor is responsible for the overall safety program on the job site. Use this manual as a part of the safety program.

The use of second rate parts could affect the efficient performance of the Jacking System. ALWAYS use genuine Akkerman parts.

Understand safety signal words, DANGER, WARNING, CAUTION, SAFETY INSTRUCTIONS, and NOTICE. When you see these words in this manual or on safety decals mounted on your equipment, follow the safety message to avoid personal injury and/or property damage.

▲ DANGER Indicates an extremely hazardous situation which, if not avoided, WILL result in death or serious injury.

▲ WARNING Indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

▲ CAUTION Indicates a potentially hazardous situation, which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices.

SAFETY INSTRUCTIONS Usually consists of individual messages stating procedures or actions that must be followed for the safe operation of a product.

NOTICE Identifies potential property damage and important installation, operator, or maintenance information.



5000 Pump Unit with Yoke and Skid

The 5000 Pump Unit has two distinct hydraulic systems powered by electric motors. The high pressure system supplies oil for the two main jacking cylinders and all intermediate jacking stations. The low pressure system supplies oil, via hydraulic lines for the boring head and conveyor. The Auxiliary Pump Unit may be easily installed to double the low pressure hydraulic flow.

The Yoke is the frame that the main cylinders push against to advance the boring head and pipe. The Yoke also acts as a dirt bucket unloading area. The Skid base is the foundation of the pump unit and yoke. It also acts as a guide for launching the boring head and pipe into the ground.

If you find any errors with this manual or know of ways to improve procedures, please let us know. Mail your suggestions to: Akkerman Inc, ATTN: Technical Publications, 58256 266th Street, Brownsdale, MN 55918.

Akkerman Inc. reserves the right to improve its product without notice or obligation.

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Safety

BE ALERT FOR SAFETY INFORMATION

When you see this safety alert symbol on your equipment or in this manual, be alert to the possibility of personal injury or property damage.

Read all safety information.

Keep safety decals clean and in good condition.
Replace missing or damaged safety decals.



**ATTENTION!
BECOME ALERT!
YOUR SAFETY IS INVOLVED!**

READ OPERATOR'S MANUAL

⚠ WARNING Unsafe operation or maintenance can cause severe injury or death.

Read and understand the Operator's Manual before operating or servicing this equipment.

Any unauthorized modifications will void the warranty.



WEAR PROTECTIVE CLOTHING

Wear OSHA approved protective clothing, such as hardhat, gloves, safety goggles, earmuffs or ear plugs, face shield, and steel-toed boots, when operating and servicing this equipment.

Wear reasonably close fitting clothing and remove jewelry before working on or near this equipment. This will help prevent the danger of catching them in moving parts or controls.



FIRE PREVENTION

⚠ CAUTION Fires can cause injury or property damage.

Keep equipment clean. Remove all debris from equipment.

Have a fire extinguisher available at all times. Keep the fire extinguisher fully charged.



HYDRAULIC OIL/FLUIDS UNDER PRESSURE

⚠ WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury.

Release all pressure before performing maintenance or repairs. Never weld near pressurized fluid lines.

DO NOT use your hands to check for leaks. When searching for leaks, use a piece of wood or cardboard.

BEFORE disconnecting Boring Head supply and return lines, BOTH Dual Valves (Boring Head and Auxiliary) must be in the OFF position and the Pump Unit, Boring Head, and Auxiliary power switches must at STOP position.

Contact medical help immediately if any oil or fluid is injected into your skin. A serious infection or reaction can emerge without proper medical treatment.



UNAUTHORIZED WELDING

⚠ WARNING Unauthorized welding can cause structural failure resulting in possible injury or death.

Do not weld on any structural member. Unauthorized welding or repair will void the warranty.



KEEP PERSONNEL AWAY FROM MOVING PARTS

⚠ WARNING Crushing hazard.

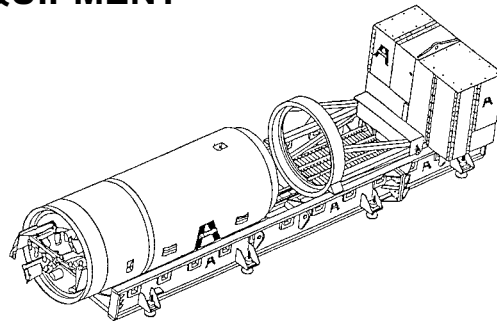
Keep personnel away from inside of yoke, on skid, or behind pump unit when jacking or moving pump unit or yoke. Failure to do so could result in serious personal injury or death.



REGULARLY CLEAN AND INSPECT EQUIPMENT

Remove any grease, oil, or debris buildup to avoid potential injury or equipment damage.

Inspect equipment for damage. If damaged, repair or replace immediately.



PRACTICE SAFE MAINTENANCE

⚠ WARNING Unexpected Jacking System movement may cause serious personal injury.

LOCKOUT power before performing any maintenance.

Shut down Pump Unit before making repairs, adjustments, or removing obstructions.

Only trained and qualified personnel should perform any maintenance or repairs.

Keep the area around the equipment clean and dry when performing maintenance.

Do not service the machine while it is in motion.

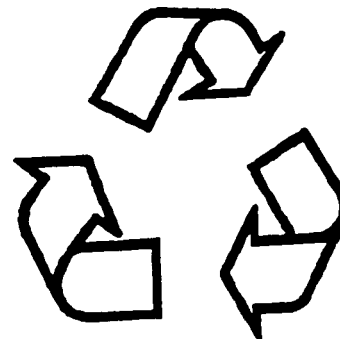
Replace worn or damaged parts. Remove grease, oil, or debris buildup.



RECYCLE WASTE

Follow local, state, federal, and international regulations when recycling or disposing of waste. Waste includes fluids/oil, fuel, filters, coolant, and batteries.

Use leakproof containers when draining fluids/oil. Do not pour waste on the ground, down a drain, or into any water source.



BEWARE OF SUSPENDED LOADS

⚠ WARNING Suspended loads may fall and cause severe personal injury or death.

If a hydraulic hose from the boom of a crane or excavator breaks, the boom can fall immediately.

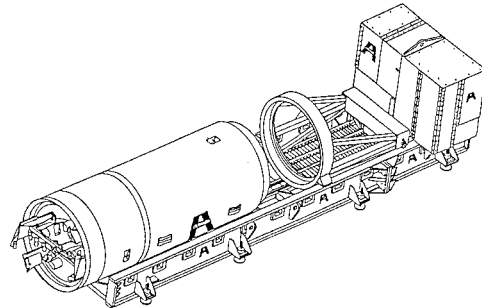
Do not enter area under or around a load.



NO RIDERS ON JACKING SYSTEM

⚠ WARNING Unexpected Jacking System movement may cause riders to slip or fall resulting in serious personal injury.

Do not allow riders on the Pump Unit or the Yoke when they are moving.



TEST TUNNEL VENTILATION

⚠ WARNING Keep Boring Head and tunnel well ventilated at all times.

Use an approved air analyzer to detect hazardous gases and oxygen content.

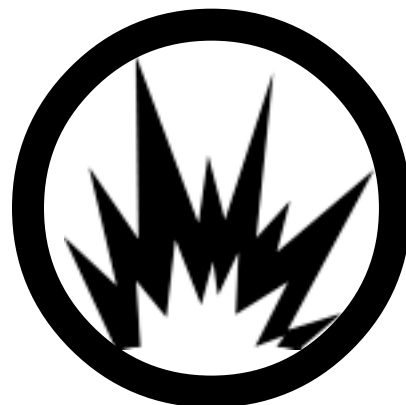
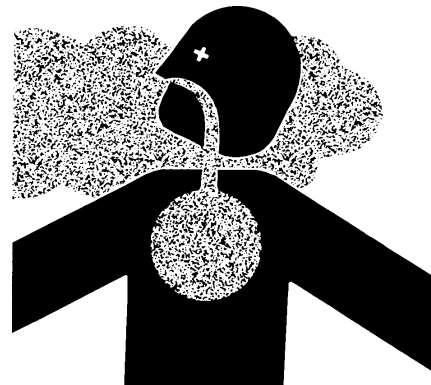
Before and during the tunnel operation, test for combustible and toxic gases and oxygen deficiency.

If the levels exceed OSHA prescribed levels, leave tunnel immediately! Do not activate or deactivate any electrical or hydraulic devices, since any sparks could cause an explosion.

Once ALL personnel are out of tunnel, cut power from power source.

Gases must be removed before reentering tunnel.

Do not use Haul Unit to evacuate the tunnel. The electrical contacts with the unit can cause explosion.



LOCKOUT POWER BEFORE SERVICING

⚠ WARNING Failure to lockout power before servicing can cause severe personal injury or death.

This machine is powered by high-voltage electricity. LOCKOUT main power supply before servicing. Electrical repairs must be performed only by a certified electrician.



SLIPPERY WHEN WET

⚠ WARNING Slips and falls can cause serious personal injury.

Ensure firm footing in wet or slippery conditions.

Replace skid-resistant material if it is damaged or missing to prevent slips and falls.

Remove any buildup of grease, oil, or debris.



KEEP JOB SITE CLEAN AND ORGANIZED

⚠ WARNING Tripping can cause serious personal injury.

Be sure to keep job site clean and organized.



KEEP AWAY FROM CONVEYORS

⚠ DANGER Contact with rotating auger conveyor or conveyor belt idler rollers, will cause severe injury or death.

Keep hands, body, and objects clear of operating auger and conveyor.

Do not operate without covers and guards in place.

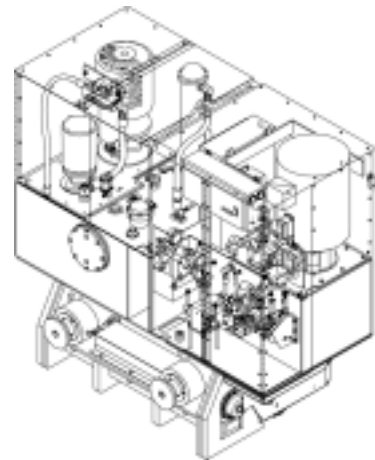
Lockout power before servicing.



HIGH PRESSURE HYDRAULICS

⚠ WARNING The 5000 Pump Unit contains high pressure hydraulics.

Keep all guards in place.



NO SMOKING IN TUNNEL

⚠ WARNING Smoking in tunnel could cause an explosion if combustible gases are present.

Do not smoke in tunnel.

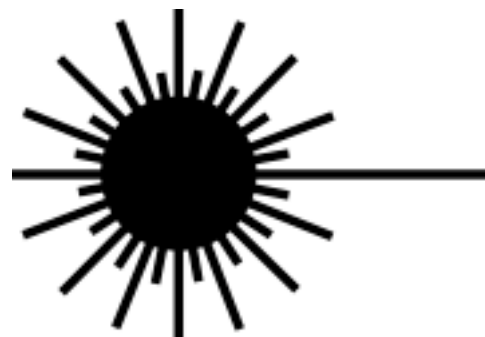


AVOID LASER LIGHT EXPOSURE

⚠ DANGER Staring into laser light will cause severe injury.

Do not stare into laser guidance system light beam. Avoid direct eye exposure.

To avoid possible exposure to radiation in excess of acceptable emission limits, all repairs to laser must be performed by the original manufacturer or an authorized service technician.



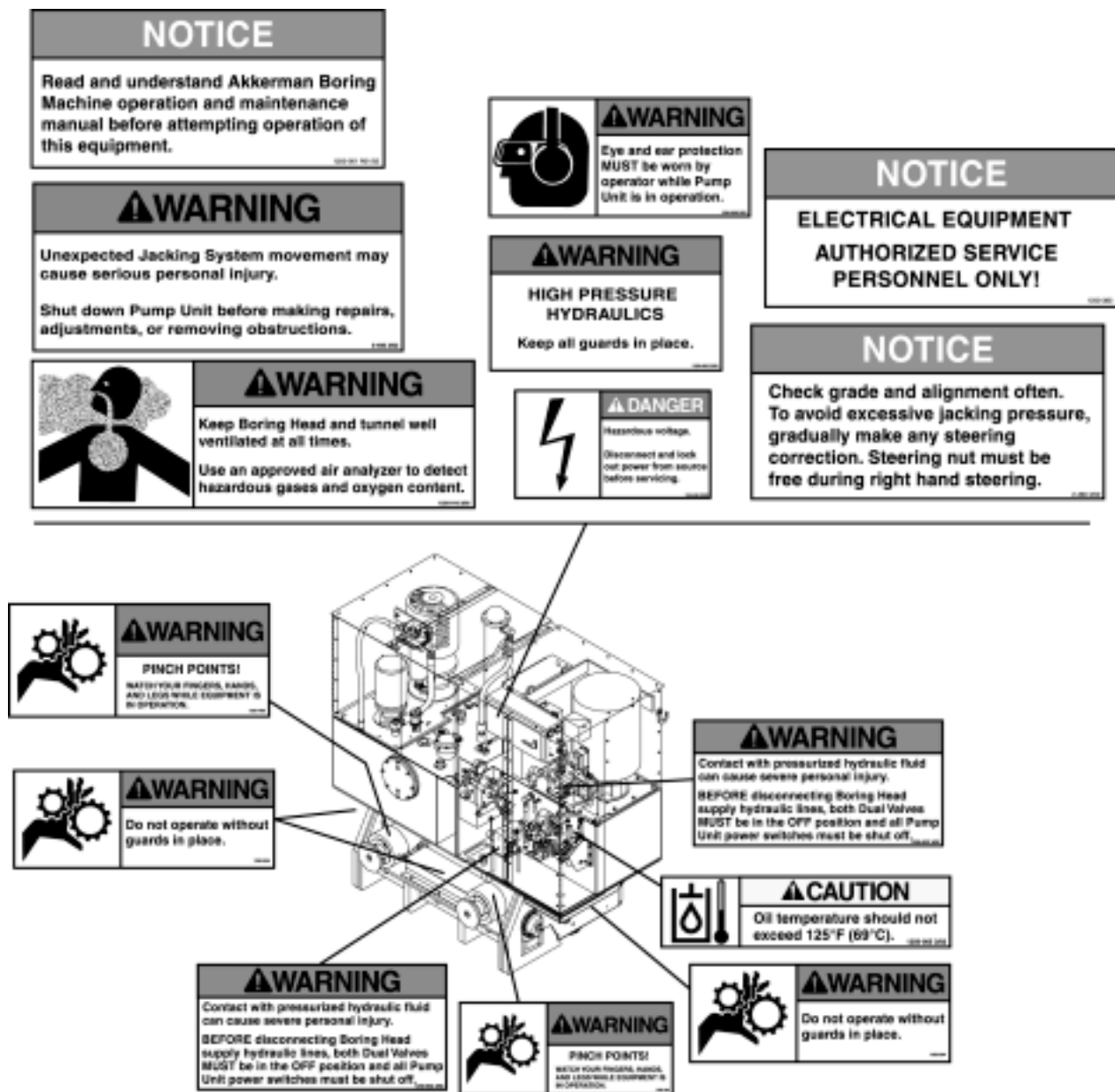
Safety Decals

Keep all safety decals clean and readable. Use soft cloth, water, and a mild soap to clean the decals if they are too dirty to read. DO NOT clean safety decals with solvent. Solvent can damage them. Replace safety decals immediately if they are damaged, missing, or hard to read.

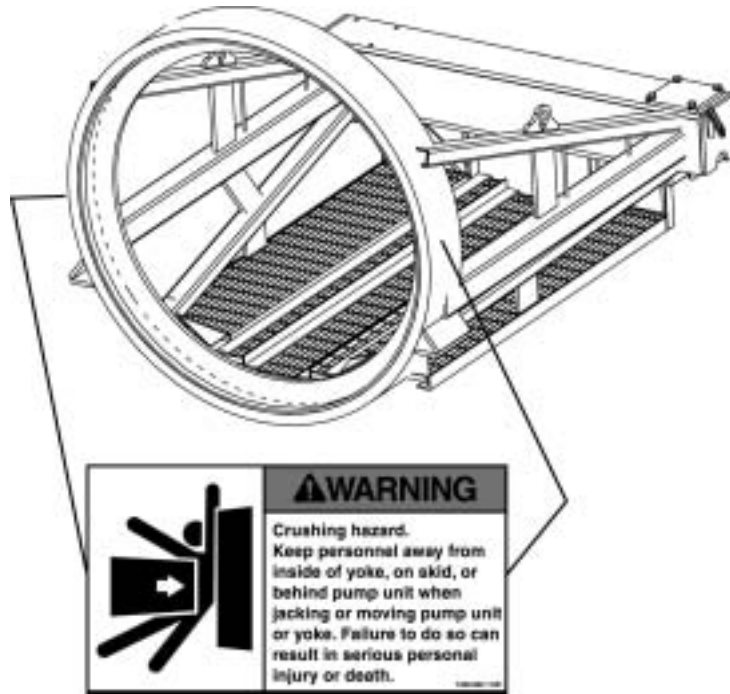
Serious injury or property damage can occur if safety instructions are not followed. Contact your Akkerman Product Support representative for free replacement safety decals.

If a part is replaced that has a safety decal on it, apply a new safety decal to the replacement part. Before applying a new decal, be sure the surface is clean and dry.

5000 PUMP UNIT

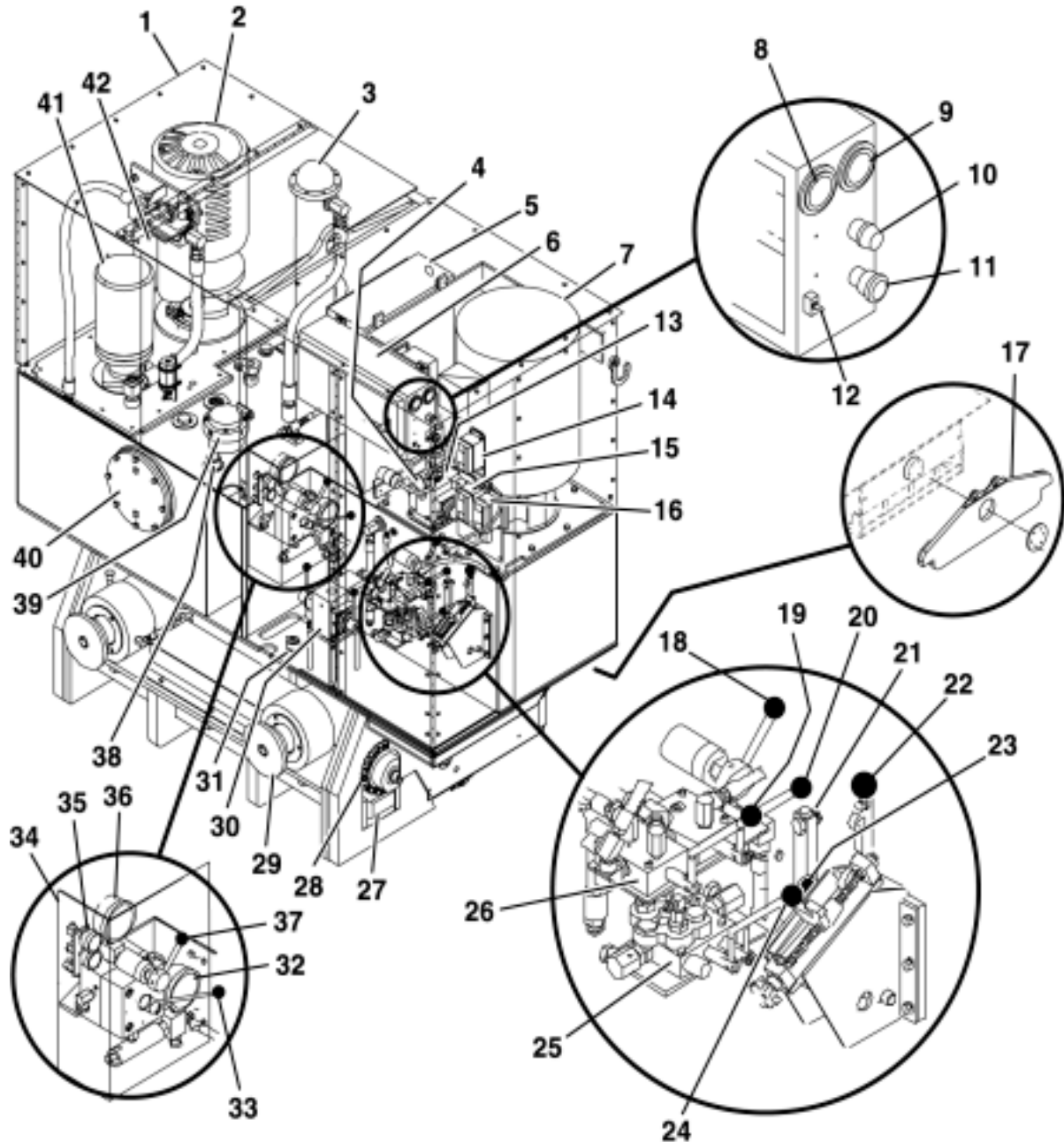


YOKE



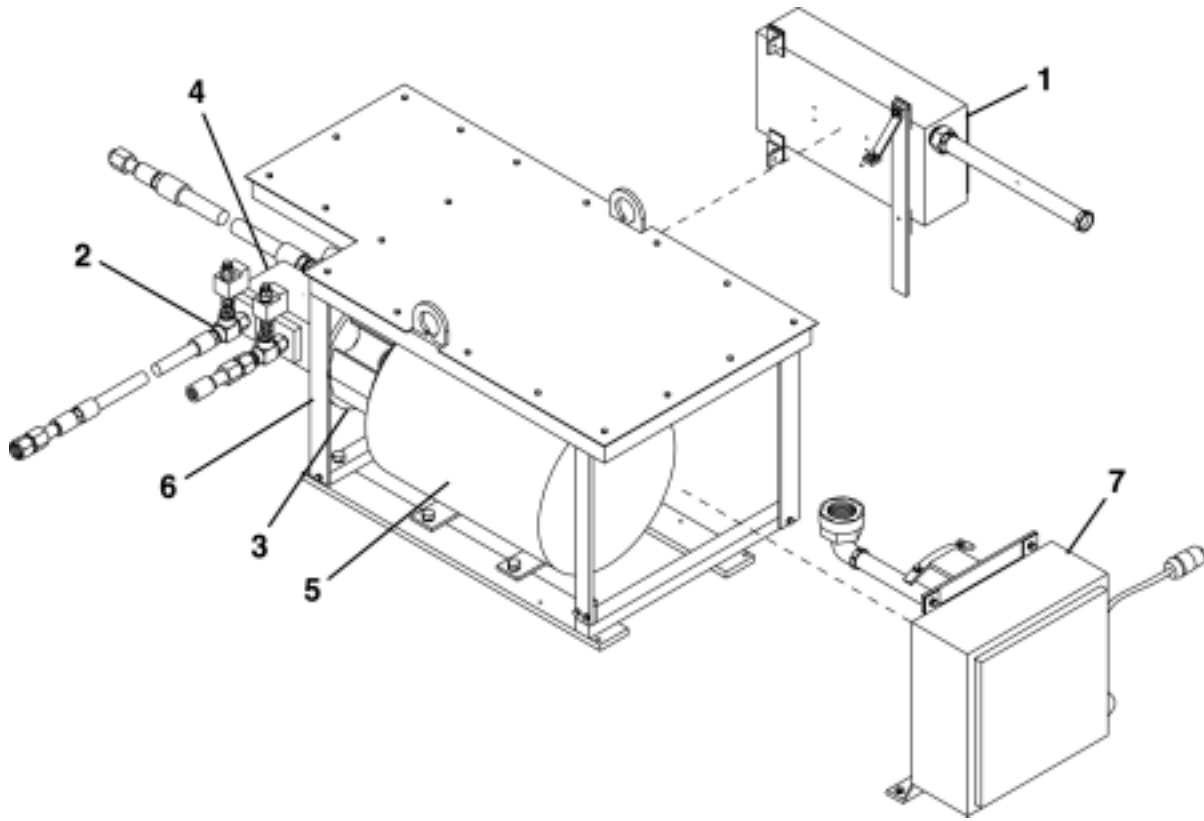
Terminology

5000 PUMP UNIT



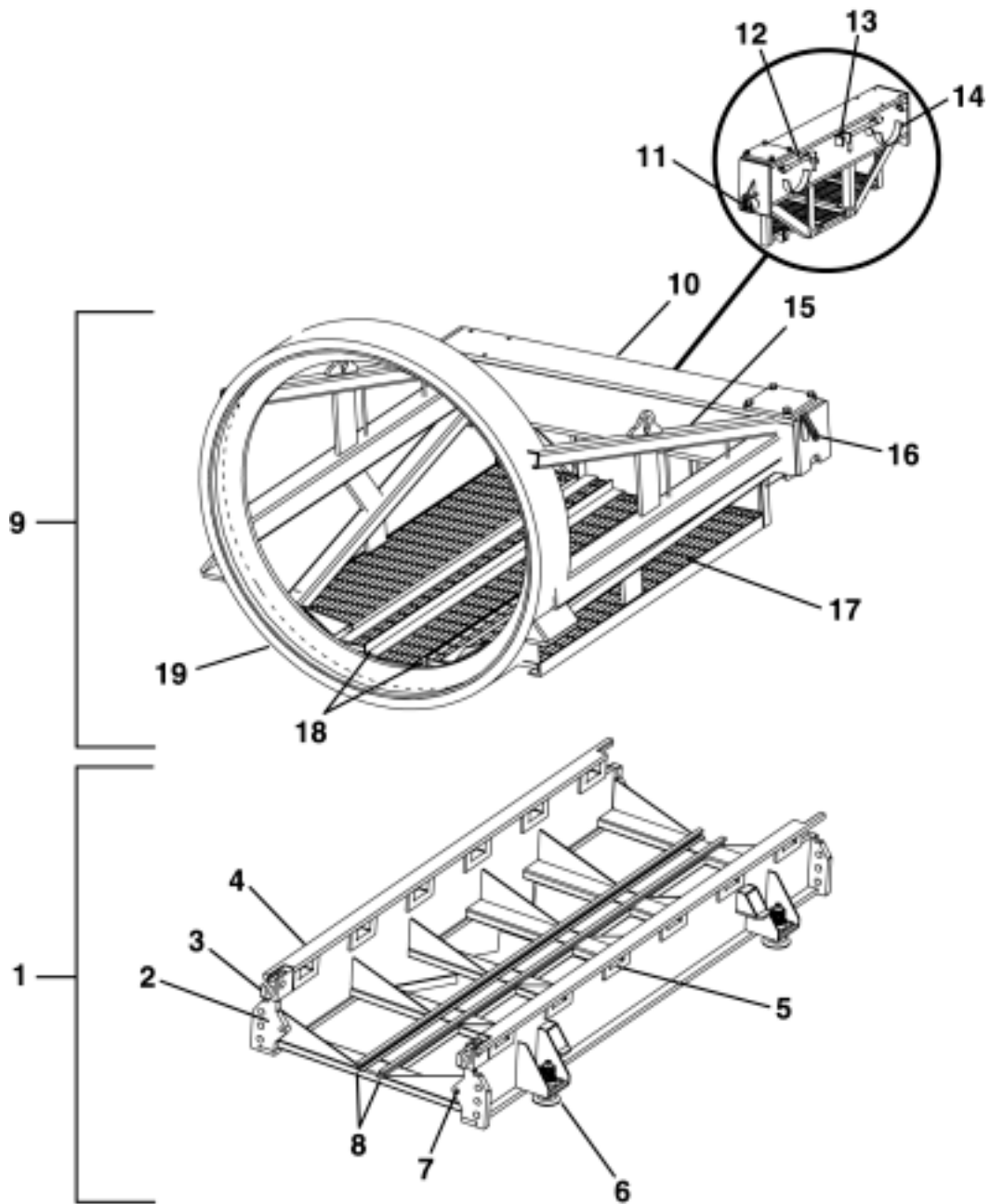
- | | | |
|-----------------------------------|--------------------------------------|---|
| 1. Cab Assembly | 15. Pump Unit Power Supply | 29. Cylinder, 200 Ton Ram |
| 2. High Pressure Motor, 50 HP | 16. Boring Head Power Supply | 30. Auxiliary Dual Valve |
| 3. Heat Exchanger | 17. Bolster | 31. Dog Control Position Indicator |
| 4. Boring Head Pressure Gauge | 18. Pressure Release Valve-Main Rams | 32. Pressure Gauge, Ram Extend |
| 5. Control Panel Enclosure | 19. Pump Unit Drive Control | 33. Dual Ram & IJS Control Valve |
| 6. Disconnect Switch Enclosure | 20. Low Pressure Ram Control | 34. Valve Shield |
| 7. Low Pressure Motor, 100 HP | 21. Hydraulic Reservoir Temp. Gauge | 35. Filter Indicator Gauges |
| 8. Low Pressure System Hourmeter | 22. Cable Stroker Control | 36. Main Ram/IJS Pressure Gauge |
| 9. High Pressure System Hourmeter | 23. Ram Lift Control | 37. Pressure Release Valve |
| 10. Low Oil Level Light | 24. Dog Control | 38. Hydraulic Oil Fill Cap |
| 11. E-Stop (Emergency Stop) | 25. Cylinder Lift Valve | 39. Low Pressure Supply/IJS
Return Filters |
| 12. Light Switch | 26. Drive Valve | 40. Boring Head Return Filters |
| 13. Boring Head Dual Valve | 27. Dog | 41. Motor, 5 HP |
| 14. Auxiliary Power Supply | 28. Drive Assembly | 42. Charge Filters |

AUXILIARY PUMP UNIT



- 1. Small Enclosure Assembly
- 2. Hydraulic Assembly
- 3. Motor To Pump Assembly
- 4. Gear Pump
- 5. Motor, 100 HP
- 6. Cab and Frame Assembly
- 7. Large Enclosure Assembly

SKID & YOKE



- | | |
|----------------------------|----------------------------|
| 1. Skid | 11. Yoke Wheel |
| 2. Skid Base | 12. Yoke Retaining Pin |
| 3. Skid Split Bar | 13. Ram Retaining Pin Stop |
| 4. Side Skid Base Assembly | 14. Ram Cradle |
| 5. Skid Pocket | 15. Yoke Ring Support |
| 6. Leveling Assembly | 16. IJS Line Holder |
| 7. Skid Locator Pin | 17. Floor |
| 8. Rail | 18. Rail (for Haul Unit) |
| 9. Yoke | 19. Yoke Ring |
| 10. Dual Ram Yoke, Rear | |

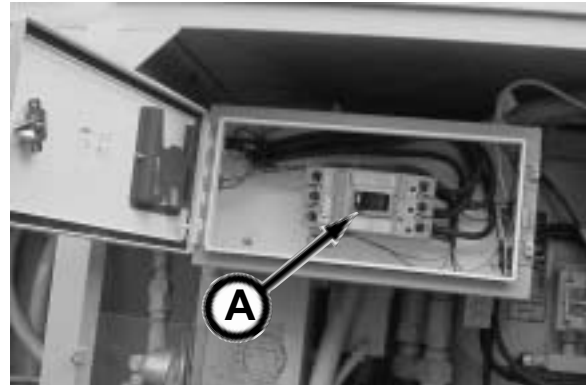
Controls & Instruments

DISCONNECT SWITCH ENCLOSURE - 5000 PUMP UNIT

DISCONNECT SWITCH (A)

⚠WARNING DO NOT store anything in the disconnect switch enclosure. Doing so could cause severe personal injury or death by coming in contact with high voltage.

The disconnect switch (A) is used as a secondary lock out/tag out point to shut off the electrical power to the 5000 Pump Unit. Only a qualified electrician is to use the disconnect switch. To disconnect electrical power, open the enclosure door and flip the Disconnect Switch (A) to the OFF position. The switch must be in the ON position for the pump unit to operate.



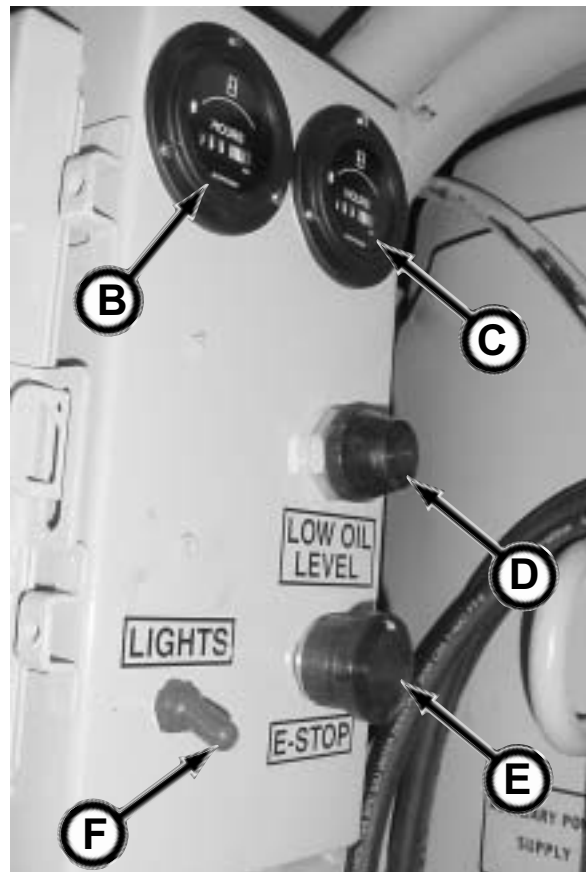
HOURMETERS

The hourmeters register in full hours and 1/10ths hours.

- Low Pressure System Hourmeter (B)
- High Pressure System Hourmeter (C)

LOW OIL LEVEL (D)

When the hydraulic reservoir oil is too low for proper operation, the Low Oil Level light will illuminate and the system pumps will shut down.



E-STOP (E)

The Emergency Stop button is the main electrical emergency switch which will stop and start the electrical motor rotation. The operating lights will remain on. The button functions as follows:

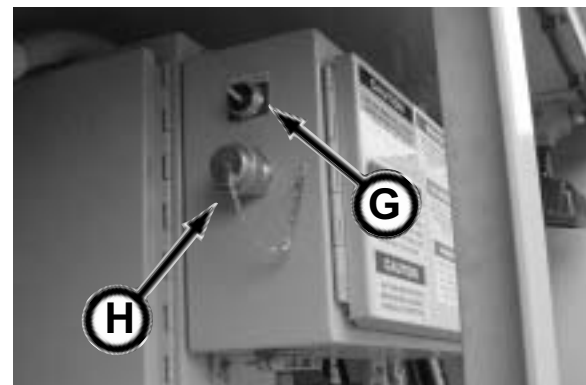
- STOP: Push button IN
- START: Pull button OUT

LIGHTS (F)

The Light switch turns the operating lights ON and OFF.

LOCAL/REMOTE SWITCH & RECEPTACLE

The Local/Remote switch (G) is used in special applications that require remote control pump unit operation. The remote control is connected to the remote receptacle (H). Contact your Akkerman Sales person or Product Support representative for more details.



The pump unit will not function if the switch is turned to the REMOTE position while the pump unit is manually controlled.

POWER SUPPLY SWITCHES

The power supply switches will activate the Boring Head (low pressure), 5000 Pump Unit (high pressure), and Auxiliary Pump Unit motors. The E-Stop button must be pulled out for these switches to be operational.

BORING HEAD (A)

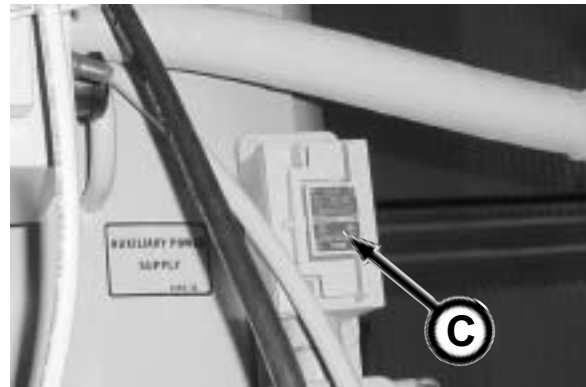
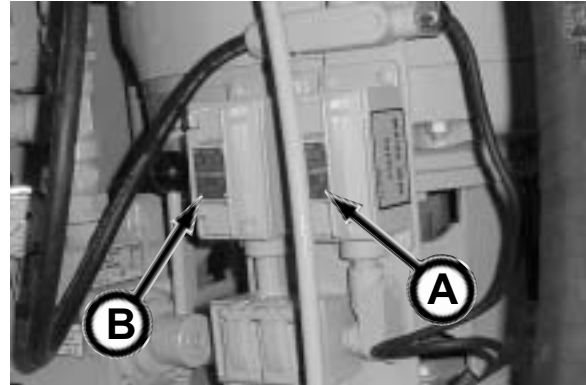
- START: Depress top portion of switch
- STOP: Depress bottom portion of switch

5000 PUMP UNIT (B)

- START: Depress top portion of switch
- STOP: Depress bottom portion of switch

AUXILIARY PUMP UNIT (C)

- START: Depress top portion of switch
- STOP: Depress bottom portion of switch



DUAL VALVE ASSEMBLIES

The dual valve assemblies control the hydraulic oil flow to the boring head components.

The left lever controls the low volume and the right lever controls the high volume. Both the low and high volume are normally used at the same time for maximum oil flow. Though the low and high volume controls can be used separately for certain conditions.

BORING HEAD (D)

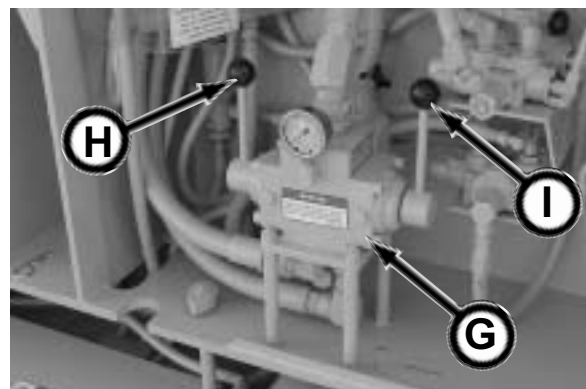
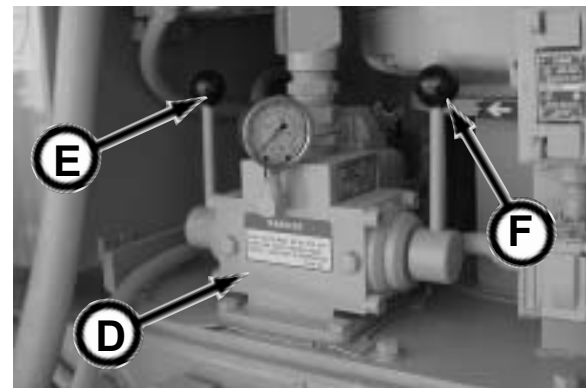
- Low Volume (E)- 28 gpm
- High Volume (F)- 32 gpm
- Combined Volume- 60 gpm

AUXILIARY PUMP UNIT (G)

- Low Volume (H)- 28 gpm
- High Volume (I)- 32 gpm
- Combined Volume- 60 gpm

Move the lever(s) COMPLETELY down to turn on the oil flow. Move the lever(s) COMPLETELY up to shut off the oil flow.

When pressure exceeds 2,600 psi, the boring head component performance will start to diminish until it reaches the relief setting of 2,800 psi. This will suspend operation, while retaining 2,800 psi within the pressure lines.

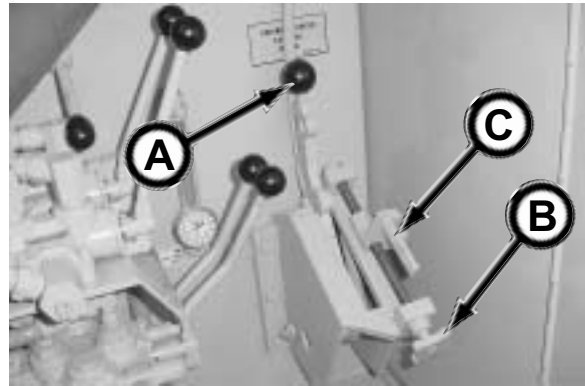


CABLE STROKER CONTROL

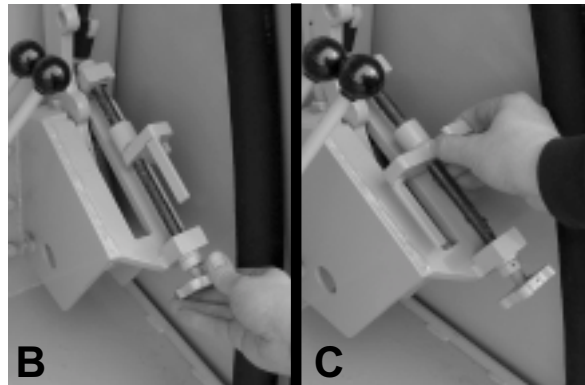
The cable stroker control (A), is a spring loaded, variable speed ram or jacking control.

Pull lever down to increase the ram or jacking speed.

Release lever to stop ram movement.



The hand wheel (B) is used to position handle stop (C) for ease of maintaining jacking speed at a desired rate.



CYLINDER VALVE

The cylinder valve (D) controls the ram lift cylinders and the dog control cylinder.

RAM LIFT CYLINDER LEVER (E)

⚠WARNING Pinch points! Watch your fingers, hands, and legs while equipment is in operation. Ram cylinders will drop instantly when the ram lift cylinder lever is released.

Move lever to raise the lift cylinders for mating the main ram cylinders to the yoke.

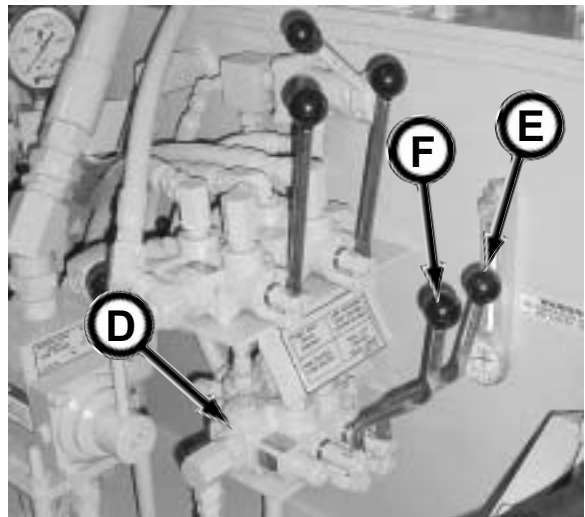
DOG CYLINDER LEVER (F)

Move lever to extend or retract dogs to lock or unlock with skid pockets.

Push-	dogs retracted (unlock)
Pull-	dogs extended (lock)

The dog position indicator (G) points to the left or right (while looking at front of pump unit) when the dogs are in the lock position.

The dog positioner points to the front (as shown) or back of the pump unit when the dogs are in the unlock position.



DRIVE VALVE

The drive valve (A) controls the pump unit drive movement on the skid assembly and the low pressure main ram cylinders for a faster extend and retract ram speed if high pressure is not required. For high speed extend and retract, use both the low pressure ram control lever and the cable stroker control.

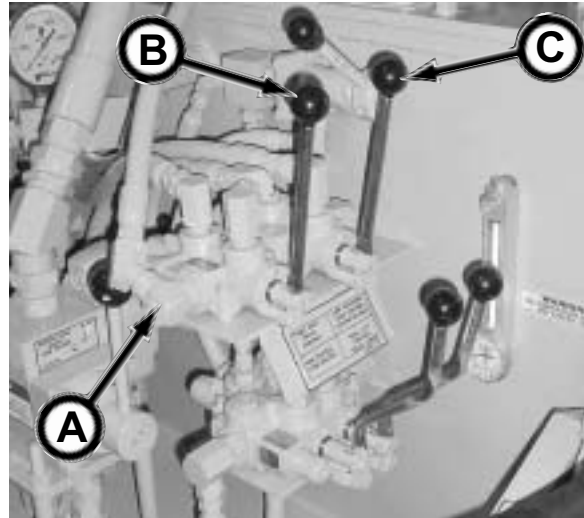
PUMP UNIT DRIVE LEVER (B)

Move lever to drive pump unit forward or backward.

Push- pump unit back
Pull- pump unit forward

LOW PRESSURE RAM CONTROL LEVER (C)

Move lever to extend and retract main ram jacking cylinders.



DUAL RAM & IJS CONTROL VALVE

This valve (D) controls the the main dual ram cylinders and the intermediate jacking station (IJS) cylinders.

MAIN DUAL RAM CYLINDERS

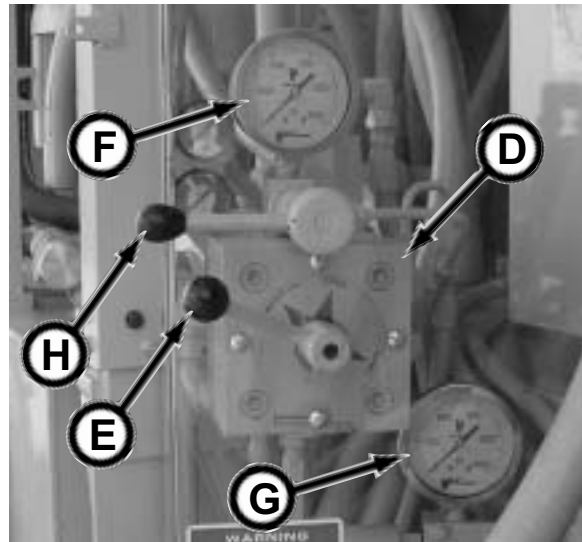
Move the selector (E) to the desired Extend or Retract, or Intermediate Jack position.

While jacking, watch system pressure gauge (F) to make sure pressure does not exceed 8,000 psi. If the system pressure exceeds the relief setting of 8,000 psi, operation will suspend, while retaining 8,000 psi in the pressure lines.

While jacking with IJS, watch the main ram cylinder extension pressure gauge (G) so it does not exceed 8,000 psi. Pressure on gauge will increase rapidly when the IJS cylinders are at the end of their stroke.

The Pressure Release Valve (H) is used to release high pressure from valve so the selector can be shifted. Valve MUST be closed to operate function on selector.

Clockwise- valve open
Counterclockwise- valve closed



MAIN RAM PRESSURE RELEASE VALVE

Use the Main Ram Pressure Release Valve to release high pressure from the main ram cylinders.

Clockwise (Up)- valve open
Counterclockwise (Down)- valve closed

NOTICE

Valve MUST be closed for operation of main rams.



FILTER INDICATOR GAUGES

To prevent under or over servicing of the hydraulic filter elements, filter indicator gauges have been installed on your 5000 Pump Unit.

CHARGE FILTER GAUGE (A).

The yellow band indicates the filters are functioning properly.

Replace both charge filters (see inset) when the filter indicator has a red band.

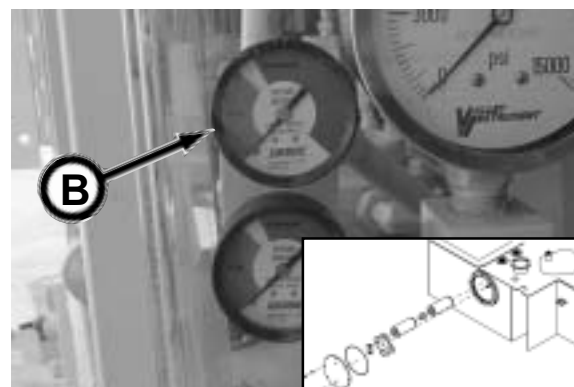


BORING HEAD RETURN FILTER GAUGE (B)

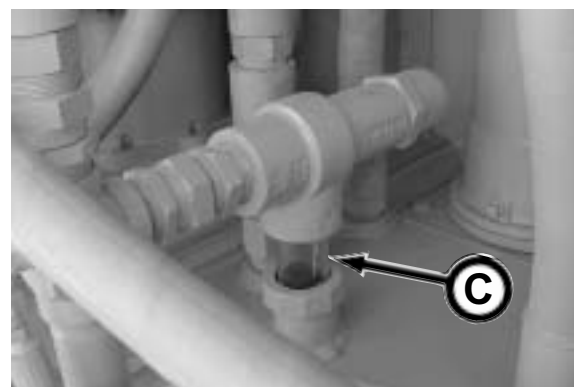
The green OK zone indicates that the filters are functioning properly.

The yellow zone indicates that the filters will soon require replacement.

Replace return filters (see inset) when the needle on the gauge is in the red CHANGE zone.



In the clear tube (C), hydraulic oil will be visible when oil is bypassing the Boring Head return filters, indicating the filters must be replaced immediately!



LOW PRESSURE SUPPLY/IJS RETURN FILTER GAUGE (D)

The green OK zone indicates that the filters are functioning properly.

The yellow zone indicates that the filters will soon require replacement.

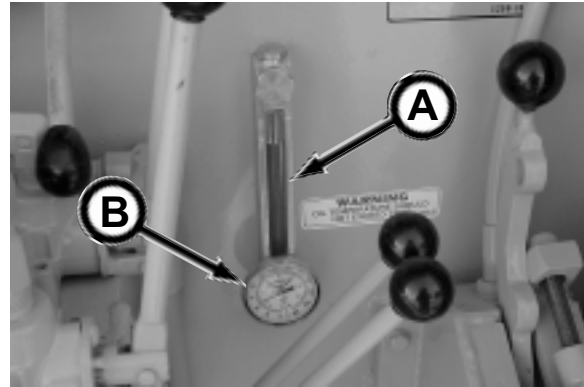
Replace filters (see inset) when the needle on the gauge is in the red CHANGE zone.



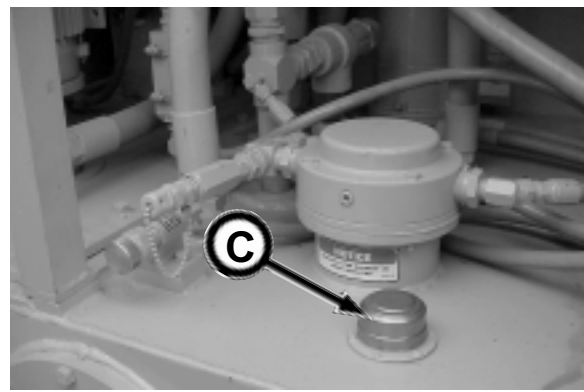
HYDRAULIC RESERVOIR

The hydraulic reservoir includes an oil level sight gauge (A) and temperature gauge (B).

The hydraulic oil temperature should not exceed 125 degrees F.



Remove the fill cap (C) to fill the hydraulic reservoir.



SMALL ENCLOSURE - AUXILIARY PUMP UNIT

⚠ WARNING DO NOT store anything in the small enclosure. Doing so could cause severe personal injury or death by coming in contact with high voltage.

The disconnect switch is used as a secondary lock out/tag out point to shut off the electrical power to the Auxiliary Pump Unit. Only a qualified electrician is to use the disconnect switch.

To disconnect electrical power, open the enclosure door (see inset) and flip the Disconnect Switch to the OFF position. The switch must be in the ON position for the Auxiliary Pump Unit to operate.



Disconnect Switch Shown In ON Position

Pre-Start Inspection

⚠ WARNING

Do not operate this equipment until you read, study, and understand this manual. A daily inspection of the equipment must be performed to prevent severe personal injury or death and equipment damage.

The contractor is fully responsible for the safety of all personnel on the job site. Check with the contractor that all site preparation requirements are in place. Be sure to comply with all OSHA regulations, such as: an active safety program is in practice, a confined space permit (if needed) is issued, personal protective equipment is being worn; flammable, combustible, and hazardous materials are properly stored; and a lockout/tagout procedure is in place.

Use the following checklist ✓ as a guide for your daily pre-start inspection.

	1. Use "ONE-CALL" notification to check for buried utility lines prior to tunneling.
	2. Check the excavated launch and reception pits or shafts for proper shoring or bracing to prevent slides or cave-ins.
	3. A qualified electrician must check that all electrical connections are properly secured and grounded prior to pump unit operation.
	4. The user's electrical distribution panel should be equipped with a ground-fault circuit interrupter for personnel protection.
	5. Thoroughly clean equipment of mud and dirt.
	6. Check condition of personal protective equipment. Replace equipment if defective.
	7. Contractor is responsible for all personnel to wear proper protective equipment on the job site.
	8. Remove combustible or flammable materials from equipment. Store materials properly.
	9. Test E-Stop (Emergency Stop) button for proper operation at the start of each shift.
	10. Test air monitoring and ventilation detectors for proper operation.
	11. Inspect pump unit, yoke, and skid for damage. Repair or replace as needed.
	12. Be sure all covers and guards are in place before operation.
	13. Be sure dogs are locked into skid.
	14. Check for proper motor rotation on all 3 electric motors.
	15. Check for loose or missing hardware. Replace damaged or missing hardware.
	16. Check for worn, loose, or damaged wire connections. Repair or replace wiring.
	17. Tighten loose clamps or fittings.
	18. Check wire harnesses for frayed or worn insulation or wires. Replace damaged or worn harnesses.
	19. No riders are allowed on the pump unit or yoke.
	20. Check for fluid leaks. Repair leak or replace components.
	21. Keep job site clean and organized.
	22. Check equipment for proper lubrication. Refer to Section 9, Periodic Maintenance.
	23. Remove all personnel from on or inside of yoke, on skid, or on or behind pump unit before jacking.
	24. Check for leaks in hydraulic hoses and/or lines (replace defective hoses and/or lines).
	25. Check hydraulic hoses and lines for wear and/or damage. Replace any defective hoses and/or lines.

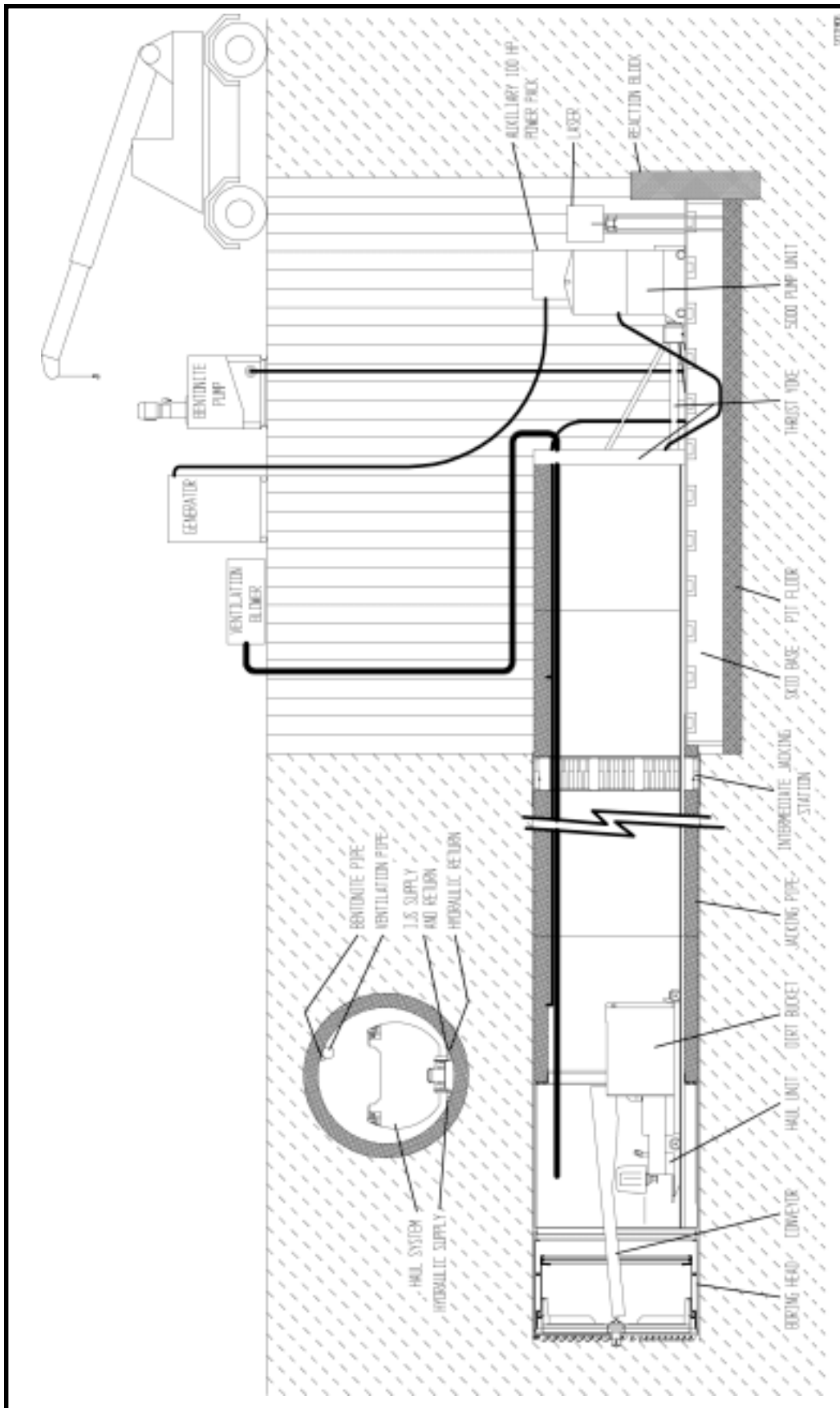
Operation

OPERATING GUIDELINES

⚠ WARNING Do not operate this equipment until you read, study, and understand this manual. Failure to do so, could result in severe personal injury or death.

1. Before operating, read and understand the Safety, Pre-Start Inspection, and Operation sections.
2. Do not operate this equipment while under the influence of alcohol, drugs, or medication.
3. Follow all Federal, State, and Local safety regulations and procedures.
4. Be sure OSHA prescribed safety protective equipment is being worn by all personnel.
5. Be sure the area is safe for operation. Keep worksite clean and orderly.
6. NEVER operate equipment if it has been engulfed with water. Contact your Akkerman Product Support representative for proper procedures on how to restore equipment for operation.
7. Have a fully charged fire extinguisher on the job site at all times.
8. Before operating, repair equipment problems.
9. Be sure the excavated launch and reception pits or shafts are properly shored or braced to prevent slides or cave-ins.
10. Test air monitoring and ventilation detectors for proper operation. Never enter a tunnel without detectors.
11. A fully trained and qualified signal person must direct the excavator or crane operator when lifting and lowering equipment into the launch or reception pits.
12. Never walk or work under any part of the excavator or crane and suspended loads.
13. Test the electrical motors for proper rotation prior to operating the pump unit.
14. Operate jacking system at lowest pressure possible to prevent excessive heat build up.
15. Operate all controls to make sure they work properly.
16. Pressure peaks cause hoses to jump without notice. Keep all personnel away from hoses during operation of equipment.
17. Lock out electrical power at the source (generator) before servicing electrical components.
18. Beware of pinch points.
19. If this manual is lost, contact your Akkerman Product Support Representative for a new manual or download this manual on the Akkerman web site at www.akkerman.com.
20. High pressure hydraulics are used on the jacking system. Be sure all covers and guards are in place before operating.
21. Check laser beam often to avoid mis-alignment. Keep boring head well ventilated to achieve a consistent temperature throughout the pipeline since changes in temperature inside the pipe can cause laser beam to stray off target.
22. Check line and grade alignment often.
23. Do not make any modifications to any Akkerman products. Doing so could cause structural failure and will void the warranty.
24. Do not make adjustments or repairs to the hydraulic system components while in operation or until all pressure is released and electrical power is locked out, tagged out.
25. Check shields and guards. They must be in place and undamaged.
26. At startup, be sure controls are in the OFF position.

TYPICAL 5000 PIPE JACKING SYSTEM LAYOUT

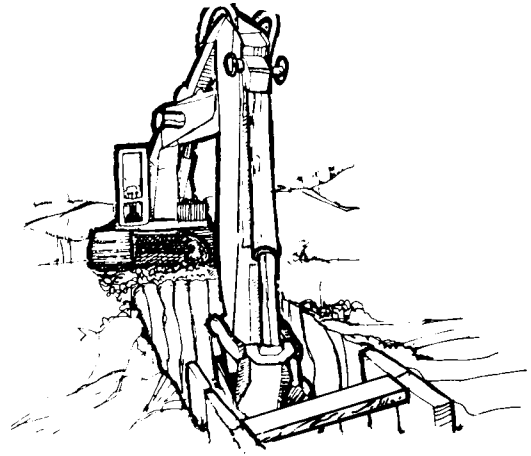


SETTING UP THE JACKING SYSTEM

1. The contractor is fully responsible for the design and construction of the OSHA required launch and reception pits. For setup and installation drawings specific to the project, pipe size and shoring type, contact the Akkerman Sales Department.

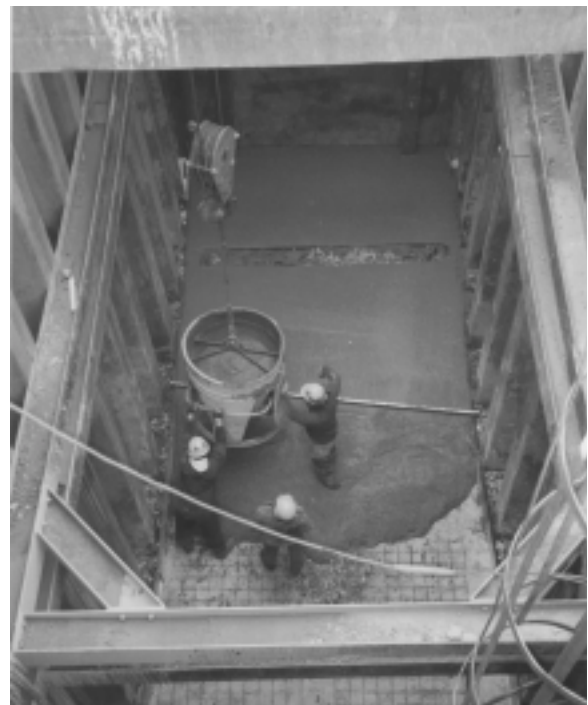
⚠ WARNING Gases may be present during excavation and could cause severe personal injury or death. Use an approved air analyzer to detect hazardous gases on the job site and in the tunnel at all times.

2. After the soil analysis, pit layout design, and survey are complete, excavate the launch and reception pits. Be sure the pits will be well drained and use proper shoring or bracing in accordance with your local, state, and federal regulations.

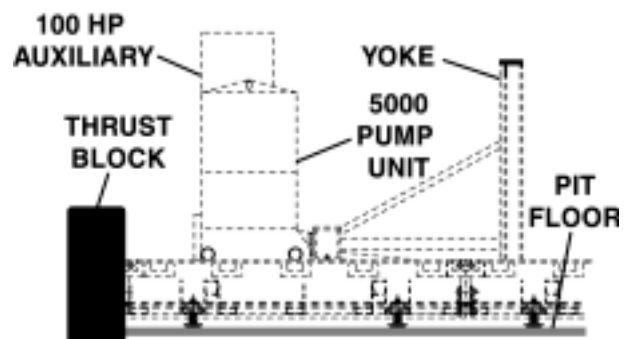


AEM is the original author and publisher of the above illustration

3. Construct a pit floor with a solid base suitable for the weight of the jacking system and pipe. Typically a pit uses 6 to 8 inches of stone for a dry pit or a 6 inch or more concrete base for a moist pit. Consult your civil and structural engineers for your pit floor requirements.
4. If using stone for the pit floor base, place road plates (1 inch plate of steel) or other solid material where the skid assembly leveling screws will be located to prevent jacking assembly from shifting during operation.

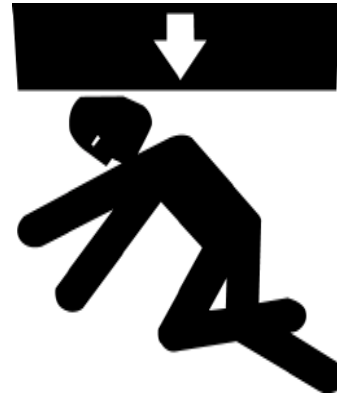


5. Construct concrete reaction block designed to withstand at least 400 tons of applied load. A structural engineer must be consulted on the design of this block. This block must be square with the line of the tunnel axis and skid assembly which will be added in the next step.

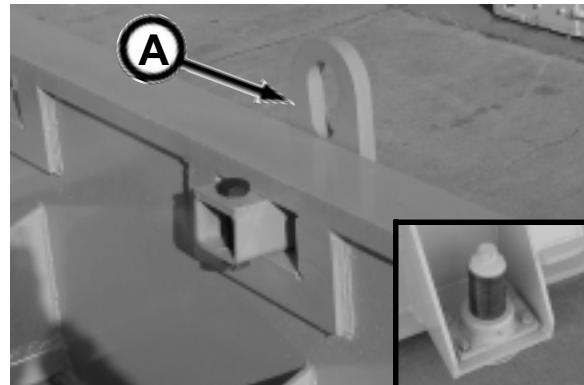


⚠WARNING Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.

NOTICE Be sure the crane or excavator and all lifting equipment is rated to lift load. Remember, you may be able to lift the load in close at ground level, but as the load radius and elevation change, the lifting capacity of the crane or excavator or other lifting equipment may decrease.

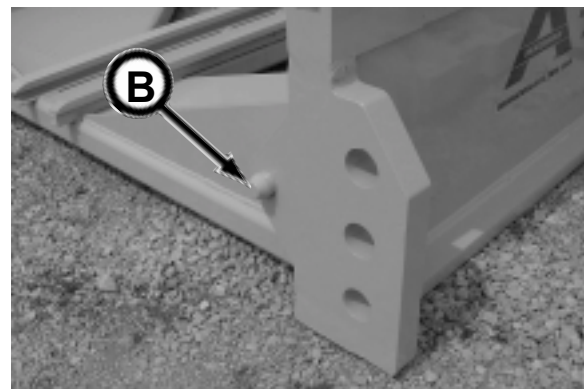


6. Lower skid assembly into launch pit using lift eye assemblies (A) and place against the thrust or reaction block. Correct the skid assembly line and grade with leveling screws (see inset).



If necessary, lower other skid assembly(s) into launch pit and mount to first skid assembly as follows.

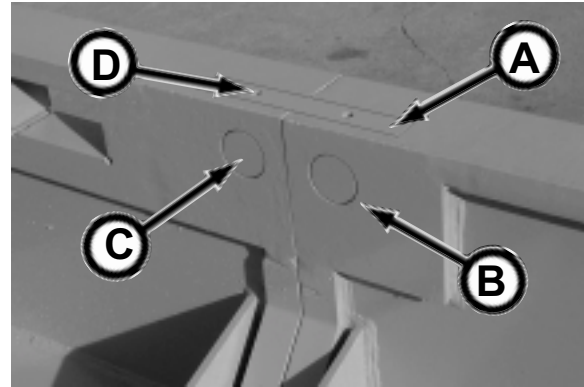
A. Align the skid sections using the locator pin (B).



B. When skid assemblies are properly aligned, mount with six 2 in. bolts and nuts.



C. To complete mounting, install skid split bars (A) into side skid base assembly making sure the holes of the bar line up with the holes (B) in the skid assembly. Insert skid split pins (C) with slot of pin at the 12 o'clock position for set screw. Secure skid split pin with set screws (D).



D. Continue mounting other skid sections, if required.

E. Check to make sure that the skid assembly is making full contact against thrust block.

NOTICE Both the left and right ends of the skid frame **MUST** be against thrust or reaction block, otherwise damage will occur to the skid frame during jacking operation.

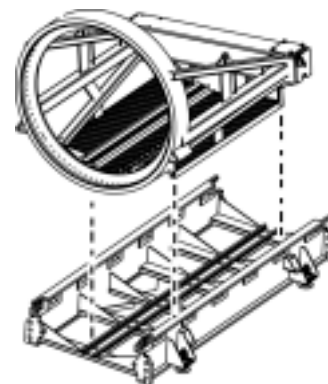


F. Once skid assemblies are properly joined, correct the skid assembly line and grade with leveling screws.

7. Lower the pump unit onto the skid assembly, checking to be sure the drive wheels are resting on the skid assembly top rails without bolster drag.



8. Lower the yoke onto the lower skid assembly rails, while making sure the yoke wheels are resting on the top skid assembly rails.



9. Lower tunnel boring machine (TBM) onto the front of the skid assembly, making sure the cutter teeth on the TBM will not strike the skid assembly when the cutter head is rotated.



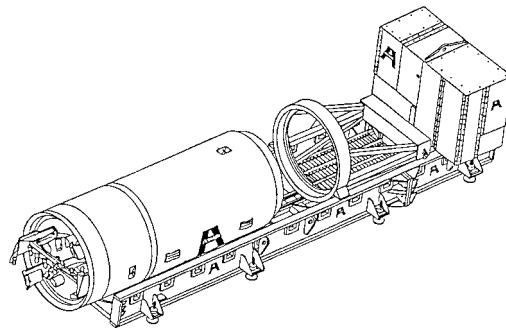
10. Lower the stand for the laser guidance system as close to the rear of the jacking pit as possible without contacting skid assembly or pump unit. Be sure the guidance system will not be affected by thrust applied to jacking system.



For proper guidance system installation, refer to your laser manufacturer's installation requirements. Be sure laser beam has a clear path to target.



11. Recheck the jacking system base grade and alignment. Check machine elevation and make final pipe line calculations allowing for the cutter bit "over cut."
12. Set up the 5000 Pump Unit for operation. Refer to Setting Up The Pump Unit - Start-Up Check in this section.



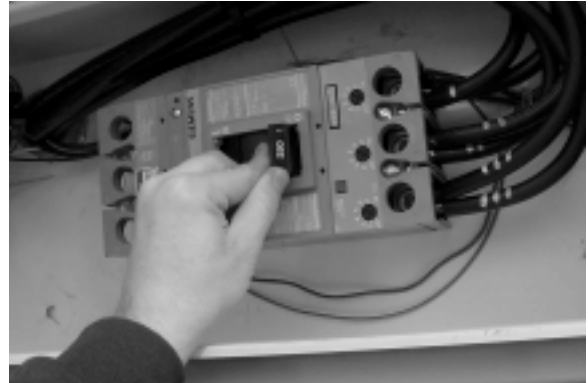
PREPARING PUMP UNIT FOR OPERATION

1. Clean equipment thoroughly.
2. Check to make sure all decals including safety decals are clean and readable.
3. Check condition of wires and cables. Repair or replace as necessary.
4. Remove the cylinder corrosion preventive from the cylinder rods if it is not compatible with hydraulic oil or seal materials.
5. Check for leaks. Repair or replace as necessary.
6. Readjust drive chain tension to 1/4 to 1/2" deflection at the midpoint of the chain.
7. Check condition of all hoses and connections. Tighten, repair or replace with new as needed.
8. Before operating, be sure the jacking system, pump unit, and auxiliary pump unit are properly set up, and cycle hydraulic functions several times to purge air from the hydraulic system.

SETTING UP THE 5000 PUMP UNIT - START-UP CHECK

⚠WARNING Any electrical work completed on the jacking system **MUST** be performed by a certified electrician.

1. Turn OFF your main power source and perform the Lockout/Tagout procedure.
2. Test to ensure no voltage is present.
3. Open Disconnect Switch enclosure. Be sure the disconnect switch is in the OFF position.



4. Push E-Stop button IN to prevent accidental starting of electric motors.



5. Make high voltage connection 480 VAC, 60 cycle, 3 phase to the input power of disconnect switch. For other voltage connections, contact your Akkerman Product Support representative.

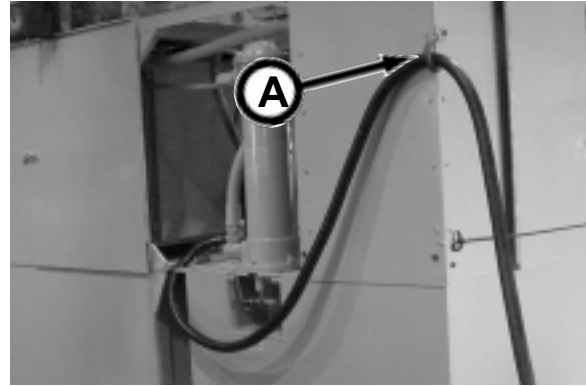


6. Properly secure power cable strain relief connector (A).

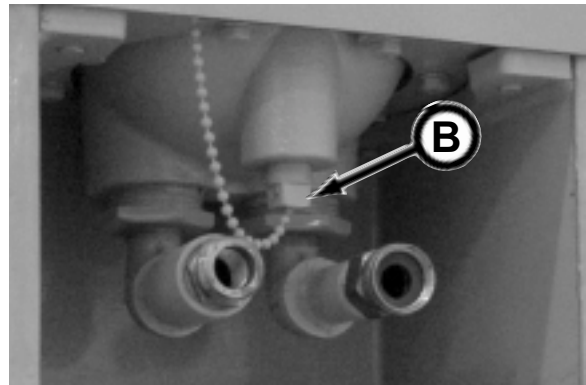
7. Close and fasten the disconnect switch enclosure cover.



8. Fasten the power cord around hook (A). Be sure the power cord does not come in contact with any moving parts.



9. Install heat exchanger drain plug (B).



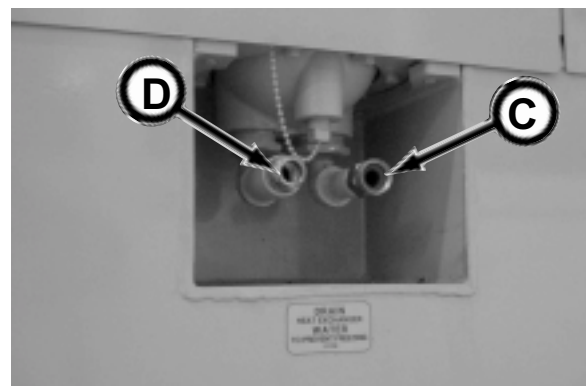
10. Connect a clean water supply hose with 15 GPM minimum to heat exchanger fitting (C).

⚠ WARNING To avoid serious personal injury, the water discharge must not flow into any electrical or machine areas and must drain safely away from the pump unit.

11. Connect a water discharge hose to heat exchanger (D).

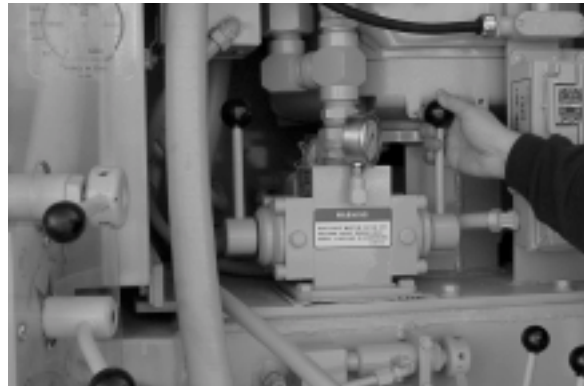
Be sure hoses do not come in contact with moving parts.

NOTICE Be sure to drain heat exchanger in cold weather. If heat exchanger freezes without being drained, damage will occur to the heat exchanger internal parts resulting in improper oil cooling and potential water contamination in the oil.



TESTING 5000 PUMP UNIT ELECTRIC MOTOR OPERATION

12. Move all Boring Head and Auxiliary dual valve controls completely UP to the OFF position.



Boring Head Dual Valve OFF



Auxiliary Pump Unit Dual Valve OFF

⚠ WARNING Any electrical work completed on the jacking system **MUST** be performed by a certified electrician.

13. Turn ON main power source.
14. Open disconnect switch enclosure and turn ON disconnect switch.



15. Close and securely fasten the disconnect switch enclosure cover.

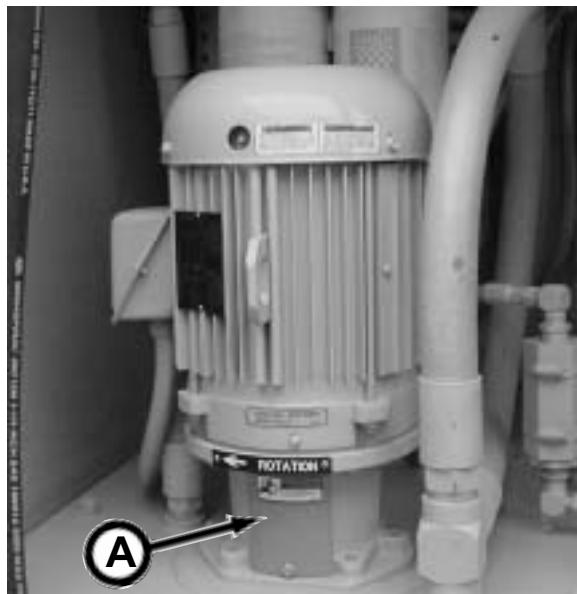


16. Pull OUT E-Stop button. The 5 HP motor will start rotating.



17. Check motor shaft for proper rotation. A rotation arrow is located on the motor base. Loosen inspection cover (A) and move cover to check motor rotation. Once checked, replace and retighten cover.

If rotation is incorrect, have your certified electrician perform the following procedure. Push E-STOP button IN, turn disconnect switch OFF, and LOCKOUT the main power source. Test to ensure no voltage is present, then rewire for proper rotation. Then turn on main power source and disconnect switch, and repeat steps 16 and 17 to recheck for proper motor rotation.



18. Push IN E-STOP button to stop 5 HP motor. This will check to be sure the E-STOP button is functioning properly. If the motor does not stop, LOCKOUT the main power source and have an electrician repair the E-STOP immediately!



19. Pull OUT E-STOP button to start 5 HP motor.

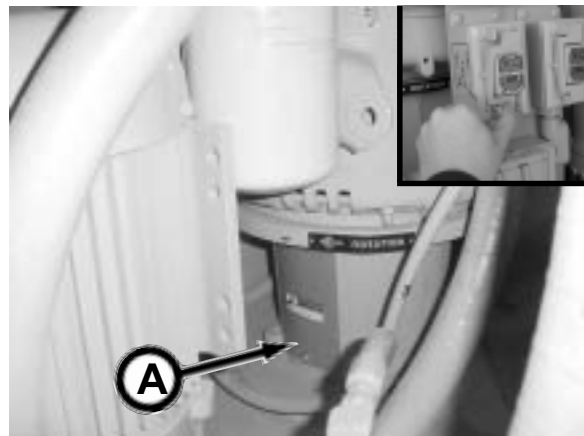


20. Depress the Pump Unit power switch to START position to start 50 HP motor.



21. Check motor shaft for proper rotation. A rotation arrow is located on the motor base. Loosen inspection cover (A) and move cover to check motor rotation. Once checked, replace and retighten cover. Then depress Pump Unit power switch to STOP position (see inset).

If rotation is incorrect, have your certified electrician perform the following procedure. Push E-STOP button IN, turn disconnect switch OFF, and LOCKOUT the main power source. Test to ensure no voltage is present, then rewire for proper rotation. Then turn on main power source and disconnect switch, pull out E-STOP button, and repeat steps 20 and 21 to recheck for proper motor rotation.



22. Push IN E-STOP button to stop 5 HP motor and 50 HP motor. This will check to be sure the E-STOP button is functioning properly. If the motors do not stop, LOCKOUT the main power source and have an electrician repair the E-STOP immediately!



23. Pull OUT E-STOP button to start 5 HP motor.

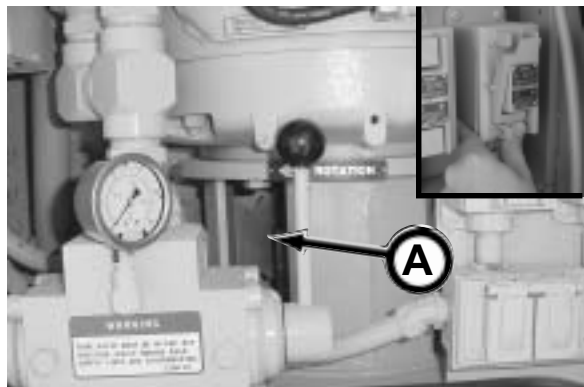


24. Depress the Boring Head power switch to START position to start the 100 HP motor.



25. Check motor shaft (A) for proper rotation. A rotation arrow is located on the motor base. Once checked, depress Boring Head power switch to the STOP position (see inset).

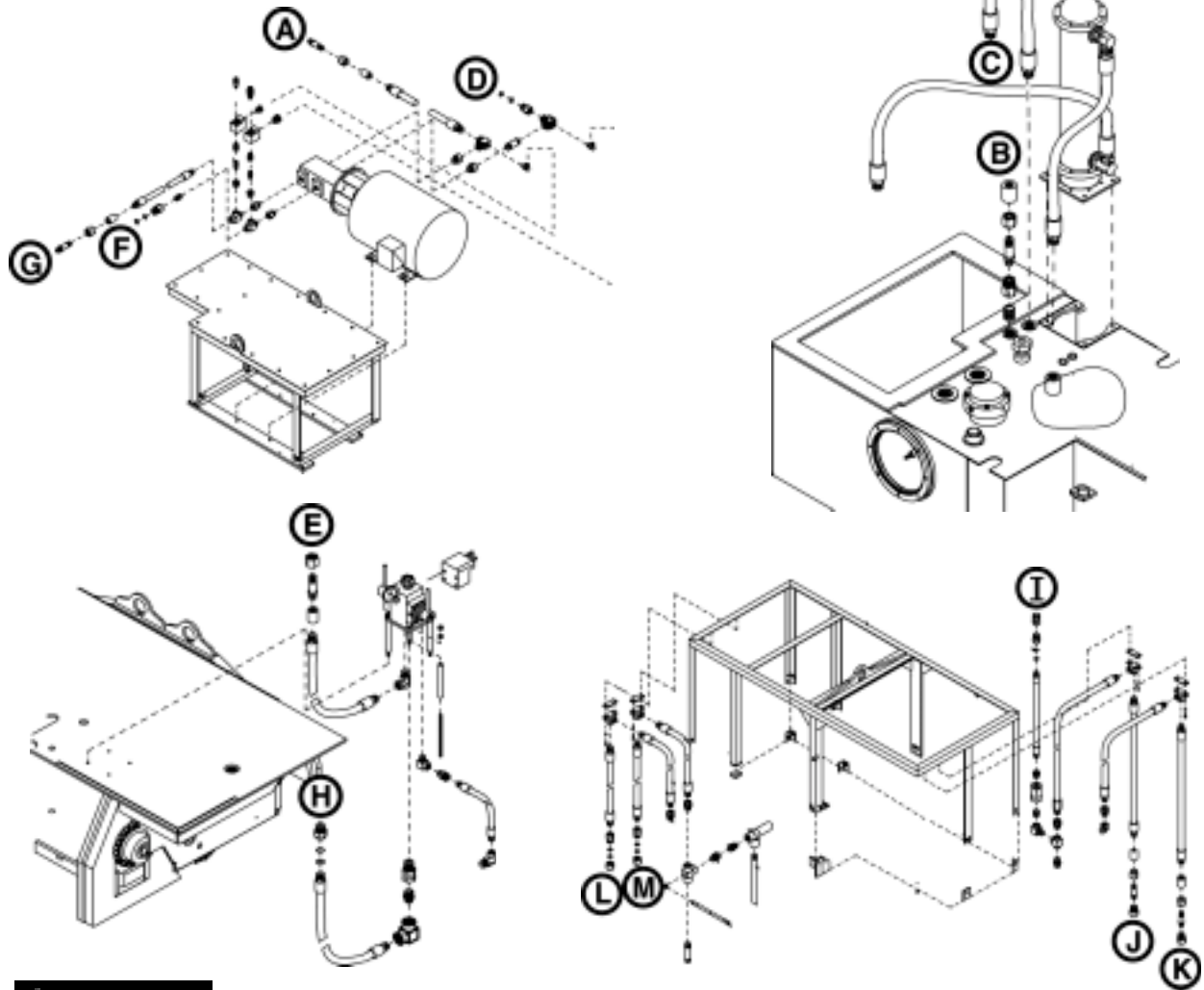
If rotation is incorrect, have your certified electrician perform the following procedure. Depress E-Stop button, turn disconnect switch OFF, and LOCKOUT the power source. Test to ensure no voltage is present, then have the electrician rewire for proper rotation. Then turn on main power source and disconnect switch, pull out E-STOP button, and repeat steps 24 and 25 to recheck for proper motor rotation.



26. Push IN E-STOP button to stop 5 HP motor and 100 HP motor. This will check to be sure the E-STOP button is functioning properly. If the motors do not stop, LOCKOUT the main power source and have an electrician repair the E-STOP immediately!
27. After Start-Up Check procedure is complete, set up the Auxiliary Pump Unit, if equipped, see Setting Up The Auxiliary Pump Unit in this section, otherwise proceed to Setting Up The Pump Unit & TBM Supply/Return Hydraulics in this section.



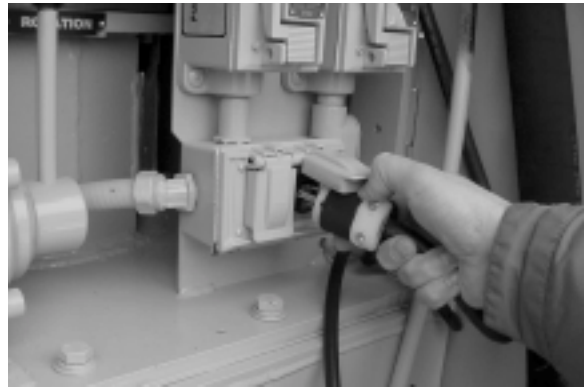
SETTING UP THE AUXILIARY PUMP UNIT



⚠ WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury. Contact medical help immediately if any oil or fluid is injected into your skin. ALWAYS switch power supply switches to the STOP position, move dual control valves to the OFF position, AND use gloves before connecting or disconnecting hydraulic oil hoses/lines.

1. Mount the Auxiliary Unit on the roof of the 5000 Pump Unit and secure with four 1/2 x 1-1/2 in. mounting screws.
2. Connect hose connection (A) from Auxiliary Unit to suction coupler (B) on 5000 Pump Unit.
3. Connect hose connection (C) on 5000 Pump Unit to pump suction port (D) on Auxiliary Unit.
4. Connect hose connection (E) on 5000 Pump Unit to hydraulic pump fitting (F) on Auxiliary Unit.
5. **For 60 gpm conveyor drive/60 gpm cutter drive:** Connect hydraulic hose connection (G) on Auxiliary Unit to auxiliary supply connection (H) on 5000 Pump Unit.
6. **For 30 gpm conveyor drive/90 gpm cutter drive:** Connect hydraulic hose connection (G) on Auxiliary Unit to hydraulic hose connection (I) on 5000 Pump Unit.
6. Connect supply hose connection (J) to Boring Head cutter drive hose, controlled by Boring Head Dual Control.
7. Connect supply hose connection (K) to Boring Head conveyor drive hose, controlled by Auxiliary Dual Control.
8. Connect Boring Head hydraulic return hose to hose connection (L) on 5000 Pump Unit.
9. Connect Conveyor hydraulic return hose to hose connection (M) on 5000 Pump Unit. (continued on next page)

10. Install start/stop switch, if not equipped, to 100 HP electric motor lift eye and secure with clamp.
11. Plug in Start/Stop switch to 110 AC outlet on pump unit.



12. Make twist lock plug connection from start/stop switch junction to Auxiliary Unit plug connection.

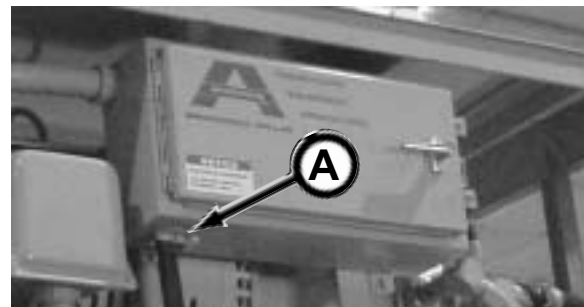


⚠WARNING Any electrical work completed on the jacking system **MUST** be performed by a certified electrician.

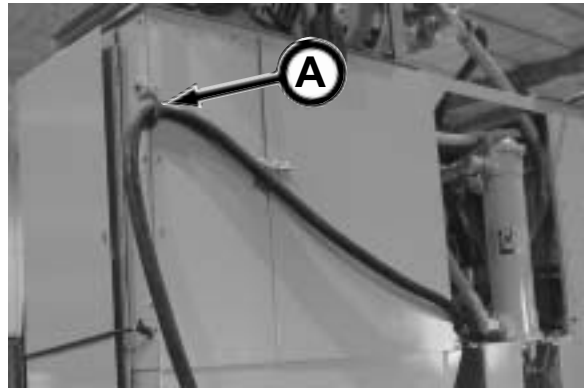
13. Turn OFF your main power source and perform the Lockout/Tagout procedure.
14. Test to ensure no voltage is present.
15. Open small enclosure on Auxiliary Unit. Be sure the disconnect switch is in the OFF position.
16. Make high voltage connection 480 VAC, 60 cycle, 3 phase to the input power of disconnect switch. For other voltage connections, contact your Akkerman Product Support representative.



17. Properly secure power cable strain relief connector (A).
18. Close and fasten the small enclosure cover.



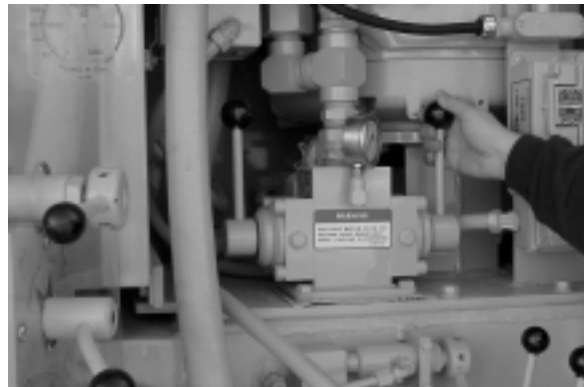
19. Fasten the power cord around hook (A).



TESTING AUXILIARY PUMP UNIT ELECTRIC MOTOR ROTATION

⚠WARNING Any electrical work completed on the jacking system **MUST** be performed by a certified electrician.

20. Move all dual valve controls completely UP to the OFF position.



Boring Head Dual Valve OFF



Auxiliary Pump Unit Dual Valve OFF

21. Turn ON main power source for the Auxiliary Pump Unit.
22. Turn ON disconnect switch on the Auxiliary Pump Unit.

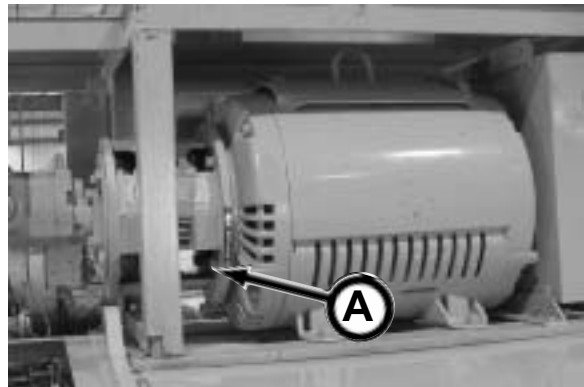


23. Depress Auxiliary power switch to START position.



24. Check motor shaft (A) for proper rotation. A rotation arrow is located on the motor base. Once checked, depress Auxiliary power switch to the STOP position.

If rotation is incorrect, have your certified electrician perform the following procedure. Turn disconnect switch OFF, and LOCKOUT the main power source for both the 5000 Pump Unit and the Auxiliary Pump Unit. Test to ensure no voltage is present, then rewire for proper rotation. Then turn on auxiliary main power source and disconnect switch, and repeat steps 23 and 24 to recheck for proper motor rotation.



25. Depress Auxiliary power switch to STOP position.



26. Turn disconnect switch OFF.



27. Close and fasten the disconnect switch small enclosure cover.
28. LOCKOUT the power source.
29. After setting up Auxiliary Pump Unit procedure is complete, proceed to Setting Up The Pump Unit & TBM Supply/Return Hydraulics in this section.



SETTING UP THE PUMP UNIT & TBM SUPPLY/RETURN HYDRAULICS

There are two hydraulic supply/return options available for setting up the 5000 Pump Unit/Auxiliary Pump Unit with the Tunnel Boring Machine; single feed supply and dual feed supply.

The single feed option supplies 60 gpm of low pressure oil to the boring head, steering, and spoil conveyor.

The dual feed option supplies an additional 60 gpm of low pressure oil with the use of the Auxiliary Pump Unit. Typically the main boring head supply will run the boring head, and steering of the TBM. The auxiliary supply primarily powers the conveyor unit. Though the auxiliary supply can power the conveyor and provide additional power to the boring head, using the TBM gear divider.

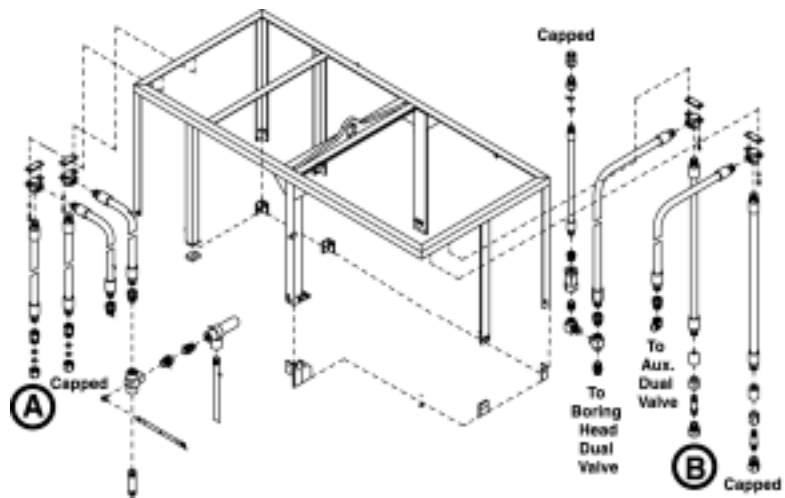
⚠ WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury. Contact medical help immediately if any oil or fluid is injected into your skin. ALWAYS switch power supply switches to the STOP position, move dual control valves to the OFF position, AND use gloves before connecting or disconnecting hydraulic oil hoses/lines.

Single Feed

Connect return line quick coupler (A) to the TBM return line quick coupler.

Connect supply quick coupler (B) to the TBM supply quick coupler.

Note the hoses that must be capped for the single feed option.



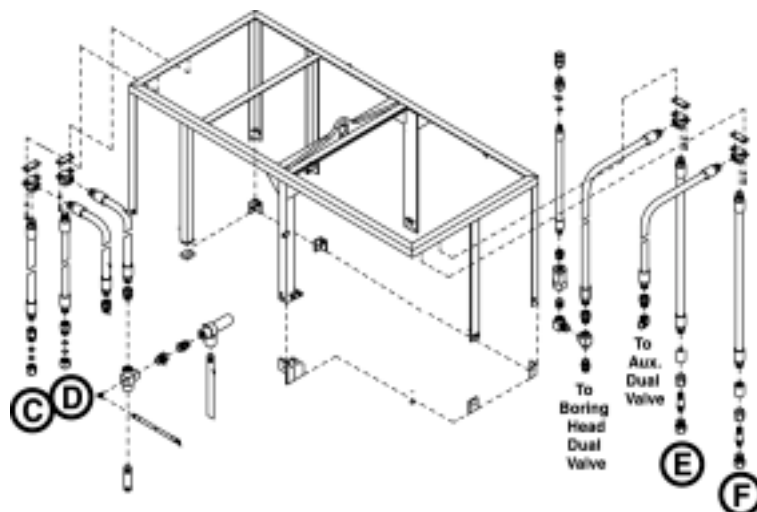
Dual Feed

Connect return line quick coupler (C) to the TBM return line quick coupler.

Connect return line quick coupler (D) to the conveyor/auxiliary return line quick coupler.

Connect supply quick coupler (E) to the TBM supply quick coupler.

Connect supply quick coupler (F) to the conveyor/auxiliary supply quick coupler.



OPERATING THE PUMP UNIT

There are several steps to safely operate the Pump Unit. Be sure to follow these steps until you have studied and understand how to properly operate the Pump Unit.

For ease of referencing certain pump unit operation procedures at a later date, subsections are listed below with the corresponding page number(s).

- A. Attaching Main Jacking Rams To Yoke, pg 6-20 - 6-22
- B. Positioning Pump Unit/Yoke With TBM, pg 6-22
- C. Installing Conveyor & Dirt Bucket, pg 6-23
- D. Positioning TBM For Jacking Operation, pg 6-23 - 6-25
- E. Jacking Operation, pg 6-25 - 6-33

⚠ WARNING FAILURE TO LOCKOUT POWER BEFORE SERVICING CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

This machine is powered by high-voltage electricity. LOCKOUT main power supply before servicing. Electrical repairs must be performed only by a certified electrician.

NOTICE NEVER operate equipment if it has been engulfed with water. Contact your Akkerman Product Support representative for proper procedures on how to restore equipment for operation.

NOTICE Recheck jacking system line and grade often.

A. ATTACH MAIN JACKING RAMS TO YOKE

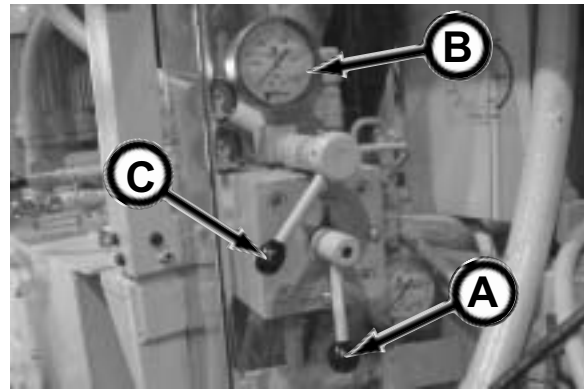
1. With the power source(s) properly connected to the Pump Unit and Auxiliary (if used) and the Disconnect Switches turned ON, pull the E-Stop button Out.



2. Start the high pressure motor by pressing START on Pump Unit power switch.



3. If selector is not in the Extend position, move the dual ram control valve selector (A) to Extend position. If the system pressure gauge (B) indicates pressure, open pressure release valve by rotating handle (B) clockwise (CW) to relieve pressure. Then close pressure release valve by rotating handle counterclockwise (CCW). After pressure is released, move selector to desired position.



4. Operate cable stroker control lever until rams are at the yoke ram cradles.



5. Start the low pressure motor by pressing START on Boring Head power switch.

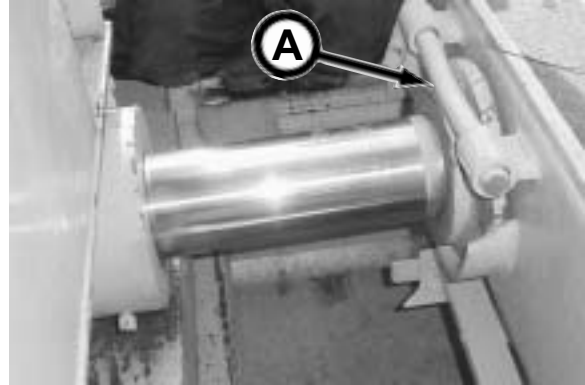


⚠WARNING PINCH POINTS! Watch your fingers, hands, and legs while equipment is in operation. Ram cylinders will drop instantly when the ram lift cylinder is released.

6. Use ram lift cylinder lever to lift rams onto the yoke ram cradles. You may need to move the main rams into position for locking.



- Secure pump unit dual rams to yoke ram cradles with locking pins (A). This will allow the yoke to move with the pump unit when it is being retracted.

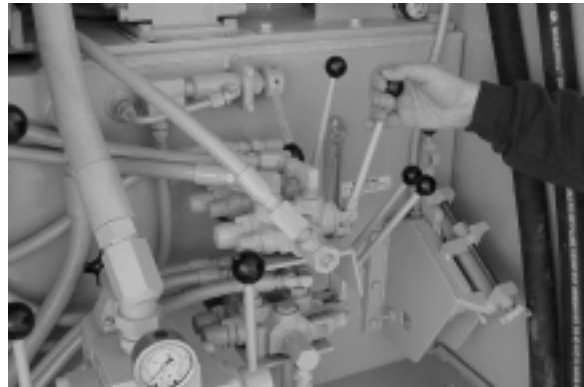


B. POSITIONING PUMP UNIT/YOKE WITH TBM

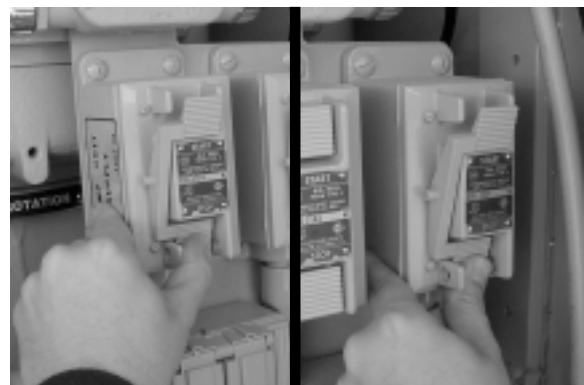
⚠ WARNING Unexpected Jacking System movement may cause riders to slip or fall resulting in serious personal injury.

Do not allow riders on the Pump Unit or the Yoke when they are moving.

- Move pump unit drive lever to drive the pump unit and yoke into position behind tunnel boring machine (TBM).



- Stop the Pump Unit by turning the Power Unit power supply to STOP and stop the Boring Head by turning the Boring Head power supply to STOP.



*Pump Unit
Power Supply OFF*

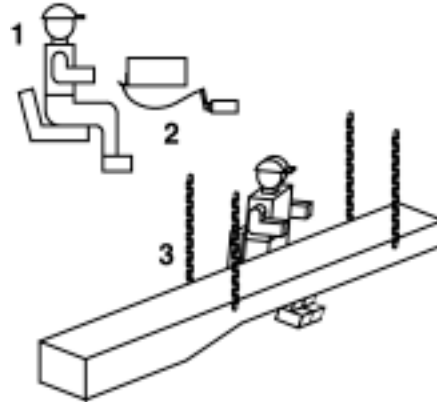
*Boring Head
Power Supply OFF*

C. INSTALLING CONVEYOR & DIRT BUCKET

⚠ WARNING Conveyor can jam in rotating cutterhead causing conveyor to swing into operator, resulting in severe personal injury.

While cutterhead is rotating:

- 1) Operator **MUST** remain seated in normal operating position.
- 2) Cutter head drive dump valve **MUST** be tethered to conveyor.
- 3) **ALL FOUR** safety chains **MUST** be secured to conveyor before operating inner drum.



10. Install conveyor. Be sure safety chains are mounted to conveyor and dump valve is tethered to conveyor.

NOTICE There are certain combinations of yokes and conveyors that will not allow the conveyor to be installed with the yoke against the TBM. In these situations, move yoke back until there is enough room to install the conveyor. Then remate the yoke with the TBM.

11. Connect pump unit hydraulics to TBM hydraulics. Refer to Setting Up The Pump Unit & TBM Supply/Return Hydraulics in this section for proper hose connections.



⚠ WARNING Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.

12. Lower dirt bucket into yoke behind conveyor.



D. POSITIONING TBM FOR JACKING OPERATION

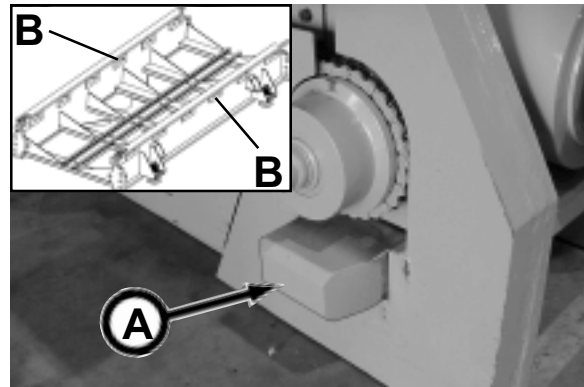
13. Start the low pressure motor by pressing **START** on Boring Head power switch.



- Lock pump unit dogs (A) into skid pockets (B) by operating the dog control valve. The dogs must be fully engaged into skid pockets before jacking.

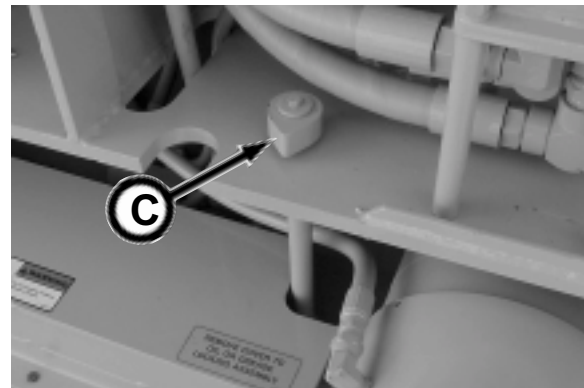
NOTICE

You will periodically have to reposition the dogs; at end of jacking ram cylinder stroke, or when unloading dirt bucket.



The dog position indicator (C) will point to the left or right side of the pump unit, looking at front of pump unit, when dogs are extended.

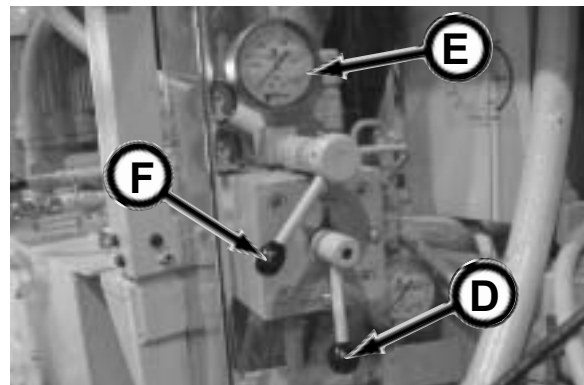
The position indicator will point forward or back of pump unit when dogs are retracted.



- Start the high pressure motor by pressing START on Pump Unit power switch.



- If selector is not in the Extend position, move the dual ram control valve selector (D) to Extend position. If the system pressure gauge (E) indicates pressure, open pressure release valve by rotating handle (F) clockwise CW to relieve pressure. Then close pressure release valve by rotating handle counterclockwise (CCW). After pressure is released, move selector to desired position.



17. Use the Cable Stroker control to move the yoke and Tunnel Boring Machine (TBM) along the skid rail until the TBM is at the area to be tunneled.



E. JACKING OPERATION

18. With the Pump Unit and Boring Head motors running, start the Auxiliary motor (if equipped) by pressing START on Auxiliary Power Supply switch.



19. Turn on the Boring Head and Auxiliary (if used) low and high volume by moving both levers completely down. The TBM operator controls the boring head, conveyor, etc. The Pump Unit operator controls the oil flow to the TBM components and high pressure jacking cylinders.

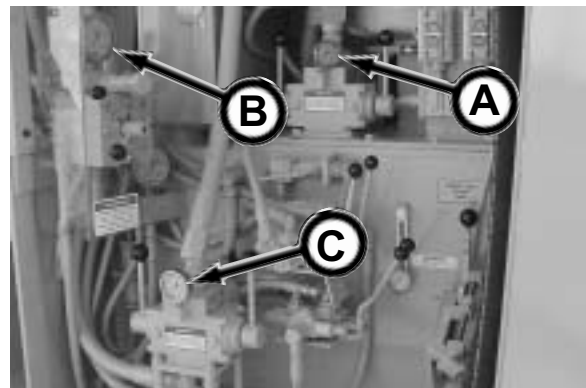


NOTICE Before rotating the cutter head, make sure the cutter teeth will not interfere with skid frame.

*Boring Head
Dual Valve Volume ON* *Auxiliary
Dual Valve Volume ON*

20. Start jacking and watch boring head pressure gauge (A), high pressure gauge (B), and auxiliary pressure gauge (C), if auxiliary power is used.

The normal working pressure for the low pressure system in firm soils is 2,200 psi. The low pressure system will start to slow down or go over relief at 2,600 psi and will be completely over relief at 2,800 psi suspending operation, while retaining 2,800 psi within the pressure lines. When this happens, the Pump Unit operator must stop jacking, and the TBM operator must either rotate the cutter head back and forth to loosen the obstruction, or the operator can move the drum advance back to remove the obstruction or change teeth. High pressure in the low pressure system may also be a result of hard ground.



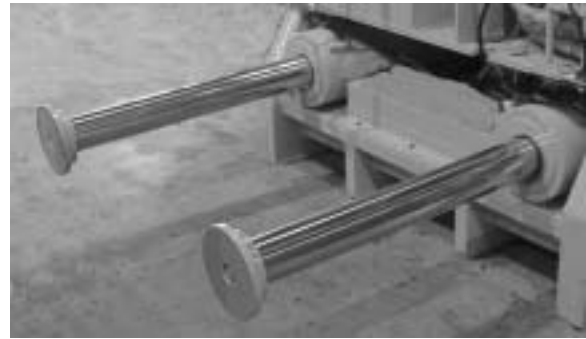
The high pressure maximum system pressure is 8,000 psi.

21. When the main rams are fully extended, the rams will stop and the jacking system pressure gauge indicates, as a general rule, decreased pressure due to the relief valve at the end of the ram cylinders.

NOTICE

The extended cylinders are shown without the skid and yoke for photographic purposes only.

At this time, you will need to unload the dirt bucket (if needed) and redog. See steps 22 through 29.



WARNING

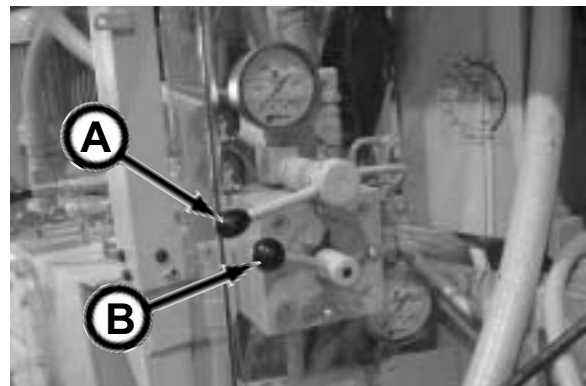
Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.

22. Unload dirt bucket.



23. Release pressure on the selector valve, if necessary, by moving the pressure release valve (A) CW. Once pressure is released, close the valve by moving the pressure release valve CCW.

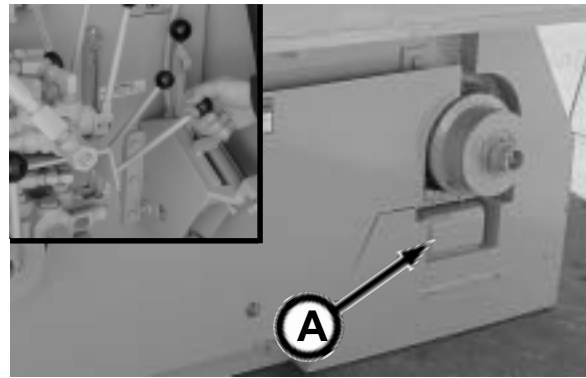
24. Move the selector valve (B) from Extend to Retract.



25. Release pressure on the main rams by moving the pressure release valve CW. Once pressure is released, close the valve by moving the pressure release valve CCW (as shown).



26. Disengage dogs (A) from skid using dog control (inset).



27. Retract main ram cylinders using low pressure system (for faster retraction) or high pressure system.

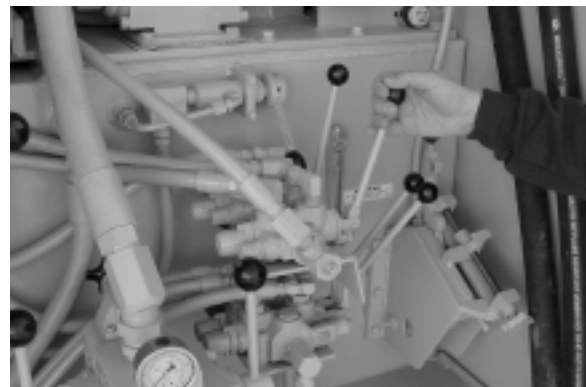
NOTICE If yoke retracts with the main rams, you must engage the drive motor, as stated in step 28, to keep the yoke in contact with the pipe.



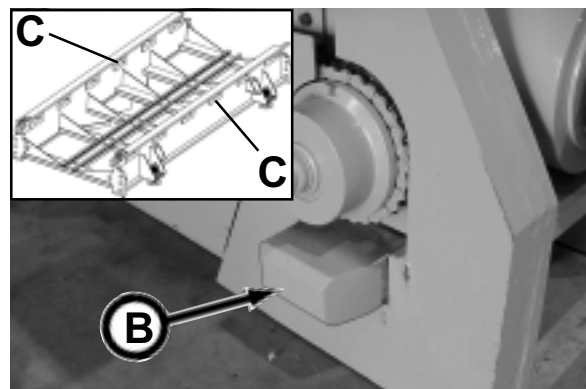
*Low Pressure
Ram Control*

*High Pressure
Ram Control*

28. Move pump unit forward with drive control.

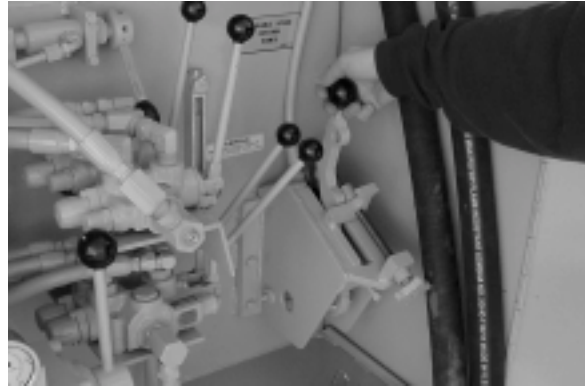


29. Lock pump unit dogs (B) into skid pockets (C) by operating the dog control valve. The dogs must be fully engaged into skid pockets before jacking.



CAUTION Pressure peaks cause hoses to jump without notice. Keep all personnel away from hoses during operation of equipment.

30. Continue jacking until the TBM has been jacked far enough into the ground to get enough space for one section of pipe.



31. Stop the Pump Unit, Boring Head, and Auxiliary motors by turning the power supply switches to STOP.



Pump Unit Power Supply OFF

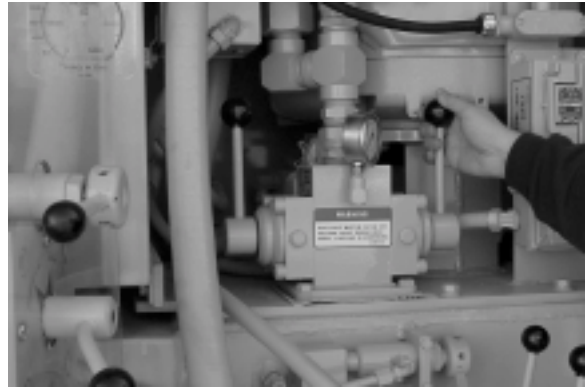


Boring Head Power Supply OFF



Auxiliary Power Supply OFF

32. Return all control valves to the OFF position.



Boring Head Dual Valve Volume OFF

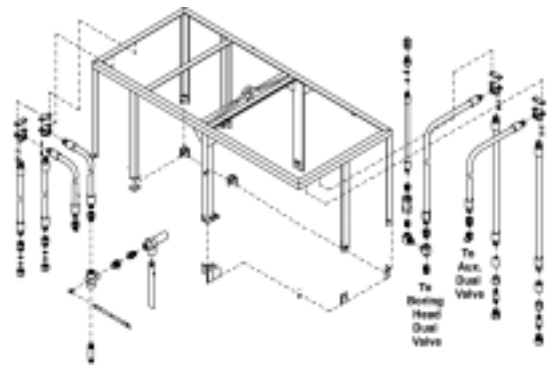


Auxiliary Pump Unit Dual Valve Volume OFF

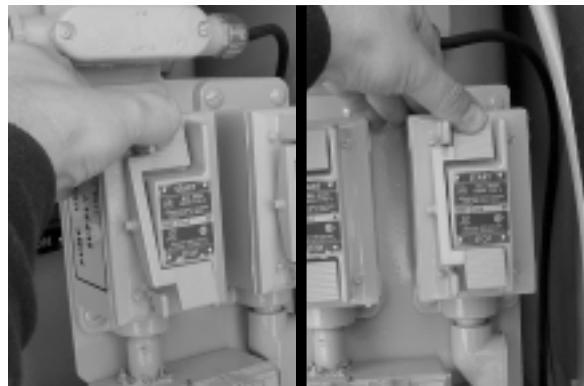
⚠WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury. Contact medical help immediately if any oil or fluid is injected into your skin.

ALWAYS switch power supply switches to the STOP position, move dual control valves to the OFF position, AND use gloves before connecting or disconnecting hydraulic oil hoses/lines.

33. Disconnect pump unit supply and return line hoses from boring head supply and return line hoses. Cap hoses.



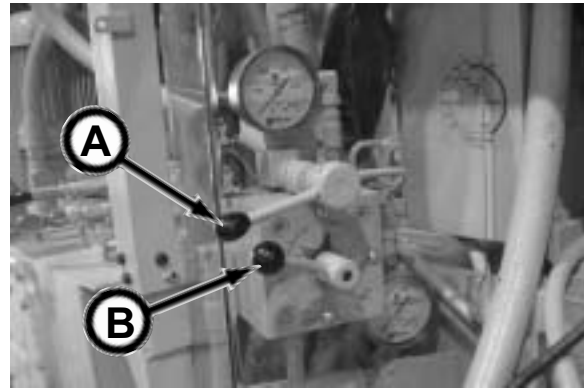
34. Start the Pump Unit and Boring Head by depressing START on Pump Unit and Boring Head power switches.



*Pump Unit
Power Supply ON*

*Boring Head
Power Supply ON*

35. Release pressure on the selector valve, if necessary, by moving the pressure release valve (A) CW. Once pressure is released, close the valve by moving the pressure release valve CCW.



36. Move the selector valve (B) from Extend to Retract.

37. Release pressure on the main rams by moving the pressure release valve CW. Once pressure is released, close the valve by moving the pressure release valve CCW (as shown).



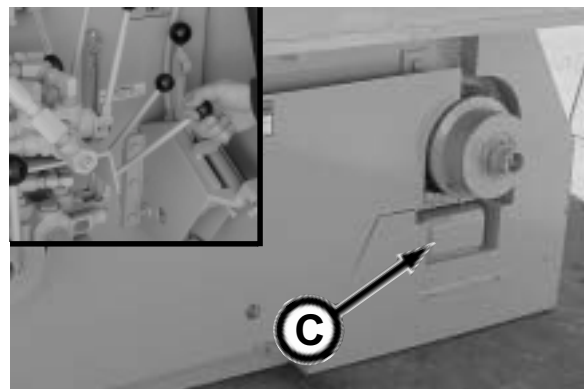
38. Retract cylinders using low pressure system (for faster retraction) or high pressure system.



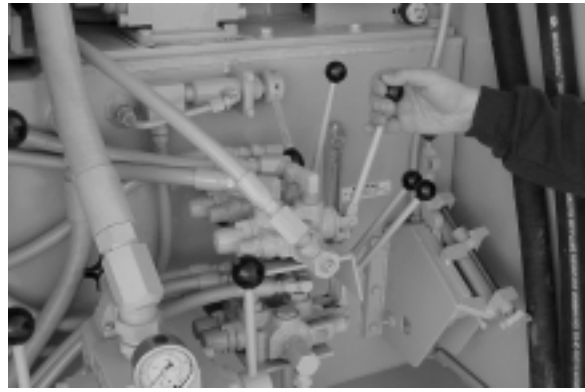
*Low Pressure
Ram Control*

*High Pressure
Ram Control*

39. Disengage dogs (C) from skid using dog control (inset).



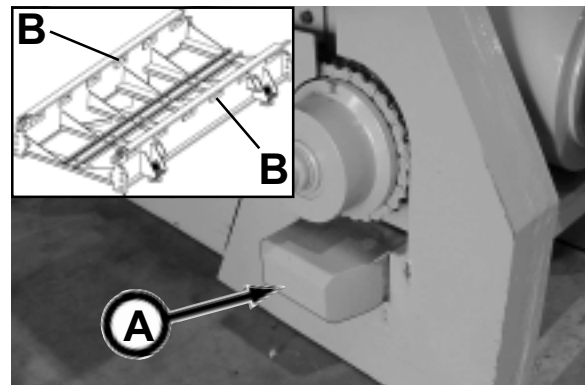
40. With drive control, move pump unit and yoke back far enough to lower the first section of pipe.



41. Lower the first section of pipe into position on skid between the TBM and yoke. Generally, the female end of the pipe will be towards the TBM. Then drive up to back of pipe to mate the yoke with the pipe.



42. Lock pump unit dogs (A) into skid pockets (B) by operating the dog control valve. The dogs must be fully engaged into skid pockets before jacking.



43. With selector at Extend position, jack until trailing section mates with the TBM.

NOTICE Redogging may be necessary.

44. Install first track section and secure to TBM. Refer to your Haul Unit Operator's Manual for track installation.

NOTICE Sections of track will need to be added as new pipe are lowered. Also, be sure there is always track connecting the pipeline and the yoke, for the haul unit and the loading and unloading of the dirt bucket.

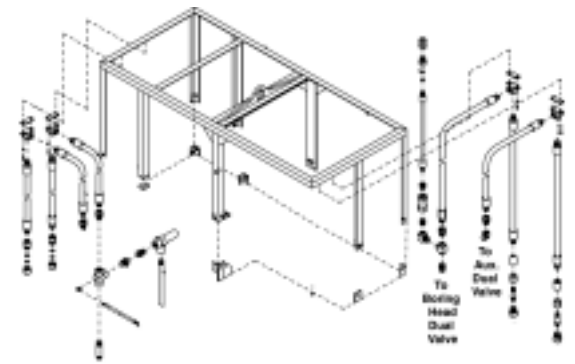


45. Stop Pump Unit by depressing STOP on power switch.



WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury. Contact medical help immediately if any oil or fluid is injected into your skin. ALWAYS switch power supply switches to the STOP position, move dual control valves to the OFF position, AND use gloves before connecting or disconnecting hydraulic oil hoses/lines.

46. Reconnect pump unit and boring head supply and return line hoses, adding additional hoses as necessary.



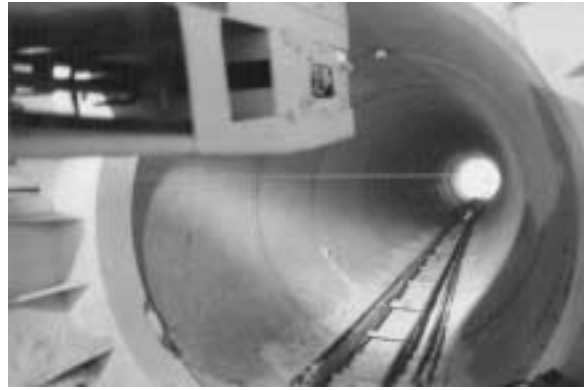
WARNING Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.

47. Lower haul unit into place with battery box end toward the TBM. Refer to your Haul Unit Operator's Manual for haul unit installation.
48. Lower dirt bucket into place on the haul unit. The haul unit will then be moved to the front of the tunnel until the dirt bucket is underneath the conveyor.



⚠ DANGER Staring into laser light will cause severe injury. Do not stare into laser guidance system light beam. Avoid direct eye exposure.

49. Recheck laser guidance system accuracy often, with and without forward thrust applied, to avoid making improper steering corrections. The conveyor must be raised to check line and grade target.



NOTICE If there is a possibility that the maximum jacking capability of 400 tons may be exceeded, Intermediate Jacking Stations should be installed. See Using Intermediate Jacking Stations in this section.



50. Continue jacking until pipe line is complete. When pipe line is complete, refer to Removing Jacking System in this section.



USING INTERMEDIATE JACKING STATIONS (IJS)

Intermediate Jacking Stations (IJS) are generally used when the thrust pressure reaches one third of the maximum pressure capacity of the pump unit or one half of the thrust capacity of the IJS, which ever occurs first. Contact the Akkerman Sales Department for more information on the proper setup and usage of IJS.

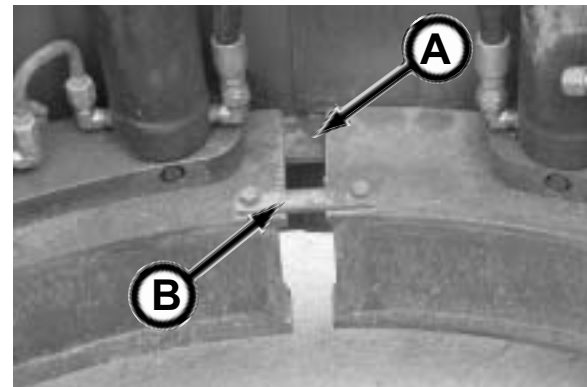
INSTALLING IJS

⚠WARNING Suspended loads may fall and cause severe injury or death. Do not allow anyone to enter area under or around a suspended load.

1. Lower IJS with the inner ring towards the front of the tunnel, between the leading pipe and the trailing pipe.



2. Cut inner ring flange (A), located at seam of sleeve, with torch and unbolt plate (B) before mating pipe with IJS.



⚠WARNING Pinch Points! Watch your fingers, hands, and legs while installing IJS sleeve.

3. SLOWLY jack until the trailing pipe slides into IJS sleeve and the IJS sleeve slides over leading pipe.

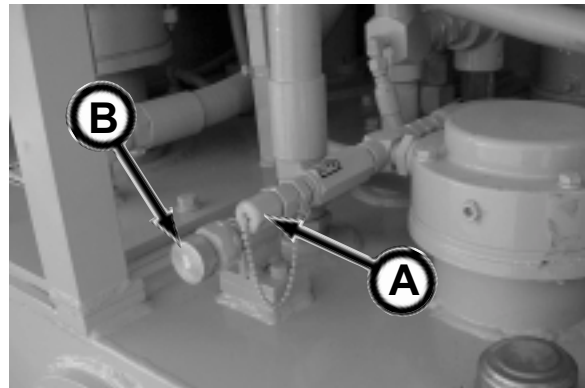


4. Use a winch or turn-buckle to squeeze the IJS sleeve until it mates with the leading and trailing pipe.
5. Tack weld seam.
6. Torch off lifting eyes.
7. Completely weld seam. Reweld flange (A) if possible.
8. Install track and sliding track. Be sure no track joints are in IJS opening.



9. Connect hydraulic hoses to Pump Unit.

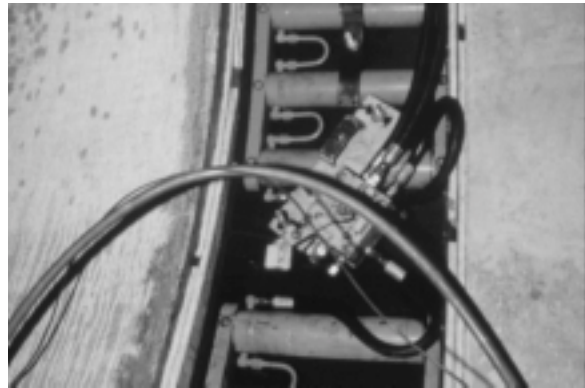
- a. Connect quick coupler (A) to intermediate jacking station valve pressure port. Use hose rated for 8,000 psi working pressure ONLY.
- b. Connect coupler (B) to the IJS tunnel return line.



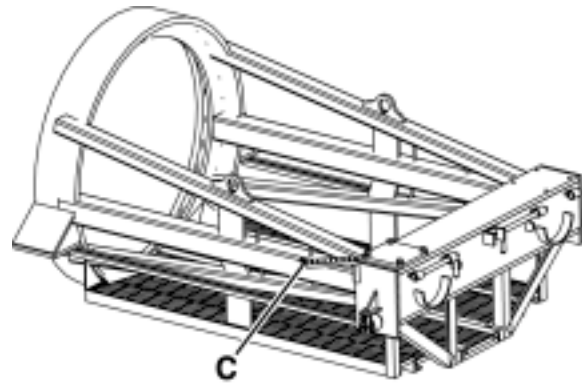
10. Mount the IJS valve between cylinder segments.

11. Connect hydraulic hoses to IJS valve:

- a. Pressure to port P
- b. Return to port T
- c. Connect cylinders to C ports



12. Secure cable weight to IJS line holder (C) on yoke.



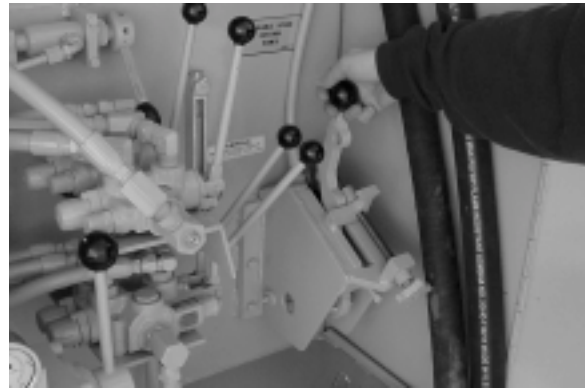
OPERATING IJS

13. With the Pump Unit running, set selector valve to Intermediate Jack (as shown).

14. Be sure pressure release valve is closed.



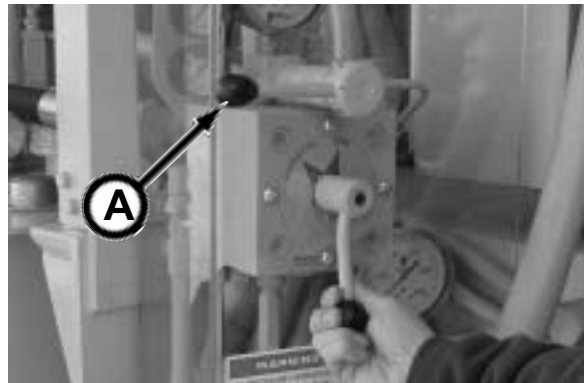
15. Pull cable for IJS #1 to open valve and operate stroker control. Operate the boring head the same as if the TBM is being jacked with the main ram cylinders.
16. When the IJS cylinders are at full extension, the pressure should start to climb rapidly.
17. Release cable and stroker control.
18. Pull cable for IJS #2 to open and operate stroker control to close IJS #1. When the IJS cylinders are at full extension, the pressure should start to climb rapidly.



NOTICE

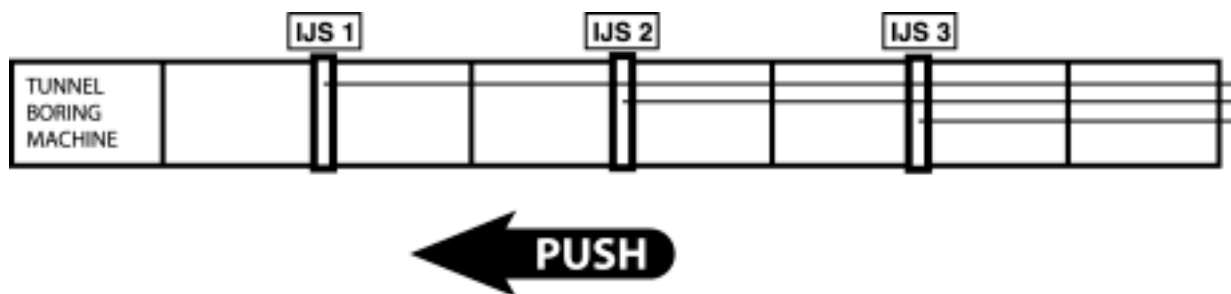
Do not operate TBM cutterhead when using IJS #2, IJS #3, etc. or when closing final IJS.

19. Release cable and stroker control.
20. Pull cable for IJS #3 to open and operate stroker control to close IJS #2. When the IJS cylinders are at full extension, the pressure should start to climb rapidly.
21. Release cable and stroker control.
22. Repeat this opening and closing process for any additional IJS.
23. Release selector valve pressure by moving pressure release (A) CW. After pressure is released, move the pressure release valve CCW to close the valve.
24. Set selector valve to Extend position. Continue jacking with main rams using the stroker control to close the last IJS.



NOTICE

Keep in mind when using the Intermediate Jacking Stations, you are mining with IJS #1, closing IJS #1 with IJS #2, closing IJS #2 with IJS #3, and closing IJS #3 with main rams.



Intermediate Jacking Station Sequence

REMOVING JACKING SYSTEM

⚠ WARNING Any electrical work completed on the jacking system **MUST** be performed by a certified electrician.

When pipe line is complete:

1. LOCKOUT power source(s). Turn Disconnect Switch OFF on Pump Unit and Auxiliary Pump Unit (if used). Disconnect electrical connections to Disconnect Switches.



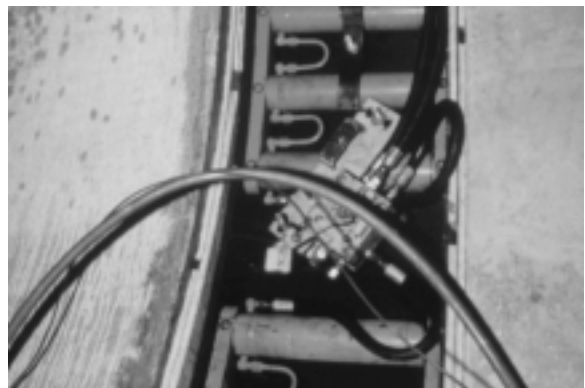
⚠ WARNING Escaping oil or other fluids under pressure can penetrate your skin causing serious injury. Contact medical help immediately if any oil or fluid is injected into your skin.

ALWAYS use gloves when connecting or disconnecting hydraulic oil hoses/lines.



NOTICE If using Intermediate Jacking Stations, the outer shell will remain in pipe line.

2. If IJS are used:
 - a. Remove IJS #1 valve, cylinder segments, and cap hoses, lines, valve and cylinder ports. Cut off valve and cylinder segment bolts. Close IJS #1 gap by operating IJS #2.
 - b. Remove IJS #2 valve, cylinder segments, and cap hoses, lines, valve and cylinder ports. Cut off valve and cylinder segment bolts. Close IJS #2 gap by operating IJS #3.
 - c. Remove IJS #3 valve, cylinder segments, and cap hoses, lines, valve and cylinder ports. Cut off valve and cylinder segment bolts. Close IJS #3 gap by operating main rams (if IJS #3 is the last IJS).
3. Disconnect hydraulic hoses and lines from inside of TBM and cap hoses.



NOTICE Reclaim oil from hydraulic hoses.

⚠ WARNING Suspended loads may fall and cause severe personal injury or death. Do not allow anyone to enter area under or around a suspended load.



4. Remove TBM.



5. Remove track.

6. Remove Pump Unit/Auxiliary, yoke, and skid(s).

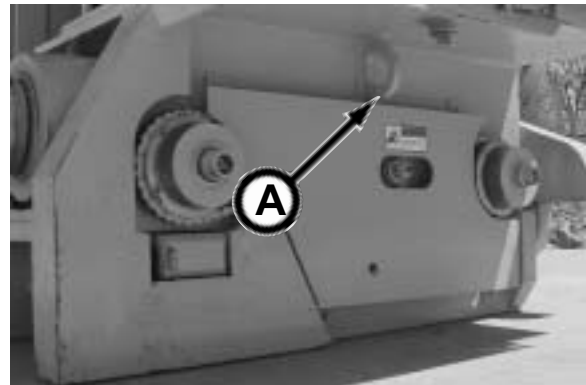


Transporting

TRANSPORTING GUIDELINES

1. Know the local, state, and federal transportation regulations.
2. Obtain required permits for transporting.
3. Remove any obstacles from the trailer floor.
4. Clean debris from Pump Unit.
5. Load and unload on level ground.
6. Securely fasten cab doors prior to shipping to prevent damage to pump unit components.
7. Use chains to fasten the pump unit (see 9 below), auxiliary pump unit, yoke, skid, and intermediate jacking stations to trailer floor.
8. Use straps around pump unit cab assembly for added protection during shipment.

9. Use tie down eyes (A) (2 places) to secure Pump Unit to trailer floor.



Lubricants

NOTICE

Use of inferior lubricants can affect the efficient performance of your 5000 Jacking System. Always use high quality lubricants as specified in this section. Refer to the Periodic Maintenance section for proper lubrication quantity, maintenance intervals, and procedures.

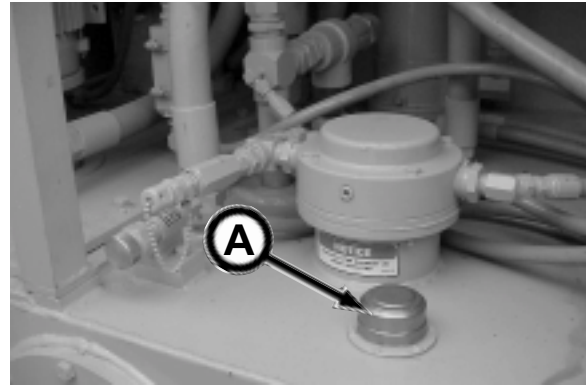
TANK LUBRICANT

The 5000 Pump Unit is filled with ISO-VG-46 20W Premium Hydraulic/Turbine Oil.

Use an API GL-1/GL-2 or equivalent when adding or changing lubricant. Replace oil cap (A).

NOTICE

If you change to a different oil, use a reputable oil supplier to meet or exceed the ISO-VG-46 20W or API GL-1/GL-2 oil specification. Do not mix oil manufacturers or grades.

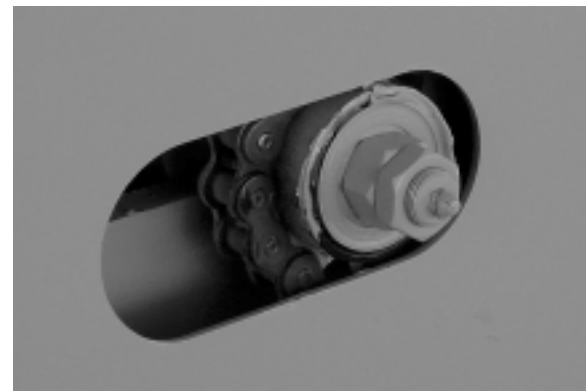


GREASE

The lubrication points are greased with Mobilgrease® XHP222 Premium Lubricating Grease.

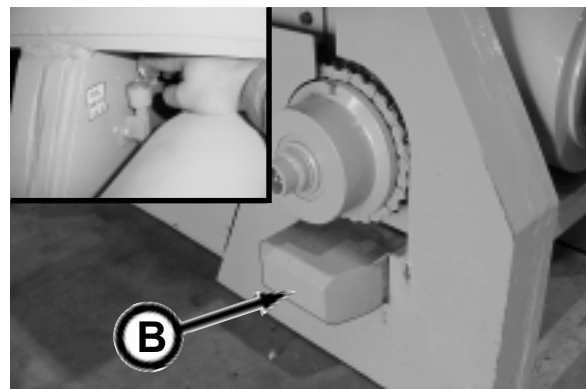
The XHP222 grease is a multi-purpose, high performance, high temperature, lithium grease.

Use Mobilgrease® XHP222 Premium Lubricating Grease or equivalent when lubricating the lubrication points.



DOG LUBRICANT

Lubricate the dogs (B) with a light weight SAE 10W, 20W, or 30W motor oil.



STORING LUBRICANTS

Your equipment can operate at maximum performance only if clean lubricants are used. Use clean containers to handle all lubricants.

Lubricants should be stored in an area protected from dust, moisture, and other contaminants.

Periodic Maintenance

⚠ WARNING Review the Safety section in this manual before performing maintenance. Failure to do so, could cause severe injury or death.

The requirements for lubrication and maintenance are shown on the maintenance charts in this section. Intervals of maintenance are based on normal operating conditions. If operating under more difficult conditions, use a shorter time interval between maintenance.

LOCKOUT POWER BEFORE SERVICING

⚠ WARNING Severe personal injury or death can result from unexpected pump unit startup or machine movement.

LOCKOUT power before attempting to make repairs or adjustments to this equipment, unless otherwise indicated. Proper lockout will prevent accidents and save lives. Performing the lockout will also prevent the equipment from moving or operating unexpectedly.



1. Disconnect the power source from the pump unit and the auxiliary pump unit (if used).
2. Push E-STOP button in.



3. On the 5000 Pump Unit, open disconnect switch enclosure and turn disconnect switch OFF. Close and securely fasten disconnect switch enclosure cover (inset).

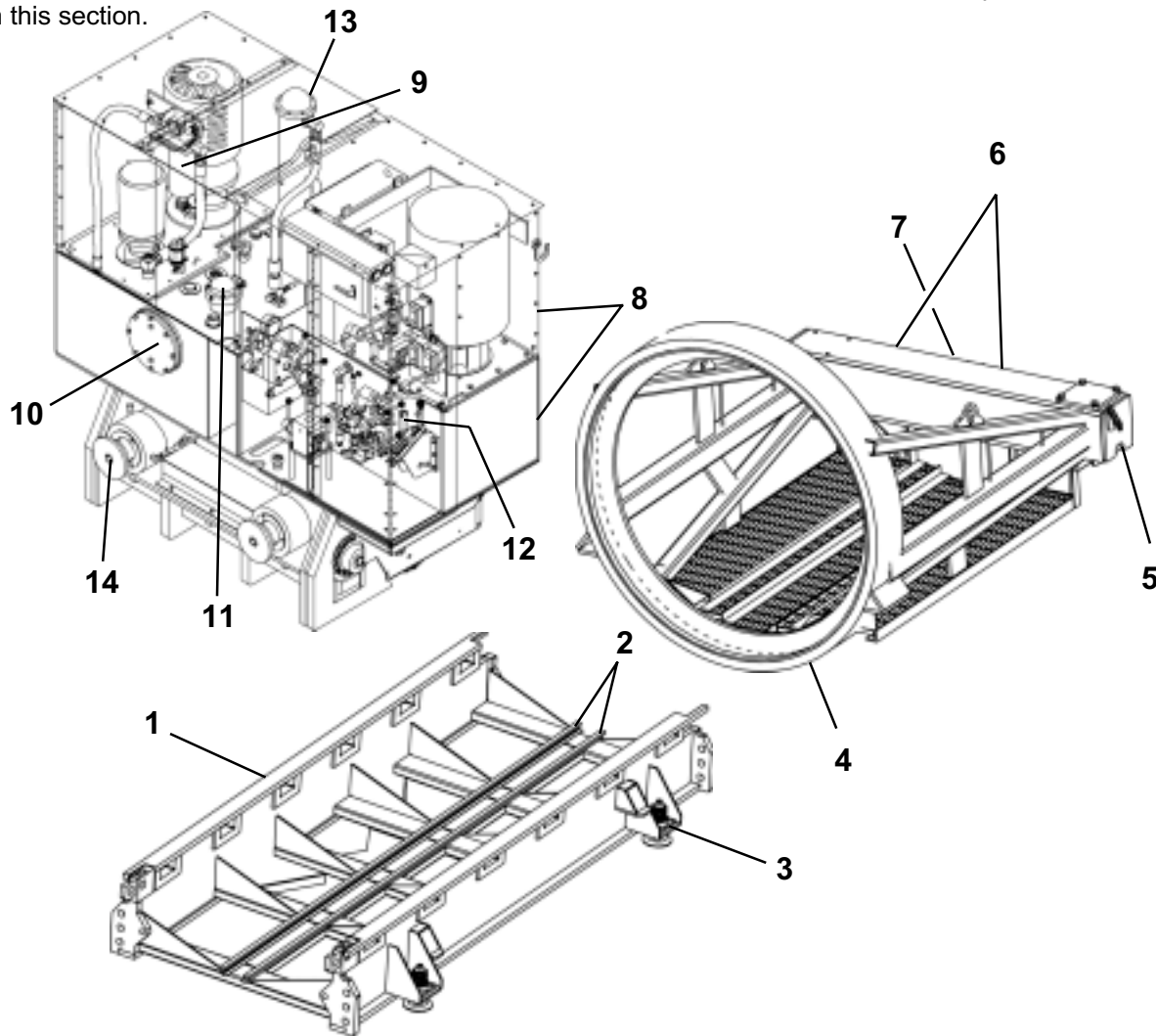


4. On the Auxiliary Pump Unit, open small enclosure and turn disconnect switch OFF. Close and securely fasten small enclosure cover (inset).



MAINTENANCE CHARTS

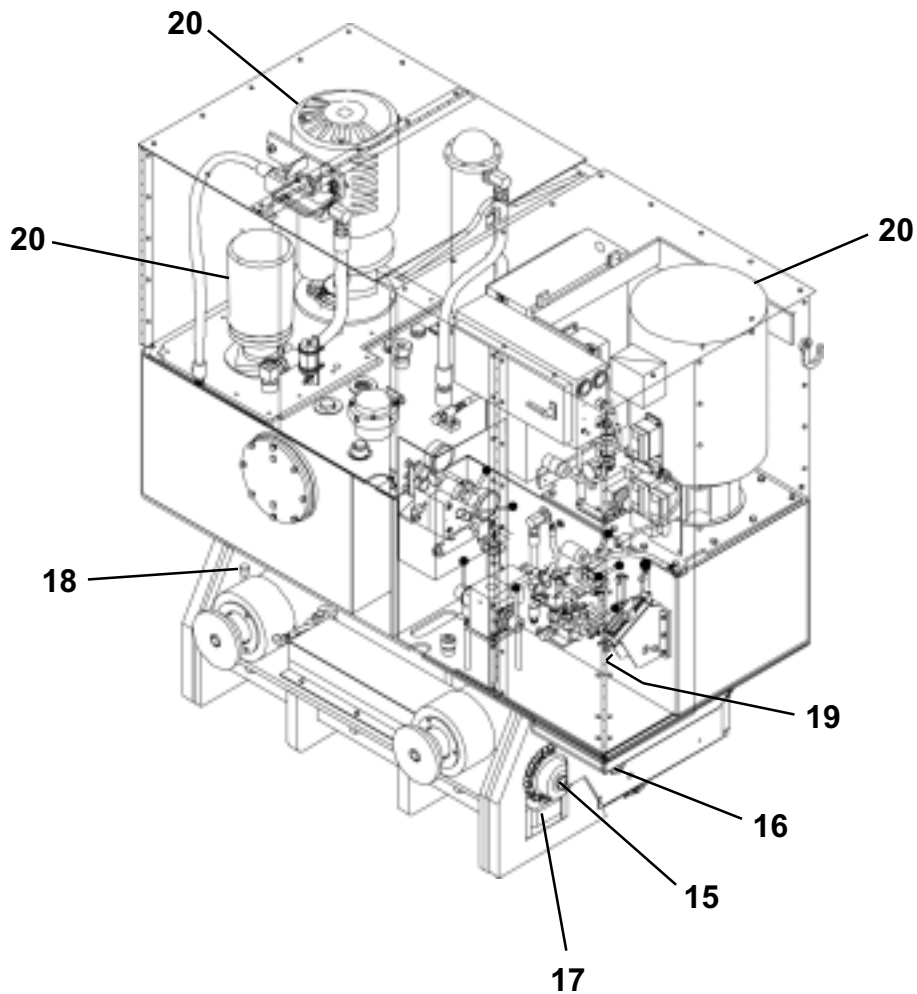
NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.



DAILY OR EVERY 10 HOURS OF OPERATION OR SHIFT CHANGE

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
1.	Skid Base	Inspect	If damaged, repair or replace.	
2.	Rails	Inspect	If damaged, repair or replace.	
3.	Leveling Screws	Lubricate	Lubricate generously.	Mobil XHP222
4.	Yoke Frame	Inspect	If damaged, repair or replace.	
5.	Yoke Wheels	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
6.	Ram Retaining Pins	Inspect	If damaged, repair or replace.	
7.	Retaining Pin Stop	Inspect	If damaged, replace with new.	
8.	Pump Unit/Auxiliary Frame	Inspect	If damaged, repair or replace.	
9.	Charge Filters	Check	Replace filters per indicator.	Charge Filters
10.	Boring Head Return Filters	Check	Replace filters per indicator.	Return Filters
11.	Low Pressure Supply IJS Return Filters	Check	Replace filters per indicator.	Return Filters
12.	Hydraulic Oil	Check Level & Condition	Refill as needed.	ISO-VG-46-20W
13.	Heat Exchanger	Drain	Drain in freezing weather.	
14.	Cyl. Ram Plate	Check	Tighten as required.	

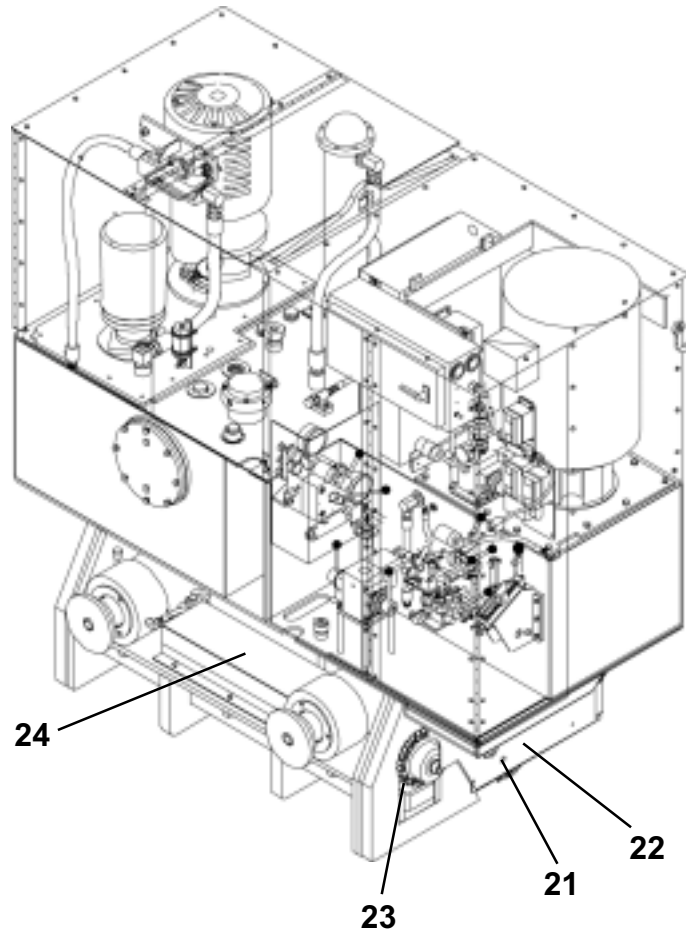
NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.



WEEKLY OR EVERY 50 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
15.	Drive Bearings	Lubricate	Lubricate with 1 to 3 shots.	Mobil XHP222
16.	Chain Tightener Brg.	Lubricate	Lubricate with 1 shot.	Mobil XHP222
17.	Dogs	Inspect	Repair or replace.	
18.	Dogs	Lubricate	One ounce.	Lt. Wt. Motor Oil
19.	Cable Stroker Control	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
20.	Motors	Check	Ventilation openings clean and drain holes open.	

NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.

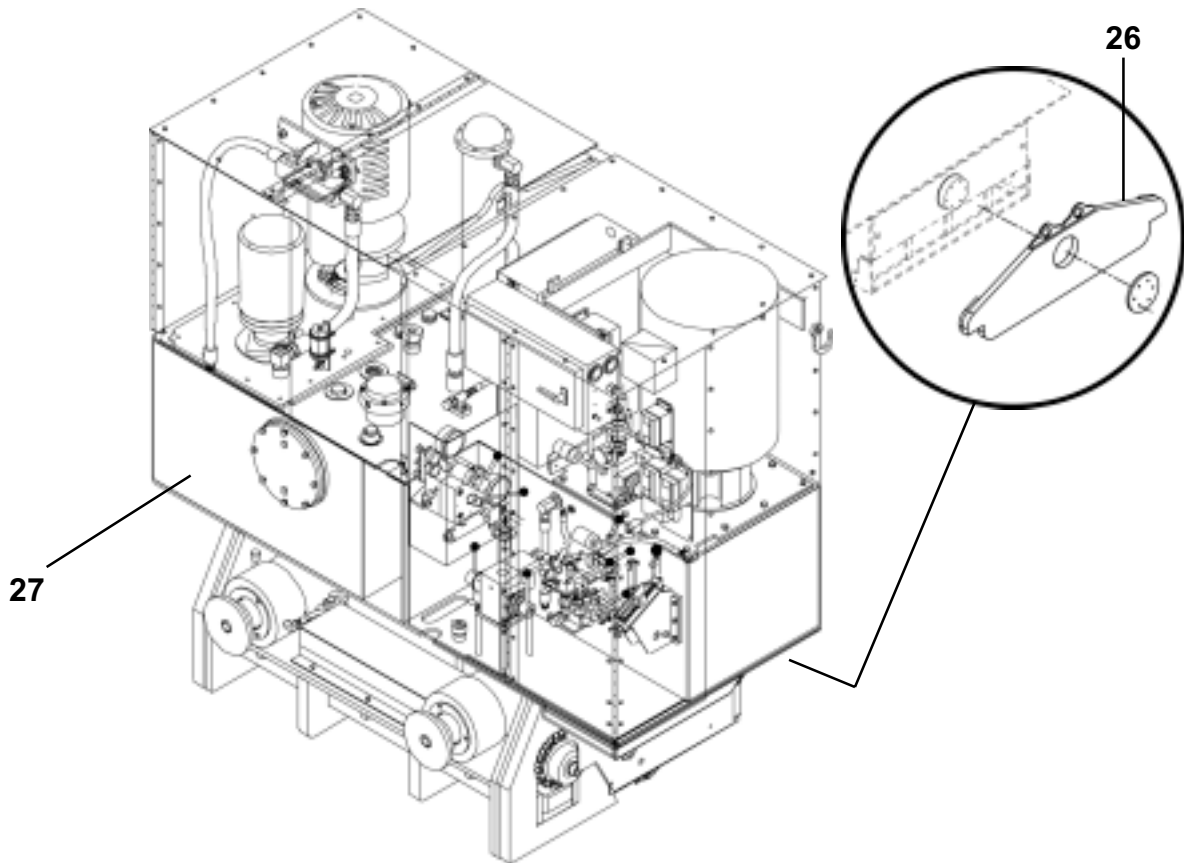


MONTHLY OR EVERY 250 HOURS OF OPERATION

ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
21.	Drive Bushing	Lubricate	Lubricate until grease is forced out.	Mobil XHP222
22.	Drive Chain	Adjustment	1/4-1/2" deflection.	
23.	Chain	Lubricate		Lt. Wt. Motor Oil
24.	Dog Linkage	Check	Tightness and dirt buildup.	
25.*	Oil Analysis	Perform analysis	Oil sample.	

* Not Shown.

NOTICE Use the item number in the chart to refer to the detailed maintenance procedures later in this section.



EVERY 500 HOURS OF OPERATION

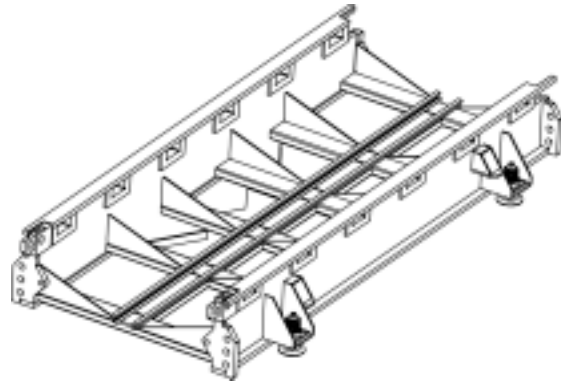
ITEM	COMPONENT	SERVICE	REQUIREMENT	MATERIAL
26.	Bolster	Check	Free movement.	ISO-VG-46-20W
27.	Hydraulic Oil	Drain and replace	Replace with new oil.	

DAILY OR EVERY 10 HOURS OF OPERATION OR SHIFT CHANGE

1. INSPECT SKID BASE

Visually inspect skid base for cracks or other damage. Also check for damaged, loose, or missing hardware. Replace with new.

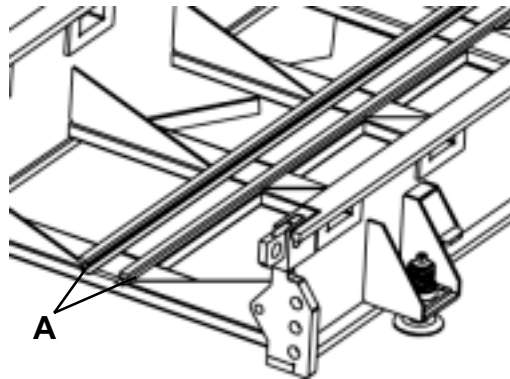
If cracks or damage are present, contact your Akkerman Product Support representative for authorized repair or replacement procedures.



2. INSPECT RAILS

Clean and inspect rails (A) for cracks or other damage.

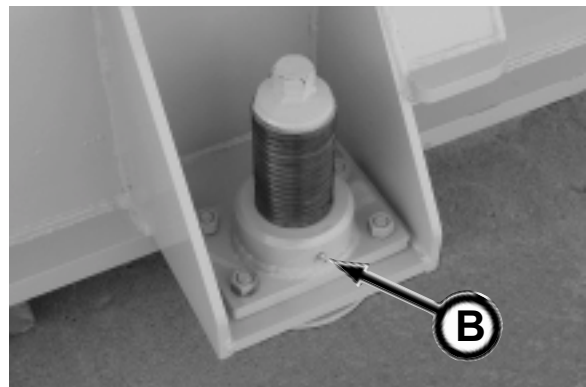
If cracks or damage are present, contact your Akkerman Product Support representative for authorized repair or replacement procedures.



3. LUBRICATE LEVELING SCREWS

Lubricate leveling screw assemblies (B) with Mobilgrease® XHP222 Premium Lubricating Grease or equivalent.

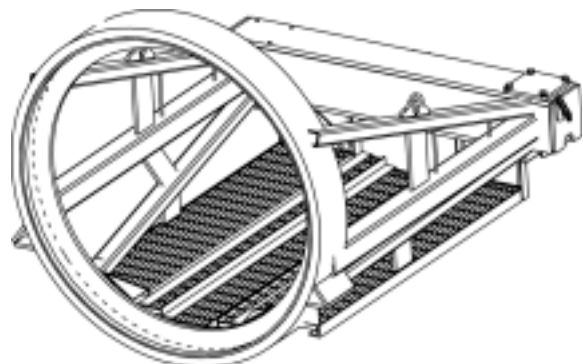
Lubricate threads thoroughly.



4. INSPECT YOKE FRAME

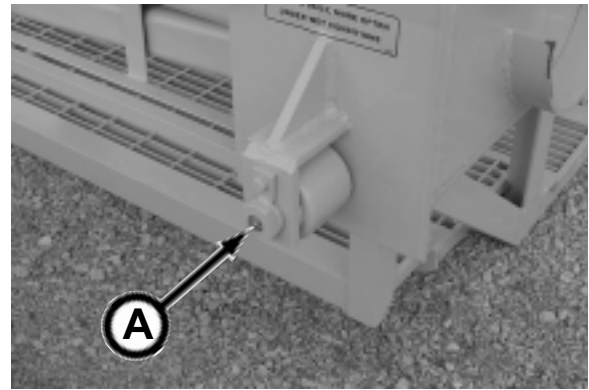
Visually inspect yoke for cracks or other damage. Also check for damaged, loose, or missing hardware. Replace with new.

If cracks or damage are present, contact your Akkerman Product Support representative for authorized repair or replacement procedures.



5. LUBRICATE YOKE WHEELS

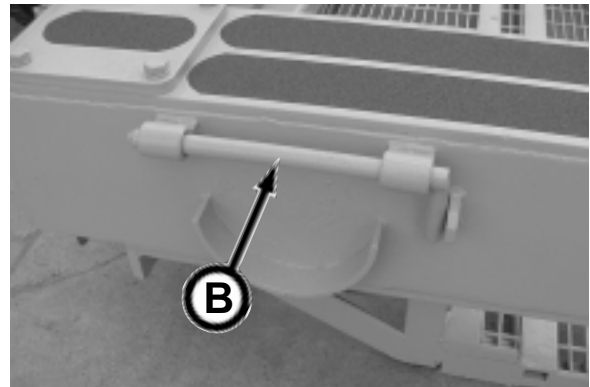
Lubricate yoke wheels (A) (2 places) with Mobilgrease® XHP222 Premium Lubricating Grease or equivalent until greased is forced out.



6. INSPECT RAM RETAINING PINS

Visually inspect retaining pins (B) (2 places) for damage.

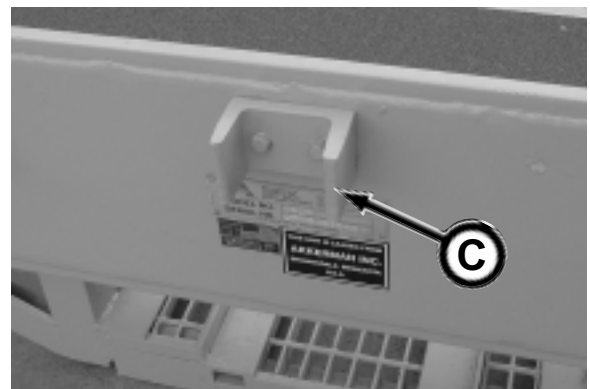
If damage is present, replace with new.



7. INSPECT RAM RETAINING PIN STOP

Visually inspect stop (C) or hardware for damage.

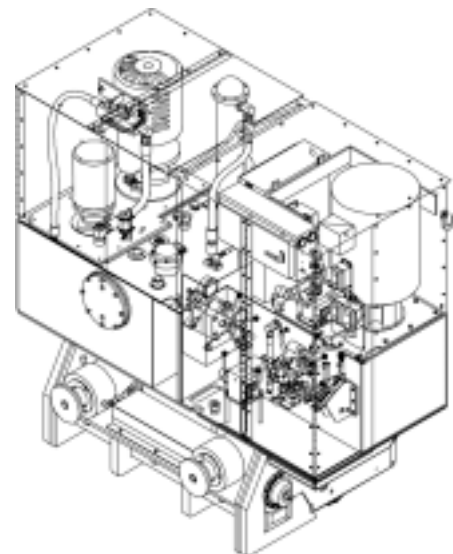
If damaged or missing, replace with new.



8. INSPECT PUMP UNIT & AUXILIARY FRAME

Visually inspect pump unit frame and cab assembly, and auxiliary pump unit frame for cracks or other damage. Also check for damaged, loose, or missing hardware. Replace with new.

If cracks or damage are present, contact your Akkerman Product Support representative for authorized repair or replacement procedures.



9. CHECK CHARGE FILTER INDICATOR

To prevent under or over servicing of the hydraulic filter elements, a charge filter indicator gauge (A) has been installed on your 5000 Pump Unit.

The yellow band indicates the filters are functioning properly.

Replace both charge filters when the filter indicator has a red band.

The filters require replacement if any of the following situations occur:

- A major component fails.
- Any sign of water contamination from an oil analysis or if oil is milky or foaming.
- A hydraulic oil sample indicates large particle contamination.

1. With pump unit power in LOCKOUT, clean and dry area around the charge filters.

2. Remove filters (B) and dispose of properly.

3. Remove filter gasket if stuck in filter housing.

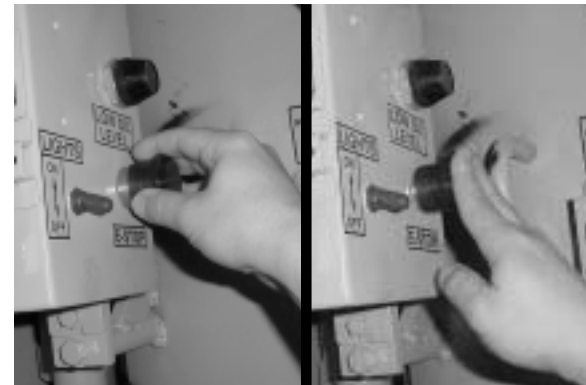
4. Install new gasket with a light coat of clean hydraulic oil. Check to be sure the gasket is not twisted and is correctly in place.

5. Fill new filter with CLEAN hydraulic oil.

6. Install new filter until gasket makes contact with filter head. Then tighten one half turn by hand.

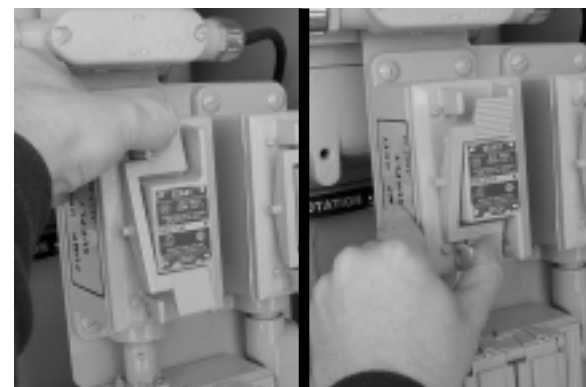
8. Check for leaks as follows:

- a. Enable power source to pump unit.
- b. Pull E-STOP button OUT.
- c. Start the high pressure motor by pressing START on the Pump Unit power switch.
- d. Allow system to reach a minimum of 75 degrees F and then run for 5 minutes. Check for leaks.
- e. Stop the high pressure motor by pressing STOP on the Pump Unit power switch.
- f. Push E-STOP button IN.
- g. LOCKOUT power source to the pump unit.



*E-STOP
Start Power*

*E-STOP
Stop Power*



*Pump Unit
Power Supply ON*

*Pump Unit
Power Supply OFF*

10. CHECK BORING HEAD RETURN FILTER INDICATOR

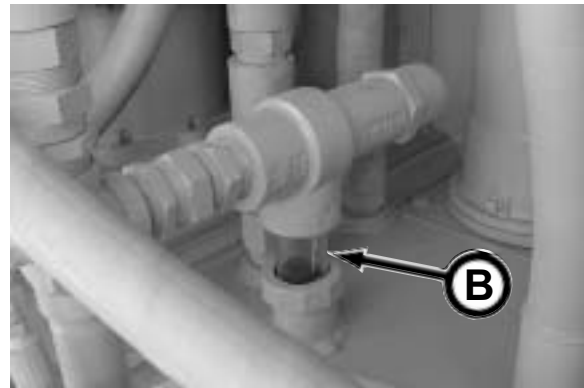
To prevent under or over servicing of the hydraulic filter elements, a boring head return filter indicator gauge (A) has been installed on your 5000 Pump Unit.

The green OK zone indicates that the filters are functioning properly.

The yellow zone indicates that the filters will soon require replacement.

Replace return filters when the needle on the gauge is in the red CHANGE zone.

In the clear tube (B), hydraulic oil will be visible when the oil is bypassing the Boring Head return filters, indicating the filters must be replaced immediately!



1. With the Pump Unit in LOCKOUT, CLEAN and DRY area around filter cover.
2. Drain oil from RT-8 barrel assembly (C) by removing plugs (D).
3. Remove cover (E) and retain hardware.
4. Inspect o-ring (F) for nicks or cuts. Replace if damaged.
5. Remove wing nut (G) and retain for reassembly.
6. Carefully remove clover plate (H) and the hydraulic filters. Retain element connectors (I) and clean barrel assembly with new hydraulic oil specified in the Lubricants section. Dispose of oil properly.

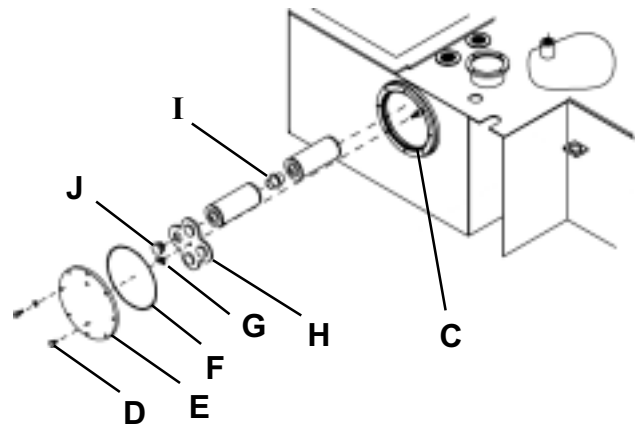
NOTICE Do not damage the filters during removal.

7. Install NEW filters with element connectors (I) (retained from step 6) and secure filters with clover plate and wing nut. Be careful not to contaminate barrel assembly while installing new filters.

NOTICE Be sure the filters are properly seated in the reservoir filter seats (not shown) and the front filter seats (J).

8. Replace cover and secure with hardware removed in step 3.

9. Replace plugs on cover.



- A - Boring Head Return Filter Indicator Gauge
- B - Tube, Bypassing
- C - RT-8 Barrel Assembly
- D - Plugs
- E - Cover
- F - O-ring
- G - Wing Nut
- H - Clover Plate
- I - Element Connectors
- J - Front Filter Seats

11. CHECK LOW PRESSURE SUPPLY/IJS RETURN FILTER INDICATOR

To prevent under or over servicing of the hydraulic filter elements, a low pressure supply/IJS return filter indicator gauge (A) has been installed on your 5000 Pump Unit.

The green OK zone indicates that the filters are functioning properly.

The yellow zone indicates that the filters will soon require replacement.

Replace filters when the needle on the gauge is in the red CHANGE zone.



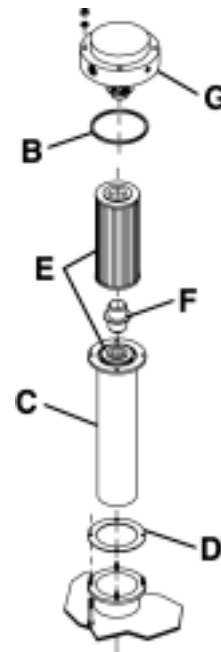
1. With the Pump Unit in LOCKOUT, CLEAN and DRY area around filter head assembly.
2. Remove filter head assembly. Retain hardware.
3. Inspect oring (B) for nicks or cuts. Replace if needed.



4. Slowly remove barrel assembly (C) with hydraulic filters and gasket (D).
5. Carefully remove the hydraulic filters (E) from barrel assembly. Retain element connector (F).

NOTICE DO NOT damage the filter during removal.

6. Clean barrel assembly with new hydraulic oil specified in the Lubricants section. Dispose of oil properly.
7. Install element connector (retained from step 5) between NEW filters and install filters into barrel assembly.
8. Install new gasket (D) and barrel assembly with hydraulic filters into reservoir. Be careful not to contaminate hydraulic reservoir while installing barrel assembly.
9. Replace filter head (G) and secure with hardware removed in step 2. If hardware is damaged, replace with new.



12. CHECK HYDRAULIC OIL LEVEL & CONDITION OF OIL

1. Check the hydraulic oil level in the reservoir with gauge (A).

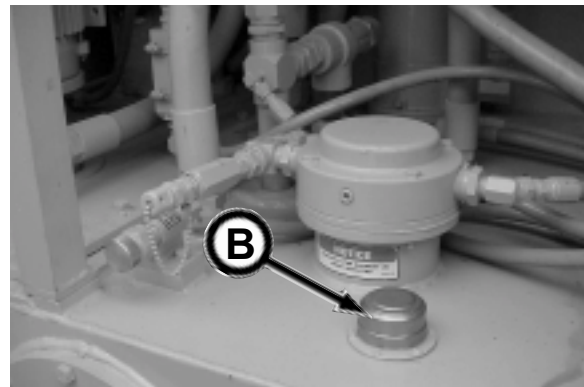
Keep oil maintained between the low and high marks on the gauge.

2. If needed, add oil to the reservoir. Clean and dry the area around the fill cap (B).
3. Refill with an ISO-VG-46-20W hydraulic oil. Do not mix manufacturers or grades.

4. Check for the following:

- a. Check for oil bubbles or foaming oil. This may indicate an air leak in the system.
- b. Check for milky oil. This indicates that there is water in the system. Be sure your oil is being properly stored.

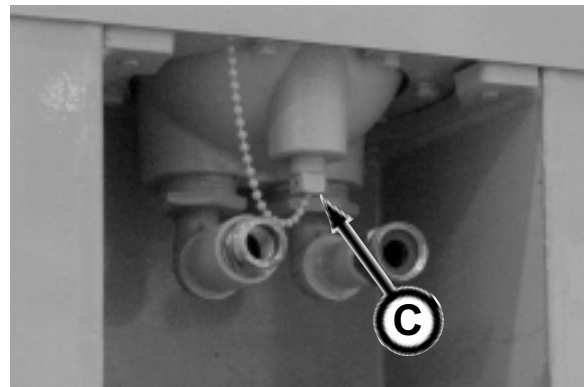
If water is in the hydraulic system, the reservoir must be drained, cleaned, and refilled with new hydraulic oil. Refer to Every 500 Hours of Operation, "27. Drain & Replace Hydraulic Oil" in this section.



13. DRAIN HEAT EXCHANGER

If the ambient temperature is freezing 32° F (0°C) or below, drain the water in heat exchanger by removing drain plug (C).

Replace drain plug.



14. CHECK CYLINDER RAM PLATE HARDWARE

Check cylinder ram plate bolts (D) and lock washers for damage. Be sure they are securely fastened against plate.

If damaged, replace with new bolt and lock washer.

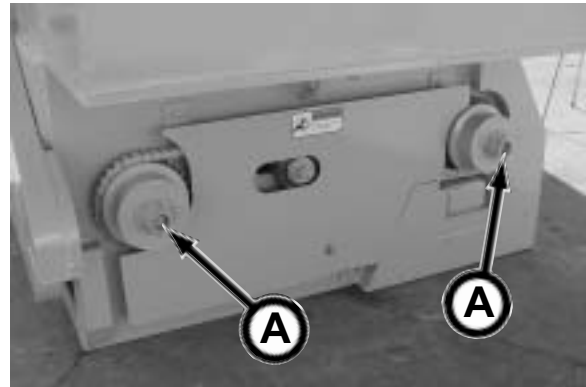


WEEKLY OR EVERY 50 HOURS OF OPERATION

15. LUBRICATE DRIVE BEARINGS

Lubricate the pump unit drive bearings (A) (4 places) with Mobilgrease® XHP222 Premium Lubricating Grease or equivalent.

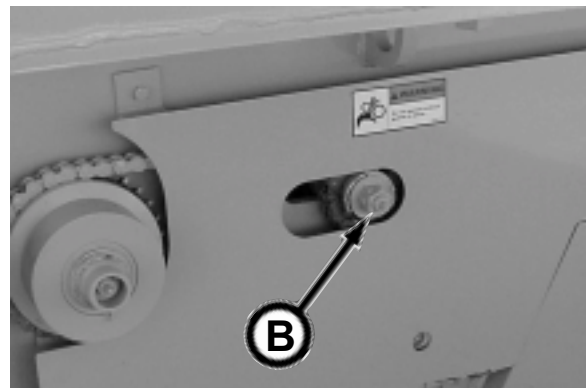
Lubricate with 1 to 3 shots.



16. LUBRICATE CHAIN TIGHTENER BEARINGS

Lubricate the pump unit chain tightener bearings (B) (2 places) with Mobilgrease® XHP222 Premium Lubricating Grease or equivalent.

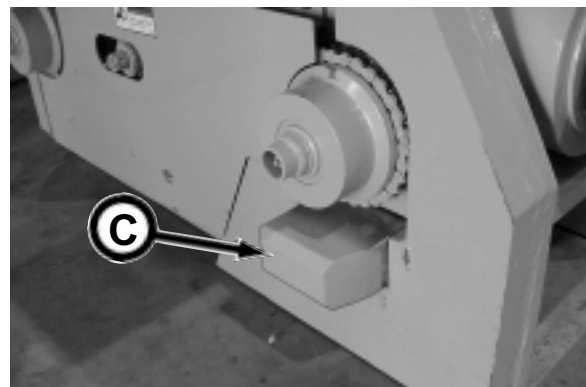
Lubricate with 1 shot.



17. INSPECT DOGS

Inspect the dogs (C) for burrs or damage from jacking.

If burrs or damage are present, repair or replace dogs.



18. LUBRICATE DOGS

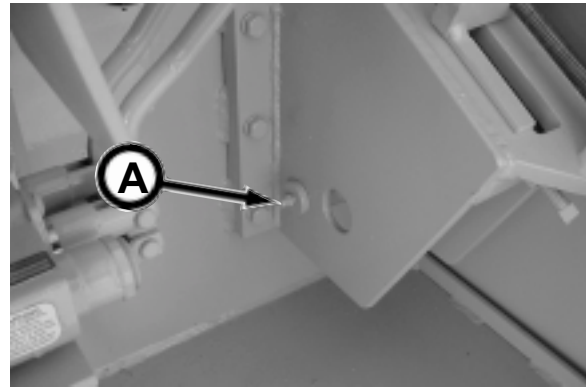
Lubricate the pump unit dogs (D) (2 places) by filling the oiler with 1 ounce (30 mL) of a light weight SAE 10W, 20W, or 30W motor oil.



19. LUBRICATE CABLE STROKER CONTROL

Lubricate the pump unit cable stroker control (A) with Mobilgrease® XHP222 Premium Lubricating Grease or equivalent.

Lubricate until grease is forced out.



20. CHECK MOTORS

Inspect each motor 5HP (B), 50HP (C), and 100HP (D & E) that the ventilation openings are clear to allow the free passage of air, and that the drain holes are open.

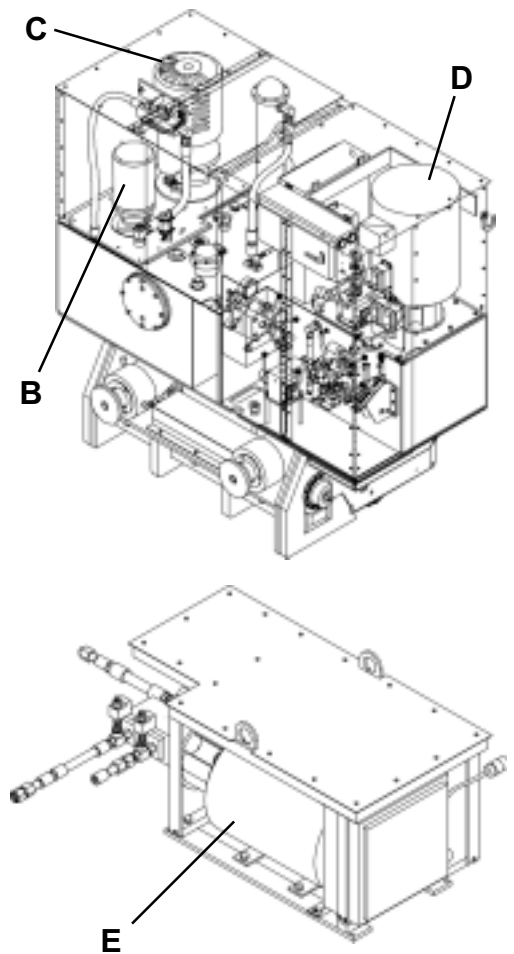
Use compressed air (maximum 50 psi) to clear openings.

Grease and oil can be removed from the motors with a petroleum solvent.

Motor Bearings

In general, the motors bearing system has sufficient grease to last indefinitely under normal service conditions. For the following service conditions: heavy vibration, heavy duty cycle, high humidity, very dirty or ambient temperatures 130-150°F (55-65°C); it is advisable to add one-quarter ounce of grease to each bearing every 3 months. Use a good quality, moisture-resistant, polyurea-based grease such as Chevron SRI #2. Lithium based greases are not compatible with polyurea-based greases; mixing the two types may result in the loss of lubrication.

When adding lubricant, keep all dirt out of the area. Wipe the fitting completely clean and use clean grease dispensing equipment. More bearing failures are caused by dirt introduced during greasing than from insufficient grease.

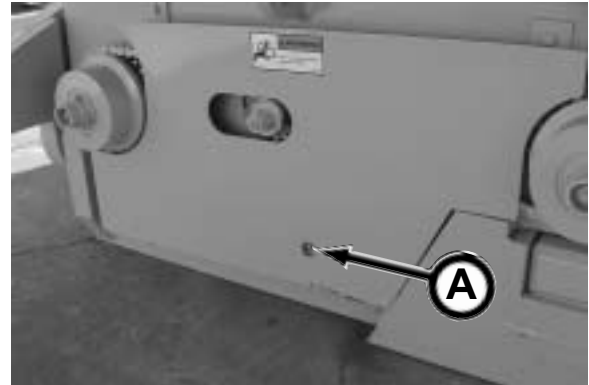


MONTHLY OR EVERY 250 HOURS OF OPERATION

21. LUBRICATE DRIVE BUSHING

Lubricate the pump unit drive bushings (A) (2 places) with Mobilgrease® XHP222 Premium Lubricating Grease or equivalent.

Lubricate with 1 to 3 shots.



22. CHECK DRIVE CHAIN TENSION

1. Remove cover.
2. Check chain deflection (2 places). Deflection should be 1/4 to 1/2 in. at midpoint of chain. Use chain tightener (B) if chain requires adjustment.
3. Lubricate drive chain. Refer to "23. Lubricate Drive Chain" in this section.
4. Replace cover.



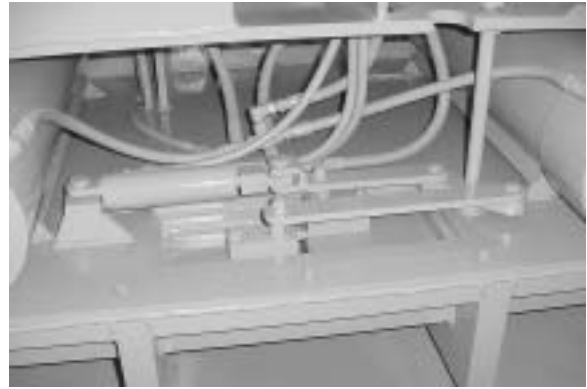
23. LUBRICATE DRIVE CHAIN

1. Remove cover.
2. Lubricate chain with a high quality chain lubricant.
3. Replace cover.



24. CHECK DOG LINKAGE

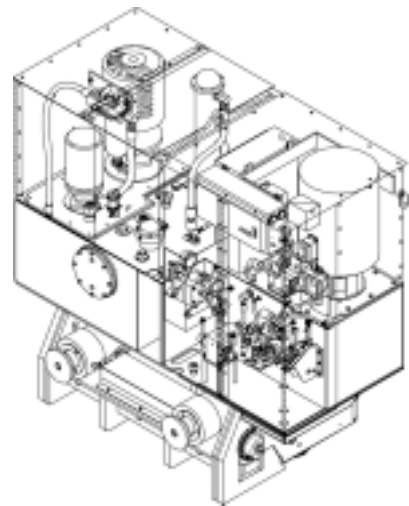
1. Remove guard.
2. Check linkage and pins for tightness. Replace loose or damaged linkage or pins as necessary.
3. Remove any dirt buildup.
4. Replace guard.



25. PERFORM HYDRAULIC OIL ANALYSIS

Test the quality of your hydraulic reservoir oil. Perform an oil analysis by sending an oil sample to a qualified testing facility.

If the test reveals higher contamination levels than allowed by your oil manufacturer, or if your oil is milky or discolored, drain and replace the hydraulic reservoir oil. If draining and replacing the hydraulic oil reservoir is required, all hydraulic filters should also be replaced.



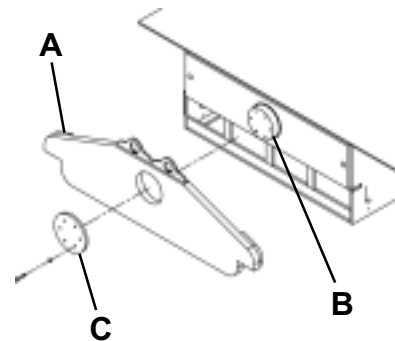
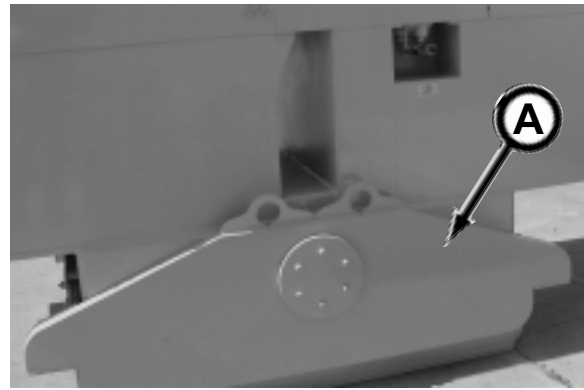
EVERY 500 HOURS OF OPERATION

26. CHECK BOLSTER PIVOT

Check bolster (A) for pivot movement.

If bolster is difficult to pivot:

1. Remove bolster. Retain hardware unless damaged.
2. Thoroughly clean bolster area and plates.
3. Lubricate bolster mounting plate (B) with an anti-sieze compound.
4. Replace bolster.
5. Lubricate the connecting plate (C) with an anti-sieze compound.
6. Mount connecting plate with hardware removed in step 1.

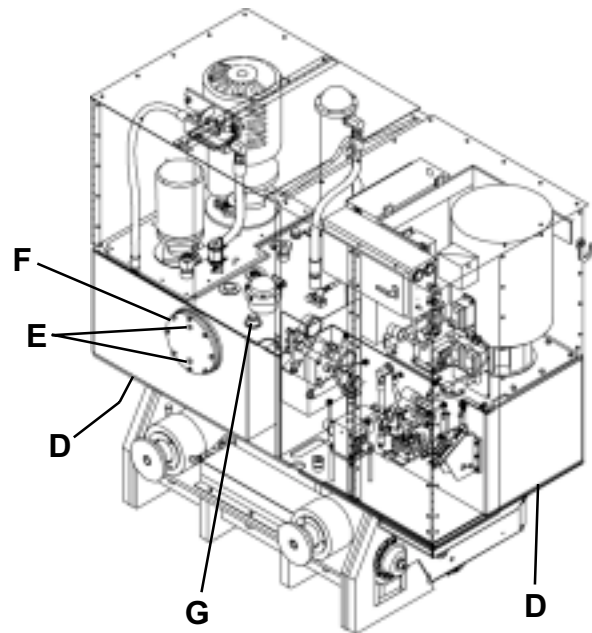


27. DRAIN & REPLACE HYDRAULIC OIL

Drain and replace the hydraulic oil reservoir every 500 hours or if any of the following situations occur:

- A major component fails.
- Any sign of water contamination from an oil analysis or if oil is milky or foaming.
- A hydraulic oil sample indicates large particle contamination.

1. Drain reservoir by removing drain plugs (D).
2. When drained, replace drain plugs.
3. Drain RT-8 filter cavity by removing plugs (E).
4. When drained, remove cover (F) and clean cavity with new hydraulic oil specified in the Lubricants section. Dispose of oil properly.
5. Replace all filters; charge filters, boring head return filters, and low pressure supply/IJS return filters. For proper replacement procedure, refer to Daily or Every 10 Hours of Operation maintenance in this section.
6. Replace RT-8 cover and plugs.
7. Clean area around fill cap (G). Remove fill cap and strainer. Clean strainer with new hydraulic oil specified in the Lubricants section. Dispose of oil properly. Replace strainer.
8. Fill with new ISO-VG-46-20W hydraulic oil.
9. Replace cap.
10. Check for leaks.



Storage

PREPARING FOR STORAGE

1. Repair worn or damaged parts.
2. Wash all equipment thoroughly.
3. Lubricate all grease points on the skid, yoke, 5000 Pump Unit, and Auxiliary Pump Unit. Grease threads on bolts used for adjustments.
4. Retract all hydraulic cylinders if possible. If not, coat exposed cylinder rods with a corrosion preventive.
5. Repaint equipment where necessary.
6. Loosen drive chain.
7. Drain heat exchanger.
8. Drain hydraulic oil and flush oil reservoir.
9. Change hydraulic filters and refill hydraulic reservoir. Check for leaks.
10. Wipe up lube spills. Dispose of rags and trash properly.
11. If possible, store equipment under cover and out of the weather in a ventilated area.

REMOVING FROM STORAGE

1. Clean equipment thoroughly.
2. Check to make sure all decals including safety decals are clean and readable.
3. Check condition of wires and cables. Repair or replace as necessary.
4. Remove the cylinder corrosion preventive from the cylinder rods if it is not compatible with hydraulic oil or seal materials.
5. Check for leaks. Repair or replace as necessary.
6. Readjust drive chain tension to 1/4 to 1/2" deflection at the midpoint of the chain.
7. Check condition of all hoses and connections. Tighten, repair or replace with new as needed.
8. Before operating, cycle hydraulic functions several times to purge air from the hydraulic system.
9. Review this Operator's Manual.

Troubleshooting

Problem	Cause	Solution
Pump Unit push cylinders stall at less than 500 psi.	Cylinders at full extension.	Retract cylinders.
	Pressure release valve is open.	Close pressure release valve.
	Worn or damaged cylinder seals.	Replace seals.
	Worn or damaged control valve seals.	Replace seals.
	Cylinder piston relief leaking.	Repair or replace.
	Worn or damaged hydraulic pump.	Repair or replace.
	If cylinders continue to stall, contact your Akkerman Product Support Representative.	
Pump Unit cylinder(s) collapse when forward thrust is stopped or intermediate jacks are used.	Pilot operated check valve leaking.	Repair or replace.
	Worn or damaged cylinder seals.	Replace seals.
	Cylinder relief valve leaking.	Repair or replace valve.
	Cylinder piston relief leaking.	Repair relief.
	Pressure release valve is leaking.	Repair or replace valve.
	If cylinders continue to collapse, contact your Akkerman Product Support Representative.	
Jacking pressure gauge pressure drops when forward thrust is stopped.	Low cylinder load.	Avoid over excavation at tunnel face.
	Worn or damaged cylinder seals.	Replace seals.
	Pilot operated check leaking.	Repair or replace check valve.
	If jacking pressure gauge continues to drop, contact your Akkerman Product Support Representative.	
The 5 HP, 50 HP, and 100 HP motors will not start.	Emergency stop switch is depressed.	Pull E-STOP button out.
	Main disconnect tripped or not turned ON.	Turn disconnect ON.
	Generator or power supply faulty.	Repair or replace.
	Low oil level.	Add hydraulic oil as needed.
	15 amp fuse tripped.	Replace fuse.
	6-1/4 amp fuse tripped.	Replace fuse.
	Faulty low oil level switch, cable or relay.	Replace.
	Faulty 480 VAC to 110 VAC transformer.	Repair by qualified technicians or replace with new.
	If motors will still not start, contact your Akkerman Product Support Representative.	

Troubleshooting

Problem	Cause	Solution
100 HP motor will not start.	Circuit heaters tripped.	Reset.
	175 amp fuse(s) blown.	Replace fuses.
	Faulty Start/Stop switch.	Replace switch.
	Low oil level.	Fill reservoir with oil.
	Faulty low oil level switch or relay.	Replace switch.
	If 100 HP motor will still not start, contact your Akkerman Product Support Representative.	
Hydraulic oil temperature gauge exceeds 150 degrees.	Heat exchanger water supply not adequate.	Water supply must be a minimum of 15 gpm.
	5 HP circuit fuse heaters tripped.	Reset.
	Excessive hydraulic circuit pressure to boring machine.	Reduce steering flow control. Replace boring head filters.
	Hydraulic circuit disconnected causing a safety relief valve to be activated.	Connect hoses.
	Excessive ambient temperature.	Provide fresh, clean, cold water source.
	Excessive horsepower required by boring machine or jacking operation.	Reduce advancement rate or install IJS.
	Heat exchanger water passages plugged.	Clean heat exchanger.
Boring head supply gauge frequently reaches 2,800 psi.	Too few cutter bar drive motors.	Reduce advancement rate or install additional motors, if possible.
	Single feed supply to boring head	Change to dual feed supply.
	Incorrect cutter bar selected for ground condition.	Change cutter head.
	Pipe advancement rate too fast.	Slow main ram thrust.
	Worn or damaged TBM inner drum thrust roller bearings.	Replace bearings.
	Worn or damaged TBM inner drum rollers.	Replace rollers.
	If boring head supply gauge continues to frequently reach 2,800 psi, contact your Akkerman Product Support Representative.	

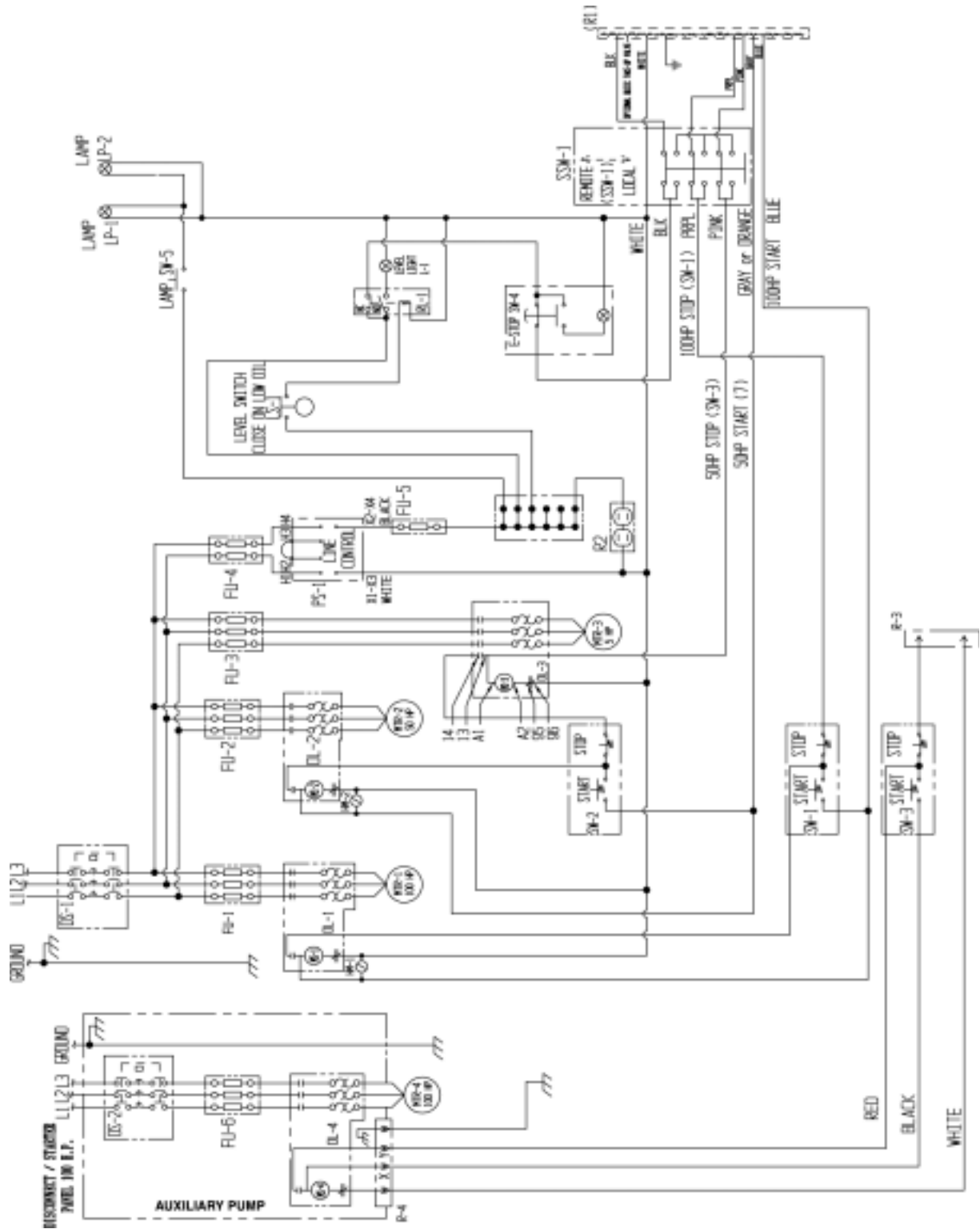
Troubleshooting

Problem	Cause	Solution
Pump Unit motors start but no oil pressure is available.	Incorrect motor rotation.	Rewire motor for proper rotation.
	Low oil level.	Add hydraulic oil as needed.
	Control valve not turned on.	Make sure the control valves are in the proper position.
	Faulty relief valve.	Replace valve.
	Flow rate turned too low.	Readjust cable stoker volume stop. Readjust TBM flow rate.
	Worn or damaged hydraulic pump.	Repair or replace pump.
	If oil pressure continues to be unavailable, contact your Akkerman Product Support Representative.	
Intermediate jacks do not operate.	<i>TEST: Select IJS position on control valve and close pressure release valve. Operate Cable Stoker Control and read system pressure gauge. Gauge reads 0 - 1,000 psi.</i>	
	Intermediate jack valve not in full ON position.	Pull cable completely to ON position.
	Worn or damaged control valve seals.	Replace seals.
	Faulty relief valve.	Repair or replace valve.
	Flow rate turned too low.	Readjust cable stoker volume stop.
	Worn or damaged hydraulic pump.	Repair or replace pump.
	If intermediate jacks still do not operate, contact your Akkerman Product Support Representative.	

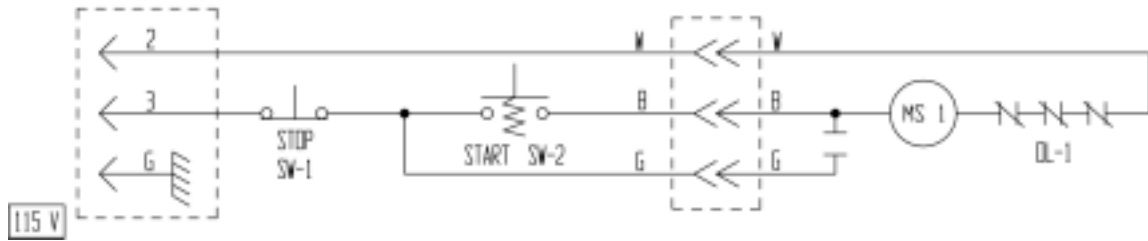
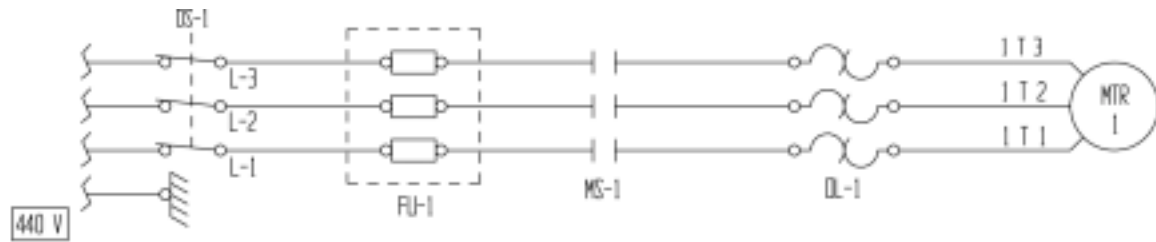
Problem	Cause	Solution
Pump Unit boring head supply will not produce 2,800 psi.	<p><i>TEST: Connect flow meter to outlet hose of supply valve (Q-10* or Q-5*). Oil temperature should be approximately 120 degrees.</i></p> <p>1) Turn on left supply handle, (facing pressure gauge). <i>Test output flow at 0 psi (approx. 32 gpm)</i> <i>Test output flow at 2,000 psi (approx. 30 gpm)</i> <i>Test output flow at 2,700 psi (approx. 29 gpm)</i></p> <p>2) Turn off left supply handle and turn on right handle. <i>Test output flow at 0 psi (approx. 28 gpm)</i> <i>Test output flow at 2,000 psi (approx. 26 gpm)</i> <i>Test output flow at 2,700 psi (approx. 25 gpm)</i></p> <p><i>If flow specifications are close to the above, refer to Cutter Bar Stalling in your TBM operation manual.</i> <i>If flow specifications are not close to the above, troubleshoot as follows:</i></p> <ol style="list-style-type: none"> 1. Replace control valve seals and repeat test. 2. Replace control valve relief and repeat test. 3. Disconnect output hose from 1 pump section (inside reservoir). 4. Connect flow meter to pump section. <p>⚠ WARNING Do not shut off flow meter restriction valve at any time during test as serious personal injury or pump damage will result.</p> <ol style="list-style-type: none"> 5. Repeat above test procedure to determine flow capacity. 6. Repeat procedure for 2nd pump section. <p>If flow specifications are now close to the above specifications:</p> <p>If flow specifications are not close to the above specifications:</p>	<p>Replace control valve.</p> <p>Replace pump.</p>

* Refer to 5000 Pump Unit Hydraulic Schematic in this section.

5000 PUMP UNIT ELECTRICAL SCHEMATIC - STANDARD

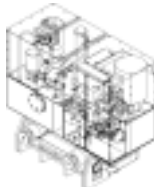


AUXILIARY PUMP UNIT ELECTRICAL SCHEMATIC



Specifications

5000 PUMP UNIT



Dimensions
 Height 90" (2,286 mm)
 Width 93" (2,362 mm)
 Depth 52" (1,321 mm)

Weight
 With Oil 12,600 lbs. (5,715 kg)
 Without Oil 10,560 lbs. (4,790 kg)

Thrust
 400 Ton Total:
 . Two 200 Ton (181 t), 36" (914 mm) Stroke Cylinders

Hydraulic Supply
 A 5 HP electric motor provides 42 GPM (159 L/min) for oil cooling and high pressure charge supply systems.

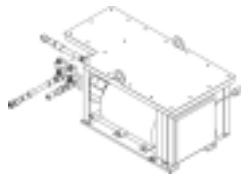
Low Pressure
 - 2,800 psi (19,306 kPa) for boring head and conveyor.
 - A 100 HP (74.5 kW) electric motor provides power for 60 GPM (227 L/min) at no load or approximately 45 GPM (170 L/min) at 2,200 psi (15,169 kPa).
 - A 100 HP (74.5 kW) auxiliary pump unit will double the flow to 120 GPM (454 L/min).

High Pressure
 - Up to 9,000 psi (55,158 kPa) for the main and intermediate jacking cylinders.
 - A 50 HP (37 kW) electric motor provides power for 9 GPM (34 L/min) at 8,000 psi (55,158 kPa).

Reservoir Capacity 275 gal. (1,041 L)

Electrical Supply
 Standard 480 Volt, 60 Hz, 3 Phase
 Optional 415 Volt, 50 Hz, 3 Phase*
 Optional 380 Volt, 50 Hz, 3 Phase*
 * At Reduced Capacity

AUXILIARY PUMP UNIT



Dimensions
 Height 25.5" (648 mm)
 Width 59" (1,499 mm)
 Depth 32" (813 mm)

Weight 1,500 lbs. (680 kg)

- A 100 HP (74.5 kW) electric motor provides power for 60 GPM (227 L/min) at no load or approximately 45 GPM (170 L/min) at 2,200 psi (15,169 kPa).

YOKE



Model	Width	Length	Height
360	72.75" (1,848mm)	91.5" (2,324mm)	44" (1,118mm)
420	72.75" (1,848mm)	93.5" (2,375mm)	51" (1,295mm)
480	72.75" (1,848mm)	93.5" (2,375mm)	58" (1,473mm)
540	72.75" (1,848mm)	93.5" (2,375mm)	65" (1,651mm)
540 Extended	72.75" (1,848mm)	123.5" (3,137mm)	65" (1,651mm)
600	77.5" (1,969mm)	93.75" (2,381mm)	72" (1,829mm)
600 Extended	77.5" (1,969mm)	123.75" (3,137mm)	72" (1,829mm)
660	79" (2,007mm)	93.75" (2,381mm)	79" (2,007mm)
720	86" (2,184mm)	93.75" (2,381mm)	86" (2,184mm)
720 Extended	86" (2,184mm)	123.75" (3,137mm)	86" (2,184mm)
780	93" (2,362mm)	123.75" (3,137mm)	93" (2,362mm)
840 Extended	100" (2,540mm)	123.75" (3,137mm)	100" (2,540mm)

SKID



Model	Width	Length	Height
Skid 2.5 Foot	80" (2,032mm)	30" (762mm)	25.5" (648mm)
Skid 7.5 Foot	91" (2,311mm)	90" (2,286mm)	25.5" (648mm)
Skid 15 Foot	91" (2,311mm)	180" (4,572mm)	25.5" (648mm)
Skid 22.5 Foot	91" (2,311mm)	270" (6,858mm)	25.5" (648mm)

Weight:
 Skid 2.5' 1,500 lbs. (680 kg)
 Skid 7.5' 4,200 lbs. (1,905 kg)
 Skid 15' 8,400 lbs. (3,810 kg)
 Skid 22.5' 12,600 lbs. (5,715 kg)

Akkerman Inc. reserves the right to improve its product without notice or obligation.

TORQUE CHART

Use these torque values as a guideline when tightening hardware unless otherwise specified in this manual.

Lubricated Coarse UNC Threads Grade 8 Fasteners			Lubricated Fine UNF Threads Grade 8 Fasteners		
Bolt Size	Torque		Bolt Size	Torque	
	ft. lbs.	(N·m)		ft. lbs.	(N·m)
1/4 - 20	10	(14)	1/4 - 28	11	(15)
5/16 - 18	20	(27)	5/16 - 24	22	(30)
3/8 - 16	35	(47)	3/8 - 24	39	(53)
7/16 - 14	56	(76)	7/16 - 20	62	(84)
1/2 - 13	85	(115)	1/2 - 20	96	(130)
9/16 - 12	123	(167)	9/16 - 18	137	(186)
5/8 - 11	170	(231)	5/8 - 18	192	(260)
3/4 - 10	301	(408)	3/4 - 16	336	(456)
7/8 - 9	450	(610)	7/8 - 14	500	(678)
1 - 8	680	(922)	1 - 12	740	(1003)
1-1/8 - 7	960	(1302)	1-1/8 - 12	1030	(1397)
1-1/4 - 7	1360	(1844)	1-1/4 - 12	1500	(2034)
1-1/2 - 6	2360	(3200)	1-1/2 - 12	2660	(3607)

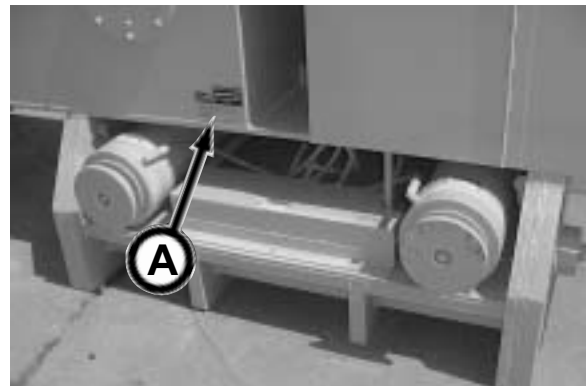
Identification Numbers

Model and serial numbers are required when ordering parts or requesting service information. Record your model and serial numbers below.

5000 PUMP UNIT (A)

Model Number _____

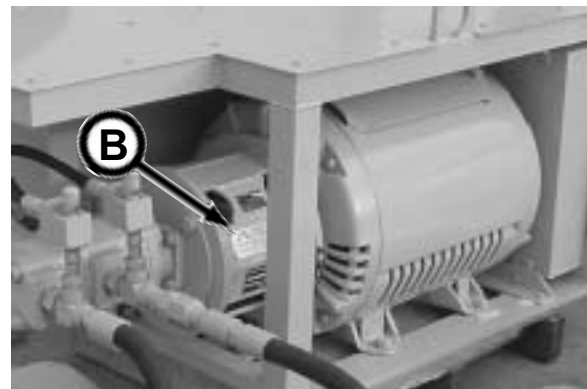
Serial Number _____



AUXILIARY PUMP UNIT (B)

Model Number _____

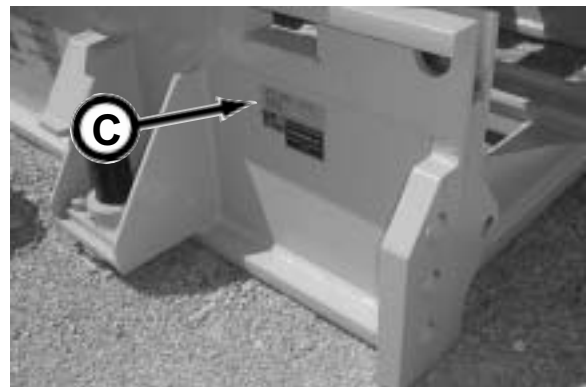
Serial Number _____



SKID (C)

Model Number _____

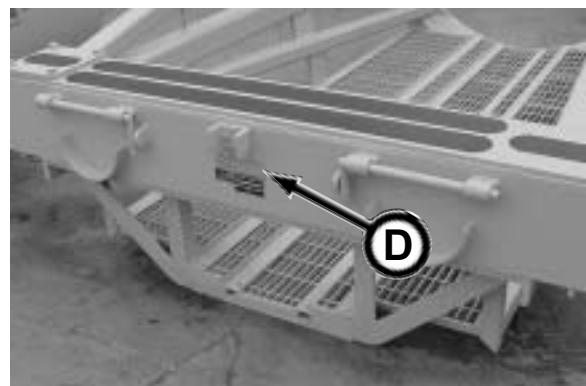
Serial Number _____



YOKE (D)

Model Number _____

Serial Number _____



Material Safety Data Sheets

The Federal Occupational, Safety, and Health Administration (OSHA) Standard 29 CFR 1910.1200, require that specific material safety data sheets (MSDS) be available to employees before operating this equipment. This may include information on substances contained in this equipment such as hydraulic fluid and gear lubricant.

Akkerman Inc. will provide, at no cost, MSDS which apply to its product line. Simply contact your Akkerman Product Support representative for a copy.

To ensure a prompt response to your MSDS request, include your return address (including zip or postal code) and the equipment's model numbers and serial numbers with your request.

Warranty

Akkerman Inc. warrants that all equipment manufactured by it be free from defects due to workmanship or material under normal use and service for a period of 90 days. This warranty does not apply to normal wear items such as cutter teeth, filters, etc. Akkerman Inc. does not warrant the fitness of its equipment for a particular purpose or application.

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